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CONTENT

SUMMARY REPORT **11**

1. BACKGROUND AND OBJECTIVES **11**

1.1 INTERACTION BETWEEN ENERGY AND ENVIRONMENT IN CHINA 11

1.2 CHALLENGES IN ENERGY AND ENVIRONMENT MANAGEMENT AND NEW INITIATIVES IN ECONOMIC INSTRUMENTS 13

1.3 RESEARCH TARGETS AND METHODOLOGIES 14

2. ENVIRONMENTAL TAXATION AND ENERGY EFFICIENCY **16**

2.1 CURRENT SITUATION AND CHALLENGES IN CHINA 16

2.2 INTERNATIONAL EXPERIENCES AND IMPLICATIONS FOR CHINA 18

2.3 MAIN CONCLUSIONS AND POLICY RECOMMENDATIONS 20

2.3.1 Main Conclusions *20*

2.3.2 Policy Recommendations *21*

3. GREEN CREDIT **27**

3.1 CURRENT SITUATION AND CHALLENGES IN CHINA 27

3.1.1 Background *27*

3.1.2 Policy Implementation Content *29*

3.1.3 Progress to Date *30*

3.1.4 Problems and Challenges *31*

3.2 INTERNATIONAL EXPERIENCES AND IMPLICATIONS TO CHINA 32

3.2.1 Relevant Exercises and Main Practices *32*

3.2.2 Experiences and Implications to China *34*

3.3 CONCLUSIONS AND POLICY RECOMMENDATIONS 35

3.3.1 Main Conclusions *35*

3.3.2 Policy Recommendations *36*

4. ENVIRONMENTAL POLLUTION LIABILITY INSURANCE **39**

4.1 CURRENT SITUATION AND CHALLENGES IN CHINA 39

4.2 INTERNATIONAL EXPERIENCES AND IMPLICATIONS TO CHINA 41

4.3 CONCLUSIONS AND POLICY RECOMMENDATIONS 43

4.3.1 Main Conclusions *43*

4.3.2 Policy Recommendations *44*

ACKNOWLEDGEMENTS **48**

RESEARCH REPORT **49**

CHAPTER 1: ENVIRONMENTAL TAXATION **49**

0 PREFACE **49**

1 ROADMAP FOR ESTABLISHING AN ENVIRONMENTALLY-RELATED TAXATION SYSTEM **52**

1.1 ASSESSMENT ON CHINA'S TAXATION STRUCTURE AND REFORM DIRECTION 52
1.1.1 Current Fiscal and taxation System *52*
1.1.2 Major Problems and Analysis of these Problems *56*
1.1.3. The Direction and Outlook of the Reform *57*
1.2 ASSESSMENT OF CHINA'S CURRENT ENVIRONMENTALLY-RELATED TAXES AND CHARGES 60
1.2.1 The Analysis of the Relationship between Macroeconomic Development and environmentally-related taxation *60*
1.2.2 Assessment on Current Environmentally-related Taxes *62*
1.2.3 Assessment of Current Pollution Discharge Fees *66*
1.3 ASSESSMENT ON RELATED INTERNATIONAL EXPERIENCE 68
1.3.1 The Development and Situation of Environmentally-related taxation System in Developed Countries *68*
1.3.2 Development and Improvement in Emerging and Developing Countries *73*
1.3.3 Summary and Reference of Related International Experience *76*
1.4 ROADMAP FOR BUILDING AN ENVIRONMENT-RELATED TAXATION SYSTEM IN CHINA 82
1.4.1 Potential environmentally-related taxation structure *82*
1.4.2 Macro and Micro Conditions for Introducing Environmental Tax *84*
1.4.3 Timetable for improving environmentally-related taxation *85*

2 DESIGN OF CARBON TAX AND ANALYSIS ON ITS IMPACTS 87

2.1 ANALYSIS ON INTERNATIONAL EXPERIENCES 87
2.1.1 Main features of carbon tax in developed countries *87*
2.1.2 The inspiration of carbon tax in developed countries to China *90*
2.1.3 The development trend of future carbon tax and international cooperation in tax *92*
2.2 DESIGN OF CHINA'S CARBON TAX PLAN 93
2.2.1 Basic issues of introducing carbon tax *93*
2.2.2 Design of Elements of Carbon Tax *96*
2.2.3 Other regulations and supporting measures *100*
2.3 ANALYSIS OF CARBON TAX'S IMPACTS ON ENVIRONMENT AND ECONOMY 102
2.3.1 Introduction to Computable General Equilibrium model *102*
2.3.2 Introduction of Model Carbon Tax *103*
2.3.3 Analysis of the Impact of Carbon tax on Economy *103*

3 MAIN CONCLUSIONS AND POLICY RECOMMENDATIONS 122

3.1 ENVIRONMENTALLY-RELATED TAXATION REFORM SHOULD CENTER ON THE INTRODUCTION OF AN ENVIRONMENTAL TAX 122
3.2 CHINA SHOULD ESTABLISH ENVIRONMENTALLY-RELATED TAXATION THROUGH INTRODUCING AN ENVIRONMENTAL TAX, RECONSTRUCTING EXISTING TAXES, AND IMPROVING TAX POLICIES 123
3.3 ENVIRONMENTALLY-RELATED TAXATION SYSTEM REFORM SHOULD PROGRESS GRADUALLY, BEGINNING WITH EASIER TASKS. 124
3.4 CARBON TAX IS AN IMPORTANT TAX POLICY OPTION FOR CHINA TO RESPOND TO CLIMATE CHANGE, ADVANCE ENERGY-SAVING AND EMISSION REDUCTION, AND DEVELOP A LOW CARBON ECONOMY .. 126
3.5 LEARNING FROM INTERNATIONAL CARBON TAX EXPERIENCES TO DESIGN A REASONABLE CARBON TAX IN CHINA 127

3.6 SELECT TIMELY, REASONABLE TAX RATES FOR THE INTRODUCTION OF A CARBON TAX IN ACCORDANCE WITH ITS ENVIRONMENTAL AND ECONOMIC AND THE ECONOMIC AND SOCIAL SITUATIONS, AT HOME AND ABROAD 127
3.7 OTHER STIPULATIONS AND SUPPORTING MEASURES NEED TO BE IMPROVED TO FACILITATE THE EXTERNAL ENVIRONMENTAL FOR LEVYING CARBON TAX 129

REFERENCES 130

CHAPTER 2: ASSESSMENT OF CURRENT POLICIES FOR ENERGY PRODUCTIVITY IN CHINA 138

ABSTRACT 138

0 BACKGROUND 138

1 DEFINITION OF ENERGY PRODUCTIVITY 139

1.1 ENERGY CONSUMPTION SYSTEM 139
1.2 DEFINITION OF ENERGY PRODUCTIVITY 139

2 CURRENT POLICY SYSTEM FOR ENERGY PRODUCTIVITY IN CHINA 146

2.1 COMMAND AND CONTROL INSTRUMENTS 146
2.1.1 Strategic Planning and Sectoral Policies 146
2.1.2 Basic Energy Laws and Regulations 148
2.1.3 Administrative Commands and Guidance 150
2.2 MARKET-BASED INSTRUMENTS 150
2.2.1 Energy Pricing Mechanism Reform 150
2.2.2 Taxation and Fees 160
2.2.3 Financial Subsidies and Government Procurement 163
2.3 INFORMATION, PERSUASION, AND ENCOURAGEMENT 169

3 POLICY SUMMARY, ASSESSMENT AND PROPOSAL 169

CHAPTER 3: A STUDY OF THE GREEN CREDIT POLICY IN CHINA 172

0 FOREWORD 172

1 DEVELOPMENT AND IMPLEMENTATION OF GREEN CREDIT 173

1.1 BACKGROUND 173
1.1.1 Lack of effective control of "highly polluting and high energy consumption" ("double high") sectors poses a serious challenge to environmental protection 173
1.1.2 New and innovative environmental management techniques must be developed; Green Credit provides an important inroad 174
1.1.3 Increasing Credit Risks Caused by Environmental Problems Provoked Serious Concern from the Banking Sector 175
1.1.4 Common Needs between the Environmental Authorities and Banking Sector are Driving Force of Green Credit in China 176
1.2 GREEN CREDIT – HISTORY OF DEVELOPMENT 177
1.2.1 Preliminary Phase (1995-2006) 177
1.2.2 Rapid Growth Phase (Since 2006) 178

1.3 GREEN CREDIT POLICY AND OPERATIONS 179
1.3.1 Relevant National Policies *179*
1.3.2 Operations and Results *183*
1.4 PROBLEMS AND CHALLENGES 188
1.4.1 Deficiencies & Defects *188*
1.4.2 Challenges Ahead *190*

2 INTERNATIONAL EXPERIENCE IN GREEN CREDIT 192

2.1 BACKGROUND AND HISTORY OF DEVELOPMENT 192
2.1.1 Background *192*
2.1.2 Green Credit policy – History of Development *194*
2.2 KEY PRACTICE AND POLICY MEASURES 196
2.2.1 Green finance initiatives by the international community and international organizations *196*
2.2.2 The industry-regulated green finance guidelines formulated by the banking industry *198*
2.2.3 State-driven credit subsidy policy *199*
2.2.4 Innovation in green financial products *201*
2.3 INSIGHT AND LESSONS FROM INTERNATIONAL EXPERIENCE 202
2.3.1 Leverage market forces to promote Green Credit *203*
2.3.2 Green Credit guidelines lay down standards widely adopted by the international banking sector *203*
2.3.3 Enforcing environmental accountability is fundamental for implementing and promoting Green Credit *203*
2.3.4 Environmental audit is an important assurance for promoting Green Credit *204*
2.3.5 Discounted interest and other possible methods of State support for Green Credit *204*

3 COMPARATIVE STUDY OF INTERNATIONAL AND CHINESE GREEN CREDIT POLICIES 204

3.1 HUGE DISPARITIES BETWEEN POLICY-MAKING AND IMPLEMENTATION PROCEDURES 205
3.1.1 State-driven Chinese model *205*
3.1.2 Equal-benefit and market-driven international model *206*
3.2 DISPARITIES IN POLICY SIGNIFICANCE, GOALS AND NATURE 207
3.2.1 Energy efficiency is key for environmental protection in China *207*
3.2.2 International practice emphasizes social & environmental responsibilities of the banking sector *207*
3.3 SIGNIFICANT DISPARITIES IN POLICY AND INSTITUTIONAL COMPREHENSIVENESS 208
3.3.1 Deficient policies and institutions constrain growth of Green Credit in China *208*
3.3.2 Comprehensive policies and institutions provide impetus for growth of Green Credit internationally *208*
3.4 DISPARITIES IN POLICY MEASURES 209
3.4.1 Insufficiency in credit alternatives, a major impediment to efficiency of Green Credit in China *209*
3.4.2 Continued innovation of financial products catalyses sustained growth of the international financial sector *209*

4 RECOMMENDATIONS FOR IMPROVEMENT AND PROMOTION OF GREEN CREDIT IN CHINA 210

4.1 MAJOR CONCLUSIONS 210

4.1.1 Preliminary China-Specific Green Credit Policy Established 210

4.1.2 Improvement Required for Chinese Green Credit Policy 211

4.1.3 Green Credit Policy an Important Macroeconomic Facility 211

4.1.4 Additional Credit Support for Energy Efficient and Emission Reduction Initiatives Needed 212

4.2 POLICY RECOMMENDATIONS 213

4.2.1 Full Comprehension of Green Credit, and Leverage its Supportive and Regulative Capacities 213

4.2.2 Introduce Market Mechanism to Reform and Improve Energy Efficiency and Emission Reduction Policies 213

4.2.3 Improve Existing Green Credit Policies and their Operability and Enforceability 214

4.2.4 Guide and Regulate Institutional External Investments, and Encourage Undertaking of Greater Social and Environmental Responsibilities 215

4.2.5 Formulate Specific Green Credit Policy to Support SME Development 216

4.2.6 Enhance Regulatory and Publicity Efforts, and Provide Investment Guidance for Private Capital 216

CHAPTER 4: STUDY ON ENVIRONMENTAL POLLUTION LIABILITY INSURANCE ... 218

1 THE NECESSITY AND FOUNDATION FOR CHINA TO CARRY OUT ENVIRONMENTAL POLLUTION LIABILITY INSURANCE 219

1.1 THE NECESSITY FOR CARRYING OUT THE ENVIRONMENTAL POLLUTION LIABILITY INSURANCE IN CHINA 219

1.1.1 China has entered a period of frequent environmental pollution accidents 219

1.1.2 The requirements for perfecting the compensation system for losses caused by environmental pollution damages and reducing the cost of government in handling environmental accidents 222

1.1.3 The needs for safeguarding the rights and interests of pollution victims and maintaining social stability 223

1.1.4 The need for helping reduce bankruptcy risks and safeguarding sustainable operation of enterprises 223

1.2 PRESENT DEVELOPMENT AND PROGRESS OF CHINA'S ENVIRONMENTAL POLLUTION LIABILITY INSURANCE 224

1.2.1 China's current situation of legislation on environmental pollution liability insurance .. 224

1.2.2 Practice and progress of China's environmental pollution liability insurance 227

1.3 MAJOR CHARACTERISTICS OF CHINA'S ENVIRONMENTAL POLLUTION LIABILITY INSURANCE AT THE CURRENT STAGE 231

1.4 MAJOR PROBLEMS FACED BY CHINA'S ENVIRONMENTAL POLLUTION LIABILITY INSURANCE AT THE CURRENT STAGE 233

1.5 MAIN REASONS THAT HAMPER THE PROMOTION OF ENVIRONMENTAL POLLUTION LIABILITY INSURANCE IN CHINA 236

2 SUMMARY AND EVALUATION OF INTERNATIONAL PRACTICAL EXPERIENCE OF ENVIRONMENTAL POLLUTION LIABILITY INSURANCE 238

2.1 THE ORIGIN AND DEVELOPMENT OF ENVIRONMENTAL POLLUTION LIABILITY INSURANCE 238

2.2 MAJOR INTERNATIONAL DEVELOPMENT PATTERNS FOR ENVIRONMENTAL POLLUTION LIABILITY INSURANCE 241

2.3 THE TREND OF INTERNATIONAL ENVIRONMENTAL POLLUTION LIABILITY INSURANCE 243

2.3.1 Legislation is an indispensable part of an environmental pollution liability insurance system 243

2.3.2 Compulsory environmental pollution liability insurance represents a major development trend 244

2.3.3 Giving provisions on liability for pollution damages and attaching more importance to environmental damage restoration expenses 246

2.3.4 Establishment of environmental relief funds and improvement in the indemnity and relief mechanism 247

2.3.5 Main features of international environmental pollution liability insurance products 248

3 CONCLUSIONS AND POLICY RECOMMENDATIONS 249

3.1 MAIN CONCLUSIONS 249

3.2 POLICY RECOMMENDATIONS 250

3.2.1 Establish a legal and regulatory framework to enable environmental pollution liability insurance 250

3.2.2 Establish a policy framework to enforce environmental pollution liability insurance 252

3.2.3 Improve the supervision and management mechanism and establish an environmental pollution liability insurance guidance center 254

3.2.4 Strengthening Efforts in relevant Education and Capacity Building 254

REFERENCES 255

CHAPTER 5: REPORT ON INTERNATIONAL EXPERIENCES IN ENVIRONMENTALLY RELATED TAXES 257

1 INTRODUCING ENVIRONMENTALLY RELATED TAXES: A WINDOW OF OPPORTUNITY FOR CHINA 257

2 WHY ENVIRONMENTAL TAXES? 259

3 POLICY OPTIONS TO INTRODUCE ENVIRONMENTAL TAXES 263

3.1 REMOVING ENVIRONMENTALLY HARMFUL SUBSIDIES AND DISTORTIONARY TAX PROVISIONS 264

3.2 RESTRUCTURING EXISTING TAXES 269

3.3 INTRODUCING NEW ENVIRONMENTAL TAXES 269

4 GREEN TAX REFORMS IN OECD COUNTRIES: MAIN FEATURES 271

5 THE EFFECTIVENESS OF ENVIRONMENTALLY RELATED TAXES: SELECTED EXAMPLES IN OECD COUNTRIES 274

6 THE CASE OF ENERGY-CARBON TAXATION 277

7 USING EXTERNAL COST TO ESTABLISH APPROPRIATE TAX RATES 285

8 THE REVENUE OF ENVIRONMENTAL TAXES 288

9 IMPLEMENTING ENVIRONMENTAL TAXES: SELECTED POLICY ISSUES 291

9.1 DISTRIBUTIONAL IMPLICATIONS OF ENVIRONMENTALLY RELATED TAXES 291
9.2 ENVIRONMENTAL TAXES AND COMPETITIVENESS 294
9.3 ACCEPTANCE BUILDING 299

ANNEX: TWELVE CRITERIA CONCERNING CHOICE OF ENVIRONMENTAL POLICY INSTRUMENTS 300

REFERENCES 301

CHAPTER 6: ENVIRONMENTAL TAX REFORMS AND MITIGATION FOR ENERGY-INTENSIVE INDUSTRIES: SOME LESSONS FROM EUROPEAN EXPERIENCE 305

REFERENCES 323

Summary Report

1. Background and Objectives

1.1 Interaction between Energy and Environment in China

While the fast economic growth over the past 30 years in China has significantly increased living standards, this has also brought huge pressures on the environment. Despite improvements in the environmental conditions of many cities and regions across the country, the deteriorating trends in the nation's environmental quality has not yet been curbed, and many citizens are subject to poor quality water, air, and soil as well as a more fragile ecological system. Risks of environmental accidents are mounting due to a range of environmental problems, including accumulated pollution from industrial and civil sources as well as emerging new problems and pressing global environmental challenges. Such risks have become a bottleneck on China's sustainable economic growth and social progress. The causes for China's environmental problems are complicated, relating to fragile natural conditions, the boom of heavy and chemical industry, extensive economic growth, energy consumption patterns, and poor environmental management. Among these causes, the rapid growth of total energy consumption, coal-centered energy structures, and low energy-efficiency largely leads to China's serious environmental pollution. (Fig.1)

Total energy consumption amounted to 2.85 billion tons of coal equivalent (tce) in 2008, while primary energy production was 2.6 billion tons -- both doubled of the year 2000 figures. The explosive growth of total energy production and consumption directly caused massive emission of pollutants, such as SO_2, smog, dust, NO_x and CO_2.

In terms of energy structure, coal remains China's main component of energy supply and consumption, accounting for 70% of total primary energy, which is 40% higher than the global average. 80% of the country's electricity is generated by thermal power. Coal is by far the most popular fuel in use. Such a coal-based energy structure has resulted in SO_2-centered pollution in China.

In terms of energy efficiency, although remarkable progress has been achieved over the past 20 years -- with a 4% average annual rate of energy conservation, the comprehensive efficiency of energy consumption in China is a mere 30% -- about 10% lower than in the developed world. Moreover, China's economic growth has been increasingly relying on the volume of energy consumption since 2002. In 2002, 2003, and 2004, the elasticity of energy consumption in China was 0.66, 1.53 and 1.59 respectively. Fortunately, the figure had dropped to 0.97 in 2005 and 0.7 in 2007, but is still 7 times that of Japan. While the energy intensity of China has decreased from 11.9 tce for 10,000 US Dollars of GDP in 2005 to 10.48 tce in 2007,

it is still 5-7 times that of the developed world. Needless to say, China's low energy efficiency is a major feature of its extensive economic growth pattern, and results in intensive pollution. It is estimated that China's SO_2 and NO_x emission per unit of GDP is 8-9 times that of OECD countries.

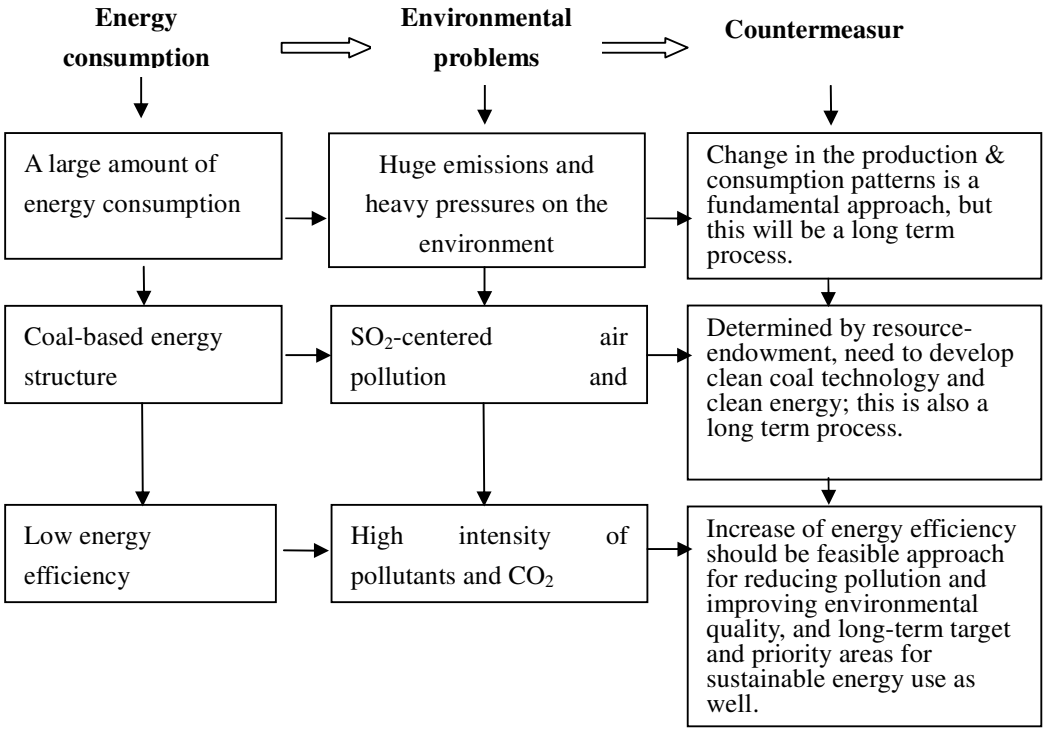

Figure 1. Interaction between energy and environment

Reducing total energy consumption, improving energy structure, and raising energy efficiency are three approaches that can help resolve China's environmental problems and balance economic growth and environmental impact. But China is currently at the middle stage of industrialization, with a relatively low level of economic development and rapid urbanization. Energy demand will undoubtedly continue to grow for a very long period of time still to come. A fundamental change in the country's economic development pattern is a prerequisite for decoupling energy demand and economic growth. Since China's natural endowment has resulted in a coal-based energy structure, improving such a structure requires clean coal technology and the development of renewable energy, such as wind energy, hydropower, solar energy, and bio-energy. Obviously, changing the country's economic development pattern or energy restructuring will take a long time. Raising energy efficiency is, comparatively, the most feasible solution to reduce the intensity of pollution, and should therefore be the long-term target and a priority area for sustainable energy use.

1.2 Challenges in Energy and Environment Management and New Initiatives in Economic Instruments

China has long relied on a command-and-control approach for managing energy and the environment. However, such an approach is confronted with many challenges as a market economy takes roots and keeps developing in China, bringing with it high administrative costs, non-lasting effects, ineffective implementation, and impaired social justice. To meet these challenges, the Chinese government has explicitly voiced the need to establish a system of economic instruments. During the 6th National Conference on Environmental Protection in 2006, Premier Wen Jiabao pointed out that China should no longer only rely on the command-and-control approach but rather, take an integrated approach including legal, economic, technical, and necessary administrative measures to protect the environment and improve environmental management by following economic and natural rules. The report of the 17th Party Congress of the Communist Party of China (CPC) in 2007 stated that reform of fiscal and taxation policies should help to promote sustainable development by incorporating environmental considerations. The Comprehensive Work Plan on Energy Conservation and Pollution Abatement issued by the State Council in 2007 has as well detailed the requirements for market-based instruments (MBI). Raising energy efficiency and developing economic instruments constitute pressing objective demands and a strong desire on the part of the Chinese government.

Drawing upon the practices and experiences over the past decade, since 2005, the Chinese government has made great efforts in developing environmentally-sound economic instruments, which target different stages of the whole spectrum of economic activities (Fig. 2).

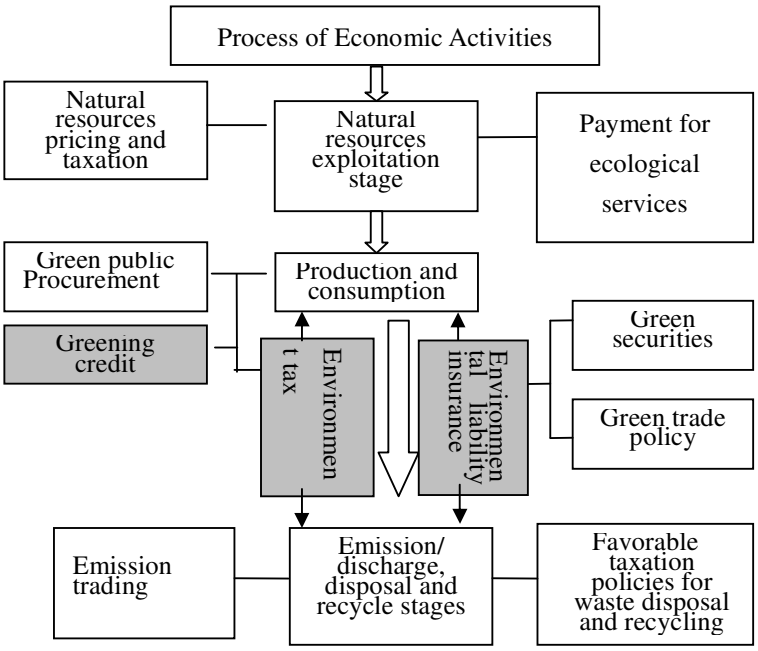

Figure 2. The system of environmental economic instruments in China

As shown in Fig. 2, China has developed a clear structure of environmental economic instruments. Resources and energy pricing and taxation policies are following a fast track of reform with more relevant support from available research work. Discharge/emission fees and preferential taxation policies for waste recycling have been in place for many years and are being continuously improved. Other new instruments, such as ecological compensation (payment for ecological services), emission trading, green trade policies, green public procurement, environmental performance evaluation and information disclosure of stock market listed companies, have started pilot programs or even nationwide implementation. In contrast, instruments such as environmental taxation, greening credit and environmental liability insurance, are in the early stages of policymaking and implementation and relevant studies are too weak to provide support for policymaking.

1.3 Research Targets and Methodologies

In the light of the above-mentioned situation, CCICED set up the Task Force on Economic Instruments for Energy Efficiency and the Environment in 2008. The overall goal of the Task Force is to make strategic and policy recommendations to the Chinese government on specific economic instruments based on the research, with the target of raising energy efficiency and improving environmental management. The Task Force is comprised of two research groups. The first task of Research Group 1 was to study the system of environmental and energy-related taxation and develop a roadmap for strengthening the environmental taxation system

that includes taxation system, which is an effective measure to increase energy prices, and provide incentives to raise energy productivity and reduce pollution intensity. Considering the pressing needs for raising energy efficiency, responding to climate change, reducing pollution and developing a low carbon economy, the second task of Research Group 1 is to design a scheme for a carbon tax in China. Bearing in mind the need to improve China's environmental management and existing economic instruments, the scope of Research Group 2 focuses on a green credit policy and on an environmental pollution liability insurance system. Green credit policy reforms traditional credit policy by incorporating environmental considerations so that, on the one hand, restrictions may be imposed upon the financing of companies who are non-compliant with environmental requirements as well as energy inefficient, energy-and-pollution intensive and natural resource-based industrial sectors. On the other hand, companies with desirable environmental performance and environment-friendly industries may enjoy preferential financing policies. Such incentives will help regulate the environmental behavior of enterprises and reduce credit risks for financial institutions. China is currently faced with frequent environmental pollution accidents, while the necessary liability and compensation schemes are not in place. Therefore it is a significant step to carry out studies on the environmental pollution liability insurance system (Fig. 3)

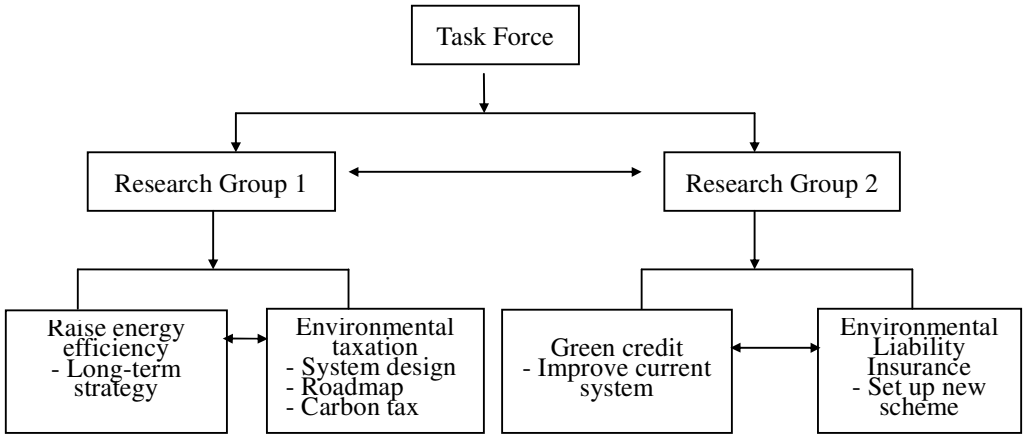

Figure 3. Scope and research tasks of the Task Force

The Task Force has made great efforts to achieve the set targets, such as: conducting desk studies on the relevant current situation in and challenges to China and on international experiences and the implications within the context of economic instruments for environmental and energy efficiency management; organizing a study tour in Germany, Sweden and localities within China on environmental and energy taxation, green credit, and environmental liability insurance; holding various meetings like a kick-off workshop, four Task Force working meetings and more than

ten internal seminars. Based on the results of these efforts, the Task Force has reached significant conclusions and has formulated policy recommendations to the Chinese Government in areas of energy productivity, environmental taxation, green credit policy, and environmental liability insurance (Fig. 4)

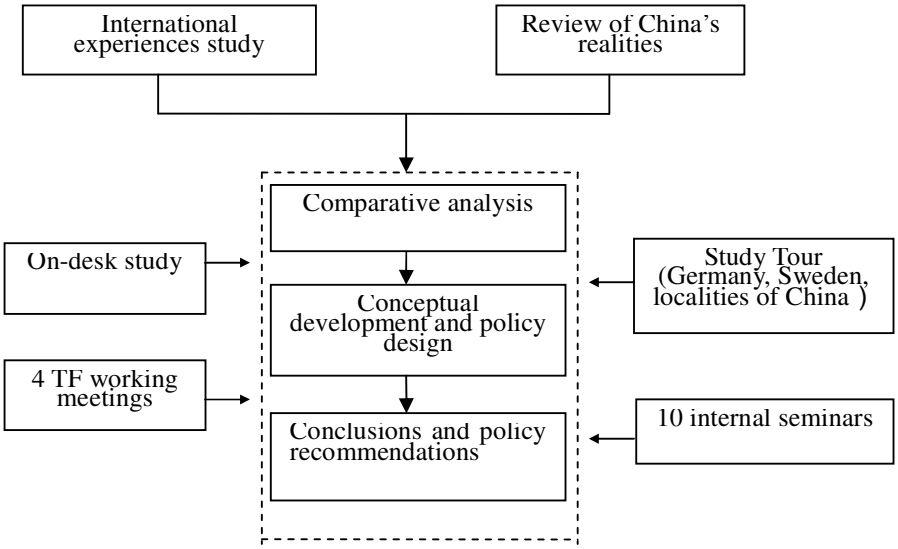

Figure 4. Methodology of the Task Force study

2. Environmental Taxation and Energy Efficiency

2.1 Current Situation and Challenges in China

As explained earlier, improved energy efficiency is the most feasible solution to the problems of intensive pollution, environmental degradation and the negative impacts of climate change, as well as the long-term target and priority area for sustainable energy use. In fact, the Chinese government has attached great importance to raising energy efficiency and has set detailed and stringent targets in this regard. According to the 11th Five-Year-Plan, China should reduce its energy intensity per 10,000 RMB of GDP from 1.22 tce in 2005 to lower than 1 tce by 2010, or a 20% drop; and decrease water consumption per unit of industrial added value by 30% and SO_2-emission and COD-discharge by 10%.

Taking a holistic view of energy and economic systems, the core objective of higher energy efficiency is to increase energy productivity. Energy productivity can be defined as the quantity and quality of goods and services produced by input of a given composition of energy; this is relevant not only to the energy efficiency of one of the links, but also to the whole chain of economic activities. In other words, the concept of energy productivity has the connotation of energy optimization and high

level of efficiency of the economic system, and thus may help gain a complete picture of the relationship between energy consumption and economic expansion. There are two ways to demonstrate an increase in energy productivity; providing the same quantity and quality of goods and services with less energy consumption, or generating more and better economic output with unchanged energy inputs. Therefore the key to raising energy productivity is to increase efficiency and optimize the entire energy and economic system.

As proven by international experiences, energy and environment related taxes serve as an effective tool for inducing higher energy prices, which further help raise energy productivity. Therefore such taxes may serve as a long-term incentive that helps curb energy demand, promote technological innovation and raise energy efficiency. The present reality in China is that the dominant policy and related measures targeting the raising of energy productivity remain administrative regulations, such as energy development plans, energy sector planning and policies, catalogues for industrial restructuring, laws and regulations on energy efficiency and pollution reduction, etc. Remarkable progress has been made in pricing reform for electricity, coal, natural gas, crude oil, refined oil and renewable energy, as well as resource taxes, preferential policies for energy conservation and pollution reductions. However, such measures could not serve as long-term incentives and there is much room for improvement. In particular, the most effective tools, namely energy and environment related taxes are still in the pipeline or even non-existent.

In light of the direction for fiscal and taxation reform in China, it may be an irreversible trend to introduce environmental tax. The "Circular of Comprehensive Work Plan on Energy Efficiency and Pollution Reduction of the State Council" issued in June 2007 stated that taxation policies that help promote energy efficiency and pollution reduction, including the levying of environmental tax, should be introduced and improved. The opinions on deepening economic institutional reform by the central government in 2008 and 2009 also pointed out that studies on environmental taxes should be carried out.

China has not yet introduced environment-targeted taxes such as an energy tax, sulphur tax or carbon tax. Therefore the pricing leverage is not effective in improving energy efficiency and pollution treatment. Current environment related taxes in China, such as consumption tax and resource tax, were not specifically geared to meet environmental challenges, but rather to regulate consumption behavior and resource use. One can tell that there is not a complete environment-related tax framework in place in China, and this partly accounts for the impotency of the current tax system to address energy and environmental issues. In addition, the fiscal difficulties in the localities of China are partially attributed to the tax sharing system, which somewhat leads to local protectionism of polluting companies and environmental non-compliance.

Therefore China has an urgent task to develop a roadmap for the introduction of a comprehensive environmental tax system, so as to establish long-term incentives

for raising energy efficiency and improving the environment.

2.2 International Experiences and Implications for China

In the early 1990s, some OECD and EU countries started comprehensive green tax reforms in a phased manner. These policies comprised three complementary approaches: 1) streamlining or abolition of environmentally harmful subsidies, including direct public expenditure, "market price support" and/or environmental tax reductions and exemptions; 2) restructuring of existing relevant taxes by taking into account of environmental standards, and 3) the introduction of new environmental taxes.

Revenue neutrality has been an overarching principle of environmental tax reforms (ETR) in EU countries, e.g. the introduction of an energy or carbon tax was offset by reducing, the rates of other taxes, such as social security contributions and personal income tax, in order to keep a constant tax burden. Such tax optimization could generate a "double dividend": the tax system would be green and effectively protecting the environment, while helping to minimize other distorting taxes, cut the welfare cost of taxation and increase employment (by reducing the tax wedge on labour). This double dividend and revenue neutrality approach reduced resistance and facilitated smooth tax reform.

Two decades of experiences in OECD and EU countries proved that environmental taxes are an effective tool. In 2006, 375 kinds of energy and environmentally related taxes were applied in OECD countries, including 150 energy related taxes, 125 transportation related taxes, some water and air pollution targeted taxes and a few other taxes on certain products like packaging, batteries, pesticides, chemical fertilizers, lubricants and household appliances. Most of these taxes played a significant role in raising energy efficiency and reducing pollution.

International experiences also show that, as part of the environmental tax system, carbon taxes are an effective tool to reduce pollutants and CO_2 emission and to improve energy efficiency. The countries that applied carbon tax witnessed large scale expansion of bio-fuel and a remarkable drop of fossil fuel consumption, which significantly adjusted their energy supply structures. In the meantime, carbon taxes also helped reduce CO_2 emissions. During 1990 and 2006, the CO_2 emission of Sweden dropped by 9% while its GDP grew by 44%. Research shows that if the Swedish tax system in 1990 had remained unchanged, Sweden would have produced 20% more CO_2 than the current level. Similar proof can be found in Germany, whose ecological tax reform helped reduce its CO_2-emission by 2-3% from 1999 to 2003. Thanks to environmental tax reform, the demand for oil in some European countries showed signs of decline. The demand dropped by 1.5%-5% on the basis of figures available in 2004. The scale of falling demand is attributable to the tax rate as well as the magnitude of its subsequent secondary effect.

The sulphur tax of Sweden introduced in 1991 resulted in a significant drop of sulphur content in oil-based fuel, or at least 50% lower than the mandatory standard. The sulphur tax also helped to reduce SO_2, NO_x and CO_2 emissions by 94%, 20% and 54% respectively, compared with the year 1970. The sulphur tax of Belgium led to a considerable fall of high-sulphur-content fuel consumption from 20% of the market share in 1994 to less than 1% in 1998. Sulphur tax helped Denmark achieve an 84% decrease of sulphur emissions within a ten year period from 1995 to 2004.

Environmental tax reform is a win-win strategy for both the environment and the economy. Not only did such tax reforms in OECD countries not bring about negative impacts on economic growth (GDP), but in some cases, even positive effects were measured. In addition, the introduction of environmental taxes helped create considerable job opportunities. For instance in Germany, 250,000 more jobs were created during 1999-2003, representing an increase of 0.5%. The tax did not negatively affect the international competitiveness of industries either. In OECD countries, the revenue of environmental tax accounts for 6%-7% of the total, or 2%-2.5% of GDP.

It should be noted that the economic and social backdrop of OECD countries and EU states were different when they carried out their respective environmental tax reforms, their policy targets also varied. For example, when Sweden introduced a carbon tax in 1991, environmental pollution was no longer a big problem in that country, and the main purpose was rather to further reduce fossil fuel consumption, improve energy efficiency, and decrease greenhouse gas (GHG) emissions. While, when Germany introduced ecological taxes, it had multiple goals: to cut labor cost, raise energy efficiency, reduce the social welfare burden and promote economic growth. These environmental taxes were designed according to the realities of different countries and did not exert negative impact on GDP growth, but rather contributed to strengthening economic development.

The experiences of OECD and EU countries demonstrate that, firstly, as long as the energy price rise keeps pace with increased average energy productivity, on average, environmental/energy taxes will neither bring about negative impact on social welfare nor result in economic losses for citizens and industries. The precondition is that the additional revenue of environmental/energy taxes can offset the losses caused by distorting taxes or the abolition of such taxes. Secondly, both theory and practical experience show that higher energy prices, even simply the announcement of the introduction and increase of such environmental taxation, can send a strong signal to consumers and companies, , and help curb their energy demand, propel technological innovation and in the end improve energy productivity. Thirdly, the introduction of environmental/energy taxes such as fuel tax, carbon tax or pollutant tax is a valid approach to help establish a long-term escalator mechanism for energy prices, while environmentally harmful subsidies and tax policies should first be eliminated.

2.3 Main Conclusions and Policy Recommendations

2.3.1 Main Conclusions

Drawing upon international experiences on environmental tax reform and taking into account the current challenges China is facing in the field of environment and development, the realities and trends for energy consumption and tax reform as well as the result of carbon tax simulation studies, the Task Force reached the following conclusions on how China could raise energy efficiency and improve environmental quality through environmental tax reform.

(1) Raising energy prices is an effective long-term incentive to improve energy productivity.

In light of the current economic development trends and mounting energy and environmental pressures, China should set higher long-term energy productivity as a national target. Attention should be paid not only to the production/supply links of energy systems, but also to energy demand/consumption. Raising energy prices is the most appropriate pathway to curb energy demand, to encourage technological innovation and in the end to optimize energy use and to improve energy productivity. Considering the complexity of energy pricing issues, China may consider adopting a long-term "escalator strategy", namely to raise energy prices progressively by small increments over a fairly long period of time. Meanwhile, the public should be informed of such price rises, in advance, so as to avoid social and economic turbulence.

(2) Environmental taxation is a key tool to help set up a long-term "escalator" energy price mechanism.

The essence of environmental taxation is to raise the cost of the environmental and resources. OECD and EU experiences demonstrate that environmental taxes such as energy tax, carbon tax, and sulphur tax are effective economic tools to help improving energy efficiency, reducing pollution and cutting CO_2-emission. By removing environmentally harmful subsidies and tax policies, an environmental tax reform could help establish a long-term "escalator" pricing mechanism.

(3) Environmental taxation will not bring about negative impact on economic growth but rather may even favor economic development.

The main target of launching environmental tax reforms is to improve energy efficiency and thereby reduce environmental impact by raising the cost of energy, natural resources and pollution. OECD and EU experiences show that as an important cost factor, if the energy price rise keeps pace with average energy productivity improvement, environmental/energy tax will, on average, neither give rise to negative implications on social welfare nor bring about economic losses for people and industries. According to the carbon tax simulation studies of the Task

Force, the short-term negative impacts will soon be offset by the long-term positive effects of the carbon tax, including a boost in economic output and corporate investment, higher employment, an increase in exports and imports, growth in fiscal revenues and so on. A carbon tax will help to promote effective regulation of energy-intensive sectors, improve energy efficiency, reduce environmental pollution, and maintain stable and rapid economic growth.

(4) The environment for introducing environmental taxation is maturing in China and a relevant tax reform should be carried out at the appropriate time.

Firstly, academics and relevant government agencies have carried out theoretical studies on environmental taxes for a long while. Such research provides solid foundations for environmental tax reform. Secondly, as China has gained very positive experience in developing energy and resource pricing mechanisms and fuel tax reform, psychologically, the general public will be in a favorable position to accept environmental taxes. Thirdly, the environmental tax will serve as an important green incentive to improve environmental quality, and help to build a resource-efficient and environment-friendly society. Therefore the introduction of environmental taxation is in accordance with the political will of China. What is more, relevant ministries have also completed a large amount of research and policy studies on environmental taxes. In this way China is a mature environment for the introduction of environmental taxes. However, given the more general context of increasing pressure from the current financial, energy and food crises around the world, it may not be the best time to introduce environmental taxes right now; that said, China should remain well prepared to launch reform in its taxation system at a more appropriate right time in the future.

2.3.2 Policy Recommendations

Based on the above conclusions, the Task Force puts forward the following policy recommendations on China's environmental tax reform, including the roadmap and action plan for carbon tax reform.

(1) Introducing environmental taxes is an important component of China's tax reform.

There are some major problems in China's existing environmental taxes. For instance, the proportion of environmentally-related taxes compared to total tax revenue and to GDP remains relatively low compared to developed countries; China has not levied any pollution targeted tax yet and there is no complete or effective environmental tax system. At the same time, the rates of pollutant emission/discharge fees remain low and regulators lack mandatory power when collecting such fees. Among these problems, lack of pollution targeted taxes and a complete and effective system of environmental taxes comes to the fore. What's more, the tax sharing system has resulted in fiscal difficulties in Governments at the sub-provincial level, and this has somewhat given rise to a "protectionism" of

polluting companies upon which local government has relied for revenue. Environmental policies will understandably not be implemented effectively in such circumstances.

Environmental taxes are a significant economic tool and long-term incentive to protect the environment. Therefore, launching an environmental tax oriented reform at the current stage will not only help to meet the daunting environmental challenges but also help to better cope with climate change, to develop a low carbon economy, and to improve the quality of China's economic growth.

(2) An environmental taxation system in China should be established step by step, by announcing and subsequently introducing new environmental taxes, restructuring existing taxation with environmental consideration and improving related environmental tax policies.

Taking into account international experiences and China's realities, the main approaches for establishing and improving an environmental tax system in China are: 1. introduce new taxes; 2. restructure existing taxes; 3. improve existing environment-related tax policies. Therefore, China's environmental tax system should be composed of three parts: environmental tax, other environment related taxes, and environmental tax policies. The three parts are inter-connected and complementary to one another and, as a complete system, play a role in environmental protection (fig 5).

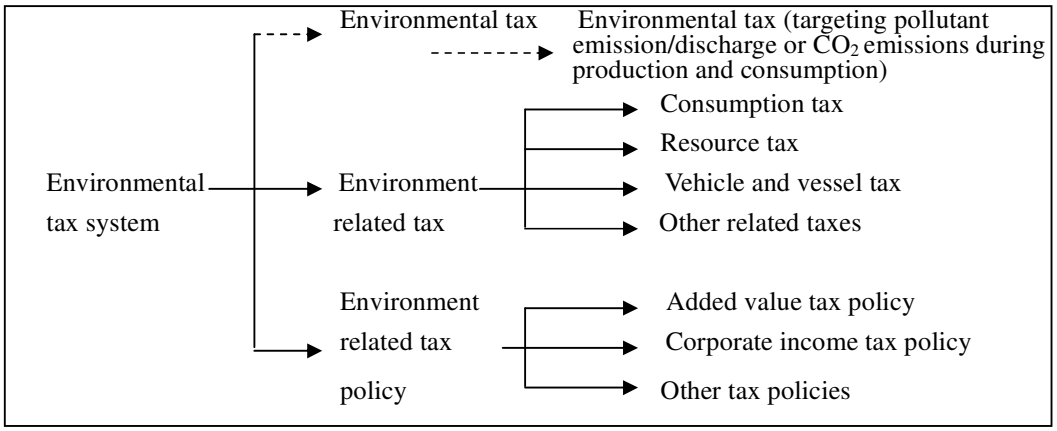

Figure 5. Composition of environmental tax system

According to China's priorities for environmental protection, namely water, air, prevention and treatment of solid waste pollution as well as the need for CO_2-reduction, China's environmental tax system may initially cover these items. With regard to carbon tax, which has become a hot issue lately, it can be introduced as one variety of environmental tax.

Table 1. Scope of environmental tax

Scope and object		Content
Pollution emission/discharge	Waste gases	Including SO_2, NO_x etc.
	Waste water	Including industrial waste water, etc.
	Solid waste	Including coal ash, metallurgical and chemical waste, construction waste, etc.
CO_2-emission	CO_2	Including CO_2 produced by the burning of coal, natural gas, oil and other fossil fuels.

(3) Environmental tax reform should take into consideration the realities of China's economic and social development levels, and adopt a gradualist and "easy ones first, hard nuts last" approach.

Despite the maturing environment for environmental tax reform in China, the Government should nevertheless take a gradualist and "easy ones first, hard nuts last" approach. The reform may be carried out in three phases: phase 1, improve existing environment related taxes such as resource tax, consumption tax, vehicle and vessel tax etc., and introduce stand-alone environmental taxes as soon as possible; phase 2, further improve environmentally-related taxes and relevant tax policies, and expand the scope of environmental taxes; phase 3, further expand the scope of environmental taxes and optimize the overall environmental tax system.

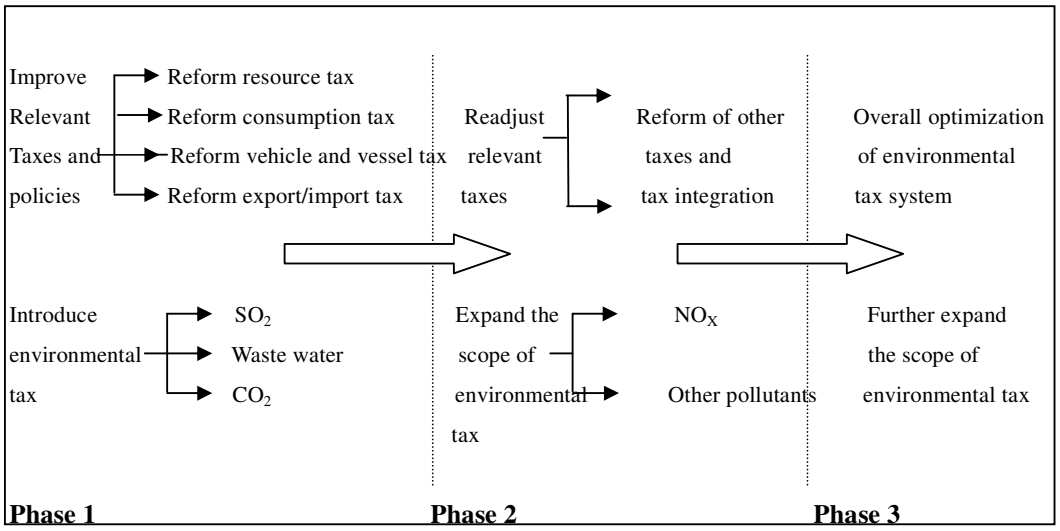

Figure 6. Roadmap of environmental tax reform

(4) A carbon tax is an important option for China to cope with climate change, promote energy efficiency and pollution reduction, and develop a low carbon economy as well.

The experiences of developed countries have proved that carbon tax/energy tax is an effective economic tool that helped considerably to cut CO_2-emissions, reduced environmental pollution and improved energy efficiency. Countries that imposed carbon taxes witnessed a significant drop of fossil fuel consumption and an optimized energy structure. Therefore, a carbon tax may also be an effective economic tool for China.

To introduce carbon taxation in China can be a good choice, since it's in line with the trends of tackling climate change and developing a low carbon economy; it has a low levying threshold and encounters no legal or administrative hurdles. Yet, there are also certain obstacles and challenges, such as the relationship between carbon, resource and consumption taxes, the effect on energy price and energy demand/supply, and the negative impact on economic growth and sector competitiveness in the short run.

(5) Develop a suitable carbon tax scheme for China based on international experiences.

According to the experiences of developed countries, careful analysis should be carried out before the introduction and designing of carbon taxation so as to minimize resistance. During the designing period, various factors should be considered, including coordination between the carbon tax and other taxes, as well as other economic tools, and international taxation coordination and collaboration, etc. The suggested factors of China's carbon tax are listed in Table 2.

Table 2. Carbon tax factors

Tax factors	Terms
Taxpayers	The entities and individuals consuming fossil fuels and directly emitting CO_2 into the natural environment are obliged to pay carbon tax.
Tax scope	Carbon tax shall be levied upon CO_2 that is directly emitted into the natural environment from fossil fuel consumption during production, operation and consumption activities.
Tax calculation	Emission amount is calculated by the fossil fuel consumption amount of taxpayers. CO_2 emission amount = fossil fuel consumption amount × CO_2 emission coefficient. Fossil fuel consumption amount refers to the total amount of fossil fuel that enterprises consume during production and operation activities producing CO_2; fossil fuel includes coal, crude oil, gasoline, diesel oil and natural gas, etc.
Tax rate	Carbon tax shall be levied at norm quota tax rate and calculated in accordance

	with different emission quantities.
Preferential tax policies	A. tax reduction for certain energy intensive sectors according to the needs for economic and social development; B. tax reduction or exemption for enterprises that reduce and recycle CO_2 through advanced technology and meet certain standards; C. exemption for individuals whose CO_2 emissions result from coal and natural gas consumption that are meeting the needs of their daily lives.
Others	Collection mode, payment deadline, payment location, etc.

(6) Choose the right timing for introducing the carbon tax and the reasonable tax rate based on the impact analysis of carbon taxation on the environment, the economy and the social situation.

The design of a carbon tax rate shall take into account the following important factors: (a) marginal cost of CO_2 reduction; (b) impact on macro-economic development and industrial competitiveness; (c) differences among various fuels and industries; (d) gradual rise of tax rate; (e) balance between carbon tax and other fossil fuel targeted taxes. Considering the economic and social realities of China, the carbon tax rate should be low in the short term and gradually rise to higher levels. By taking these factors into account, carbon tax can be effective in regulating human behaviour resulting in CO_2 emissions, while avoiding negative effects on the international competitiveness of Chinese industry and on the daily lives of low-income groups.

Based on estimations using carbon tax modelling, it is suggested that a lower rate be chosen when initially implementing a carbon tax, in order to alleviate the negative influence of the tax on the economy and the resistance of the relevant stakeholders. For instance, the maximum rate of the carbon tax rate might not be more than RMB 15 per ton CO_2 in the beginning and this will still allow for different options and designs there under. Meanwhile, the dynamic adjustment mechanism of the carbon tax rate should be established, and the tax rate could be changed according to the fluctuation of the social and economic situation.

The timing for introducing a carbon tax is subject to having a favourable external environment, including a sound domestic and global economy, and a moderate tax burden. With the Chinese economy still recovering from the repercussions of the global financial crisis and resource tax reform in the pipeline, the best time might be to introduce the carbon tax when the Chinese economy has fully recovered and resource taxes are well established. However, such an environmental tax reform can already contribute to the recovery process: it spurs innovation and triggers cost reduction. The development of international climate negotiations and domestic priorities for environmental protection/climate change should also be seriously taken into account for the decision as to when to introduce a carbon tax. A suggested timetable for the introduction of a carbon tax is as follows:

Table 3. Suggested timetable for the introduction of a carbon tax

	Timing	Remarks
The first best case: "fast scenario"	12th Five-Year-Plan period (2011-2015)	On the basis of resource tax reform, to find the right timing to introduce a carbon tax as a part of environmental taxation.
The second best case: "Slow scenario"	13th Five-Year-Plan period (2016-2020)	China cannot effectively reach its domestic target of coping with climate change if carbon tax has not been introduced by 2020.

(7) Improve supporting systems and create a favorable external environment for the carbon tax.

It is suggested that the carbon tax should be a central tax and aimed at supporting the development of energy efficiency and new and renewable energy. The carbon tax revenue should be incorporated into the regular Government budgets and be managed together with other taxes while maintaining an emphasis on energy efficiency and environmental protection.

It is also important to promote the publicity of the carbon tax, establish a regular rate adjustment and notification mechanisms, strengthen the supporting capacity of the carbon tax collection and management, and coordinate the relationship between the carbon tax and other energy related policy measures on energy efficiency, renewable energy and efficiency standards.

3. Green Credit

3.1 Current Situation and Challenges in China

3.1.1 Background

Achievements in social and economic development over the past three decades, since the country's reform and opening-up, have made China the most exciting story in the world. China's global GDP ranking has risen from 15th in 1978 to 4th in 2008. Per-capita GDP grew by an average of 9.1% every year, from USD 190 in 1978 to USD 2,360 in 2008[1]. Rapid economic growth and urbanization have put the environment under tremendous pressure. Environmental issues and pollution problems pose serious challenges. As such, despite a host of state-driven initiatives, China has missed its environmental goals set in the tenth Five-Year-Plan.

The Chinese government has attached great importance to challenges in environment and resources and has adopted a series of policies and taken respective actions. In the 17th CPC National Congress Report, President Hu Jintao pointed out, "The cost of resources and environment brought by economic growth is too great." Meanwhile, Premier Wen Jiabao stressed many times that the objective of energy saving and emission reduction as specified in *the Eleventh Five-Year-Plan* is obligatory. Furthermore, the State Council promulgated *Opinions on Strengthening Environmental Protection by Implementing Scientific Outlook on Development* in 2005 and issued the *Comprehensive Work Plan for Energy Saving and Emission Reduction* in 2007. Both are the programmatic documents by which the Chinese government has carried out environmental protection and promoted energy saving and emission reduction in recent years. In these documents, an overall plan has been made for the implementation of environmental protection and energy efficiency.

According to statistics, the energy consumed and pollutants discharged in the so-called "double-high" industries (petroleum processing, coking and nuclear fuel processing, manufacturing of raw materials and chemicals, manufacturing of nonmetallic mineral products, ferrous metal smelting and rolling, non-ferrous metal smelting and rolling as well as the production and supply of electricity and heat)[2] account for approximately 70 percent of total generated across all industrial activities. In non-industrial activities, construction and road traffic are recognized as the two major sectors with respect to energy consumption and pollutant emission. While people's living standards are improving, domestic refuse and sewage discharge are increasingly becoming the leading sources of pollution.

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[1] National Statistics Bureau of China, 2008. "Part 16 of the Series of Report on Achievements in China's Economic and Social Development During the 30 Years since Reform and Opening-up". http://www.stats.gov.cn/tjfx/ztfx/jnggkf30n/t20081117_402517351.htm (accessed on April 6, 2009).

[2] These six industries are referred to as "high energy-consuming and high polluting" industries or, in short, "double-high" industries.

Due to the underdevelopment of China's capital market, banks have always been the most dominant institutions for enterprises, governmental agencies and individuals to acquire external financing. On average, about 80 percent of external financing for these said entities is provided through banks. According to statistics, as of the end of 2008, the outstanding medium- & long-term loan from banks stood at RMB 2.6226 trillion in "double-high" industries, RMB 1.5843 trillion in water conservancy, environment and public utilities management, and RMB 2.3594 trillion in traffic and transportation, warehouse and postal service, while the outstanding loan in real property was RMB 5.2818 trillion and RMB 114.8 billion in automobile consumption. The sum of these balances amounted to 39.8 percent of GDP. Financing activities conducted by the banking sector have an extremely significant impact on the development of these industries and departments.

Therefore, the banking sector plays an irreplaceable role in effectively implementing environmental protection and energy efficiency, and striking a balance among economic growth, investment return and environmental protection. By incorporating "green" factors such as environment protection and energy efficiency into the banks' financing activities (namely, implementation of green credit), the environment protection sector may obtain effective support to solve environmental problems of environmental pollution and ecology degradation caused by "double-high" industries, traffic and transportation, real estate construction and consumption as well as people's daily life.

Meanwhile, the Chinese government has stepped up efforts for energy efficiency and pollution reduction in recent years, including stricter environmental regulation. Numerous seriously polluting factories were closed down or ordered to restrict production, resulting in increasing bad loans for banks. Such negative impact propelled financial institutions including banks to seriously consider environment-induced financial risks and adopted relevant preventative measures. According to the statistics of the China Banking Regulatory Commission, by the end of March 2007, the total non-performing loans of the five major banks in energy intensive and heavily polluting industries stood at 43.709 billion RMB, representing a bad loan ratio of 3.28%. The calcium carbide, iron alloy and cement industries topped the list with a bad loan ratio of 28.8%, 27.6% and 20% respectively.

In order to exert efficiently the function of banking sector in facilitating environment protection and energy efficiency and to reduce the credit risks caused by environmental and social risks practically, the banking regulatory authorities, environment protection authorities and other relevant departments have consolidated their cooperation to promote banks and other financial institutions in implementing the scientific outlook on development and have issued Green Credit-oriented documents such as *Opinions on Implementing Environmental Protection Policies and Regulations and Preventing Credit Risks* and *the Guiding Opinions on Credit Granting for Promoting Energy Efficiency and Pollution Reduction,* which put forward an overall requirement for implementation of green credit in the banking

sector. The banking sector is thus eager to cooperate with the environmental authority and competent departments to gain a better understanding of environmental policies development and get access to corporate environmental information, both of which can play an important role in better controlling credit risks, ensuring banking assets safety and reducing non performing loans.

Against such a political, economic, and environmental background, amid close collaboration between the Ministry of Environmental Protection and China Banking Regulatory Commission, the country witnessed a rapid development of green credit policy and its far-reaching implications.

3.1.2 Policy Implementation Content

Green credit is an economic tool that has been implemented with distinct Chinese characteristics, including a set of financial credit-centered policies and mechanisms and practices for promoting energy efficiency and pollution reduction. China's green credit policy has four aspects. First, green projects or companies are supported by appropriate credit policies and measures (related to loan term, interest rate, and loan limit). Second, non-compliant projects or companies are discouraged by punitive credit measures, such as loan suspension and withdrawal. Third, banks are able to reduce their credit risk in lending activities by supervising and urging their customers to strengthen management of environmental risks and improve resource efficiency. Forth, banks are required to seek new business opportunities for advancing environmental protection and energy efficiency and to develop new financial products to expand credit and related services. Through green credit activities, banks can facilitate sustainable development and achieve a win-win for themselves, their customers, and the whole society through collaboration with enterprises and other stakeholders.

China has a long history of green credit policy. In 1995, the People's Bank of China issued the Circular on Implementing Credit Policy and Strengthening Environmental Protection, which required banks to consider resource protection and pollution control in lending policies. In 2004, the National Development and Reform Commission, People's Bank of China and China Banking Regulatory Commission jointly issued the Circular on Strengthening Coordination between Industrial and Credit Policies and Controlling Credit Risks, which denied credit support for all new projects related to restricted or obsolete industries.

Since 2006, China's green credit policy has advanced even further. The former State Environmental Protection Administration, China Banking Regulatory Commission, and People's Bank of China carried out consultations and joint studies as the basis for issuing a variety of documents around 2007 to enhance green credit policies. These documents include: The Guiding Opinions on Improving and Strengthening Financial Services for Energy Efficiency and Environmental Protection by PBOC, Opinions on Implementing Environmental Regulations and Policies and Preventing Credit Risks by SEPA, CBRC and PBOC, Circular on

Preventing and Controlling Credit Risks of Energy Intensive and Heavily Polluting Industries and The Guiding Opinions on Credit Granting for Promoting Energy Efficiency and Pollution Reduction by CBRC, and so on. In addition, SEPA, CBRC and PBOC signed a working agreement to incorporate environmental information into the credit reporting system and strengthen information-sharing and exchange. Amongst the above-mentioned documents, the Opinions on Implementing Environmental Regulations and Policies and Preventing Credit Risks and The Guiding Opinions on Credit Granting for Promoting Energy Efficiency and Pollution Reduction comprise the core of China's green credit policy.

According to the Opinions on Implementing Environmental Regulations and Policies and Preventing Credit Risks, financial institutions and environmental regulators should abide by the requirement of environmental laws and regulations and impose stricter environmental supervision and credit management on new projects. Financial institutions should implement more stringent loan review, granting, and management policies. On the one hand, no additional loans should be approved for projects that seriously breach environmental laws and regulations while on the other hand, preferential lending policies should be applied to green projects. The Guiding Opinions on Credit Granting for Promoting Energy Efficiency and Pollution Reduction requires banks to adopt the principle of "differentiated treatment, supporting some sectors while restraining others" and to strengthen management with respect to due diligence, examination on lending, post-lending supervision, compliance, loan contract, authority of credit granting, policies of industrial credit granting, process of risk management, risk pricing, internal audit control, personnel assignment and training, information disclosure, and stakeholders with the aims of promoting the sustainable development of the banking business, China's economy and society while also efficiently preventing various risks incurred by the banks' customers due to high energy consumption, high emissions and heavy pollution.

3.1.3 Progress to Date

In the wake of the introduction of China's national green credit policies, the subordinate environmental and banking authorities at all levels have put forward local policies. According to incomplete statistics, more than 20 localities, including Fujian Province, have developed local policies. Recently, Hebei Province has developed a performance evaluation system for green credit implementation.

In the meantime, green credit policies were also well-received by commercial banks. According to the requirement of The Guiding Opinions on Credit Granting for Promoting Energy Efficiency and Pollution Reduction, commercial banks have developed internal management systems for controlling environmental risk within the credit system. Many banks, such as Industrial and Commercial Bank of China, China Construction Bank and China Development Bank, not only introduced a strict environmental review mechanism, but have also implemented an "environmental veto" mechanism within the credit approval process. The active involvement of

banks has been critical to ensuring the effectiveness of green credit policies and making this a high-profile economic tool that attracts substantial popular attention. In China, green credit is an important and successful measure for promoting energy efficiency and pollution reduction.

By June 2008, the five major commercial banks, namely Industrial and Commercial Bank of China, Agricultural Bank of China, Bank of China, China Construction Bank and Bank of Communications, had lent a total of 377.952 billion RMB to support 595 key green projects and 110.529 billion to 1619 projects related to green technology and product dissemination. This represents an increase of 50.694 billion and 15.965 billion, respectively, since January 2008. Policy banks (non-commercial banks) loaned 224.058 billion RMB to support green projects including clean energy, waste water treatment, and so on. The National Development Bank lent 30 billion RMB through the Special Fund for Energy Efficiency and Pollution Reduction, of which, 4.5 billion RMB was invested in Taihu Lake treatment. Over the same period, the five commercial banks approved facility and loans of 14.905 billion RMB and 12.767 billion RMB, respectively, for the restricted industries. This was 1.022 billion RMB and 0.508 billion RMB less, respectively, compared to the beginning of the year, and 364 million RMB and 358 million, respectively, for industries that will be gradually phased out (this represents a 141 million RMB and 124 million RMB drop, respectively, for such industries).

3.1.4 Problems and Challenges

Despite the early progress that has been achieved, China needs to be clear that the development of green credit policy is still in the initial stage, there is much room for improvement in terms of policy content and technical support. China is faced with quite a few problems and challenges in this regard.

The main problems are: First, an incomplete policy system and inefficient implementation; second, lack of diversity and effectiveness of available tools for implementation; third, insufficient information exchange; fourth, lack of supervision, evaluation, and regulation of banks and their reluctance for voluntary action; and fifth, the low capacity of banks and financial institutions for policy implementation.

China is also confronted with many challenges. First, due to fierce competition among commercial banks the implementation of the green credit policy is facing a great challenge; second, protectionism in the localities obstructs the implementation of green credit policy; third, private capital is not well regulated and non-compliant small and medium sized enterprises may still get funding support through this channel; fourth, small and medium sized banks and financial institutions are both most affected by environmental regulations and most resistant to green credit policy.

3.2 International Experiences and Implications to China

3.2.1 Relevant Exercises and Main Practices

There is no explicit "green credit policy" in other countries, though similar sustainable banking concepts and initiatives are plenty in the international community, such as the principle of self-discipline in environmental governance, and state promoted green financial products. These practices can be classified in four categories.

(1) Green financial initiatives of the international community and multinational organizations

The UN Conference on Environment and Development, in 1992, put forward the Declaration on Environment and Sustainable Development of the Banking Sector, which was a great contribution of the banking sector in the area of environmental protection. So far, 272 institutions and organizations around the world have signed the declaration. Bank of Shanghai was the first Chinese bank that signed on the document; it demonstrated that Chinese banks were trying to become greener by doing their part in promoting environmental protection and sustainable development.

OECD countries have agreed on a Revised Recommendation on Common Approaches to the Environment and Officially Supported Export Credits, which sets out strengthened environment-related requirements for export deals to qualify for support from OECD Members' Export Credit Agencies. The Revised Recommendation calls on the OECD Members to evaluate carefully any export credit applications with a loan period over two years that are officially supported and make sure their potential environmental impact meets the standards of relevant international organizations, in particular the World Bank and the IFC.

(2) Self-disciplinary principles of green financing

Faced with widespread criticism for their poor environmental, social and human rights performance, a number of international banks have initiated and advocated the Equator Principles, which helped internalize environmental, social and human rights risks, and improve the image of the banks. The Equator Principles are a set of self-disciplinary benchmarks for the banking sector to shoulder more social and environmental responsibilities. They include 10 basic principles, 8 environmental and social performance standards of the IFC, and 62 Environmental, Health and Safety Guidelines of the World Bank and the IFC, which should be complied with during financing activities. The Equator Principles enjoy growing influence with more than 60 international banks which have signed up to them, including a few from developing countries like Brazil and China. The capital raised by these banks accounts for about 90% of the global total.

(3) State-promoted subsidies to green credit

In order to support green projects, which often show low returns and are of a public and long-term nature, it is a common practice for many countries to grant low rate loans to these projects through policy banks or commercial banks. The experience of the UK, Japan and Germany are of particular interest to China.

The Household Energy Efficiency Law of the UK in 1995 required a 30% drop of household energy consumption within 10 years on the basis of 1996 or 1997 figures. In order to achieve this goal, the UK government introduced a set of policies and measures to improve energy efficiency, including discount loans, low rate loans or interest free loans for equipment investment and technological development projects to improve energy efficiency. Within the 200 million pound Energy Efficiency Fund in 2002, 25% was used for discount loans, of which 10 million pounds were granted as interest free loans.

In order to propel enterprises to maintain a balance between environmental and economic interests during production activities, the Development Bank of Japan put forward a financing policy based on an "environmental rating". The rating result would determine who could access loans and at what rate. Driven by the need for tackling climate change and CO_2 reduction, the Bank again introduced an environmental-rating-based discounted loan in 2007. Those rated companies who commit to reduce CO_2 emission per unit of production by more than 5% in 5 years will enjoy an additional rate discount of 1% when applying for CO_2 treatment loans.

In Germany, the policy bank KFW Bankengruppe raises money in the capital market while financial subsidy policies for environmental projects are channeled through commercial banks. In this way, government subsidies can be exploited to their fullest extent. This is how Germany does it: First, the KFW Bankengruppe raises money in the capital market with the support of a government subsidy, and then the KFW Bankengruppe will use the capital raised to develop long-term and low-rate financial products and sell them to commercial banks, finally, after adjusting the rate, the commercial banks will sell the green financial products and services to end clients with very preferential rates and loan periods. This practice can also contribute to energy efficiency improvement and GHG emission reduction.

(4) Innovation on green financial products

The international obligation for GHG emission reduction has not only created an active carbon trading market, but has also impelled financial institutions, including banks, to innovate on new green financial products, such as carbon financing and energy efficiency financing. Many banks have started to develop products that are oriented to a low carbon economy and CO_2 emission reduction. Green financial products and services for individuals and small and medium sized enterprises have covered such business as loan, deposit, credit card and lease.

3.2.2 Experiences and Implications to China

Comparing Chinese and international policies and green credit practices, one can discover that China has some successful experience and some shortcomings as well. The banking regulatory authorities, environment protection authorities the other competent departments have done a good job in taking joint actions and working out relevant policies, thereby providing a good platform for fair competition among banks. Meanwhile, banking regulatory authorities and environment protection authorities have provided the banking sector with a relatively complete and timely service of environmental information via regulatory information sharing, thus facilitating the banks' capacity to manage environmental risks, and materialize the joint oversight on enterprises with high environmental risks. However, one can also identify several shortcomings. Firstly, the green credit policy is largely government-led in China, while international practice emphasizes joint promotion by government, market, and the banking sector. Secondly, China's green credit policy system is incomplete and less practicable compared with those in foreign countries. Thirdly, policy tools and insufficiently diversified and innovation in green financial products is lacking. Fourthly, Chinese banks are required to promote energy efficiency and pollution reduction, and shoulder more social and environmental responsibilities, potentially neglecting their legitimate need for reasonable profit in implementing green credit policy.

Developed countries, including the US, Japan, and European nations, have actively promoted the development of diversified green financial products, such as green credit and financial subsidies, which play a positive role in environmental protection and GHG emission reduction. China could learn a lot from the experiences of these countries.

First, the role of the market should be stressed in promoting green credit policy. Green credit policy contains two core aspects: preferential credit policy for green projects, and restricting or denying lending support for projects with negative environmental and social impacts. International experience, particularly the German experience, shows that the market plays an essential role in both aspects. State support for the policy banks may be channeled through the capital market and the direct involvement of commercial banks can help move the green credit policy closer to end clients in order to maximize efficiency. Ultimately, the green credit policy should not only bring about more environmental and social responsibilities for banks but new business and profit opportunities as well.

Second, green credit benchmarks are widely accepted and advocated by the international community and the banking sector. However, there is much room for improvement in terms of policy completeness and practicability in China. The 8 Social and Environmental Performance Standards of the IFC and the EHS Guidelines referenced in the Equator Principles may serve as effective tools that help the banks to accurately rate the risk of a project and assist the client to improve project design for reduced operational risks.

Third, clearly defined environmental liability is the basis for implementing green credit policy. Only by clearly stipulating environmental liability, rights and obligations in the law, can the government, enterprises and the banks be propelled to protect the environment and reduce pollution.

Fourth, environmental review is critical for promoting green credit policy. Due to the complexity of environmental issues and diversity of technological processes, it is often difficult for banks alone to identify the environmental implications of a certain project, and the support of the environmental agencies in terms of environmental assessment is particularly necessary. The Japanese and German experiences show that environmental review is not only beneficial for the banks but can also help reward the green companies and punish the dirty ones.

3.3 Conclusions and Policy Recommendations

3.3.1 Main Conclusions

(1) A green credit policy with Chinese characteristics has been well-established

A Green credit policy with Chinese characteristics is well established. The core content of the policy is preferential lending support for green projects, and strict review and loan restrictions for energy intensive and heavily polluting projects. The close collaboration between environmental agencies and the banking sector, in policy development, information sharing and personnel training, has pushed forward the development of green credit policy in China. Under government regulation and the guidance of a scientific approach to development, more and more banks have set up internal mechanisms and procedures for green credit and voluntarily shoulder more social and environmental responsibilities. A top-down system of green credit policy has been well established in China. With expanding content, the green credit policy has become an important and successful economic tool for promoting energy efficiency and pollution reduction.

(2) There is much room for improvement in China's green credit policy

Compared with advanced international practices, there is still much room for improvement in China's green credit policy. Only by resolving the problems can the policy better meet the domestic need. The most prominent problem of China's green credit policy is reliance on administrative measures and not market mechanisms, which has so far resulted in inefficiency. In the future, China should strengthen the role of market forces in developing more green financial products. Sector-oriented green credit policies also need to be developed so as to ensure efficient implementation.

(3) The green credit policy is an important tool for modulating and regulating macro-economic activities

Against the background of financial crisis, lending support is often the decisive factor for the subsistence and development of enterprises. As China introduced its economic stimulus package, a large amount of capital is pouring into the market and the lending scale is sharply expanding. In the first half of this year alone, the total loans granted exceeded 7 trillion RMB. This has given rise to concerns over lax implementation of the green credit policy, repetitive construction, excessive production capacity and new bad loans. As a matter of fact, the green credit policy should play an important role in encouraging lending support for projects with attractive economic, social and environmental returns while discouraging credit loans for projects that seriously pollute and damage the environment. It should thereby help achieve the overall goal of "sustained economic growth, improved industrial structure and better development". In the recently introduced set of policies for regulating industries with excessive production capacities, including iron, steel, cement etc., the State Council has clearly identified strengthened environmental supervision and stricter credit management as macro regulatory measures. Therefore it can be said that the green credit policy not only helps promote energy efficiency and pollution reduction, but also serves as an important tool to achieve macro regulatory goals.

3.3.2 Policy Recommendations

(1) Clarify and stress the supportive aspects of the green credit policy

There is currently a misconception that the green credit policy is basically a punitive tool. But, in fact, the green credit policy includes not only punitive and restrictive measures, but also positive measures, such as subsidies and loan preferences for green projects by means of credit instruments. Such supportive measures are also very important for achieving the goal of improved energy efficiency and pollution reduction. Because of the misconception, the supportive side of the green credit policy has not been stressed. The policy has centered upon the punitive aspect while very few supportive tools were developed. This has resulted in a lack of innovation and a weak structure of the green credit policy, which hampers the effectiveness of the policy in supporting the energy efficiency and pollution reduction program.

Therefore China should put more weight on the supportive and regulatory aspect of the green credit policy. It remains important to further strengthen the social and environmental responsibility of banks, and curb the development of energy intensive and heavily polluting industries by credit restrictions. However, it is also essential to encourage the innovation of supportive green policies and credit products, such as loan preferences and subsidies. Meanwhile, it is necessary to reform existing financial and taxation policies for energy efficiency improvement and pollution reduction so as to raise capital efficiency and ensure the policies are fair and widely

applicable.

(2) Improve the enabling policies for energy efficiency and pollution reduction through market-based reform in the financing area

The Chinese government has attached great importance to the energy efficiency and pollution reduction program. China has not only established the Special Fund for Energy Efficiency and Pollution Reduction, but also provided capital support for green projects through the National Development Reform Commission and China Development Bank. Within the 4 trillion RMB stimulus package, a considerable sum of 400 billion will be used to support green projects. The absence of a market-based mechanism has resulted in low capital efficiency, and the administrative approval procedures will also easily breed corruption.

In order to make the use of capital more effective, transparent and fair, market-based reform shall be introduced, mainly through the leverage exerted by financial institutions to expand the effect of energy efficiency and environmental protection.

(a) Establish a national guarantee fund for energy efficiency and emission reduction, and offer credit guarantees for eligible credit capital by sharing risks with financial institutions in the banking sector.

(b) Offer interest subsidies to key energy efficiency and emission reduction projects. The government may confirm the range of subsidies for loan interest through invitation to bidding and tender towards financial institutions and the banking sector.

(3) Improve the existing green credit policy and strengthen its practicability and effectiveness

(a) Accelerate the introduction of industrial policies related to green credit; require banks to clarify the policy boundary and scope in reviewing the credit grant; restrict higher energy consumption and pollution projects in order to adjust the industrial structure and promote sustainable development, (b) The collaboration among environmental agencies, competent industrial authorities and banks, should be further strengthened. The environmental agencies should establish close collaboration with competent industrial authorities, provide timely corporate environmental information by developing sector guidelines for implementation of green credit policy, carry out “green project” verification, and establish an integrated environmental risk rating system for enterprises and projects. These measures will help improve the practicability and effectiveness of the green credit policy. The banks should create more green financial products, conduct strict credit management and review, acquire timely green credit information, and provide green loans for green projects. By doing this, the banks and environmental agencies can together support the work of energy efficiency and environmental protection projects, and further facilitate sustainable development.

(c) A supervision and information disclosure mechanism for green credit implementation should be established as soon as possible. Disclosure of information about non-compliant companies, as well as the banks' implementation of green credit policy will help the banks to shoulder their social and environmental responsibilities.

(4) Guide and regulate overseas investment by Chinese financing institutions and strengthen their social and environmental responsibilities

China should also strengthen its regulation and management of its overseas investment and develop relevant policies in this area. Large companies and banks should be encouraged to manage their investment or credit granting process by adopting international benchmarks. Additionally, with regard to the large amount of private investment by small and medium sized enterprises, targeted polices are also needed for greening such investment.

(5) Develop a special green credit policy to support the healthy development of small and medium sized enterprises (SMEs)

Affected by the financial crisis, access to loans has become difficult for SMEs which is a prominent problem for their development. The situation of SMEs needing renovation or development of environmental facilities is particularly severe.

Therefore, when developing financial policies for supporting SMEs, the Chinese government should work on the introduction of a special policy and develop special green financial products for SMEs. Loans should be provided to support the development of green SMEs that enjoy healthy prospects and are in compliance with national industrial policies and the policy of energy saving and pollution reduction. At the same time, the Chinese government should impose on SMEs a strict review of energy saving, pollution reduction and credit granting processes, and reject lending support for heavily polluting and high energy consuming SMEs.

(6) Strengthen supervision and education, and better regulate private capital flow

The lack of effective regulation on private capital has incapacitated China's macro-regulatory policies, while the expansion of the sector and its neglect of social and environmental interests continued. Therefore, in addition to introducing green credit within public financial institutions, it is also important to strengthen the supervision and regulation of the private capital lending sector.

Supervision should be strengthened on heavily polluting and energy intensive companies, and severe punitive measures should be imposed on non-compliant activities. Thus, the investor will learn a lesson from the punishment and realize the high financial and environmental costs if social and environmental interests are neglected. What's more, the government should strengthen education on financial and environmental issues and the related costs of irrational investment. Such education will help investors to develop awareness of the risks involved in funding

industries with high energy consumption and pollution.

4. Environmental Pollution Liability Insurance

4.1 Current Situation and Challenges in China

Over the past 30 years, China has achieved amazing economic success but at the same time, large-scale environmental problems and conflicts have accelerated due to a tremendous expansion of economic aggregates, irrational industrial structure, and poor factory location. China has hence entered an era characterized by frequent environmental accidents. According to statistics, from 1998 to 2005, the annual direct loss caused by pollution accidents in China reached i140 million RMB, on average. Between 2003 and 2006, there were a total of 5,532 environmental pollution/destruction accidents, resulting in a direct economic loss of 637.267 million RMB and a total compensation/fines of 178.534 million RMB, while seriously impairing the health, life, and property of local residents. An environmental risk survey of China's petro-chemical industry carried out by the former State Environmental Protection Administration in 2006 showed that 81% of the 7,555 surveyed petro-chemical projects are located in environmentally-sensitive areas, such as river valleys and highly populated regions. 45% of these projects are associated with high environmental risk and those located in major river basins pose threats to the local environment, with no preventive mechanism in place.

Against this background, administrative regulation alone is not enough to prevent environmental emergencies. Therefore, it is absolutely imperative to establish a long-term mechanism for environmental risk management, especially environmental pollution liability insurance. Environmental pollution liability insurance requires the insurer to bear the responsibility of economic compensation and pollution treatment in case the insured party accidentally causes environmental pollution so that any victims are compensated on a timely basis, even if the insured is not solvent. Environmental pollution liability insurance has only been developed over a few decades in some developed countries. Such insurance has become the main financial instrument to prevent environmental risk and resolve the problem of environmental damage compensation. For this reason, many companies have used environmental pollution liability insurance to better manage their environmental risks. The introduction of environmental pollution liability insurance in China will help improve pollution compensation mechanisms, strengthen preventive management of environmental accidents, reduce the cost for the government in the wake of environmental emergencies, safeguard the legitimate rights of the victims, maintain social stability, reduce bankruptcy cases, and ensure sustained corporate development.

In recent years, China has made some progress with respect to environmental

pollution liability insurance. In 2007, the former State Environmental Protection Administration and China Insurance Regulatory Commission jointly issued the Regulatory Opinions on Environmental Pollution Liability Insurance. The Regulatory Opinions state the principle, target, implementation, and supporting mechanisms of environmental pollution liability insurance and serve as the most important guideline at the national level. In the meantime, some provinces, like Jiangsu and Liaoning, have already initiated legislation in this field.

Since the promulgation of the Regulatory Opinions in 2007, many insurance companies (including PICC, Ping An Insurance, and Pacific Insurance) have developed environmental pollution liability insurance products and gained approval from the China Insurance Regulatory Commission. In 2008, the Ministry of Environmental Protection and the China Insurance Regulatory Commission co-hosted the National Working Meeting on Environmental Pollution Liability Insurance Pilot Programs, marking the formal launch of pilot programs across the country. Provinces and municipalities, including Jiangsu, Chongqing, Hubei, Hunan, Henan, Ningbo, Shenyang, Shenzhen and Suzhou, were identified as regions where pilot programs could be carried out with enterprises that produce, operate, store, transport, and/or consume hazardous chemicals, and specifically with the petro-chemical industry, which is prone to pollution accidents and with hazardous waste disposal enterprises, waste landfills, waste water treatment plants, and industrial parks. In July 2008, the Hunan branch of Ping An Insurance Company compensated the victims of pollution accidents caused by Hao Hua Chemical Company. This was the first case of environmental pollution liability insurance reimbursement in China, signaling a new age for environmental pollution liability insurance.

Generally speaking, environmental pollution liability insurance is still in an initial stage of development in China, and there are many problems that need to be addressed: First, due to cost considerations and lack of awareness, few companies are interested in buying environmental pollution liability insurance. Second, the underwriting ability of Chinese insurance companies needs to be improved to manage profitability uncertainty and the higher operational risk of environmental pollution liability insurance. Third, too much government intervention will not help to establish a long-term mechanism for pollution compensation and may, in fact, undermine the credibility of environmental pollution liability insurance. Fourth, because the environmental pollution liability insurance is a new development in China, many people are not yet aware of its role, nor the needed policies, operation, and management of such insurance. Fifth, the current global financial crisis exerts considerable negative impact on the popularization of environmental pollution liability insurance in China.

Additional factors constrain the popularity of environmental pollution liability insurance in China. First, legal support is lacking. No national law or regulation on environmental pollution liability insurance currently exists in China. Second,

liabilities can be obscure and there is a lack of internal push for environmental pollution liability insurance. Third, standards for insurance product pricing and reimbursement are lacking. China has neither developed an environmental risk assessment methodology nor pollution damage verifications and compensation standards. These technical obstacles need to be resolved to facilitate a broader acceptance of environmental pollution liability insurance. Fourth, incentives are lacking for both the insured and insurer, and there is a high operational risk for insurance companies. Fifth, there is a lack of policy and financial support from the central government to the pilot regions. As no special funds have been provided at the national level, the programs are currently mainly supported by local governments.

4.2 International Experiences and Implications to China

At present, there are two advanced models of environmental pollution liability insurance in foreign countries; namely, *mandatory* environmental pollution liability insurance (which has been adopted by the US, Germany, Russia, and Argentina) and *voluntary* environmental pollution liability insurance (which has been adopted by France and the UK). Mandatory environmental pollution liability insurance focuses on mandatory insurance complemented by voluntary insurance. In this model, mandatory environmental pollution liability insurance is imposed on risky firms while most others can buy the insurance on a voluntary basis. The mandatory model involves insurance as well as other financial guarantees by law (e.g. financial guarantees and fund). Such financial guarantees make the insurance more flexible.

Countries that have adopted the voluntary model differ in their approaches, priority areas, operational models, and insurance products, but there are also some similarities amongst them with respect to the overall trends of Environmental Pollution Liability Insurance. First, legislation serves as the basis and a precondition for introducing Environmental Pollution Liability Insurance. In this respect, laws set the legal status and provide for an operation model, an underwriting approach, managing institutions, compensation liabilities, and priority areas. The law endows the insurance with more mandatory power. Legislation is also a benchmark of the development level of environmental pollution liability insurance. Second, mandatory insurance is a general trend of environmental pollution liability insurance development. All countries with the mandatory approach have developed catalogues to better manage environmental pollution liability insurance. The catalogues are developed in accordance with the management needs of different countries and normally include an equipment catalogue, a product catalogue, and a risk assessment based catalogue. Third, compensation liability for pollution damage is specified and increasing weight is given to environmental restoration. There are clear provisions in the laws of these countries regarding the compensation liability of pollution damage. Such provisions play a vital role in regulating insurance policies and pay-outs. The insurer must bear compensation liability as stipulated by law and pay more attention

to its responsibility for environmental restoration. Relevant provisions can be found in the laws of the US and Germany, and the environmental pollution liability insurance of Argentina is even purely restoration-oriented. Fourth, the establishment of an environmental aid fund is an important supplement to the compensation mechanism. When pollution damage exceeds the cap of insurance reimbursement and the insurer is insolvent for extra loss, some countries have established environmental aid funds to help control operational risks of insurance companies. Every environmental pollution liability insurance policy sets a cap on single reimbursement and total pay-out within certain insurance periods; in other words, insurance companies underwrite a limited liability. The environmental aid fund therefore plays a very important supplementary role to improve the environmental pollution liability insurance, preventing possible social conflicts and safeguarding the environmental rights of the people.

In the long run, the environmental pollution liability insurance products of different countries are becoming increasingly less profit-centered. The following are some prominent features: First, the scope of coverage is gradually expanding. Initially environmental pollution liability insurance only covered environmental emergencies and incidental accidents, but the scope of coverage has gradually expanded to environmental damage caused by accumulative pollution. Second, a pay-out cap was set to reduce the operational risk of insurers. Third, the time limit of claims was extended. Because of the invisibility of damage caused by environmental pollution, people began to pay attention to the accumulative and long-term nature of such damage, and the time limit for claims was extended. The US applies the "sunset clause" for environmental pollution liability insurance where both parties of the insurance contract agree that the insured may make a claim against the insurer up to 30 years after the insurance's expiry date. The Environmental Liability Insurance Law of Germany sets the time limit for a claim at 10 years, there have been several developments with respect to product diversification. In addition to environmental damage liability insurance, in the US, many other products can be found, including Underwriter Environmental Damage Liability Insurance, Errors and Omissions Insurance of Professional Environmental Risks, and Asbestos and Lead Abatement Contractors General Liability Insurance, etc. Fifth, there has been a professionalization in the way such insurance is managed. Considering the complexity of environmental issues, many countries have set up specialized agencies to manage relevant business. For instance, Argentina established an Advisory Committee on Environmental Risk Assessment and Fiscal Guarantee, whose responsibility covers environmental standards and guidelines, and general regulations on contract clauses of Environmental Damage Risk Insurance. India has also set up an Environmental Court and an Advisory Committee on Public Liability Insurance, which are mainly responsible for dispute settlements relating to public liability insurances.

4.3 Conclusions and Policy Recommendations

4.3.1 Main Conclusions

(1) Environmental pollution liability insurance has been widely-adopted as an advanced market-based instrument

Environmental pollution liability insurance is a widely-adopted management tool for environment protection in the world. As currently a prominent way for enterprises to fulfill their environmental responsibility, environmental pollution liability insurance has a good performance in terms of preventing environment risk and compensating pollution damage. After several decades of development, many countries have already built relatively complete systems for environmental pollution liability insurance (including the refinement of legal and regulatory systems, diversified insurance products, etc.), and enterprises recognize its value in fulfilling environmental responsibility. With such a market operation, government help with no longer be required. In these countries, Environmental pollution liability insurance is on a positive trend and can play an important role in enhancing enterprises' environment protection and safeguarding victims' rights. According to international experiences, it is necessary and feasible to promote environmental pollution liability insurance in China, and the experiences relating to laws and market run are particularly worth further study.

(2) Environmental pollution liability insurance is a challenge to implement in China and there are opportunities for improvement; it is critical to respond to the challenge and take the opportunities to improve relevant laws, regulations, policies, and standards

With both increasing environmental requirements and more frequent environmental accidents, there is great market potential for environmental pollution liability insurance. Still, considering the imperfection of the socialist market economic system of China at the current stage, the inadequate incorporation of environmental cost into products and services as well as the severe lack of experience with employing market-based approaches to resolve environmental problems, the wider uptake of environmental pollution liability insurance confronts strong challenges. In general, Environmental Pollution Liability Insurance is at an early stage in China, and the market remains rather small. Compared with the US and Germany, supporting laws, regulations, policies and standard are still very weak, and the necessary guidance to spur further development of Environmental Pollution Liability Insurance is weak. Therefore, establishing and improving relevant laws, policies, and standards are key for the development of environmental pollution liability insurance in China.

(3) Duly adjust the strategy for environmental pollution liability insurance to reflect the realities of the current financial crisis

The influence of the financial crisis on the national macro-economy has not yet come to an end, and it does not favor the promotion of environmental pollution liability insurance. Hence, appropriate adjustment to the development strategy for environmental pollution liability insurance is needed to respond to changes in the economic situation and in the priority of the nation's economic development. While the scale of existing experiments with environmental pollution liability insurance can be maintained, the pilot exploration should focus more on certain areas and industries with high environmental risks and high frequency of accidents. More efforts in the form of pilots to solve technical problems, enhance the technical properties, and gradually improve the related mechanisms and policies, while accumulating experiences and lessons with an aim to lay a foundation for a more comprehensive implementation of environmental pollution liability insurance in the future.

4.3.2 Policy Recommendations

(1) Establish a legal and regulatory framework to enable environmental pollution liability insurance

(a) To improve related laws and regulations for the identification and division of responsibility for environmental damage, strengthen environmental responsibility and accountability, implement the "responsible-party pays" principle to create a real binding force for environmental liability on enterprises that can generate market demand and create the motivation for enabling effective environmental pollution liability insurance. First, it is necessary to improve the content of the identification and division of responsibility for environmental damage, enshrine in relevant laws the liability of those who create environmental accidents makers to provide compensation. In international practice, compensation relates to casualties, property damage, and ecological environment recovery (or remediation) expenses. The liability provisions can be specified in one special law or within a number of laws. Second, efforts are needed to strengthen investigation of criminal and civil liability of those who create environmental incidents, and various approaches should be explored to reduce reliance on the current method of mainly administrative punishment. Finally, efforts are needed to enhance and implement liability investigation, so that those who create environmental incidents will conscientiously realize the serious legal implications regarding compensation and the significance of environmental risk prevention, which is of great importance to promoting environmental pollution liability insurance.

(b) Legislation is the primary tool for building an environmental pollution liability insurance system in China, at the current stage. It is extremely difficult to promote environmental pollution liability insurance without a legal basis. Efforts should be made to expedite the legal construction of environmental pollution

liability insurance, and to establish a legal system that favors the promotion of such insurance. First, it is necessary to implement legislation primarily at the national level. The contents of pollution liability insurance should be appended into the special laws concerning environmental protection during their amendment, such as Environmental Protection Law of PRC, or Law of PRC on Prevention and Control of Water Pollution, Law of PRC on Prevention and Control of Atmospheric Pollution, Law of PRC on Prevention of Environmental Pollution Caused by Solid Waste, and so forth. Second, efforts should be made to work out detailed rules or administration measures for the implementation of the environmental pollution liability insurance, which explicitly stipulate the relation between environmental pollution liability insurance and the civil liability system, the scope of application of liability insurance and the limits to the subject matter, the status of a third party under the liability insurance, liability for payment by the liable insurer, the plea and reconciliation on a claim of a third party under the liability insurance, and other issues. In addition, it is necessary to encourage the regions with legislative rights to take the initiative to carry out the legislation work of environmental pollution liability insurance, map out supporting regulations, policies, and measures, and launch experiments in order to accumulate experience for the formulation of relevant national laws.

(c) Thirdly, clear channels for third party compensation must be made available for those who have been damaged by environmental pollution. At present, third parties have an arduous task to receive compensation, even if liability is clear.

(2) Establish a policy framework to enforce environmental pollution liability insurance

(a) The MEP should work to develop the standards and guidelines for environmental pollution liability insurance. This includes developing a compensation standard for pollution damage, environmental risk assessment standard, clean-up standards for contaminated sites, and so on so that the relevant activities can be implemented in accordance with certain criteria with the aim of regulating related market subjects' behavior vis-à-vis environmental pollution liability insurance and ensuring that environmental pollution liability insurance functions according to policy objectives.

(b) By combining international development trends regarding environmental pollution liability insurance with the actual situation in China, it is necessary to adopt a model in which both mandatory and voluntary insurance are combined, and encourage the majority of enterprises to purchase environmental pollution liability insurance on a voluntary basis. First, efforts should be made to fully analyze the economic contribution, pollution discharge, frequency of pollution accidents, technological progress, social influence and other factors of industries with high pollution and high environmental risks. This involves studying and proposing a directory of industrial technology for mandatory environmental pollution liability insurance, and determining the methods for industries that need to purchase mandatory environmental pollution liability insurance. According to China's

industrial environmental risks and the conditions of accidents, enterprises that produce, transport, store, and use dangerous chemicals and petrochemicals, those that carry out hazardous waste disposal, and other industries should be included within the scope of management under the mandatory environmental pollution liability insurance. Second, it is necessary to study and propose technical guidelines on the establishment of the directory. In this respect, the basic requirements for methods under the mandatory insurance must be specified, and indicators and parameters regarding procedures to establishment the directory and perform technical selection should be standardized. In addition, the directory of industrial techniques under the mandatory environmental pollution liability insurance should be subject to dynamic and timely adjustment; techniques included in the directory should reflect actual management needs, with the aim of deliberately including techniques with higher environmental risks and greater harms within the scope of management under the mandatory environmental pollution liability insurance.

(c) Environmental pollution liability insurance is in the public interest. Policy support from the central government is needed for the initial implementation of such insurance. Internationally, the provision of proper tax abatement and exemption is a common practice. The launch of appropriate preferential policies at the initial stage in China's implementation of environmental pollution liability insurance will not only encourage a greater number of pollution-discharging enterprises to purchase the insurance, but it will also diminish the operating risks of insurance companies. Thus, the benefits of both insurers and insured enterprises are guaranteed, which complies with the State's policy orientation of energy conservation and emission reduction. Therefore, MEP should join hands actively with financial, taxation, and banking management authorities to speed up the favorable and incentive policies which support the environmental pollution liability insurance, such as reimbursing companies with a certain proportion of their discharge fees as their premium paid to the insurers, connecting the insurance with the green credit system, tax reduction and exemption for insurances companies and so forth. In addition, it is recommended to establish a special fiscal fund to subsidize insurers and insurants in pilot areas to put forward the environmental pollution liability insurance on a voluntary basis.

(d) It is necessary for the country to establish an environmental relief fund as early as possible, which can be used for compensation where indemnity exceeds the limit of the environmental liability insurance and policy holders are unable to bear indemnity liability, in order to alleviate the financial impact of major environmental accidents and even environmental disasters. The environmental relief fund is chiefly aimed at safeguarding the rights and interests of victims and dissolving social contradictions caused by accidents. As a result, society assumes part of victims' losses. Such funding is a major supplement to the environmental pollution liability insurance, and an important part of the national compensation and relief mechanism. The environmental relief fund can be established by referring to overseas countries' experience, with a wide variety of fund sources, including: part of the funds transferred by the government through national finance appropriation, pollution

discharge fees, funds raised through social organizations, and private donations, etc.

(3) Improve the supervision and management mechanism and establish an environmental pollution liability insurance guidance center

(a) It is important to strengthen collaboration between environmental and insurance authorities, with clear-cut distribution of labor to establish jointly the mechanism for investigation, loss adjustment, claims auditing and liability verification of environmental pollution accidents. It will be necessary to strengthen routine supervision and administration, conduct information exchange and communication in a timely manner, and establish an approval and solicitation system for environmental pollution liability insurance products to tackle problems arising from implementation of the insurance, and ensure the development of environmental pollution liability insurance in conformity with the established policy objectives.

(b) Establish an Environmental Pollution Liability Insurance Guidance Center under the administration of the MEP. The major responsibilities of this center would be to formulate industrial environmental risk assessment guidelines and compensation standards for damages from pollution, to develop and refine an industrial process directory for compulsory environmental pollution liability insurance, to conduct studies on financial and taxation policies conducive to environmental pollution liability insurance, etc.

(4) Strengthening efforts in relevant education and capacity building

(a) The MEP and CIRC should actively carry out nationwide training on the subject ofn environmental pollution liability insurance for relevant personnel to improve their understanding of its importance so as to gain in-depth understanding of the requirements, goals, and methods of environmental pollution liability insurance and grasp the basic management skills and technical approaches.

(b) It is necessary to strengthen actively the fundamental research on environmental pollution liability insurance, which includes the accumulation of relevant data, research on environmental standards and so forth. It is also necessary to increase investment in the study gradually, to enhance the R&D of relevant insurance products, and to promote the technical support system of the environmental pollution liability insurance.

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Research Report

Chapter 1: Environmental Taxation

0 Preface

Until 2007, China's environment pollution had generally been "accelerating", which was becoming a severe situation for the environment, and the degree of environmental pollution was fairly high. The emission of major pollutants far exceeded the environmental capacity. In 2006, the emission amount of major pollutants — sulfur dioxide and chemical oxygen demand (COD) — was respectively 25.944 million tonnes and 14.313 million tonnes, which represented respectively an increase of 1.8% and 1.2% from the previous year. The government recently implemented a series of energy-saving and emission-reduction measures. As a result, in 2007, the energy consumption per unit of GDP fell by 3.27% from the previous year; the amount of sulfur dioxide emissions was 24.681 million tonnes, a decrease of 4.7% from the previous year; and the amount of chemical oxygen demand emissions was 13.813 million tonnes, a decrease of 3.2% from the previous year; this is the first time China achieved a double decrease. In 2008, the energy consumption per unit of GDP fell by 4.59% from the previous year; chemical oxygen demand (COD) fell by 4.42%; and sulfur dioxide emissions fell by 5.95%.[3]

The "Outline of 11th Five-Year Plan for National Economic and Social Development" sets the following targets: the energy consumption per unit of GDP should fall by approximately 20% and total emissions of major pollutants should fall by 10% during the period of the 11th five-year plan. Thus by 2010, the emissions of chemical oxygen demand and sulfur dioxide will have been reduced by 10% from their 2005 levels. , In other words,, chemical oxygen demand emissions will drop from 14.142 million tonnes in 2005 to 12.728 million tonnes in 2010, and sulfur dioxide from 25.494 million tonnes in 2005 to 22.944 million tonnes in 2010. The current progress of energy-saving and emission-reduction measures indicates that the target of 10% reduction for major pollutants can be guaranteed. However, even though the targets set in the "11th Five-Year Plan" can be realized, the emission amounts of sulfur dioxide and COD still far exceed the environmental capacity. So, the energy-saving and emission-reduction policies should continue in order to improve environmental quality. Besides the two major pollutants, other indexes affecting environmental quality are emerging, for example, the ammonia nitrogen pollution in water and the nitrogen oxide in air. The environmental quality will be influenced if these two pollutants do not decline.

Meanwhile, as the largest emitter of greenhouse gases in the world, China is faced with the great challenge of responding to climate change. According to "China's

[3] "Report on the Work of the Government (2009)".

National Assessment Report on Climate Change" issued at the end of 2006，China's carbon dioxide emission from fossil fuel combustion in 2000 was 3.4 billion tonnes (with 0.87 billion tonnes of carbon), accounting for 12.78% of the world's total emission amount, ranking No. 2. According to the "White Paper—China's Policies and Actions for Addressing Climate Change", China's carbon dioxide emissions from energy consumption in 2004 totaled 5.07 billion tonnes.

With the tremendous historic debt of environmental pollution and the increasing new debt, the conflict between economic and social development and restriction of resource and environment is an increasingly serious problem. Therefore, the Chinese government is highly concerned with environmental protection. For the purpose of building a harmonious socialist society and constructing ecological civilization, as well as implementing the Scientific Outlook on Development and in the execution of its sustainable development strategy, it has become an important goal of China's development to reduce energy consumption, waste pollution and emission. Therefore, the Chinese government has set restrictive indices for energy-saving and emission-reduction in the "Outline of the 11th Five-Year Plan for National Economic and Social Development". In June 2007, the State Council issued the "Notice of the State Council on Printing and Distributing the Comprehensive Work Scheme of Energy Conservation and Reducing the Discharge of Pollutants", requiring to establish and improve the complete work responsibility and accountability system, as well as forming a work pattern for energy-saving and emission-reduction which is government-oriented, enterprise-dominated and promoted throughout the whole society.

With limited per capita resources and energy, it is definitely necessary for China to develop a low carbon economy because of the pressure of global climate change. On June 4th 2007, "China's National Climate Change Programme" was officially issued, and subsequently China issued the "White Paper—China's Policies and Actions for Addressing Climate Change" in October 2008. The two documents clearly state the specific targets, basic principles, key sectors and policy measures for addressing climate change. The issue and implementation of "China's National Climate Change Programme" highlighted China's stance as a responsible large nation, and it will play a positive role in the work of China's response to climate change, as well as making a new contribution to the world's response to climate change.

In the meantime, the environmental policy system of China has been long dominated by a command–and-control means of environmental administration. Since the 1980s, even though much effective research and pilot work has been conducted in the area of economic instruments, there is no complete environmental economic instruments system and the strengths of environmental economic instruments means are not showing fully.

At present, the application of environmental economic instruments has become an important orientation in the development of international environmental policies. As key economic instruments, environmentally-related taxation has been adopted by

more and more countries. Environmentally-related taxation is taken as the breakthrough for solving environmental problems. Practice shows that environmentally-related taxes, including sulfur tax and carbon tax, not only bring a positive effect on environmental protection, but also provide a stable funding resource for environmental treatment. As for China's current environmental protection policies, the major means for treating environmental pollution are command and control, pollution discharge fees and some environmental-related taxation regulations. Incomplete economic instruments, the lack of an independent environmental tax and an environmentally-related taxation system in line with the market economy all lead to poor results of environmental treatment. The levy of environmentally-related taxation will largely make up for the weakness of the environmental discharge fee. In the mean time, the combination of environmentally-related taxation with other environmental economic instruments and command and control will contribute to the achievement of the emission-reduction targets in the "11th Five-Year Plan".

In conclusion, given the serious environmental situation faced by China and the absence of effective environmental protection policies, an environmental taxation system would be the most appropriate of important economic instruments and long-term system arrangements serving this purpose. Thus the research on environmentally-related taxation has great significance to China. For this purpose, the "Notice of the State Council on Printing and Distributing the 'Eleventh Five-Year Plan'" requires that "Environmental protection through command and control should be transformed into the solution of environmental problems through legal, economic, technological and necessary command and control, the economic rules and natural law should be observed consciously, and the level of environmental protection work should be improved. The demand of environmental protection should be given full consideration in the reform of resource tax, consumption tax and import and export tax, environmental taxation system should be established through exploitation, and the construction of resource-saving and environment-friendly society should be promoted through using the leverage of taxation." This is the first time for the State Council to put forward the requirement of research on an environmental taxation system. Again, the "Notice of the State Council on Printing and Distributing the Comprehensive Work Scheme of Energy Conservation and Reducing the Discharge of Pollutants", issued in June 2007, clearly mentions the research on the levy of environmentally-related taxation. In 2008, the Ministry of Finance, State Administration of Taxation and Ministry of Environmental Protection formally launched the work of systematic research and design of China's environmental taxation system. The statements and actions of policy-makers in the government showed that the policy-makers have fully recognized the important function of taxation in environmental treatment, which means that the introduction of environmental tax has become the consensus at the policy-making level.

This Task Force has the following two specific research targets: **First**, making an assessment on China's current environmental taxation system and work out the

roadmap for establishing relevant environmental taxation systems in combination with international practice; and **Second**, with the reference of international experience, proposing the program design for China to introduce carbon tax and analyzing its potential influence on China's environment and economy.

The levy of carbon tax is chosen as this project's key task of environmentally-related taxation research, which is based on the following considerations. First, the need for developing a low carbon economy: "High carbon mode" will seriously restrict China's future development, while a "low carbon economy" will be an important breakthrough in China's construction of an "Ecological civilization". Second, good policy will of Chinese government. China has fully recognized the importance and urgency of responding to climate change and is beginning to research to establish long-term mechanisms and policy measures in favor of energy-saving and environmental protection. Third, existing research on environmentally-related taxation such as pollution emission tax and polluting product tax has been made and special research on carbon tax at the technical level needs to be conducted.

Accordingly, this research report consists of two parts. The first part describes the roadmap for the establishment of an environmental-related taxation system in four sections, namely: assessment on China's taxation structure and reform direction; assessment on China's current environmental taxation and charge system; assessment on related international experience; and the roadmap for building an environmentally-related taxation system in China.

The second part puts forward the carbon tax design scheme and its impacts consisting three sections namely: international experience analysis; carbon tax design scheme in China; and the influence of carbon tax on the environment and economy.

1 Roadmap for Establishing an Environmentally-related Taxation System

1.1 Assessment on China's Taxation Structure and Reform Direction

1.1.1 Current Fiscal and taxation System

1. Current taxation system situation

The current taxation system of China was constructed on the basis of taxation reform in 1994. China basically realized the simplification, standardization and uniformization of taxation after the taxation reform in 1994 and further reforms afterwards. China has formed multiple taxation systems with main taxes being turnover taxes and income tax, with multiple taxes, multiple links and multiple levels, which preliminarily constitutes a taxation system in compliance with a socialist

market economy.

At present, there are 19 taxes in China's taxation system, and among which 18 are actually levied. The 19 taxes are respectively value-added tax, consumption tax, business tax, customs duty, enterprise income tax, individual income tax, resource tax, urban land use tax, tax on farm land occupation, urban maintenance and construction tax, land value-added tax, fixed-asset investment regulation tax, house property tax, vehicle and vessel tax, vehicle purchase tax, tonnage tax, stamp tax, contract tax and tobacco leaf tax. Now the fixed asset investment regulation tax is in ceasing stage. Please refer to table 1.1 for the details.

Table 1.1 the structure of current taxation system in China

Taxation type	**Taxation item**
Turnover taxes	Value-added tax, consumption tax, business tax, tobacco leaf tax, customs duty
Income taxes	Enterprise income tax, individual income tax
Property taxes	House property tax, vehicle and vessel tax
Action taxes	Vehicle purchase tax, stamp tax, land value-added tax, urban maintenance and construction tax, fixed asset investment regulation tax (ceased), tax on farm land occupation, contract tax, tonnage tax
Resource taxes	Resource tax, urban land use tax

In terms of total tax revenue, the tax revenue reached RMB 4562.197 billion Yuan in 2007 from RMB 512.688 billion Yuan in 1994, increased by 8.90 times in all and by 18.55% annually. The proportion of tax revenue in GDP also increased from 10.64% to 17.73%. In terms of the structure of tax revenue, turnover taxes and income tax are the main taxes. During the period from 1994 to 2007, the average proportion of the three major turnover taxes in tax revenue was 60.83% and the average proportion of income taxes in tax revenue was 20.30%, and the proportion for the other 14 taxes was 18.94%.

Table 1.2 Situation of total tax revenue unit: 100 million Yuan

Year	**Tax revenue**	**Annual growth rate (%)**	**GDP**	**Proportion of tax revenue in GDP (%)**
1994	5126.88	20.48	48197.90	10.64
1995	6038.04	17.77	60793.70	9.93
1996	6909.82	14.44	71176.60	9.71
1997	8234.04	19.16	78973.00	10.43
1998	9262.80	12.49	84402.30	10.97
1999	10682.58	15.33	89677.10	11.91
2000	12581.51	17.78	99214.60	12.68
2001	15301.38	21.62	109655.20	13.95
2002	17636.45	15.26	120332.70	14.66
2003	20017.31	13.50	135822.80	14.74
2004	24165.68	20.72	159878.30	15.12
2005	28778.54	19.09	183867.90	15.65
2006	34809.72	20.96	210871.00	16.51
2007	45621.97	31.06	257306.00	17.73

Source: China Statistical Yearbook

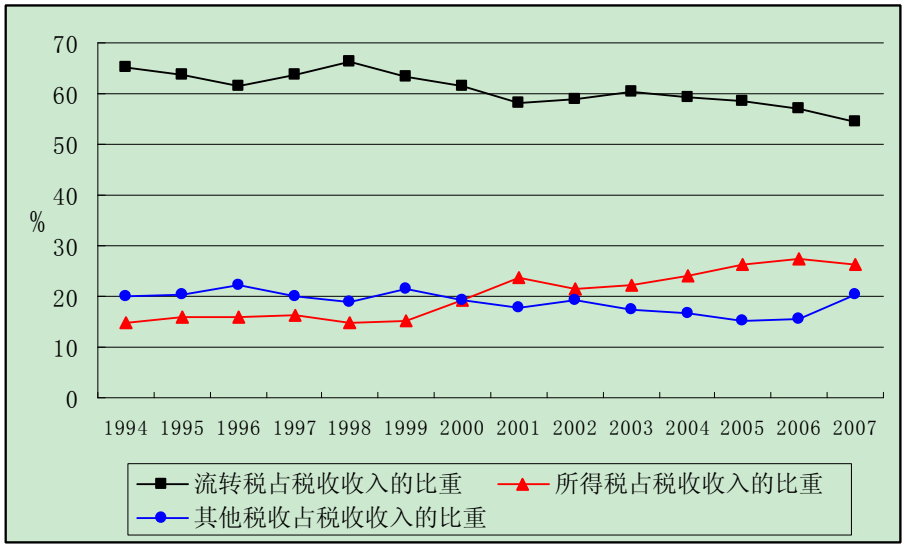

Figure 1.1 the situation of China's tax system structure from 1994 to 2007

Black curve (流转税占税收收入的比重): proportion of turnover taxes in tax revenue
Red curve (所得税占税收收入的比重): proportion of income taxes in tax revenue
Blue curve (其他税占税收收入的比重): proportion of other taxes in tax revenue

Note: turnover tax is the total of value-added tax (including value-added tax for imported tax), consumption tax (including consumption tax for imported tax) and business tax, deducted export rebates; and income tax is the total of enterprise income tax, foreign-invested or foreign enterprise income tax and individual income tax.

Source: China Statistical Yearbook, Finance Yearbook of China, Tax Yearbook of China.

2. Current situation of the fiscal system

The current fiscal system implemented in China is a multilevel, l tax-sharing fiscal system. According to the tax-sharing system reform in 1994, the central and local governments distributed fiscal revenues according to different tax categories, and central taxes, local taxes and shared taxes by central and local government were set up. The tax-sharing fiscal system was slightly adjusted several times after 1994. Please refer to table 1.3 for the division of tax categories between central and local governments. Over the period from 1994 to 2007, the average proportion of central tax revenue was 54.96% and the average proportion of local tax revenue was 45.04% (please refer to table 1.4).

Tale 1.3 Division of taxes between central and local governments

Central taxes	Customs tax, consumption tax and value-added tax withheld by customs, consumption tax, vehicle purchase tax, tonnage tax, individual income tax (interest income tax), enterprise income tax (part industries and enterprises), business tax (part industries) and urban maintenance and construction tax (part industries).	Note: enterprise income tax owned by central tax includes enterprise income tax from railway transportation, state postal bureau, ICBC, ABC, BOC, CCB, State Development Bank, Agricultural Development Bank of China, Import and Export Bank of China and ocean, petrol, natural gas enterprises. Business tax and urban maintenance and construction tax owned by the central refer to taxes paid collectively by the railway department, the headquarters of all banks and all insurance enterprises.
Local taxes	Business tax (excluding part industries), urban maintenance and construction tax, urban land use tax, house property tax, urban house property tax, land value-added tax, stamp tax, vehicle and vessel tax, tobacco leaf tax and fixed asset investment regulation tax.	Note: the agricultural and livestock taxes, taxes on special agricultural products, tax on slaughtering animals and banquet tax were abolished, which were all local taxes in the past; operation tax of vehicle and vessel and driving license tax on vehicle and vessel are combined as vehicle and vessel tax; fixed asset investment regulation tax now is ceased.
Taxes shared by the central and local	Value-added tax (75% to central tax and 25% to local tax), securities transaction stamp tax (97% to central tax and 3% to local tax), resource tax (marine crude oil resource tax belongs to the central tax), enterprise income tax (except few industries and enterprises) and individual income tax (60% to central tax and 40% to local tax)	Note: the sharing of income tax uses the year 2001 as base year. Revenue exceeding that of 2001 is shared.

Source: According to "Decision of State Council on Implementing Tax sharing Management System" (No. 15[93] of State Council) and the latest policies on tax sharing system.

Table 1.4 Situation of central and local tax revenue Unit: 100 million RMB

Year	Central tax revenue	Proportion(%)	Local tax revenue (%)	Proportion
1994	2831.97	55.24	2294.91	44.76
1995	3205.27	53.08	2822.77	46.92
1996	3460.83	50.09	3448.99	49.91
1997	4232.00	51.40	4002.04	48.60
1998	4824.35	52.08	4438.45	47.92
1999	5747.65	53.80	4934.93	46.20
2000	6892.65	54.78	5688.86	45.22
2001	8338.62	54.50	6962.76	45.50
2002	10230.29	58.01	7406.16	41.99
2003	11604.04	57.97	8413.27	42.03
2004	14166.09	58.62	9999.59	41.38
2005	16051.81	55.78	12726.73	44.22
2006	19576.14	56.24	15233.58	43.76
2007	26369.85	57.80	19252.12	42.20

Source: China Statistical Yearbook, Finance Yearbook of China.

1.1.2 Major Problems and Analysis of these Problems

1. Major problems in China's current tax system

After further tax system reforms since 1994, especially the new round of tax system reform beginning in 2004, the tax system has been improved greatly. However, there are still some problems, which are:

First, the taxation structure needs to be further improved. In terms of proportion of turnover taxes and income taxes in tax revenue, though the proportion of turnover taxes shows the trend of decline, but it remains high. The high proportion of turnover taxes is harmful to playing the role of income taxes in macroeconomic control such as economic stability and fair income distribution. In the meantime, the low proportion of property tax in tax revenue is harmful to the improvement of the local tax system.

Second, some tax categories need to be improved. The new round of tax system reform beginning in 2004 has reformed the tax categories including value-added tax, business tax, consumption tax, enterprise income tax, individual income tax, resource tax, tax on farm land occupation, urban land use tax, with further improvement on the tax categories. However, there still remain problems in some taxes including value-added tax, resource tax, and house property tax. These problems such as narrow scope of value-added tax, classified collection mode of individual income tax and the low resource tax rate need to be improved and optimized.

As for environmental protection, the major problems of the current tax system are: unlike in other countries, there is no environmental tax directly related to environmental protection, and an environmental-related tax system has not been set up, which influences the effectiveness of environment tax measures.

2. The major problems in the current tax-sharing system

The major problems in the current tax-sharing system itself are as follows:

First, lack of main tax in the local tax system. At present, the local taxes are mainly small taxes with scattered sources and hard to collect. The establishment of the tax system lags behind. In the meantime, the revenue is low without the main tax.

Second, incomplete transfer payment system. The current compensation forms and compensation methods in the fiscal transfer payment system are not reasonable, thus the aim of an equal public service level cannot be realized. On the contrary, the disparity of fiscal revenue abilities and basic public service levels between different regions expands.

Third, incomplete fiscal system of sub-provincial governments. The current tax sharing system initially regulates the fiscal distribution relationship between central government and provincial governments. However, the absence of strict regulation on the fiscal distribution relationship among sub-provincial governments has

resulted in fiscal difficulties in grass-root governments.

In terms of environmental protection, the fiscal problems in grass-root governments caused by the current tax-sharing system have resulted in problems such as protection of polluting enterprises, and inadequate enforcement of environmental measures by local government. The problems are as follows:

First: with the financial difficulties of grass-root governments, it is hard to require the governments to close down enterprises with high pollution, which is an important revenue source, or require the government not to approve or introduce polluting enterprises.

Second, the governments are not able to set aside special fiscal funding for environmental control programs. For this purpose, the financial difficulties in grass-root governments influenced local environmental protection and caused the pollution to grow out of control, leading to an adverse circle.

1.1.3. The Direction and Outlook of the Reform

1. The overall direction of tax system reform

As for the direction of tax system reform, "Decisions by Central Committee of CPC on Issues Regarding Perfecting Socialist Market Economic System" adopted at the 3rd Plenary Session of 16th Central Committee of the CPC in October 2003 clearly stated the targets and tasks to implement tax system reform step by step. The subsequent important meetings set some clear targets and requirements for tax system reform (please refer to table 1.5). According to these requirements, the general thought of China's future tax system reform is: in compliance with the general plan of the Seventeenth National Congress of the CPC on implementing fiscal and taxation system helpful to scientific development, with the requirements of improving the socialist market economy, to further improve the multiple taxation system with the main focus on turnover taxes and income taxes, with the combination of property tax, resource tax and other taxes with special purpose, with multiple taxes, multiple links and multiple levels; the local taxation system should be improved to meet the need of equal basic public service and primary function area construction; work hard to build human-oriented, energetic, effective, more equal, more open and high civilized taxation system.

Table 1.5 Taxation system reform target set at important meetings

Date	Meeting	Contents
October 2003	Decisions by Central Committee of CPC on Issues Regarding Perfecting Socialist Market Economic System" adopted at the 3rd Plenary Session of 16th Central Committee of CPC	Reform the system of tax refunding on exported goods; uniform of all kinds of enterprise tax system; change of value-added tax from production mode to consumer mode through taking equipment investment into deduction scope; promote consumption tax by adequately increasing tax base, improvement of individual income tax combining comprehensive income tax with classified income tax; reform urban construction tax & fee system, levy uniform property tax when conditions are meet and terminate certain charges;

		under the premise of uniform tax system, give appropriate tax administration power to local governments; create conditions for urban and rural tax system uniform.
March 2006	The "11th five-year plan for national economic and social development" issued on the Fourth Session of the Tenth National People's Congress	Transfer of value-added tax from production mode to consumer mode in the whole country; adjust the scope, part of tax rate and payment method of consumption tax; levy fuel oil tax at the right time, reasonably adjust the incident and items of business tax; promote the system of refunding taxes on exported goods; unify all kinds of enterprise tax system; implement individual income tax combining comprehensive income tax with classified income tax; reform house property tax system, levy uniform property tax and terminate certain charges; reform resource tax system, improve urban maintenance and construction tax, tax on farm land occupation and stamp tax.
October 2006	"Decision by Central committee of CPC on some important issues regarding building harmonious socialist society" adopted at the 6th Plenary Session of the 16th Central Committee of CPC	Implement fiscal and taxation policy and financial policy promoting employment, improve fiscal and taxation policies matching the fiscal capacity with the expenditure responsibilities, improve other taxation measures advancing the building of harmonious socialist society, such as measures helpful to environmental protection.
October 2007	"Report to the Seventeenth National Congress of CPC"	Implement fiscal and taxation system helpful to scientific development and construct and improve compensation systems for use of resources and for damage caused to ecosystem.

2. The levy of environmental tax is one of the directions of taxation system reform

The above analysis of the situation of the current taxation system and the environmental taxation system shows that the absence of an (independent) environmental tax is one of the major problems of China's current taxation system. Therefore the levy of environmental tax will be one of the key components of further taxation reform in China. For a long time, the command-and-control measures (administrative measures and legal measures) have been for the major part in environment management, and the enterprises are forced to execute environmental standards and control pollution. Those who fail to do so will be imposed administrative penalties. These command-and-control measures used to have some effect on environmental protection, but with the transform to a market economy and the development of multiple economic entities, only legal and administrative intervention is far from solving the environmental pollution problem, and other economic instruments based on market mechanisms such as taxation and charges are urgently needed. With the establishment and improvement of a socialist market economy and the continuous development of multiple taxation systems over the past 30 years, the trend for economic instruments to play a larger role has come into being and is now unchangeable. Thus the economic and taxation conditions for China to levy an environmental tax have been met.

Actually, related documents issued by the governments have pointed out more than once that the levy of environmental tax is one of the directions of taxation system reform. For example, the Notice of the State Council on Printing and Distributing the Comprehensive Work Scheme of Energy Conservation and Reducing the Discharge

of Pollutants (No.15 [2007] of the State Council) issued in June 2007 required to formulate and improve taxation measures on energy-saving and emission-reduction, which included research on the levy of environmental tax. The Opinions on Deepening the Reform Work of Economic System in 2008 and 2009 also make the same requirements.

3. The levy of environmental tax is the direction of improving environmental taxation system

Based on international experience, an environmental taxation system consists of a series of taxes related to environmental protection and other taxation provisions. Despite some differences of detailed provisions on environmental taxation systems of different countries due to different national situations and taxation systems, the environmentally-related taxation system is generally composed of two parts. **One part** is for the purpose of environmental protection, which includes all kinds of special or independent taxes, taxing on the pollution and action causing environmental damage. As the main part of an environmentally-related taxation system, it plays an import role. **The other part** is the specific taxation provisions related to environmental protection in other general taxes. This part includes taxation preferential provisions, stimulating taxpayers to control pollution and protect the environment, and penalty provisions discouraging taxpayers from polluting or damaging the environment. As a supplementary component in the environmentally-related taxation system, it assists the independent environmental tax.

From the content of the environmentally-related taxation system and international practice, the above two parts are complementary to each other, but not contradictory to each other. To protect the environment effectively needs the coordination between independent environmental tax and other general taxes. Only independent environmental tax or only general taxes will affect the result of environmental tax for environmental protection.

There is no independent environmental tax in China's current taxation system, with only some specific provisions related to environmental protection in some taxes. Apparently, in terms of setting up and improving the environmental taxation system, the thought of reform of China's environmental taxation system includes: **first,** the levy of an independent environmental tax, which means introducing and building an independent environmental tax on the basis of maintaining the current taxation system and taxes, and improving and adjusting policy provisions related to environmental protection; and **second,** improving the "green" degree of current taxes through adjustment and reform of current taxes related to environmental protection, such as provisions in consumption tax, resource tax and all tax preference policy.

1.2 Assessment of China's Current Environmentally-related taxes and Charges

1.2.1 The Analysis of the Relationship between Macroeconomic Development and environmentally-related taxation

The relationship between taxation and economy can be summarized as: taxation is determined by the economy and the economy is influenced by taxation. In other words, economic scale and structure determines the tax revenue scale and structure, and at the same time tax also influences economic scale and structure. Taxation and economy depend on each other, influence each other and stimulate each other. Therefore, it is necessary for taxation and economy to realize positive interactions with each other.

Tax policy is an important tool of macroeconomic control and its relationship with macroeconomic development is the same as the above. To be specific: **first**, tax policy affects economic growth, such as the aggregate and pattern of economic growth; **second**, tax policy affects economic structure, including regional structure and industrial structure; and **third**, tax policy affects social welfare, including income distribution, environmental protection, etc. Based on the understanding of the above, the relationship between macro-economic development and environmentally-related taxation is as follows:

1. Economic development level requires further improvement of environmentally-related taxation

With the continuous growth of China's economy, the environmental situation is becoming increasingly serious. The deterioration of the environment not only directly affects the living quality of Chinese people, but restricts the sustainable development of China's society and economy. International research on the impact of economic development on environmental pollution shows that the relationship between environmental pollution and per capita GDP could be represented graphically as an inverted U-shaped curve, which is called Kuznets curve. In other words, during the process of economic development, the environmental situation will first be deteriorated and then gradually be improved. Kuznets curve shows that the government will strengthen environmental management when the development of the economy reaches a certain level, and then environmental pollution will gradually decline. However, related research on Kuznets curve of China shows that the relationship between daily mean concentration of SO_2, PM10 and NO_X in urban areas and per capita GDP is an inverted U-shaped Kuznets curve, with the turning point at USD 4,000 to 10,000, basically the same as a developed country. Some cities in eastern China are reaching or have passed the turning point of their Kuznets curve (WANG Jinnan, 2005). According to statistics, in 2008, national per capita GDP in 2008 China exceeded USD 3,000, per capital GDP in coastal cities exceeded

USD 6,000, and the figure in Shanghai exceeded USD 10,000. Thus it is possible and necessary for China to learn from international experience in order to implement related environmental policy, especially economic policy such as environmentally-related taxation.

2. The transformation of economic development pattern requires further improvement of environmental tax policy

In addition to economic growth, economic development must also emphasize the protection of the ecological environment. The growth of GDP cannot be gained at the price of the ecological environment. China's economic growth in the past years has been quite fast, but China also suffers great resource and environment damage. It is directly related to the unreasonable economic structure and extensive growth pattern. The extensive growth pattern with high-pollution and energy-intensive consumption could not meet the requirements of economic development. Therefore, it is necessary to accelerate the adjustment of the economic structure and transformation of the economic development pattern from extensive growth to intensive growth, and turn the emphasis from pure pursuit for GDP expansion to improvement of economic structure, economic efficiency and economic growth quality. International practice shows that environmentally-related taxation is one of the effective environmental tools. China will use environmentally-related taxation as a regulation tool to accelerate the transform of economic development pattern. The improvement of environmentally-related taxation will assist transformation of the economic operational mechanism, advance enterprises on the road of intensive expanded reproduction and cleaner production, development of resource-saving, environmentally-friendly, quality-efficient and science-and-technology-oriented enterprises and industries, thus advancing transformation of the economic development pattern, adjustment of the economic structure and implementation of a scientific outlook on development.

3. The improvement of environmentally-related taxation should take the macroeconomic situation into consideration

The reform of resource tax and the levy of environmental tax are part of the improvements to environmentally-related taxation or the environmental tax system. With the reform of resource tax, the levy of environmental tax will inevitably affect GDP growth, industrial competitive power, import and export, disposable income of residents and commodity price. Therefore, it is necessary to select the right moment for environmentally-related taxation according to GDP growth, PPI, and CPI, etc. It is inappropriate to conduct the reform when China's economy is overheated or in decline. On one hand, when the economy is overheated, the reform of resource tax and the levy of environmental tax will push up commodity price; and on the other hand, in the economic downturn, the reform of resource tax and the levy of environmental tax. Environmental tax will hinder economic recovery. Overheated or declined economies are both obstacles to the launch of environmentally-related taxation. Therefore, the timing for launching environmentally-related taxation must

be that when there is no great attack to the macro-economy.

4. The environmentally-related taxation should not greatly affect economic development

The improvement of environmentally-related taxation, such as a high environmental tax rate, will be helpful to realize a better environmental protection effect. However, the high environmental tax rate will have an adverse impact on macroeconomic development, including economic growth and industrial competitive power. Since China is still at the preliminary stage of socialism, development remains China's primary task. There are many problems that can be solved through development, not only providing financial support to environmental protection, but also helping to keep China's rightful position in the complicated international situation. Thus China's environmentally-related taxation should also take the requirement of economic development into full consideration to avoid great impact to macroeconomic development. China should promote economic development at the same time as conducting environmental protection and pay attention to both of them.

Simply put, during the process of improving environmentally-related taxation, China should pay attention to both environmental protection and economic development, and should realize beneficial interaction between economic development and environmentally-related taxation.

1.2.2 Assessment on Current Environmentally-related Taxes

1. The current situation of environmentally-related taxes

According to the international community's definition of international community for environmental tax or environmentally-related tax, environmentally-related taxes in China's current taxes include: consumption tax, resource tax and vehicle and vessel tax. In the meantime, there are also some provisions related to environmental protection in other taxes, such as value-added tax, enterprise income tax and customs tax. Please refer to table 1.6 and table 1.7 for the details of current environmentally-related taxes.

Table 1.6 Situation of current environmentally-related taxes

Name of Taxes	Provisions	Purpose	Effects to environmental protection
Resource Tax	The enterprises and individuals who exploit taxable mineral products and manufacture salt should pay this tax as specific duty in accordance with sales amount or consumption amount.	Adjusting differential income and advancing reasonable exploitation and utilization of mineral resource	Certain effect of environmental protection can be achieved through the levy of resource tax on pollution-related energy products such as crude oil, coal
Consumption Tax	On the basis of popular value-added tax on commodities, some consumer commodities are	Adjusting product structure, leading consumer direction,	Certain effect of environmental protection can be achieved through

	levied with consumption tax. The tax items include: tobacco, alcohol, firecrackers, fireworks, cosmetics, petroleum products, valuable jewelry and jade, yachts, automobile tires, motorcycles, cars, disposable wooden chopsticks, real wood floor, etc.	holding premature consumption and guarantying state fiscal revenue.	the levy of consumption tax on products such as firecrackers, fireworks, cars and motorcycles which may directly or indirectly cause environmental pollution and giving preferential tax measures to environment-friendly products.
Vehicle and vessel Tax	The owners or administrators of vehicles and vessels in territory of China should pay Vehicle and vessel tax according to due taxable unit at specific duty.	Organizing income, utilization and consumption of vehicles and vessels.	Certain emission-reduction effect can be achieved though levy of Vehicle and vessel tax

Source: Provisions of related tax categories.

Table 1.7 Situation of current environmentally-related tax policies

Name of Taxes	**Provisions**	**Purpose**	**Effects to environmental protection**
Value-added Tax	Preferential measures for encouraging comprehensive utilization of resources, advancing recycling of waste and old materials, encouraging clean energy and environmental-friendly products and waste water treatment.	Encouraging comprehensive utilization of resources, recycling of waste and old materials, and the popularity of clean energy and environmental-friendly products.	Certain environmental protection effect can be achieved through preferential measures to part industries, Certain environmental protection effect can be achieved though encouraging comprehensive utilization of resources, emission-reduction and supporting environmental and recycling industries.
Income Tax	Tax deduction or exemption is given to enterprises' income from environmental protection or energy saving or water saving programs meeting given conditions. Tax credit is given to investment in special equipments for environmental protection, energy saving and water saving, production safety to a scale. Income from products meeting certain national industrial policies though comprehensive utilization of resources can be deducted from taxable income; accelerated depreciation policy; deduction of public donation.	Encouraging manufacture and use of environmental protection equipments and implementation of environmental protection project	Certain environmental protection effect can be achieved through encouraging comprehensive utilization of resources, emission-reduction and supporting environmental and recycling industries.
Business Tax	Business tax exemption is given to	Popularizing	Certain environmental

	transfer of environmental protection technology.	environmental protection technology	protection effect can be achieved.
Custom duties	Export tax is levied on part export of "high pollution, high energy consumption and resource" products, abolish some tax refund to part resource products; lowering import tax rate for importing resource products, basic spare parts and daily necessities; tax deduction and exemption is given to importing environmental protection equipments	Restricting resource exploitation and promoting the use of environmental protection equipments.	Certain environmental protection effect can be achieved through resource-saving.

Source: Provisions of related taxes.

As for the scale of environmentally-related taxes and charges revenue, revenue has been growing fast. The environmental tax and charge revenue in 2007 was RMB122.825 billion Yuan, 3.2 times more than that of 2000. The average annual growth rate during the period from 2001 to 2007 was 18.29%.

However, as to the proportions of environmental tax and charge revenue in total tax revenue and GDP, it is quite low. During the period from 2000 to 2007, the proportions of environmental tax and charge revenue in total tax revenue and GDP were respectively 2.86% and 0.43%. Compared with the mean proportion in OECD countries which are respectively 6-7% and 2-2.5%, there remains a big gap between China and OECD countries in terms of environmental tax revenue, which means there is great room for Chinas to develop its environmental taxation.

Table 1.8 Situation of revenue from environmentally-related taxes and charges Unit: 100 million RMB

Year	Domestic consumption tax	Pollution discharge fee	Resource tax	Vehicle and vessel tax	Total revenue
2000	239.13	57.96	63.62	23.40	384.11
2001	295.49	62.20	67.11	24.60	449.40
2002	304.43	67.44	75.08	28.90	475.85
2003	364.31	73.10	83.30	32.20	552.91
2004	477.43	94.20	98.80	35.60	706.03
2005	511.03	123.16	142.20	38.89	815.28
2006	650.75	144.14	207.11	49.96	1051.96
2007	725.34	173.60	261.15	68.16	1228.25

Note: Domestic consumption tax (consumption tax revenue deducted the revenue from tobacco and alcohol which is irrelevant to environmental protection). Vehicle and vessel tax before 2007 refers to the total of operation tax of vehicle and vessel was and driving license tax on vehicle and vessel.

Source: China Statistical Yearbook, Fiscal Yearbook of China, Tax Yearbook of China, China Environment Statistical Annual Report; data of Vehicle and vessel tax before 2007 are from the website of State Administration of Taxation.

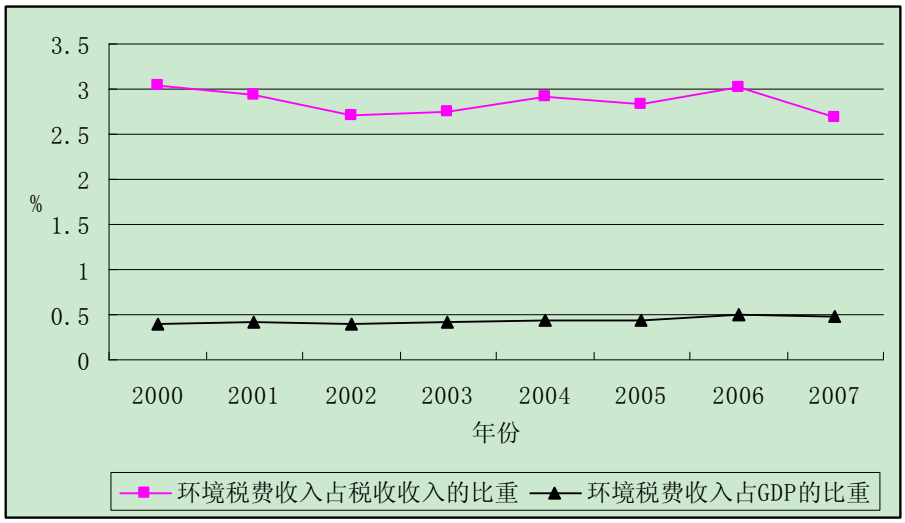

Figure 1.2 Proportions of environmentally-related taxes and charges revenue in total tax revenue and GDP

2. Problems with the current environmentally-related taxation in China

First, the absence of tax directly related to pollution emission. Unlike other international developed countries, there remains no environmental tax directly related to environmental protection, such as sulfur tax, nitrogen tax, and waste water tax in China. Since the emission of major pollutants is adjusted through a relevant pollutant-emission charge system, leading to failure of the main pollution control issues such as air pollution and water pollution. The difference in enforceability and collection management between taxation and charging causes a negative effect on environmental protection, and the supporting scope and force of environmental protection is lagging behind the demand of relevant laws and regulations.

Second, the current environmentally-related taxation is not systematic, resulting in adverse effects. Current environmentally-related taxes such as the levy of consumption tax and resource tax were not initially for environmental protection, but for other purposes such as adjusting consumption and resource conservation and utilization. These taxes are not specially designed for environmental protection. The provisions of environmentally-related taxes in the current system lack an integrated approach to their design. The disordered situation of separate and disconnected regulations fails to form a joint power with which to control environmental issues in a systematic manner. In addition, the control scope and effect of environmentally-related taxation is restricted and vulnerable to the conflicts from other control targets. Excessive and low-quality preferential measures issued by multiple departments lead to a lack of coordination of different control targets and offsets due to environmental protection target by other control targets.

In general, as an environmental policy measure implemented for years, China's current environmental tax and charge policies have played a positive role in

environmental protection. However, the problems with system design and collection management lead to failure of playing its due effect. Therefore, it is necessary for China to further strengthen the construction of its environmental taxation system.

1.2.3 Assessment of Current Pollution Discharge Fees

1. The current situation of pollution discharge fees

As for the environmental fee system, China is charging a pollution discharge fee for the emission of pollutants such as waste water, waste gas and solid waste. The current pollution discharge fee system covers five fields, which are waste water, waste gas, waste residue, noise and radioactive substance, and includes 113 items. Please refer to table 1.9 for the details.

Table 1.9 Situation of current pollution discharge fees

Pollution discharge fee	Contents	Purpose	Effect to environmental protection
Waste water discharge fee	Waste water discharge fee is charged for discharging pollutant to water in accordance with different types and amount of pollutant. Those who discharge waste to water exceeding national or local limitation should pay for fee of excessive discharge.	Control of the discharge of waste water	Reducing the discharge of waste to water and realize waste water emission after reaching due standards
Waste gas discharge fee	Waste water discharge fee is charged for discharging pollutant to air in accordance with different types and amount of pollutant.	Control of the discharge of waste gas	Reducing the discharge of waste gas and realize waste gas emission after reaching due standards
Solid waste and dangerous wastes discharge fee	Pollution discharge fee for solid waste is charged on those without equipments and sites for industrial solid waste storage and treatment or whose equipments and sites fail to meet environmental protection standards in accordance with different types and amount of solid waste. Pollution discharge fee for dangerous waste is charged on those who treat dangerous waste with landfill method but fail to meet the requirements of environmental protection department of state council in accordance with different types and amount of dangerous waste.	Control of the discharge of solid waste and dangerous waste	Reducing the discharge of solid waste and dangerous waste
Pollution discharge fee for excessive noise	Pollution discharge fee for excessive noise is charged for discharging noise pollution exceeding national standard of environmental noise which disturbs others' normal lives, work and study according to decibels.	Control of the discharge of noise	Reducing the discharge of noise and realize noise emission after reaching due standards

The revenue of pollution discharge fees directly related to environment has been growing rapidly. The revenue of pollution discharge fee in 2007 was RMB 17.360 billion Yuan, 3.0 times of that in 2000. The annual average growth rate during the period from 2001 to 2007 was 17.32%. In terms of internal structure of pollution discharge fee, the revenue of waste water discharge fee, solid waste and noisy changes slightly, the growth is mainly from waste gas discharge fee.

Table 1.10 Situation of China's revenue of pollution discharge fees from 2002 to 2007
Unit: 100 million RMB

Year	Pollution discharge fee	Waste water discharge fee	Waste gas discharge fee	Pollution discharge fee for noise	Pollution discharge fee for solid waste
2002	67.44	17.95	7.91	3.75	0.90
2003	73.10	-	-	-	-
2004	94.20	34.32	49.66	6.83	3.37
2005	123.16	36.42	75.69	7.30	3.75
2006	144.14	34.00	100.00	7.00	3.00
2007	173.60	-	-	-	-

Source: National Report on Environmental Statistic

2. Problems in current policy of pollution discharge fees

The policy of polluter-pays principle specified for the pollution discharge fee was specified in the field of pollution prevention and control, which is an important component in China's environmental management system and economic stimulation measures. During the past two decades, since the introduction of the pollution discharge fee in 1982, the policy of pollution discharge fee has been playing an important role in China's environmental protection. Pollution discharge fee policy not only urges polluters to conduct pollution prevention and control, but the funding from the pollution discharge fee promotes the capability development of China's environmental protection system. However, there are the following problems in the practice of implementing the policy.

First, a low level of pollution discharge fee, resulting in the situation that the cost of breaking the law is lower than the cost for following the law. Though the pollution discharge fee may increase enterprises' cost for emitting pollution, due to the problem of weak enforcement of the collection of the pollution discharge fee, the frequency of pollution discharge fee collection is fairly low. As for the implementation of the system of pollution discharge fee collection in China, the level of pollution discharge fee collection is only 50% of the cost for operating the pollution treatment facilities, or even less than 10% in some projects. The pollution discharge fee system has some effects on reducing enterprises' pollution behavior. However, as the cost of charging is lower than the cost of treatment, the goal of

effectively stimulating pollution treatment has not been achieved, and there is still the phenomenon of the enterprises prefer paying a pollution discharge fee than conducting pollution treatment.

Second, the collection of pollution discharge fees lacks powerful legal assurance with a low compulsory effect. "The Regulations on the Administration of Collection and Use of Pollution Discharge Fee" issued by State Council in July 2003 designed collection system similar to tax collection. However, since pollution discharge fee lacks the complete characteristics of compulsory enforcement, being gratis and fixity, which is unique to tax, there is no strong guarantee for regulations on taxation management. Such situation has resulted in the problem of low degree authoritativeness and insufficient compulsory enforcement in actual implementation, such as the phenomenon of "agreed collection of pollution discharge fee" between the paying units and the environmental protection departments, i.e., to reduce the amount of pollution discharge fee, or even the severe phenomenon of randomly delay, which will inevitably result in the deficient rate of collection of pollution discharge fee. On the other side, enterprises would rather turn in the pollution discharge fee than conducting treatment for the pollutants because the cost of pollution treatment is much higher than the amount of pollution discharge fee they should pay.

Compared with environmental taxation system, the weakness of pollution discharge fee system is easy to see. Beside, the public income system in China needs to be standalone. All the above shows that it is necessary to change pollution discharge fee to environmental tax.

1.3 Assessment on Related International Experience

The timing of levying environmentally-related taxes in developed countries was relatively early. Exploration and practice in most countries show that treating environment with tax methods has achieved obvious social effect, environmental pollution has been effectively held under control and environmental quality has been further improved. Learning from the international experiences in implementing environmentally-related taxes in developed countries and the development of emerging and developing countries is helpful to the improvement of a related taxation system in China.

1.3.1 The Development and Situation of Environmentally-related taxation System in Developed Countries

As an economic method of protecting environmental quality, environmentally-related taxes have been implemented for 30 to 40 years in developed countries. During the past 15 years, more and more OECD countries began to implement environmentally-related taxes and formed a mature environmental taxation system.

1. Development process of environmentally-related taxation system in developed countries

From the development of environmentally-related taxation systems in developed countries, it experiences three phases:

The first phase was of separate and scattered pollution taxes from 1960s and 1970s to early 1980s. In order to respond to the daily increasing environmental pollution problems in 1950s and 1960s, developed countries successively began to issue different types of pollution taxes (charges) for the purpose of pollution treatment. For example, France began to implement charges on water pollution in 1964. Former Federal Germany began to collect lubricant tax from lubricant manufacturers, and the revenue from lubricant tax was reallocated to enterprises recycling and treating waste oil. The environmentally-related taxes in this period were mainly charges for compensating the cost, requiring polluter to bear the cost for monitoring pollution discharge. Special pollution discharge fees such as user fee and charge for special purpose were the early form of environmentally-related taxes.

The second phase was the focusing on end-of-pipe treatment from 1980s to early 1990s. In this phase, environmentally-related taxes were levied on two ends of inputs and emissions. The types of environmentally-related taxes were increasing. Pollution emission tax, product tax and energy tax were emerging gradually, and main tax items included: vehicle fuel tax, light fuel tax, electricity tax, climate change tax, coal and coke tax, aviation fuel tax, tax on transportation tools with engine, tax on final waste treatment, package tax, water resource tax and royalty. All kinds of environmentally-related taxes, on the one hand, would mobilize fiscal revenue and on the other, would guide production and consumption.

The third phase was the phase of a comprehensive "Green" taxation system from the mid-1990s up to now. With further improvement of public awareness for environmental protection since the mid-1990s, environmental protection measures began to change their focus from “end-of-pipe treatment “to “comprehensive preventing and control”. Developed countries, especially EU member countries began to change to comprehensively and systematically adjust their taxation systems in order to make them more suitable for environmental protection. Finland (in 1990), Norway (in 1991), Denmark (in 1992), Sweden (in 1992 and in 2001), Netherlands (in 1992) and Germany (in 1999)[4] successively conducted significant "Green" taxation system reforms. Environmentally-related taxes rapidly developed in this period. For the purpose of implementing sustainable development strategy, countries carried out fiscal and taxation policies helpful to environmental protection and many also conducted comprehensive environmentally-related taxation system reform. Environmentally-related taxes had become the major environmental policies. On one hand, many countries abolished some provisions failing to meet the requirements of environmental protection, or harmful to sustainable development, for example the

[4] “Report on International experience in Environmentally related Taxes”by Barde, etc, 2009

abolishment of tax preference measures to pollutant energy such as coal. On the other hand, countries adjusted former existing taxes and adopted new measures helpful to environmental protection; to be specific, to adjust and modify consumption tax, income tax and motor tax, increase consumption tax rate on energies with pollution, deduct tax on cleaner energies, encourage the research and development of environmental protection technology, and accelerate depreciation of environmental protection equipment and tax preference on energy-saving vehicles.

2. The situation of environmentally-related taxation systems in developed countries

The term "environmentally related taxes" (ERT) has been used by the OECD to describe any tax related to the environment. In OECD countries, revenue from environmentally related taxes accounts for 6% to 7% in the total of tax revenue and 1% to 2.5% in GDP.[5] Overall, the environmentally related taxes in developed countries mainly include three parts: tax related to pollutant emission, tax related to environmental protection and other tax regulating measures.

-- Special taxes on pollutant emission

Typical environmentally-related taxes in developed countries include air pollution tax (sulfur dioxide tax, carbon dioxide tax), water pollution tax, solid waste tax (and waste tax) and noise tax.

Air pollution tax includes mainly sulfur dioxide tax and carbon dioxide tax. Sulfur dioxide tax is collected on sulfur dioxide emitted into the air. According to US tax law, in areas where the sulfur dioxide concentration reaches Grade I and Grade II, every pound of sulfur dioxide emitted into the air should pay 15 cents and 10 cents respectively in order to encourage manufacturers to install pollution control equipment and change to use fuels with low sulfur content. Sweden began to levy carbon dioxide tax according to the content of petroleum and coal in 1991. In addition, countries such as the Netherlands, Norway, Japan and Germany also began to collect carbon dioxide tax. Carbon dioxide tax is collected on carbon dioxide emitted into the air from fuel. The UK began to collect carbon dioxide tax in 1972 and Finland in 1990. In 1991, Sweden began to collect carbon dioxide tax on oil, coal, natural gas, liquefied petroleum gas, gasoline and domestic aviation fuel according to average carbon content and heat productivity. Later on, Norway, Netherlands, Denmark, France, US, Germany and Australia successively began to collect carbon dioxide tax.

Water pollution tax taxes activities that pollute water. At present, most western, industrialized countries collect water pollution tax on water polluting activities. Among these countries, the tax system in Germany and Netherlands are the most advanced. According to the "law on waste water tax" in Germany, taxpayers should

[5] The definition is from "Report on International experience in Environmentally related Taxes"by Barde, etc, 2009.

pay waste water tax for waste water directly emitted into water. Water pollution tax applies a uniform flat tax rate on the basis of a pollution unit (equal to the pollution load of one person in one year). The revenue of water pollution tax all belongs to local revenue for the improvement of local water quality. In the meantime, the law also stipulates when the emitted waste water reaches a certain minimum standard, water pollution tax can be reduced; and the investment of taxpayers for improving waste water facilities can offset payable tax. The water pollution tax in the Netherlands is collected from enterprises, companies, families and individuals for directly and indirectly emitting waste, pollutant and toxic substances into surface water or purifying plants, and the collection standard is "population equivalent" (equal to the amount of pollutant emitted into the water by one person in one year)

Solid waste tax taxes solid waste at a flat rate according to waste type and actual volume with the tax objects of beverage packages, waste paper and paper products and used tires. Some people take it as a product tax on pollution caused by manufacture, consumption and disposal. It is the major part of environmentally-related tax in most OECD countries. For example, the "law on environmentally related taxes" in Belgium in 1993 contains the following provisions: environmental tax is applied to beverage containers, waste cameras, some packages for industrial use, pesticides, paper and cells. ① Package tax. For the purpose of encouraging manufacture of light containers and reuse of containers, Norway began to collect tax on beverage containers as early as 1974. All beverage containers unable to be recycled have to bear a 30% tax. The more beverage containers are recycled, the fewer new beverage containers bearing the tax need to be purchased. This measure caused the number of used beer cans to be sharply reduced from 12 million in 1973 to 1.4 million in 1975. The US carried out a deposit method for beverage containers. In other words, customers pay a certain deposit when buying beverages and receive the deposit back when they return the containers. Italy collects 100 lira of environmental tax for the manufacturing of non-degradable plastic package bags (5 times the cost of manufacturing the plastic package bags). ② Used tires tax. The US, France, Norway and Italy have all implemented a tax collection system on used tires according to numbers in order to promote the use of renewed tires and save raw materials. ③ Fertilizer tax. Sweden began to collect fertilizer tax in 1984 at the rate of 0.6 krone for every kilogram of nitrogen and 12 krone of phosphorus, which increased the price by 35%. The tax revenue is used for research, agricultural consultancy and treatment of salinization of soil. Austria, Belgium and Finland all began the levy of fertilizer tax successively. ④ Tax on products containing CFCs. The US formulated a high tax rate for products containing CFCs in order to increase the costs of fluorine, chlorine and hydrogen, thus reducing their adverse effect on the atmospheric ozone layer.

Waste disposal tax. Originating in Finland, it is mainly used to mobilize funds for collecting and disposing of household waste. It takes the family as a collection unit, and families with few members will get certain tax reduction and exemption. Finland also levies government waste collection tax according to the amount of waste from

each family (local city governments can select from two taxes). Italy began to collect waste disposal tax in 1984 on everyone as funding for local governments to dispose of waste. Finland and UK also began this tax in 1996. France collects waste tax on the basis of 300 kilograms of waste by one person in one year.

Noise tax is a tax collected on special noise sources higher than certain decibels. The revenue is used to install noise isolation facilities near airports or to arrange relocation of residents. Noise tax is collected in countries such as the US, Germany, Japan and Finland. The Dutch government collects noise tax from users of civil planes, such as airline companies on the action of generating noise in certain areas such as airports with the tax base of the generating amount of noise. Japan collects noise tax on the basis of the times and numbers of planes landing. Los Angeles in the US collects USD 1 for every passenger and for every ton of goods as noise treatment tax.

-- Taxes related to eco-environmental conservation

For example, France began to collect a forest fell tax: 6000 francs for every hectare of forest felled for the purpose of urban planning and industrial construction, and 3000 francs for every hectare of forest felled for other purposes; and enterprises in the US whose taxable income of alternative minimum tax exceeds 2 USD million should pay environmental tax at the tax rate of 0.12%.

-- Tax regulating policies and incentive measures for improving environment and restricting pollution

Developed countries make full use of the regulating effect of tax to advance environmental protection. ① Measures such as the pre-tax expenditure of R&D budgets, tax deduction of technology transfer fees and preferential tax for introducing high/new environmental technologies have been adopted to encourage the research, development, introduction and application of environmental technologies. For example, the US has been giving tax reductions and exemption to research on new pollution control technologies and the production of alternatives for pollutants since 1960s. ② Measures such as tax refunds for environmental protection investment and approval of accelerated depreciation of environmental protection facilities have been adopted to encourage investment in environmental protection. For example, in Japan, fixed asset tax on facilities for public hazard prevention and control can be reduced by 40%~70% of the former tax rate depending on facilities type, and accelerated depreciation will be given to all environmental protection facilities through increasing 14%-20% special depreciation rate on the basis of the former rate. The US gives tax deductions or exemptions for public investment in urban waste storage facilities, dangerous waste treatment facilities and municipal waste water treatment plants. German laws stipulate that environmental protection facilities can depreciate by 60% in the fiscal year in which they are purchased or constructed and 10% every year afterwards. Canada also stipulates provisions related to the accelerated depreciation of investment in water

and air pollution control. ③To advance the development of environmental protection industries through the manufacture and use of environmental-friendly products. For example, many countries give tax preferences to environmental-friendly products through low tax rates and tax exemptions for waste recycle and reuse. For example, Germany gives tax exemption on products reducing or eliminating environmental damage. Many countries also advocate green consumption through consumption tax exemption. In the US, those who buy a new energy car can deduct USD 2000 from their federal tax and there is no upper limit for the number of cars purchased. For users who buy solar and wind energy equipment, 30% of the first USD 2000 and 20% of the next USD 8000 for the equipment can be deducted from their individual income tax of that year. Japan also has a preferential automobile purchasing tax for buying cars favouring environmental protection. ④ To encourage environmental actions, the US stipulates a preference for taxes that encourage private afforestation: only land tax is levied for private afforestation but without green and wood tax, and expenses for private afforestation can offset individual income tax. ⑤ Heavy tax on polluting products and actions harmful to environmental protection, which can be seen in related articles on consumption tax and energy tax.

1.3.2 Development and Improvement in Emerging and Developing Countries

Environmental issues become more and more prominent and urgent in emerging countries and developing countries at the same time as economic development. In view of experiences and lessons in developed countries in the process of environmental protection with environmentally-related taxes, international organizations such as the World Bank, UNEDP, OECD have all actively advocated this work, and some new research achievements have been made, and research on green and environmentally-related taxes has made great achievements. Experts from international organizations suggest that developing countries "should collect environmentally-related taxes in connection with damages to the environment". Many emerging countries and developing countries have begun to take environmental protection as one of the important targets in its taxation system reform. For the purpose of sustainable social and economic development, developing countries increasingly emphasize environmental protection through research on environmentally-related taxes and the implementation of environmentally-related tax policy and take action to protect the environment.

1. Situation of taxation systems in emerging and developing countries

-- Actively conduct research on environmentally-related taxes

Environmental protection has become a major global issue of common concern. Issues such as limitation of greenhouse gas emissions are pointing towards developing countries such as India. Developing countries may bear more international pressure in future development. In the meantime, the daily increasing pollution situation in developing countries also imposes pressure on developing

countries. After theoretical research and actual practice in OECD countries, emerging countries and developing countries proactively conduct research on environmentally-related taxes and issue laws on environment. For example, on the basis of maintaining rapid economic development, India takes enhancing pollution treatment as a set policy of future Indian governments. Amazonas State in Brazil declared on June 5th 2007 that the first regional "Law on Climate Change and Environment" of Brazil began to take effect. This law officially stipulated for the first time that state government is responsible for taking measures to mitigate climate change. It also stipulated that enterprises in Amazonas State are responsible for reducing carbon dioxide emissions or offering economic compensation for carbon dioxide emission. The imperfect laws and regulations in most developing countries are far from enough to solve their serious environmental problems, and the levy of environmentally-related taxes will supplement the deficiency in environmental laws and regulations to a certain degree.

-- Starting to implement a environmentally-related taxation system and policy

To respond to environmental protection pressure from home and abroad, emerging countries and developing countries began to implement environmentally-related taxation systems and policies. For example, after entering OECD, Korea began to advocate an environmental resource tax. India and Poland also began to implement environmentally-related taxation systems and policies. And in 2007, developing countries such as Thailand implemented new environmentally-related taxation policies.

Poland started its environmental reform in 1989, and therefore, tax rate was significantly increased and the collection system was strengthened. Poland mainly depended on a comprehensive system, combining environmental standards with environmental tax and (natural) resource tax to solve environmental problems. The scope of pollution tax and (natural) resource tax is quite wide. At present, Poland collects pollution tax on thousands of pollutants, mainly on three types of pollutants such as sulfur dioxide, carbon dioxide and salty water for coal mining. The tax rates were determined by the harm level and would adjust over time according to certain proportions. And the tax rate for new pollutants can be determined according to the existing tax rates. The tax rates for major pollutants in Poland have been fairly high for a long time. For example, the sulfur dioxide tax, which is the main source of Poland's revenue, has been higher than USD 70 per ton of sulfur dioxide since 1991, which is relatively high compared with OECD countries. The Polish government carries out the system of special funds for special purposes, which returns tax revenue to enterprises and municipal government through special environmental funds. There are three levels of environmental funds: national environmental protection funds and water resource management funds (national fund), 49 regional environmental funds and 2400 municipal environmental funds. The ownership of pollution tax, water extraction fee, pollution treatment fee, wood fell tax and geology fee has a clear budgetary distribution among these three levels of fund. Poland takes

the lead in developing countries for the treatment of pollution through taxation methods, which has a positive effect on ecological conservation[6].

In accordance with the requirements of opening up its economic policy and its commitment to the WTO, India has been conducting significant reform on its taxation system since 1991. The reform included tax reductions on customs tariffs and on consumption tax, the decrease of enterprise tax, the increase of the taxable base, and strengthening tax management. After the taxation system reform, India began to implement environment related tax policy. In terms of income tax, there is a depreciation rate of 80% in pollution control equipment and energy-saving devices, and any enterprise engaged in development, maintenance and infrastructure facilities construction, such as roads, highways, bridges, airports, harbors, railways, industrial cities, inland waterways, water supply projects, water treatment system, irrigation projects, sanitary and waste water projects and solid waste treatment projects can receive 100% of profit and benefit from tax reductions for 10 years. In terms of consumption tax, the rate for most commodities are between 0 to 16%, but the tax rate for commodities such as motor cycles, tires, soft beverages containing carbon dioxide, air-conditioners, polyester filament yarn, chewing tobacco products is 32%, and gasoline consumption tax is 30% plus 7 rupees for each litre of gasoline consumed. According to the tax law, the development of the information industry without pollution in special economic zones, and golf courses, seawater desalination and hotels in coastal restriction areas will receive tax preferentials. And enterprises in special economic zones are exempted from environmental consultancy and assessment. In 2007, India launched its new environmentally-related taxation.

2. Difficulties and challenges faced by emerging developing countries in the process of development and improvement of environmentally-related taxation systems

--The conflicts between economic development and resource and environmental protection.

The priority in developing countries is economic development and the focus on the environment is second to economic development. If environmental issues do not receive enough concern, the policy guidance of government is not helpful to environment and resource protection. Low price of natural resources, and subsidies for agriculture, transportation and resources all lead to excessive use of natural resources and the environment. Low prices causes low efficiency of resource utilization, and low technology content causes waste of national resources and unsustainable utilization. Let us take India as an example. A report by the World Bank issued in April 2007 argued that with the strong development of India's economy, India's "land, water, air and forest resource are facing unprecedented pressure"; with the development of investment in the architecture, mining and steel departments, "air and water are seriously polluted; mercury is found in food and

[6] "International Comparison and Reference on Environmental Tax"by WANG Zhelin.

other chemicals and heavy metals are found in drinking water". India remains a country with the service industry as its major industry. In its future economic development, industry with the representative of manufacture industry will develop rapidly. Current enterprise and manufacturing in India brings heavy pressure on environment and pollution issues. In addition, poor construction of infrastructure and facilities requires intensive and rapid development, which will bring difficulties on environmental protection. Environmental issues should be impassable difficulty during the process of economic development in developing countries, or even hold back economic development. How to manage the subtle balance between the environment and development relates to sustainable and rapid development of developing countries.

-- Limitation of out-dated administration methods of government and public finance

Since there is disparity between developing countries and developed countries in terms of finance and administration method, developing countries cannot copy the measures of the developed countries. Developing countries should take the domestic situation into consideration to select reasonable environmentally-related tax categories in order to achieve maximum environmental protection with minimum cost. For example, some developed countries collect pollution tax according to the emission situation of pollutants. But the information is hard to obtain in developing countries or the cost is too high. To collect pollution tax needs the government to monitor and administer the situation of pollution emission from enterprises, but there are too many small enterprises and out-dated administration methods and conditions, leading to difficulty in enforcement and high cost.

-- Imperfect market system

Perfect market systems can transmit price fluctuation caused by tax which is an economic method to economic individuals, and then real economy will adjust related economic measures accordingly, thus government can use tax to adjust economic growth patterns. If the market system is imperfect, price fluctuation caused by tax cannot reach specific real economy, which causes the control intention of government to come to nothing. The environmentally-related taxes in developed countries are more effective than those in developing countries. Compared with developed countries, market system in emerging countries and developing countries is inadequate, directly affecting the implementation of environmentally-related taxes.

1.3.3 Summary and Reference of Related International Experience

From the practice of implementing environmentally-related taxes, it can be seen that the implementation situation is diversified, with lots of differences in different countries. This part mainly analyzes the common features and implementation effects, neglecting their differences, and thus provides inspiration to China.

1. The common features of environmentally-related taxes in developed countries

--Clear target and wide scope of environmentally-related taxation

The target of environmentally-related taxation and measures in developed countries is clear which is effectively controlling pollution and protecting environment. In developed countries, the environment is widely understood as the natural existing in which people are living, and which provide resource functions, recipient functions and service functions to the people and other creatures in economies. And the connotation of environmentally-related taxes is extremely wide. The scope of environmentally-related taxes involves many aspects such as air, water resource, living environment and urban environment, including more than 50 tax categories and relevant articles. Regulating measures such as tax preference relevant to environmental protection involve energy-related tax, vehicle related tax, pollution tax, resource tax and income tax.

--Large difference between the structure and specific tax system in environmentally-related taxes

The specific differences are as follows: **First**, different effects of environmentally-related taxes in different countries. In developed countries with high pollution and public voice such as Denmark, Finland, Sweden and Netherlands, the position of environmentally-related taxes is high. **Second**, different structures of environmentally-related taxes. Denmark and Finland pay attention to carbon tax and sulfur tax, but do not levy water pollution tax; France and Germany are not so highly concerned with carbon tax and sulfur tax, but more interested in water pollution tax. **Third**, different tax rates for environmentally-related taxes. Taking carbon tax as an example, the rate of carbon tax is EUR 0.4 per ton of carbon dioxide in Netherlands and EUR 5.5-11.1 per ton of carbon dioxide in Finland and Denmark, and the rate in Sweden is as high as EUR 37.9 per ton of carbon dioxide.

-- Flexible and diversified tax preference policies

When developed countries implemented environmentally-related taxes, they also considered the impact of environmentally-related taxes on all industries and economic links, and were concerned with reducing the adverse impact to maximum level, paid attention to regulating effect of tax rate difference and tax reduction and exemption, and stipulated flexible and diversified tax preference policy. In addition, for the purpose of protecting the competitiveness of industrial products and services in the international market, EU members also implemented environmentally-related taxes, rebates and tax reductions or exemption measures. For example, while increasing the energy tax rate, Germany also stipulated a series of tax reduction and exemption measures: all methods of local public transportation(such as bus and school bus, railway and taxi) should only pay 50% of the increased energy tax; public vans and railway transportation (railway, trolleybus, trackless trolley bus, local train, subway and aerotrain) should only pay 50% of the electricity tax; the

electricity tax rate for manufacture department is only 20%; and enterprises manufacturing heat and electricity together and monthly utility rate or annual arbitrary utility rate no less than 70% can be exempted from current mineral oil tax. Sweden divides gasoline into clean gasoline and unclean gasoline according to impact of their emissions on the environment and whether they contain lead, and imposes different tax rates accordingly. Sweden also gave 75% of carbon tax reduction to the industrial department (and tax exemption from energy tax); and the tax reduction decreased to 50% in July 1997. In Denmark, the industrial department enjoyed a 50% of carbon dioxide tax reduction from 1993 to 1995. When the UK conducted environmentally-related tax reform, it implemented a series of preferential policies. During the period from 1993 to 1999, the fuel tax had been increasing by 5-6% every year and by 6-10% after that period. The design objective to "progressively increase method of fuel tax" was to reduce carbon dioxide emission and consider other environmental factors. The UK began to levy "climate change tax" on energy utilization of commercial and public departments. Industrial departments signing environment agreements can get a refund of 80% of the "climate change tax". Enterprises can select one carbon dioxide emission-trade system to realize their target since 2002. The revenue from that can be refunded through the following methods: reducing national insurance that enterprises pay; tax reduction and exemption from the investment in energy and renewable energy sources. Waste landfill tax beginning in 1996 can also be refunded to taxpayer through reducing national insurance; and the same method is used for a new tax category levied on mineral resource.[7]

-- Many countries implement systems of special funds for special purposes

Most developed countries implement systems of special funds for special purpose, and the revenue collected through environmentally-related taxes forms a special fund for expenditure on improving the environment, for compensation of pollution from accidents and for encouraging energy-saving and environmental protection. For example, Denmark has set up a green income refund, with which the tax revenue can be refunded to enterprises in part or in whole through reducing other taxes and subsidy. The US uses environmentally-related tax revenue from different pollution subjects to establish many funds, among which tax revenue from consumption tax on chemical materials, on gasoline and income tax surcharge has formed Superfund, to provide funding for waste treatment. Tax is levied on subjects that may cause pollution accidents and special fund is established as compensation to victims of pollution accidents. As to the countries in the process of economic transition and developing countries, the fund for environmental protection is in serious shortage, and system of special fund for special purpose from environmental taxes seen as effective transitional measure to make up for environmental protection and treating pollution, thus the system is widely used to promote environmental protection. System of special fund for special purpose can easily get political support and be

[7] "Report on International experience in Environmentally related Taxes"by Barde, etc, 2009.

accepted by the society. However, some researchers believe that the system of special funds for special purposes can cause reduction in tax revenue over time, and that the tax rate can be raised to higher than the effective level. In the long term, it will cause the system to lose effect and become rigid[8].

2. The implementation effect of environmentally-related taxes

After 40 years of practice and exploitation, environmentally-related taxation system become more and more improved. In 2006, 375 environmentally-related tax categories are implemented in OECD countries[9]. Obvious social effect has been achieved through tax method to treat environment and environment quality in OECD countries has been greatly improved. For example, sulfur tax in Sweden beginning in 1991 caused sulfur content in oil base fuel to decrease by 50%. Sulfur content in light fuel has decrease to less than 0.076% (less than half of mandatory standard which is 0.2%). It is estimated that the emission amount of sulfur dioxide has reduced by 94% compared with that of 1970, and emission amount of sulfur reduced by 6,000 tonnes, and nitrogen oxide has reduced by 20% and carbon dioxide by 54% since the levy of sulfur tax[10]. Carbon tax causes the emission amount of carbon dioxide has been reduced by more than 20% every year in Norway. The levy of sulfur tax led to 84% reduction of sulfur emission amount during the period from 1995 to 2004 in Denmark[11]. People reduce the use of Freon since the levy of consumption tax on chemicals harmful to ozone in US, and the levy of gasoline tax encourages consumption of energy-saving vehicles, thus reduced pollution emission.

Environmental tax brings a certain degree of effect on the economy. The levy of environmental tax increases the price of some resources, energy and fuel, leading enterprises to improve skills and accelerate technical innovation, which improves the enterprises' competitive power to a certain degree. For example, tax on ozone layer damaging fluoride in the US stimulated enterprises to develop new alternatives. Tax on diesel fuel containing sulfur in Sweden stimulated enterprises to develop new fuels with less pollution. In addition, the introduction of environmental tax promotes the development of environmental industries in developed countries. Taking Germany as an example, Germany began ecological taxation reform (ETR) in 1999. Germany increased energy tax from 1999 to 2003 to reduce labour cost and adjust tax structure. The reform has positive impacts on macro economy. Analysis to data shows that ecological taxation reform causes GDP to grow by 0.1-0.2% every year, employed population to increase by 250,000 people, and carbon dioxide emission and energy consumption of enterprises to decrease by 2-3%. During the period from 1999 to 2005, carbon dioxide emission and fuel sales had decreased by 17%; population taking public transportation had increased by 5%; and people sharing vehicles has increased. The share of new type vehicles with low pollution increased

[8] "Report on International experience in Environmentally related Taxes"by Barde, etc, 2009.
[9] "Report on International experience in Environmentally related Taxes"by Barde, etc, 2009.
[10] "Report on International experience in Environmentally related Taxes"by Barde, etc, 2009.
[11] "Report on International experience in Environmentally related Taxes"by Barde, etc, 2009.

from 1% in 1998 to 4.6% in 2003[12].

In micro aspect, ecological taxation reform has increased the market opportunities, promoted ecological efficiency and innovation, reduced energy cost, reduced tax rate on environmental-friendly technologies and improved products competitiveness. For example, the ecological analysis of Japan's environmental policy shows that environmental policy can bring technical innovation with low environmental damage and high production efficiency, which could stimulate the prosperous development of new industries and make significant contribution to economic growth. The introduction of environmental tax has advanced research on environmental technology and stimulated enterprises to improve the competitiveness of environmental-friendly products in international market[13]. In addition, ecological taxation reform also influenced people's action to a certain degree. Objectively, environmental tax has increased energy price, but it has also had some effect on transiting consumption structure to energy-saving mode. For example, Ireland levied tax on plastic shopping bags since March 2001. One plastic shopping bag should cost 15 Euro cents as tax, which declines the use of plastic shopping bags by 90% after half a year.

3. Reference and inspiration

Analysis of international practice of environmentally-related taxes shows that the levy of environmentally-related taxes can supplement the shortage of environmental laws and regulations and tradable emission rights, and the deficiency of environmental protection funds in developing countries. During China's process of economic structure transition, we should identify an opportune moment to launch environmentally-related taxes to show its regulating effect, and advance environmental protection and pollution prevention and control.

-- Research on, design of and levy of environmentally-related taxes should be based on the national situation. Different economic development levels and environmental situations require different content and focus of their tax systems. The levy of an environmental tax should consider China's national situation and the tax burden should not be too heavy. First, the per capita income is low. The per capita GDP in developed countries was USD 8,000 when they began environmentally-related taxes. But per capita GDP of China in 2007 was USD 2,500. A heavy tax burden would increase the burden on taxpayers. Second, developed countries had already entered a post-industrialized age or information age when they began introducing environmentally-related taxes, but China still remains in the middle of its industrialized age. Levy of environmentally-related taxes should have an impact on enterprises' international competitiveness. Third, China can only bear common but differentiated responsibilities for environmental protection. Protection of the natural

[12] Kai Schlegelmilch, The impact of the ecological tax reform in Germany, 2007.

13 "Implementation Situation of Environmental Tax Environmental Tax in Japan", by WANG Tong, www.drcnet.com.cn/DRCNET.Channel Web/ ,2007

environment on which the survival and development of human beings rely is the common responsibility of all countries in the globe and developed countries should bear the main responsibility. As for developing countries such as China, the primary task is to develop its economy and dispel poverty, and then the effect of environmentally-related taxes on environmental protection and sustainable economic development can be considered.

-- Gradual progress starting from easier tasks. Environmental protection is a worldwide issue. At the beginning, environmental tax will definitely cause a tax burden increase. Even in developed countries, there was a progressive process. The tax rate was increased gradually, and tax scope was expanded gradually and new tax was levied gradually and thus achievement could be made. For example, in Finland, the tax rate for carbon dioxide had increased by 14 times during the period from 1990 to 1998. And in Denmark, after the levy of carbon dioxide tax in 1992, an energy package programme, lasting for years (from 1995 to 2002) included measures to increase new tax categories. In 1999, Germany and UK conducted green taxation reforms, which were implemented in the following years[14]. So China could not expect to do it in one step when implementing environmental tax; China should follow the due sequence and gradual progress starting from easier tasks. In accordance with the requirements of environmental protection and greens tax system, we **first** should make slight changes to the current taxation system, especially provisions for value-added tax, consumption tax, income tax, customs tax and resource tax. **Second**, advance fee-to-tax reform, which changes former administrative fees to environmental tax or energy tax, for example, changing the waste water discharge fee to pollution tax. **Third**, the introduction of an independent environmental tax or energy tax. After the step of transforming administrative fees into tax, we should gradually levy independent environmental tax or energy tax, such as pollution tax, waste tax, noise tax, carbon dioxide tax, sulfur dioxide tax and energy tax. The introduction of an independent environmental tax should be carried out through a gradual progress. When the conditions are met, or people's awareness is uniform, the more difficult steps can be taken. For example, tax on carbon dioxide and sulfur dioxide with serious pollution on air can go first, because that the executive cost is low and the public can accept, and at the same time, the effect to reduce sulfur and carbon emission is obvious. In order to achieve significant effect, the tax rate needs to be high. However, under China's current situation, high tax rate is hard to be accepted by the society and may influence the whole economic development. Thus environmental tax should be advanced in a regular order and improved with the progress of pollution control technology.

-- With the focus on regulating effect of tax and the combination of incentive and restriction. The levy of environmental tax will increase the cost of enterprise's manufacture and residents' living. Some EU members advance green tax reform on the basis of fixed tax burden, and new environmental tax could be offset through tax

[14] "Report on International experience in Environmentally related Taxes"by Barde, etc, 2009.

reduction or exemption (tax transformation). All EU members and Norway conducted green tax reform with double dividends method, which strengthened environmental protection through increase of tax revenue according to environmentally-related tax base, and reduce labor cost through reduction of tax wedge (especially reducing social insurance of employees), thus the employment was increased. Research shows that large tax reduction or exemption is provided to private sectors (mainly energy-intensified department), environmental tax is mainly paid by family users, and only a small part is paid by industrial users[15]. China should learn from international experience to pay attention to the incentive mechanism and reduce pressure of all parties. For example, government should sign agreements with enterprises to give tax preference or tax reduction and exemption to enterprises, which meet the requirements of environmental protection. In addition, government can also use reduce or exempt low-income population and certain industries from tax burden.

In addition, China should focus on the coordination of tax with other measures. The solution to environmental issues could not rely on one single measure. International community is increasingly emphasizing coordination of all measures, which includes coordination of tax with administrative measure, tax measure with other economic measures and the coordination between different methods in tax measure.

1.4 Roadmap for Building an Environment-Related Taxation System in China

1.4.1 Potential environmentally-related taxation structure

1. Design for a future environmentally-related taxation system

As for the reform in OECD countries, the establishment and improvement of the environmental taxation system consists of three aspects. First, reducing or abolishing those subsidies harmful to the environment. Second, reorganizing existing taxes according to environment standards. Third, levy of new environmental tax. The reform ideas in these three aspects in OECD countries have an important reference function for the design and reform of China's environmental taxation system.

There is no independent environmental tax in China's current taxation system, with only some specific provisions related to environmental protection in some tax categories. In terms of constructing a perfect environmental taxation system, the construction and improvement of the environmental taxation system in China should respect the following reform thoughts: 1. introducing new tax; 2. reconstructing current taxes; and 3. improving environmentally-related tax policies

Following these thoughts, the levy of an environmental tax and improvement of

[15] "Report on International experience in Environmentally related Taxes"by Barde, etc, 2009.

environmentally-related taxes and tax policies will construct the basic structure of China's environmentally-related taxation system which is composed of three parts: environmental tax, taxes related to environment and other environment-related tax policies. Please refer to figure 1.2 for a potential environmentally-related taxation structure of China. The three parts reflect different taxes and have different degrees of pertinence to environmental protection. Environmental tax is a special tax levied on all pollutant emissions, such as waste gas, waste water and solid waste. The purpose of environmental tax, which is directly related to environmental protection, is to reduce pollutant emission and ecological damage. Taxes related to the environment refer to tax categories having a certain effect on environmental protection, but the purpose of which is not limited to environmental protection, such as consumption tax and resource tax. Other environmentally-related tax policies mainly refer to value-added tax, enterprise income tax whose purpose is not related to environmental protection, but certain tax preference or tax penalty measures to these taxes can partly have an effect onenvironmental protection. The three parts are connected with each other and supplement each other. No one can substitute another. They play their roles in environmental protection as a whole system.

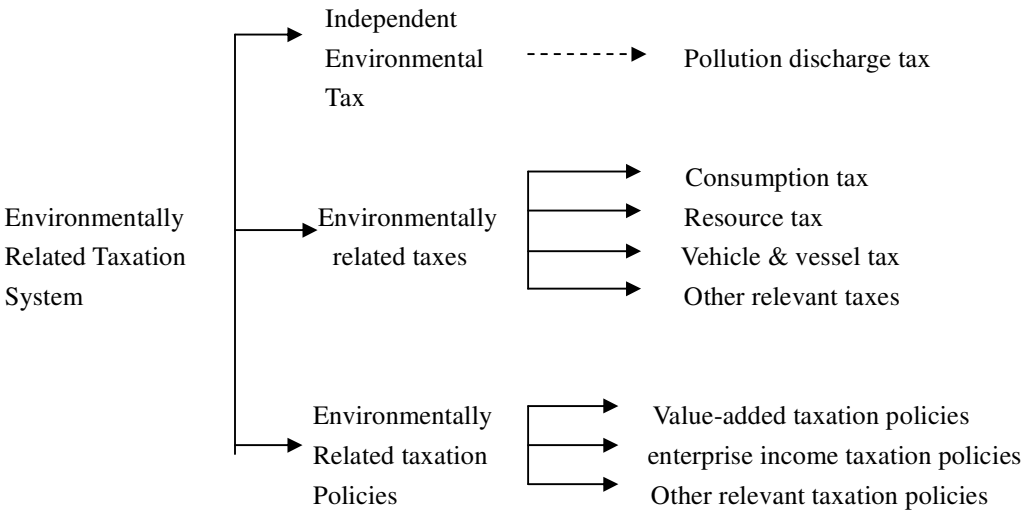

Figure 1.3 Structure of Environmental Taxation System

environmentally related

According to international practice and the universality and equality of tax, environmental tax should be levied on actions, products and materials causing ecological damage and environmental pollution, such as resource exploitation. In other words, all actions harmful to the environment should be taken as tax objects. The analysis of China's major environmental issues and a forecast of future development shows that areas such as water pollution control, air pollution control and solid waste pollution control should be the focus of future environmental protection. Such action is the most serious problem in environmental pollution. Iindustrial waste emission alone accounts for 70% of China's pollution source. Such

a tax, which directly restricts pollutant emission and promotes environmental friendly change of economic actions, meets most closely the theoretical principle of ERT. Therefore, to impose this tax first on these types of pollution is in line with the primary control target of environmentally-related taxation in China. Please refer to table 1.11 for potential scope and objects of environmental tax.

Table 1.11 Potential scope and objects of Environmental Tax

Scope and objects of Environmental Tax		Specific contents
Emission of pollutant	Waste gas	Includes sulfur dioxide and nitrogen oxide, etc
	Waste water	Includes industrial waste water, etc
	Solid waste	Includes coal dust, waste residue from metallurgy and chemical industries, tailings, construction waste, etc.
Carbon dioxide emission	carbon dioxide	Includes carbon dioxide emitted from combustion of fossil fuel such as coal, natural gas, gasoline, diesel fuel.

1.4.2 Macro and Micro Conditions for Introducing Environmental Tax

Since the introduction of environmental tax is restricted by factors and conditions such as slowdown of economic growth, imperfect pricing mechanisms for production factors such as resources, insufficient means modification of environmental laws and tax collection administration and technical monitoring level by environmental authorities, it is more difficult to introduce an environmental tax than reform current environmentally-related taxes such as consumption tax and resource tax. Viewing from the current external environment, the introduction of environmental tax. Environmental tax, in the future, should meet the following premises or conditions:

1. A healthy economic environment home and abroad. According to the above analysis on the relationship between macroeconomic development and environmentally-related taxation, the introduction of an Environmental Tax must occur at the most appropriate opportunity when the overall economy is in steady development. For this purpose, the introduction of the Environmental Tax needs a healthy economic environment at home and abroad. At present, suffering from ^the international financial crisis, the trend of China's economic growth is showing signs of a slowdown, which constitutes a direct obstacle to the introduction of an environmental tax. In the mean time, international financial crisis also influence the import of China's main trade countries. Poor international economic environment is not helpful to the introduction of environmental tax. The harmful effect from economic environment at home and abroad may lead to the delay of the introduction of environmental tax.

2. Moderate tax burden. The introduction of environmental tax will inevitably increase the burden of enterprises and individual taxpayers. Although the improvement of environmental protection awareness of Chinese people makes it easier for the society to accept environmental tax, heavy tax burden will lead to the resistance from taxpayers who are significantly influenced. For this purpose, at the beginning of introduction, low tax burden and design relevant preferential such as tax rebate or subsidy to taxpayers who are significantly influenced will reduce the resistance to the implement of this tax.

3. High tax collection level. Compared with traditional tax, the collection of environmental tax is more complicated, especially that the tax base calculation and practical operation in collection is very difficult. Environmental tax is collected with tax base on emitted pollutant and acceding to emission amount. It is of strong technology, and a number of professional technicians to conduct environment monitoring at the site and analysis and calculation to all kind of pollutants emitted. But these conditions can not be met right now. Therefore, taxation authorities need to cooperate with environmental departments in order to improve tax collection level.

4. Good social environment. The introduction of environmental tax should be based on good social environment. With improvement of environmental protection awareness of Chinese people, traditional environmental regulation mode can no longer meet the requirement of the public to environment, and the public ask the government to take more effective command and control. Improvement of environmental protection awareness of Chinese people makes it easier for the public to accept environmental tax and reduce resistance.

1.4.3 Timetable for improving environmentally-related taxation

Construction of perfect environmentally-related taxation could not be accomplished in one move, but needs certain process. The three parts of environmentally-related taxation reform: the introduction of environmental tax, reform of other environmentally-related taxes and improvement of tax policies related to the environment have different conditions and time selection. The appropriate implementation procedures should be selected according to China's actual situation. The introduction of environmental tax is hindered by many conditions, but the reform of the other two parts is relatively easier. Therefore, for the purpose of setting up perfect environmentally-related taxation, we can conduct reform on the other two parts before the introduction of environmental tax. While at the same time, introducing environmental tax, and after that, the reform of the two other parts should also be improved.

As to the introduction of environmental tax, the emission of pollutant such as sulfur dioxide, nitrogen oxide, carbon dioxide and industrial waste water should be the potential objects of environmental tax. However, as a new tax, environmental tax will be restricted by many factors, so at the beginning of environmental tax, the

scope should be not too broad and the principle of gradually progressing & starting from easier tasks should be followed. According to the fact that major environmental issues and targets of environmental protection policies should be implemented by stages and in groups, the introduction of environmental tax should start with key pollution source and objects easy to collect, and scope can be expanded when the conditions are mature.

In accordance with the design for a future environmentally-related taxation system and on the basis of current undergoing reforms, the reform roadmap for a future environmentally-related taxation system could be divided into three phases with the following contents:

1. Reform content of the first phase

First, improvement of environmentally-related taxes, such as resource tax, consumption tax, vehicle and vessel tax. Because it is relatively easier to conduct reform and adjustment to environmentally-related taxes than to levy a new tax, the improvement of environmentally-related taxation system should start with the improvement of environmentally-related taxes such as resource tax, consumption tax, and vehicle and vessel tax on the basis of current taxation system.

Second, introduction of an independent environmental tax as soon as possible based on China's situation of economic and social development. To reduce the resistance and negative effect of the environmental tax, we should follow the principle of gradually progressing & starting from easier tasks, and take different tax items into the scope of environmental tax collection phase by phase. This thought is not only in compliance with the requirement of step-by-step implementation of new taxation system reform, but also in accordance with ERT reforms in international experience. Sulfur dioxide, nitrogen oxide, carbon dioxide and waste water are the potential environmental tax items. According to implementing major environmental issues and targets of environmental protection policy by stages and in groups, the introduction of environmental tax should start with key pollution source and objects easy to collect, and scope can be expanded when the conditions are mature.

2. Reform content of the second phase

First is to further improve environmentally-related taxes and tax policies. On the basis of reform to environment related taxes and tax policies in the first phase, all taxes and policies should be further improved. Second is to expand the scope of environmental tax. The scope of environmental tax should be expanded on the basis reform in the first stage. In the mean time, if environmental tax fails to be levied in the first phase, it should be done in this phase.

3. Reform content of the third phase

First is to continue to expand the scope of environmental tax. According to the reform situation in the first and second phases and reform target, scope of environmental tax should be expanded continuously.

Second is to conduct all-round optimization of the tax reform according to the situation of reform of environmentally-related taxation system. After the introduction of environmental tax and improvement of environmentally-related taxes and tax policies, it is necessary to optimize the structure of environmentally-related taxation, thus to construct mature and perfect environmentally-related taxation system.

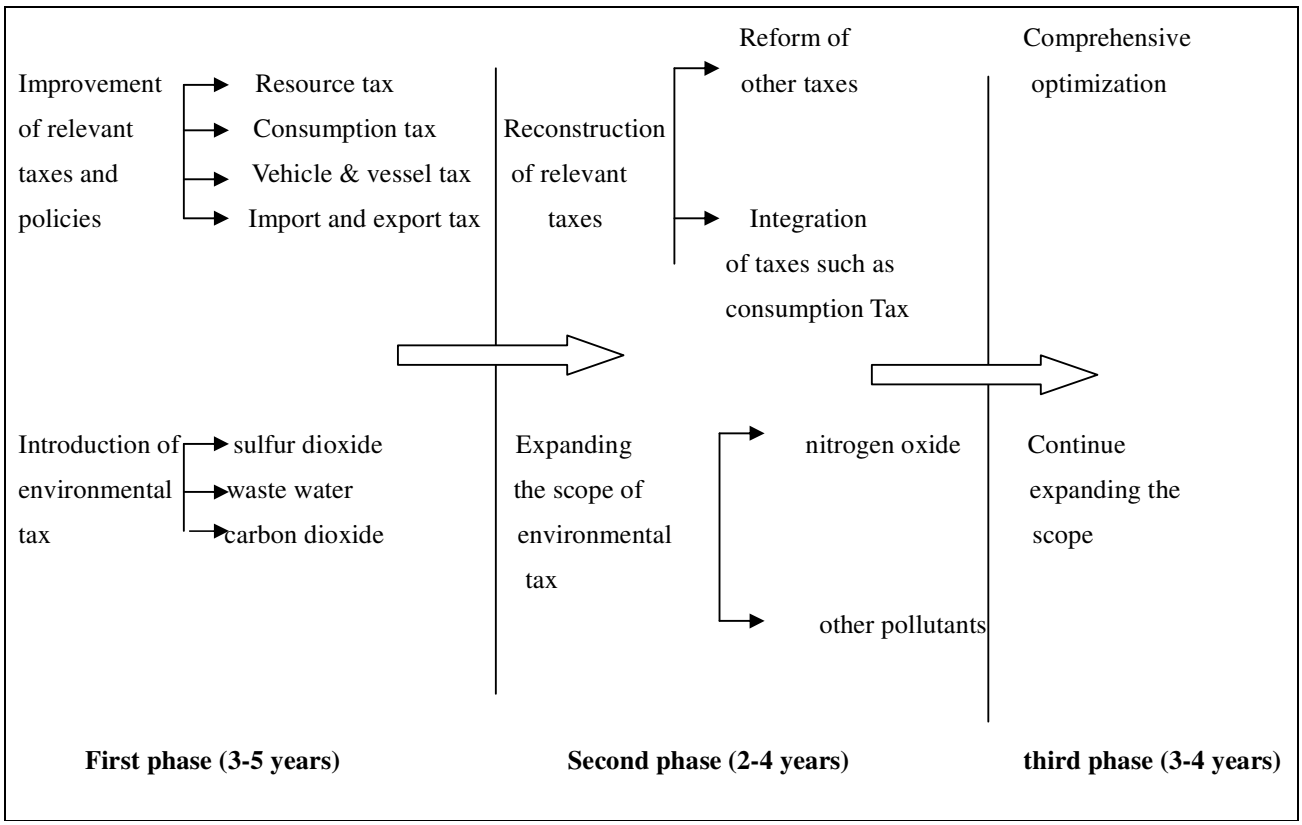

Figure 1.4 Roadmap for environmentally-related taxation System Reform

2 Design of Carbon Tax and Analysis on its Impacts

2.1 Analysis on International Experiences

As an old saying goes: “By other's faults, wise men correct their own”. We will analyze the experiences of other countries in introducing carbon tax.

2.1.1 Main features of carbon tax in developed countries

At present, carbon tax is mainly levied in developed countries, most of which are EU members. The forms of carbon tax are diversified: in some countries, it is an independent tax, while in most countries it is a tax item included in the already

existing energy tax or consumption tax. From the carbon tax arrangement, the following four features can be seen:

1. Carbon tax is collected according to carbon content

Theoretically, carbon tax is levied on emission of CO_2. But in practice, the tax rate for carbon tax is designed according to carbon content in fossil fuels such as coal, petroleum, natural gas (such as Denmark, Sweden, Norway, etc.)[16]

The purpose for that is to create a uniform price for CO_2 emission, despite the fuel type. Firstly, it is feasible, because sufficient and clear connections can be established between carbon content and CO_2 emission amounts in different fuels. In addition, the CO_2 emission from fossil fuel consumption accounts for 65-85% of total CO_2 emission amount. Therefore, CO_2 tax on fossil fuel basically covers large sources of CO_2 emission.

Secondly, collection according to carbon content has its advantages in practice, and reduces tax collection cost. If CO_2 emission amount is directly taken as the tax object, the technical cost is very high and operate will be rather difficult.

However, strictly speaking, collecting CO_2 tax on fossil fuel is different from collecting tax on CO_2 emission amount. The former only encourages enterprises to reduce consumption of fossil fuel, but not helpful to stimulating enterprises to research on the technologies of eliminating CO_2 emission or CO_2 recycling and reuse.

2. Control the cost of carbon tax collection

No matter how perfect a tax policy is in system design, it is of little significance if it is unfeasible or unpalatable in tax collection and will finally be given up. Developed countries focus on reducing cost of carbon tax collection in the design of carbon tax with the following methods:

-- Tax collect point is close to the production links and import links of fuels in order to be collected and controlled easily.

-- There is no need to go to each emission sites to monitor the actual CO_2 emission amount.

-- Reducing administrative cost of tax authorities. Taking the tax bureau in Sweden as an example, the administrative expenditure every year is 7 million krone, but the collected energy tax totals 70 billion krone, thus the administrative cost rate of tax authorities is only 0.01%.

-- Low tax rate level makes carbon tax easy to be collected and administrated. Even if differential tax rates are applied, it should be a widespread treatment as possible as it can, but not preferential to individual companies/ enterprises.

[16] Only few countries (Poland, Czech, etc) directly collect tax on carbon dioxide or carbon oxide emission.

3. Increase carbon tax rate gradually.

At the beginning of introducing carbon tax, all developed countries selected relatively low tax rate and then increase it gradually. At the same time, they used tax reform forecast system to inform the public that the tax rate would increase gradually. This method reduced the resistance at the beginning of tax levy through considering the bearing capability of taxpayers, and it effectively guided the taxpayers to change their behavior. At the beginning of introducing CO_2 tax in 1991 in Sweden, the tax rate was only EUR 27 per ton of CO_2, but now the rate has increased to EUR 114 per ton of CO_2.

4. Preferential tax rates are applied to maintain the international competitiveness of domestic products.

To maintain the international competitiveness of domestic products, differential tax rates are used in developed countries. Sectors such as industry and agriculture, which are greatly influenced by carbon tax, enjoy low tax rate, but family and service business pay carbon tax at normal rate, which is relatively high.

Taking Sweden as an example, its arrangement for fissile fuel and heating supply departments is: family and service business should pay 100% energy tax and 100% carbon dioxide tax; industry and agriculture not participating in EU emission trade system should pay only 21% of carbon dioxide tax without energy tax and enjoy 0.8% of tax preference (the part of carbon dioxide tax exceeding 0.8% of the industrial and agricultural product price can enjoy further tax reduction); as to the devices participating in EU emission trade system, the industry and heating production of combined heat and power generation plants need to pay 15% carbon dioxide tax without energy tax, and centralized heat supply plants need to pay 100% energy tax and 94% carbon dioxide tax. Sweden has been increasing energy tax rate for years and the preferential to industry and agriculture has been increasing (Please refer to Table 1.12)

Figure 1.5 Gradual increase of carbon tax rate in Sweden from 1991 to 2005

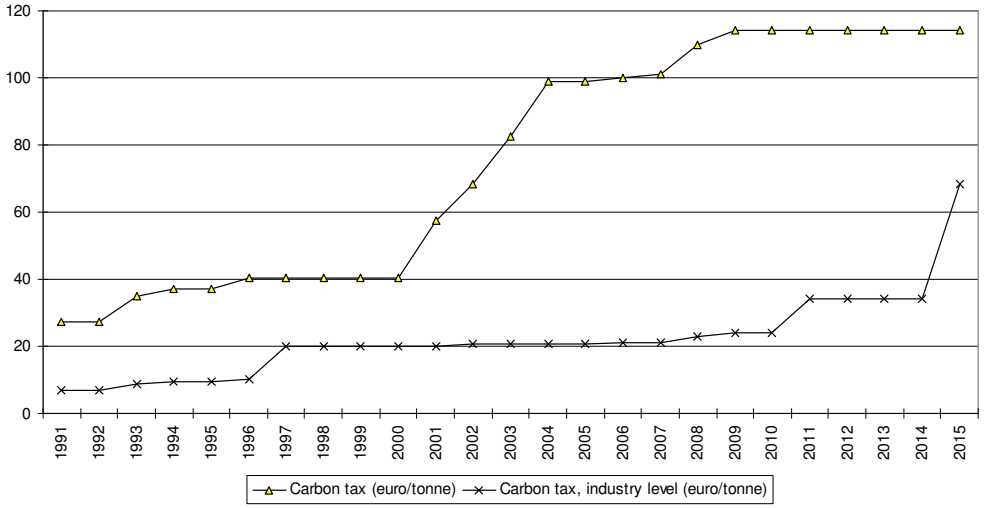

Table 1.12 Energy tax rate of gasoline for heating supply from 1993 to 2008
Unit: EUR per thousand litres

Year	Family and service business Energy tax and carbon dioxide tax	Industry, agriculture and combined heat and power generation plants carbon dioxide tax (energy tax rate is 0)
1993	110	27
1997	196	57
2001	241	58
2002	273	59
2004	362	59
2008	397	66
The minimum tax rate in EU	*21*	*21*

Source: Swedish Ministry of Finance (2009)

2.1.2 The inspiration of carbon tax in developed countries to China

Though China is in a different development stage from developed countries and the disparity of economic and social environments are great, research on the process of introducing carbon tax, the development process and design of carbon tax in developed countries provides substantial inspiration and reference significance to China.

1. Carbon tax is an effective economic instrument that the Chinese government can select

The effect of levying carbon tax / energy tax in developed countries show that as a part of the environmentally-related taxation system, carbon tax is an effective economic instrument, playing an important role in reducing pollutant emission and CO2 emission, as well as improving energy efficiency. In countries with carbon tax, the utilization scope of biological fuel has expanded substantially and the use of fossil fuel is obviously reduced, leading to the change of the energy supply structure. In the meantime, levy of carbon tax greatly reduces emission of greenhouse gases. During the period from 1990 to 2006, the emission amount of greenhouse gas in Sweden had reduced by 9%, but its GDP had grown by 44%. Research shows that if the carbon tax rate had been maintaining at the level in 1990, the emission amount of greenhouse gas in Sweden would have been 20% more.

Because of serious environmental pollution and low energy efficiency in China, the purpose of environmentally-related taxation system should be solving the problem of

major pollutants emission, such as air pollution and water pollution, and improving energy efficiency. In terms of environmental policy of China, current command and control is high in cost, thus it is necessary to strengthen the use of economic instruments, especially tax means. At present, the main worry of levying environmental tax is the negative impact to GDP, especially in the context of global financial crisis. Practice in EU member states shows that environmentally-related tax reform and levy of carbon tax can realize the coexistence of environmental protection and economic growth, which is powerful evidence for dispelling the above worry. Carbon tax is an effective economic instrument Chinese government can select.

2. Reasonable design should be made to reduce resistance when introducing carbon tax

When introducing carbon tax and reforming environmentally-related taxation system, some EU members reduced resistance to reform and guaranteed the success of reform through maintaining revenue neutrality such as decreasing tax burden of other taxes (social insurance contributions and individual income tax) and through reasonable use of environmental tax revenue.

It should be mentioned that the backgrounds of levying carbon tax in different countries were different and with various policy purpose. For example, when Sweden levied carbon tax in 1991, it had initially solved the problem of environmental pollution. The main purpose of levying carbon tax was to further reduce the use of fossil fuel, improve energy efficiency and reduce emission of pollutants and greenhouse gases. But the purpose of ecological taxation reform in Germany was to solve the problems of social insurance cost and economic growth while reducing labor cost and improving energy efficiency. The result of reasonable design on the basis of national situation is that the introduction of new tax had imposed no negative impact to GDP growth. Actually, it has advanced economic growth in the long term.

In order to reduce resistance, China should reasonably design the system and learn from related strategies in other countries, such as maintaining revenue neutrality, implementing forecast system, designing tax preference, and gradually increasing tax rate.

3. The introduction of carbon tax should coordinate the relationship between carbon tax with other tax categories and other economic measures

Environmentally-related /energy taxation system in EU members is the result of development for years. Some countries design a number of environmental taxes and energy taxes. An environmentally-related taxation system includes taxes on energy, pollution emission, transportation, water, waste and other pollution product, covering the whole energy and environmental pollution scope. All EU members collect energy tax. Though difference exists in the setting of other environmental taxes, but in terms of energy tax, there is a tendency of more and more consideration

of carbon emission. In environmental taxation system in EU members, environmental fees are considered as environmental tax. Though environmental fees have the nature of service charge, and the use of environmental fees is different from environmental tax, but the specific collection method is the same with tax.

At present, the environmental taxation system in China is imperfect, so when levying environmental tax and improving environmentally-related taxation system, it can be better designed in advance, and it is not necessarily to have too many environmental taxes. A better choice is to levy an environmental tax, with the tax items such as SO2 tax, CO2 tax, NOx tax, so as to simplify the tax system. Tax items like energy tax, carbon tax and SO2 tax all relate to tax on energy and fossil fuel. China already has resource tax and consumption tax, and the relations between these taxes should be handled well in the construction of China's environmental taxation system. Carbon emission should be considered in related taxes like energy tax. Carbon tax can be collected on the basis of current consumption tax, with more consideration on the element of carbon emission.

2.1.3 The development trend of future carbon tax and international cooperation in tax

Energy tax commonly exists in all OECD countries, but carbon (or carbon dioxide) tax is relatively new, but more and more countries are beginning to levy carbon (or carbon dioxide) tax[17].Newly-levied carbon tax coexists with already existing energy tax and in some countries, carbon tax is a part of energy tax or consumption tax, thus it is difficult to define "carbon tax". But there is a common trend which is in the reform of energy tax in EU members, carbon emission is more and more considered.

Many environmental issues go beyond one country or region, carbon dioxide emission and its impact on climate change is an environmental issue with international focus, and it is a development issue in nature. Although carbon tax is only an economic policy at national level, the international coordination system in carbon tax cannot be missing. And governments have conducted a series of international cooperation in programs of responding to climate change, and several cooperation frameworks have been signed such as the "United Nations Framework Convention on Climate Change", the "Kyoto Protocol" and the "Bali Roadmap". China promotes and actively participates in such international climate cooperation, and insists in bearing common but differentiated responsibilities. We should stress issues of international coordination and cooperation in tax, as well as handling well the relation between tax and three flexible systems, especially relation between tax and clean development mechanism.

17 The countries with carbon tax include Denmark, Finland, Ireland, Italy, Germany, Netherlands, UK, Estonia, Poland and Slovenia.

2.2 Design of China's Carbon Tax Plan

2.2.1 Basic issues of introducing carbon tax

1. The necessity for introducing carbon tax

China now is in the apex of energy consumption and pollutant emission. New pattern of industrialization and the development of low carbon energy is the requirement of China's sustainable development and the way to win by striking after dropping behind. Although the means of taxation is not the only policy option and could not solve all the problems, in process of market economy, the application of taxation is a necessity as a component of economic instruments.

The experiences of developed countries proved carbon tax/energy tax as an effective economic tool that helped considerably cut CO2 emission, reduce environmental pollution and improve energy efficiency. Countries that imposed carbon tax had witnessed significant drop of fossil fuel consumption and optimized energy structure. At present, China is facing greater pressure from international climate change negotiations. Some developed countries such as the United States even proposed "carbon tariff" on Chinese products. Under this condition, carbon tax may be an effective economic tool for China to respond to the climate change, promote energy saving and emission reduction and develop low-carbon economy.

2. The positioning of carbon tax in environmentally-related taxation system

Carbon tax is an environmental tax imposed on carbon dioxide emission. In actual collection, carbon tax represents as taxing on fossil fuel (such as coal, natural gas, gasoline and diesel fuel) according to its carbon content or carbon emission amount. Therefore, carbon tax inevitably has certain commons or overlapping with resource tax and consumption tax levied on fossil fuel.

The relationship between carbon tax and resource tax and consumption tax is that: first, if carbon is not considered as direct tax on carbon emission, its tax objects have something in common with resource tax and consumption tax, which are fossil fuel such as coal, natural gas, gasoline and diesel fuel; and second, they all have impact on energy price and promote energy-saving and emission-reduction.

However, strictly speaking, their tax objects are different: first, carbon tax is on carbon dioxide emission from combustion of fossil fuel, while resource tax and consumption tax is on fossil fuel itself; second, carbon tax is designed according to carbon content in fossil fuel, but resource tax and consumption tax consider nothing of carbon content; and third, the scope of carbon tax is larger than that of resource tax and consumption tax. For example, the overlapping part of scope of carbon tax and resource tax are mineral resource such as coal, crude oil, and natural gas; and overlapping part of scope of carbon tax and consumption resource are petroleum products such as gasoline and diesel fuel.

3. Targets and principles of carbon tax

Carbon tax is on carbon dioxide emission, thus the most direct target of levying carbon tax is to reduce carbon dioxide emission. The short-term target of carbon tax is to control greenhouse gases emission in order to positively responding to global climate change. In the long term, carbon tax aims to play important role in energy saving, reducing pollutant emission such as sulfur dioxide and nitrogen oxide. The long-term targets of carbon tax are advancing national energy-saving and emission-reduction goal, and providing policy guarantee to transformation of economic development pattern.

The principles of carbon tax should include:

First, the principle of combining both restrictions and incentives. The introduction of carbon tax needs to take account of effects of both restraint and incentive. On one hand, carbon tax will restrict consumption of fossil fuel to reduce greenhouse gases emission and change the situation of unreasonable energy consumption structure and low energy efficiency. On the other hand, carbon tax will stipulate enterprises to use cleaner energy and renewable energy to improve energy efficiency and to promote sustainable development of environment, economy and society. Therefore, a mechanism laying equal stress on incentive and restraint helpful to energy and resource conservation and environmental protection needs to be established.

Second, the principle of paying attention to both environmental protection and economic development. Levy of carbon tax requires the coordination between environmental protection and economic development. On one hand, economic development could not be achieved at the price of ecological environment. To effectively reduce carbon dioxide emission, strong incentive of carbon tax to enterprises must be ensured to advance enterprises to change behavior of consuming fossil fuel. On the other hand, levy of carbon tax also needs to consider enterprises' bearing capability and its negative impact on economic development. High carbon tax rate will influence competitive power of enterprises thus to affect economic development. Therefore, while protecting ecology, the negative impact to economy must be reduced to the minimum level. The relationship between environmental protection and economic development should be maintained balanced.

Third, the principle of being based on national situations and rational referring to international experience. Levy of carbon tax will inevitably learn from international experience. However, there are disparities between China and developed countries in terms of economic development level, science and technology level and management level as well as difference in aspects such as taxation system, taxpayers and social environment. So the levy of a carbon tax should be based on national situations, but not blindly copy methods of other countries. Thus carbon tax suitable to China's development and feasible under actual social and economic conditions can be established.

Forth, the principle of gradual progress. China's national situations determine that

the implementation of carbon tax should be a gradual process. Under the background of economic globalization, theory and practice all show that carbon tax will influence international competitiveness of enterprises and thus will inevitably face resistance. The timing of introducing carbon tax is also an importance factor to ensure successful implementation of environmentally-related taxation. Spreading carbon tax step-by-step and increasing tax rate gradually can reduce its impact to enterprises' competitiveness and resistance from society.

4. The advantages and disadvantages in levying carbon tax

As one of the potential options of introducing environmental tax in the future, carbon tax has following advantages:

First, carbon tax plays an important role in energy-saving and emission-reduction. From China's current environmental situation and requirements of strengthening energy-saving and emission-reduction and responding to climate change, carbon tax will reduce carbon dioxide emission, which will help China fulfill its due international responsibility as a developing country in environmental issues such as reduction of greenhouse gases emission, thus certain secondary effect in energy-saving can be achieved.

Second, the collection requirements of carbon tax are relatively low. The tax objects of carbon tax are fossil fuels such as coal, petroleum and natural gas, that emit carbon dioxide. Though the tax basis of carbon tax is the amount of carbon dioxide emission, it can be collected indirectly according to carbon content of fossil fuel and there is no need to check the actual emission amount. Compared with other environmental taxes such as sulfur tax and nitrogen tax which needs to check actual emission amount for direct levy, carbon tax can be more easily collected completely by tax authorities without the coordination of environment department.

Third, levy of carbon tax has no legal and departmental obstacles. Levy of carbon tax does not involve in fee-to-tax reform, or contradicting benefits between different departments or relevant obstacles of environmental laws. Thus compared with other options of introducing environmental tax, the levy of carbon tax is relatively easier.

Of course, there are also some disadvantages in levying carbon tax, mainly as follows:

First, there is overlapping between carbon tax and resource tax and consumption, thus the relation need to be coordinated. At present, China has conduct reform to consumption tax related to petroleum products by increasing tax rates. And China plans to reform resource tax in the near future. These reforms will influence the introduction of carbon tax.

Second, similar with other environmental taxes, levy of carbon tax will affect energy price, supply of and demand for energy, thus the economic growth and industrial competitive power will be affected. From the above, it can be seen that levy of carbon tax will encounter resistance from domestic and abroad economic

environment and taxpayers. Therefore, carbon tax should meet the external conditions such as favorable domestic macroeconomic environment, good international economic environment and moderate tax rate.

5. Timing of introducing carbon tax

The timing of introducing carbon tax is subject to favorable external environment, including sound domestic and global economy, and moderate tax burden. With the Chinese economy still recovering from the repercussions of global financial crisis and resource tax reform in the pipeline, a good time to introduce carbon tax is when Chinese economy fully recovered and resource tax well established. The development of international climate negotiations and domestic priorities for environmental protection/climate change should also be seriously taken note of. A suggested timetable for carbon tax is as follows:

Table 1.13 Timing of Introducing Carbon Tax

	Timing	Remarks
The first best case: "fast scenario"	12th Five-Year-Plan period (2011-2015)	On the basis of resource tax reform, to find the right timing to introduce a carbon tax as a part of environmental taxation.
The second best case: "Slow scenario"	13th Five-Year-Plan period (2016-2020)	China cannot effectively reach its domestic target of coping with climate change if carbon tax has not been introduced by 2020.

2.2.2 Design of Elements of Carbon Tax

The elements of carbon tax include tax scope and objects, taxpayer, tax base, tax rate, tax preferences and collection mode. Considering the international experience with carbon tax and goals and principles of levying carbon tax, the preliminary design of elements of carbon tax is as follows:

Table 1.14 Design of elements of carbon tax

Elements of the carbon tax	**Basic provisions**
Tax payer	The units and individuals who directly emit CO_2 to the environment for consuming fossil fuel are tax payers of carbon tax
Tax scope	Accordingly to related provisions, carbon tax should be levied on CO_2 directly emitted to environment from consuming fossil fuel during the process of manufacture, operation and consumption.
Tax base	Estimating the emission amount according to the consumption amount of fossil fuel. The emission amount of CO_2 = consumption amount of fossil fuel × CO_2 emission coefficient The consumption amount of fossil fuel refers to the actual amount of fuel consumed in its manufacture and operation, including coal, raw oil, gasoline,

	diesel oil, natural gas, etc.
Tax rate	Specific tax rate, the tax should be collected according to the emission amount as specific duty.
Tax preferences	A. tax reduction for certain energy intensive sectors according to the needs for economic and social development; B. tax reduction or exemption for enterprises that reduce and recycle CO_2 through advanced technology and meet certain standards
Other tax elements	Other elements such as procedures of carbon tax levy, term of tax payment, place of tax payment, etc (omitted)

1. Tax scope and taxpayer

Carbon tax is a tax imposing on CO_2 emission, so the tax scope and objects can be defined as CO_2 directly emitted to environment from consuming fossil fuel during the process of manufacture, operation and consumption. Accordingly, the taxpayer of carbon tax can be defined as unit and individual who directly emit CO_2 to environment for consuming fossil fuel.

2. Tax base

First, the selection of tax base. Because the tax object of carbon tax is CO_2 directly emitted to environment, it is most reasonable theoretically to take the actual CO_2 emission amount as tax base. However, taking actual CO_2 emission amount as tax base involves in monitoring CO_2 emission, which is difficult to operate technically and higher in collection cost. In practice, the estimated CO_2 emission amount is used as tax base, which is to calculate the CO_2 emission amount according to the carbon content in fossil fuel such as coal, petroleum and natural gas. CO_2 emission amount is in strict proportion with the fuel type and fuel amount. And since the use amount of fossil fuel is easy to determine, the CO_2 emission amount can be calculated easily according to fossil fuel use amount. This type of tax base does not involve in monitoring gases emission, which is easy to operate technically and lower tax collection cost.

In view of actual collection of carbon tax, most countries such as Denmark, Sweden and Norway all use the estimated emission amount as tax base. Only few countries directly use the actual emission amount of carbon dioxide/carbon oxide as tax base. Considering China's actual situation, tax authorities are unable to monitor CO_2 emission. Therefore, taking estimated CO_2 emission amount as the tax base is easy to operate and helpful to reducing collection cost.

Table 1.15 Comparison between different tax bases for carbon tax

Tax base of carbon tax	Actual CO_2 emission amount	Estimated CO_2 emission amount
Advantages	Directly related to ecological damage Accurate tax base for tax calculation It can be taken as the basis of	Directly related to ecological damage Accurate tax base for tax calculation Lower collection cost

	carbon trade	
Disadvantages	1. Higher collection cost	1. Not helpful to conduct technological research on carbon dioxide emission eliminating, recycling and reuse. 2. Cannot be taken as the basis of carbon trade

Second, the determination of estimated emission amount. According to benchmark method in the energy part of the "IPCC Guidelines for National Greenhouse Gas Inventories", the calculation formula of CO_2 emission amount from fossil fuel is:

CO_2 emission amount = consumption amount of fossil fuel × CO_2 emission coefficient

CO_2 emission coefficient = lower heating value × carbon emission factor × carbon oxidation ratio × carbon transfer coefficient

In this formula, consumption amount of fossil fuel refers to the actual consumption amount of fossil fuel (in mass or in volume) emitting CO_2 in the process of manufacture and operation, such as coal, crude oil, gasoline, diesel oil and natural gas. And the consumption amount is determined by account record of enterprises. CO_2 emission coefficient refers to the CO_2 emission amount of per unit fossil fuel.

Lower heating value (also known as net calorific value) is defined as the amount of heat released from per fully combusting unit mass or volume of fossil fuels. Carbon emission factor refers to the carbon emission amount of per unit of fossil fuel. Carbon oxidation ratio refers to the ratio of carbon oxidation. Carbon transfer coefficient refers to the coefficient of carbon to transfer to carbon dioxide, which is 44/12.

3. The determination of tax rate

Since CO_2 emission amount is taken as the tax base of carbon tax, the method of amount-based calculation should be adopted, which is to adopt the form of flat tax rate. The design of tax rate for carbon tax is relatively complicated, in which the damage of air pollution has to be assessed, especially the cost for long-term measures of reducing carbon dioxide. And the determination of tax rate must be based on the consideration of impact of carbon tax on economy and comprehensive and detailed calculation.

To be specific, the design of tax rate for carbon tax should follow the following principles:

First，carbon tax rate should represent the marginal cost of CO_2 emission reduction to the maximum level. The design of the tax rate should be helpful to positive response from taxpayer, which means the tax rate should be able to influence the emission behavior and consumption behavior of taxpayers. As to CO_2 emission behavior, the carbon tax rate should be higher than the expected marginal cost of enterprises for using alternative energies or taking technical measures in order to

reduce CO_2 emission.

Second, the design of the carbon tax rate should consider its impact on macro economy and industrial competitiveness. Higher tax rate has more impact to macro economy and industrial competitive power. Thus the carbon tax rate should be determined according to the targets of social and economic development of a country. For example, for the purpose of protecting the international competitiveness of key industrial and economic departments, carbon tax policy with high tax rate can only be considered in case tax reduction and exemption is given to energy-intensified industries participating in international competition.

Third, differentiated factors should be fully considered in the design of the carbon tax rate, which means, different fossil fuels such as coal, petroleum and natural gas should be imposed with a different tax rate. For the purpose of encouraging use of environment-friendly products instead of polluting products, the tax rates for alternatives are different according to carbon content. In the mean time, in order to reduce economic burden of key industrial and economic departments, different tax rates should be implemented in accordance with the energy demand price and energy efficiency of different departments. The method of "one rate for all" must not be adopted.

Fourth, the tax rate should be raised gradually. During a certain period, the carbon tax rate should maintain moderate and steady, neither too high nor too low is appropriate. Strategically speaking, low tax rate at the beginning of implementing carbon tax is better and then it can increase gradually, so that the attack to economy can be avoided and social resistance can be reduced.

In addition, carbon tax rate is also influenced by factor such as the balance between carbon tax and other taxes related to fossil fuel, and whether to implement international carbon tax. Thus the tax rate should be determined by taking comprehensive factors into consideration.

In general, in view of development phase of China's society and economy, in order to affect CO_2 emission behavior of taxpayers without too much influence to China's international competitiveness of the industry and to the living quality of population with low income, low tax rate with little negative impact on economy can be used in the short term, and then the rate will be gradually raised.

Based on the calculation results of the carbon tax CGE model, in order to reduce the rejection of the introduction and the affection on economy, we suggest that at the first beginning of introducing carbon tax, the tax rate should be low, not higher than 15 Yuan per ton of CO_2. Here we propose three options: the lowest is 5 Yuan /tCO_2, modest one 10 Yuan /tCO_2, and the highest 15 Yuan /tCO_2. Tax rate of carbon tax should be increased gradually after introduction according to the actual condition of social and economic development. Dynamic adjustment mechanism of tax rate should be established.

4. Tax preference

Combing the international experience and China's national situation, the tax preference in carbon tax is designed as follows:

First, in order to ensure stable economic development and protect international competitive power of industries, tax reduction or exemption, or refunding arrangement to energy-intensified industries such as electricity and heavy industry in different period should be established and improved in accordance with the demand situation for energy and development situation of related industry. However, there must be given conditions for high energy-consumption industry to enjoy tax preference, for example signing voluntary agreements with government and making efforts to reduce energy consumption and pollution emission.

Second, in order to promote the development of technologies on energy saving and carbon emission reduction, tax reduction or exemption is given to the enterprises which actively apply technologies to reduce the emission and recycle CO_2 and reach certain standard.

2.2.3 Other regulations and supporting measures

1. The division and use of carbon tax revenue

First, the division of carbon tax. There are three options for the division of carbon tax revenue: local tax, central tax, and tax shared by central and local governments. Generally speaking, according to the division standard of central tax and local tax, local tax has the features of non-movable, not redistributable without the effect of macro control, and tax burden is hard to transfer. Carbon tax will have impact on whole macro economy and industrial development and relates to international coordination. Judging from this, carbon tax is more appropriate as central tax than local tax. It is recommended to take carbon tax as central tax in this paper so that central revenue can use carbon tax to support energy-saving, the use of new energy and renewable energy sources, the development of new energy technology and the development of other energy-saving causes.

Second, the use of carbon tax revenue. Environmental tax including carbon tax can be used in the following two forms. 1. Used as special fund for special purpose to protect environment; and 2. Taken into general budget expenditure. Generally speaking, the form of special fund for special purpose is mainly used at the beginning of environmental tax when the tax rate is low and the purpose of it is to protect environment. But there are problems of insufficient fund and being harmful to unified administration of fiscal revenue with the form of special fund for special purpose. Therefore, most countries take carbon tax into general budget expenditure.

With regard to strengthening China's financial management, it is recommended to take carbon tax into general budget expenditure for conducting unified use and management with other taxes revenue. Due to China's low level of economic

development at present stage and shortage of fund needed for energy saving and emission reduction, it's necessary to reasonably use carbon tax revenue and increase the expenses on energy saving and environmental protection, especially the expenses on fighting climate change, improvement of energy efficiency, research on new energy-saving technologies, development of new energy technologies, utilization of new energies and renewable energies, carbon sink accumulation projects (such as afforestation projects) and strengthening of relevant scientific research and management, as well as promoting the increase of proportional expenses for international exchanges and cooperation, so as to push forward economic development and enhance China's competitiveness, which will provide the basis for China's long-term sustainability and development.

2. Establishment of scientific and effective implementation modes

First, strengthen the publicity of carbon tax. Levy of carbon tax is new to China. It will suffer strong resistance without public support. It is necessary to do well in publicity work of carbon tax. The national and international significance of carbon tax levy should be extensively publicized to the society in various forms and through various medias, as well as its important function for energy saving and emission reduction and the necessity for collecting carbon tax, so as to enhance the public's willingness of acceptance.

Second is to establish forecast system and the system of periodic tax rate adjustment. The levy of carbon tax will inevitably increase the enterprises' cost. If the tax rate is designed at high level in the beginning, it would be beyond the public's willingness of acceptance, and it may significantly reduce the domestic enterprises' competitiveness or even affect the development of the whole economy. China is in the phase of economic transformation when the mechanism of market economy has not been consummated. Therefore, we propose to adopt the internationally accepted method, i.e., to give forecast while introducing carbon tax and adopt the strategy of progressive time sequence. The tax rate may be raised annually through providing forecast to enterprises until it gets the ideal level. Such measure may give the enterprises a buffer time and sufficient period for adjustment, which will be beneficial to mitigating the carbon tax's impact on the enterprises, and at the same time, it may guide the enterprises to actively conduct long-term environmental protection behaviors such as improving the production technologies and increasing energy efficiency.

3. Other supporting policies

First, improving the capability of tax collection and management. Compared with other environmental tax, the collection of carbon tax is relatively easies, but improvement of tax collection capability remains the important insurance of successful implementation of carbon tax. For this purpose, it is necessary to establish reliable reporting system and checking system. At the same time, professional training to tax collectors should be strengthened to make them become integrated

talents meeting all kinds of knowledge.

Second, coordination between carbon tax and other policy measures of reducing CO_2 emission. Carbon tax is only one of many policies to reduce CO_2 emission, there are also other policies such as tax categories taxing on energy (fossil fuel), use of renewable energy resource and alternative energies, carbon sink and energy efficiency standard. Carbon tax should be coordinated with these policy measures to form joint power and play role in emission-reduction. In addition, the low carbon dioxide emission-reduction technology needs the technical aid and support of developed countries.

2.3 Analysis of carbon tax's impacts on environment and economy

We conduct the quantitative analysis on the economic impact of levying carbon tax with Computable General Equilibrium (CGE model) with analysis focus on the changes of macro variables such as economic aggregate, investment, consumption, import and export, price, fiscal revenue and expenditure, residents' income and energy consumption amount and CO_2 emission amount before and after levy of carbon tax.

2.3.1 Introduction to Computable General Equilibrium model

Computable General Equilibrium model (CGE) is a simulation model combining input-output model and linear programming representing optimal policy. CGE model realizes balance between supply and demand under the general equilibrium conditions through adjustment to the quantity and price of commodities and production elements. The theoretical basis of CGE model is general equilibrium theory of Léon Walras: manufacturer will determine the optimal supply amount through optimal investment following the principle of maximum-profit or minimum-cost and under the restrict of resource; consumers will determine the optimal demand amount through optimal expenditure decision following the principle of maximum utility efficiency; and equilibrium pricing will make the optimal supply equals to optimal demand, and realize the most reasonable use of resource and meeting the consumption demand to the maximum level, thus to make economy in stable equilibrium state.

Our CGE model constructs the social accounting matrix of 2005 according to input-output table in 2005 combining funds flow statement and international balance sheet as the calculation basis of CGE model. The model includes 42 manufacturing departments, 42 types of commodities, 4 types of labor, 5 types of families in rural areas and 7 types of families in urban areas. The exogenous variables of model include fiscal indicators, financial indicators and foreign trade indicators. Fiscal indicators include carbon tax, income tax, value-added tax, business tax and duty; and financial indicators include foreign exchange rate, deposit and loan interest rate, deposit-reserve ratio. Foreign trade indicators include world export prices indices of

imported commodities and export price index. These variables can be used to simulate the analysis of the impact of the exogenous variables' change on the whole macro economy and all industrial departments.

2.3.2 Introduction of Model Carbon Tax

We introduce energy demand function, major pollutants, emission of major greenhouse gas (CO_2), and variable of energy and environment policies (carbon tax) into Computable General Equilibrium model, to describe the changes of macroeconomic indicators such GDP, output of various department and employment, and emission of CO_2 under the simulated-scene of implement carbon tax.

1. Tax base of carbon tax

The tax object of carbon tax is CO_2 directly emitted to the environment, and it should take the actual CO_2 emission amount as the tax base. In our model, CO_2 emission amount is calculated according to carbon content in fossil fuel such as coal, petroleum and natural gas.

CO_2 emission amount = consumption amount of fossil fuel × CO_2 emission coefficient

CO_2 emission coefficient = lower heating value × carbon emission factor × carbon oxidation ratio ×carbon transfer coefficient

In this formula, consumption amount of fossil fuel refers to the actual consumption amount of fossil fuel emitting CO_2 in the process of manufacture and operation, such as coal, crude oil, gasoline, diesel oil and natural gas.

2. Carbon tax rate

The carbon tax is collected with the tax base of CO_2 emission amount and according to the amount, thus flat tax rate is used. The tax rate scope is preliminarily decided as from 20 to 100 Yuan/ton of CO_2.

3. Simulation schemes

Assume the carbon tax begins in 2005. Take the carbon tax rate as variables to the CGE model, to design 5 simulation schemes with the rate of 20 Yuan/ton, 40 Yuan/ton, 60 Yuan/ton, 80 Yuan/ton, and 100 Yuan/ton.

2.3.3 Analysis of the Impact of Carbon tax on Economy

To research the impact of carbon tax on China's economy, we use CGE model to predict the figures of main indicators of national economy during the period from 2010 to 2013, and take this as the standard scheme. And then introduce carbon tax to model as variable, to see the changes of main economic indicator compared with standard scheme with different carbon tax rate, thus to quantify the impact of carbon tax on China's economy.

Standard scheme: use CGE model to predict the main indicators of national economy during the period from 2010 to 2013

Table 1.16 Standard scheme

Economic indicators		Growth rate			
		2010	2011	2012	2013
GDP	Actual value	8.1%	8.3%	8.4%	8.6%
Total Retail Sales of Consumer	Actual value	15.3%	15.6%	16.1%	16.3%
Total investment in fixed assets	Actual value	26%	26.3%	26.8%	26.9%
Export	nominal value	5.2%	6.3%	8.1%	9.2%
Import	nominal value	12.2%	15.0%	18.3%	19.7%
Per capita net income in rural areas	Actual value in rural areas	7.3%	7.5%	7.7%	8.0%
Per capita disposable income in urban areas	Actual value in urban areas	7.7%	7.8%	8.1%	8.3%
Consumer price index （CPI）	CPI	4.0%	4.1%	4.3%	4.5%
New job opportunities	Impact (10000 people）	806	816	825	836
Fiscal revenue	Nominal value	9.8%	10.7%	10.9%	11.2%

Simulation Scheme No.1 with the carbon tax rate of RMB 20 Yuan per ton

In accordance with simulation scheme, assume that the carbon tax begins in 2010. Please refer to Table1.17 for the results.

Table 1.17 Changes of the growth of main economic indicators

(compared with standard scheme) unit: %

Economic indicators		Growth rate			
		2010	2011	2012	2013
GDP	Actual value	7.89	8.25	8.42	8.69
	Impact	−0.21	−0.05	0.02	0.09
Total Retail Sales of Consumer	Impact	−0.25	−0.11	0.30	0.41
Total investment in fixed assets	Impact	−0.47	−0.23	0.11	0.20
Export	Impact	−0.35	−0.13	0.12	0.22
Import	Impact	0.15	0.17	0.18	0.23
Per capita net income in rural areas	Impact	−0.08	−0.04	0.01	0.07
Per capita disposable income in urban areas	Impact	−0.06	−0.02	0.01	0.05
Consumer price index	Impact	0.32	0.22	0.20	0.18

（CPI）					
New job opportunities	Impact (10000 people）	−15	−3	3	12
Fiscal revenue	Impact	−0. 19	−0. 18	0. 03	0. 11
CO_2 emission amount	Impact	−2. 03	−1. 85	−1. 63	−1. 52
SO_2 emission amount	Impact	7. 89	8. 25	8. 42	8. 69

First, the slowdown of economic growth rate is decreasing year by year. Levy of carbon tax will cause actual GDP growth rate to reduce by 0.11% in 2010 and 0.05% in 2011, and the reduction is decreasing year by year. With the impact of carbon tax on improving energy utility efficiency and technical progress, carbon tax will begin to accelerate the economic aggregate in 2012, and actual GDP growth rate will increase by 0.02% in 2012 and by 0.09 in 2013.

Second, the restriction to enterprises' investment is decreasing rapidly year by year. Levy of carbon will reduce the investment capability of enterprises, with the impact of restricting investment. With the motivation and capability of investment recovery, the impact will rapidly decrease. Simulation results show that the actual growth rate of total investment in fixed assets will reduce by 0.47% in 2010 and by 0.23 in 2011. But actual growth rate of total investment in fixed assets will increase by 0.11% in 2012 and by 0.20 in 2013. The restriction imposed on investment by carbon tax levy shows the trend of rapid decrease year by year.

Third, carbon tax has little impact on the income and the expenditure of residents. The income and expenditure of residents will reduce slightly in line with the decrease of economic growth. The actual growth rate of total retail sales of consumer will reduce by 0.25% in 2010 and by 0.11 in 2011; the actual growth rate of per capita net income in rural areas will reduce by 0.08% in 2010 and by 0.04 in 2011; and the actual growth rate of per capita disposable income in urban areas will reduce by 0.06% in 2010 and by 0.02 in 2011

Fourth, the export decreases while the import increases. With the downturn of output growth, the export growth rate will drop. However, the rise of price of domestic fossil fuel will cause increase of export. Simulation results show that nominal export growth rate will reduce by 0.35% in 2010 and by 0.13 in 2011; and nominal import growth rate will rise by 0.15% in 2010 and by 0.17 in 2011;

Fifth, the consumer price index will rise slightly. Simulation results show that the growth rate of consumer price index will rise by 0.32% in 2010 and 0.22% in 2011, because the rise of price of fossil fuel leads to the rise of price aggregate.

Sixth, the job opportunities will drop slightly. The labor entering employment will reduce by 150 thousand people in 2010 and 30 thousand people in 2011. Results show that output decline affects the growth of job opportunities slightly.

Seventh, the fiscal revenue growth declines slightly. Simulation results show that

the fiscal revenue growth rate will decline by 0.19% in 2010 and by 0.18% in 2011. The revenue from carbon tax will be RMB 94.8 billion Yuan in 2010 and RMB 96.2 billion Yuan in 2011. The tax reduction measures such as value-added tax transformation and tax reimbursement for export beginning in 2009 offsets the increase of carbon tax revenue.

In addition, we estimated the impact on China's economy in the context of keeping the overall tax burden stable while levying carbon tax, with the following results:

Table 1.18 Changes of the growth of main economic indicators

(compared with standard scheme) unit: %

Economic indicators		**Growth rate**			
		2010	**2011**	**2012**	**2013**
GDP	Actual value	7.87	8.23	8.41	8.66
	Impact	-0.23	-0.07	0.01	0.06
Total Retail Sales of Consumer	Impact	-0.27	-0.13	0.28	0.39
Total investment in fixed assets	Impact	-0.49	-0.25	0.10	0.19
Export	Impact	-0.38	-0.15	0.11	0.21
Import	Impact	0.15	0.17	0.16	0.21
Per capita net income in rural areas	Impact	-0.09	-0.05	0.00	0.05
Per capita disposable income in urban areas	Impact	-0.07	-0.03	0.01	0.04
Consumer price index（CPI）	Impact	0.31	0.21	0.20	0.22
New job opportunities	Impact (10000 people）	-16	-4	2	11
Fiscal revenue	Impact	0	0	0	0
CO_2 emission amount	Impact	-2.01	-1.83	-1.61	-1.51
SO_2 emission amount	Impact	-1.97	-1.79	-1.57	-1.47

Eighth, emissions of both CO_2 and SO_2 declines. With the levy of carbon tax, emission amount of CO_2 will decline by 2.03% in 2010, 1.85% in 2011 and 1.63% in 2012; emission amount of SO_2 will decline by 1.99% in 2010, 1.81% in 2011 and 1.59% in 2012.

Ninth, output from high energy-consumption industries is substantially affected and the effect of structural adjustment is obvious. Simulation results show that

industrial departments affected significantly by carbon tax are coal exploitation and washing, petroleum and natural gas exploitation, chemical industry, metal smelting and smelting and rolling industry chemical industry, metal smelting and smelting and rolling industry with the respective output decrease by 2.72%, 2.03%, 1.51%, 1.48% and 1.45%. Please refer to Table 1.19 for the specific impact of carbon tax on the output of 42 industrial departments.

Table 1.19 Impact of carbon tax on the output of industrial departments (%)

Departments	Impact	**Departments**	Impact
Agriculture	1.12	Coal exploitation and washing	-2.72
Petroleum and natural gas exploitation	-2.03	Metal mine exposition and washing	-0.38
Non-metal exploitation and washing	-0.45	Food manufacturing and tobacco processing	-0.37
Textile	-0.21	Clothing, leather and products	-0.11
Wood processing and furniture manufacturing	-0.08	Papermaking, printing and	-0.05
Oil process, coking and Nuclear fuel Processing	-1.51	Chemical industry	-1.48
Non-metal minerals product industry	-1.03	Metal smelting and rolling industry	-1.45
Metal product industry	-0.07	Standard and special equipment manufacturing	0.32
Transportation Equipment Manufacturing	0.45	Electric, mechanical and equipment manufacturing	1.08
Communications, computer and other electronic manufacturing	2.01	Instruments and meters and other cultural and office machines manufacturing	0.87
Other manufacturing	0.32	Waste and waste material	1.05
Electricity and heating production and supply	0.52	Fuel gas production and supply	2.06
Water reduction and supply	0.38	Construction industry	0.02
Transportation and storage	0.04	Mail business	0.12
Information transfer, computing service and software industry	0.92	Wholesales and retail business	0.57
Accommodation and catering industry	0.35	Banking and insurance industry	0.48
Real estate industry	0.93	Renting and commercial service industry	0.12
Tourism industry	0.25	Science research business	0.12
Comprehensive technical service industry	0.06	Other service industry	0.08
Education business	0.03	Health, social insurance and social welfare business	0.01

Cultural, sports and entertainment industry	0.02	Public administration and social organization	0.02

2. Simulation Scheme No. 2 with the tax rate of RMB 40 Yuan per ton

In accordance with simulation scheme, assume that the carbon tax begins in 2010. Please refer to Table 1.20 for the results.

Table 1.20 Changes of the growth of main economic indicators

(compared with standard scheme) unit: %

Economic indicators		**Growth rate**			
		2010	**2011**	**2012**	**2013**
GDP	Actual value	7.74	8.18	8.43	8.72
	Impact	-0.36	-0.12	0.03	0.12
Total Retail Sales of Consumer	Impact	-0.31	-0.13	0.35	0.47
Total investment in fixed assets	Impact	-0.57	-0.28	0.16	0.29
Export	Impact	-0.55	-0.18	0.19	0.27
Import	Impact	0.18	0.22	0.26	0.38
Per capita net income in rural areas	Impact	-0.13	-0.05	0.03	0.12
Per capita disposable income in urban areas	Impact	-0.12	-0.04	0.02	0.09
Consumer price index（CPI）	Impact	0.46	0.29	0.21	0.19
New job opportunities	Impact (10000 people）	-31	-11	4	13
Fiscal revenue	Impact	-0.15	-0.14	0.06	0.17
CO_2 emission amount	Impact	-3.85	-3.71	-3.65	-3.59
SO_2 emission amount	Impact	7.74	8.18	8.43	8.72

First, the slowdown of economic growth rate is decreasing year by year. Levy of carbon tax causes actual GDP growth rate to reduce by 0.36% in 2010 and 0.12% in 2011, the reduction is decreasing year by year. With the impact of carbon tax on improving energy utility efficiency and technical progress, carbon tax will begin to accelerate the economic aggregate in 2012, and actual GDP growth rate will increase by 0.03% in 2012 and by 0.12 in 2013.

Second, the restriction of enterprises' investment is decreasing rapidly year by year. Levy of carbon will reduce the investment capability of enterprises with the impact of restricting investment. With the motivation and capability of investment

recovery, the impact will rapidly decrease. Simulation results show that the actual growth rate of total investment in fixed assets will reduce by 0.57% in 2010 and by 0.28 in 2011. But actual growth rate of total investment in fixed assets will increase by 0.16% in 2012 and by 0.29 in 2013. The restriction imposed on investment by carbon tax levy shows the trend of rapid decrease year by year.

Third, carbon tax has little impact on the income and the expenditure of residents. The income and expenditure of residents will reduce slightly in line with the decrease of economic growth. The actual growth rate of total retail sales of consumer will reduce by 0.31% in 2010 and by 0.13 in 2011; the actual growth rate of per capita net income in rural areas will reduce by 0.13% in 2010 and by 0.05 in 2011; and the actual growth rate of per capita disposable income in urban areas will reduce by 0.12% in 2010 and by 0.04in 2011

Fourth, the export decreases while the import increases. With the downturn of output growth, the export growth rate will drop. However, the rise of price of domestic fossil fuel will cause increase of export. Simulation results show that nominal export growth rate will reduce by 0.55% in 2010 and by 0.18 in 2011; and nominal import growth rate will rise by 0.18% in 2010 and by 0.22 in 2011;

Fifth, the consumer price index will rise slightly. Simulation results show that the growth rate of consumer price index will rise by 0.46% in 2010 and 0.29% in 2011 because the rise of price of fossil fuel leads to the rise of price aggregate.

Sixth, the job opportunities will drop slightly. The labor entering employment will reduce by 310 thousand people in 2010 and 110 thousand people in 2011. Results show that output decline affects the growth of job opportunities slightly.

Seventh, the fiscal revenue growth declines slightly. Simulation results show that the fiscal revenue growth rate will decline by 0.15% in 2010 and by 0.14% in 2011. The revenue from carbon tax will be RMB 175.1 billion Yuan in 2010 and RMB 179.6 billion Yuan in 2011. The tax reduction measures such as value-added tax transformation and tax reimbursement for export beginning in 2009 offset the increase of carbon tax revenue.

In addition, we estimated the impact on China's economy in the context of keeping the overall tax burden stable while levying carbon tax, with the following results:

Table 1.21 Changes of the growth of main economic indicators

(compared with standard scheme) unit: %

Economic indicators		Growth rate			
		2010	2011	2012	2013
GDP	Actual value	7.71	8.15	8.41	8.70
	Impact	−0.39	−0.15	0.01	0.10
Total Retail Sales of Consumer	Impact	−0.33	−0.15	0.33	0.45

Total investment in fixed assets	Impact	−0. 60	−0. 30	0. 14	0. 27
Export	Impact	−0. 58	−0. 20	0. 17	0. 25
Import	Impact e	0. 16	0. 20	0. 24	0. 36
Per capita net income in rural areas	Impact	−0. 14	−0. 06	0. 02	0. 11
Per capita disposable income in urban areas	Impact	−0. 13	−0. 05	0. 01	0. 08
Consumer price index （CPI）	Impact	0. 45	0. 28	0. 20	0. 18
New job opportunities	Impact (10000 people）	−32	−12	3	12
Fiscal revenue	Impact	0. 0	0. 0	0. 0	0. 0
CO_2 emission amount	Impact	−3. 87	−3. 73	−3. 66	−3. 60
SO_2 emission amount	Impact	7. 71	8. 15	8. 41	8. 70

Eighth, emissions of both CO_2 and SO_2 decline. With the levy of carbon tax, emission amount of CO_2 will decline by 3.85% in 2010, 3.71% in 2011 and 3.65% in 2012; emission amount of SO_2 will decline by 3.81% in 2010, 3.67% in 2011 and 3.61% in 2012.

Ninth, output from high energy-consumption industries is substantially affected and the effect of structural adjustment is obvious. Simulation results show that industrial departments affected significantly by carbon tax are coal exploitation and washing, petroleum and natural gas exploitation, chemical industry, metal smelting and smelting and rolling industry with the respective output decrease by 4.01%, 3.89%, 3.80%, 2.89% and 2.59%. Please refer to Table1.22 for the specific impact of carbon tax on the output of industrial departments

Table 1.22 Impact of carbon tax on the output of industrial departments (%)

Departments	Impact	**Departments**	Impact
Agriculture	1.98	Coal exploitation and washing	-4.01
Petroleum and natural gas exploitation	-3.89	Metal mine exploitation and washing	-1.75
Non-metal exploitation and washing	-1.73	Food manufacturing and tobacco processing	-1.27
Textile	-1.03	Clothing, leather and products	-0.85
Wood processing and furniture manufacturing	-0.54	Papermaking, printing and	-0.32
Oil process, coking and nuclear fuel processing	-3.80	Chemical industry	-2.89
Non-metal minerals product industry	-1.92	Metal smelting and rolling industry	-2.59

Metal product industry	-0.96	Standard and special equipment manufacturing	2.12
Transportation equipment manufacturing	3.25	Electric, mechanical and equipment manufacturing	3.39
Communications, computer and other electronic manufacturing	3.18	Instruments and meters and other cultural and office machines manufacturing	1.28
Other manufacturing	1.07	Waste and waste material	2.01
Electricity and heating production and supply	1.42	Fuel gas production and supply	2.53
Water production and supply	0.96	Construction industry	0.34
Transportation and storage	0.13	Mail business	0.28
Information transfer, computing service and software industry	1.69	Wholesales and retail business	1.21
Accommodation and catering industry	0.78	Banking and insurance industry	0.99
Real estate industry	1.18	Renting and commercial service industry	0.23
Tourism industry	0.49	Science research	0.26
Comprehensive technical service industry	0.13	Other service industry	0.12
Education business	0.09	Health, social insurance and social welfare business	0.03
Cultural, sports and entertainment industry	0.03	Public administration and social organization	0.04

3. Simulation Scheme No. 3 with the tax rate of RMB 60 Yuan per ton

In accordance with simulation scheme, assume that the carbon tax begins in 2010. Please refer to Table 1.23for the results.

Table 1.23 Changes of the growth of main economic indicators

(compared with standard scheme) unit: %

Economic indicators		**Growth rate**			
		2010	**2011**	**2012**	**2013**
GDP	Actual value	7.64	8.15	8.46	8.75
	Impact	-0.46	-0.15	0.06	0.15
Total Retail Sales of Consumer	Impact	-0.42	-0.16	0.38	0.49
Total investment in fixed assets	Impact	-0.63	-0.31	0.23	0.35
Export	Impact	-0.62	-0.21	0.25	0.30
Import	Impact	0.23	0.26	0.28	0.31
Per capita net income in rural areas	Impact	-0.18	-0.06	0.05	0.16
Per capita disposable income in urban areas	Impact	-0.17	-0.07	0.04	0.13
Consumer price index	Impact	0.52	0.30	0.25	0.21

（CPI）					
New job opportunities	Impact (10000 people）	-42	-14	5	16
Fiscal revenue	Impact	-0.11	-0.10	0.08	0.19
CO_2 emission amount	Impact	-4.39	-4.29	-4.21	-4.16
SO_2 emission amount	Impact	-4.35	-4.25	-4.17	-4.12

First, the slowdown of economic growth rate is decreasing year by year. Levy of carbon tax will cause actual GDP growth rate to reduce by 0.46% in 2010 and 0.15% in 2011. The reduction is decreasing year by year. With the impact of carbon tax on improving energy utility efficiency and technical progress, carbon tax will begin to accelerate the economic aggregate in 2012. And actual GDP growth rate will increase by 0.06% in 2012 and by 0.15 in 2013.

Second, the restriction to enterprises' investment is decreasing rapidly year by year. Levy of carbon will reduce the investment capability of enterprises with the impact of restricting investment. With the motivation and capability of investment recovery, the impact will rapidly decrease. Simulation results show that the actual growth rate of total investment in fixed assets will reduce by 0.63% in 2010 and by 0.31 in 2011. But actual growth rate of total investment in fixed assets will increase by 0.23% in 2012 and by 0.35 in 2013. The restriction imposed on investment by carbon tax levy shows the trend of rapid decrease year by year.

Third, carbon tax has little impact on the income and the expenditure of residents. The income and expenditure of residents will reduce slightly in line with the decrease of economic growth. The actual growth rate of total retail sales of consumer will reduce by 0.42% in 2010 and by 0.16 in 2011; the actual growth rate of per capita net income in rural areas will reduce by 0.18% in 2010 and by 0.06 in 2011; and the actual growth rate of per capita disposable income in urban areas will reduce by 0.17% in 2012 and by 0.07in 201

Fourth, the export decreases while the import increases. With the downturn of output growth, the export growth rate will drop. However, the rise of price of domestic fossil fuel will cause increase of export. Simulation results show that nominal export growth rate will reduce by 0.62% in 2010 and by 0.21in 2011; and nominal import growth rate will rise by 0.23% in 2010 and by 0.26 in 2011.

Fifth, the consumer price index will rise slightly. Simulation results show that the growth rate of consumer price index will rise by 0.52% in 2010 and 0.30% in 2011 because the rise of price of fossil fuel leads to the rise of price aggregate.

Sixth, the job opportunities will drop slightly. The labor entering employment will reduce by 420 thousand people in 2010 and 140 thousand people in 2011. Results show that output decline affects the growth of job opportunities slightly.

Seventh, the fiscal revenue growth declines slightly. Simulation results show that the fiscal revenue growth rate will decline by 0.11% in 2010 and by 0.10% in 2011.

The revenue from carbon tax will be RMB 271.5 billion Yuan in 2010 and RMB 276.9 billion Yuan in 2011. The tax reduction measures such as value-added tax transformation and tax reimbursement for export beginning in 2009 offset the increase of carbon tax revenue.

In addition, we estimated the impact on China's economy in the context of keeping the overall tax burden stable while levying carbon tax, with the following results:

Table 1.24 Changes of the growth of main economic indicators (compared with standard scheme) unit: %

Economic indicators		Growth rate			
		2010	2011	2012	2013
GDP	Actual value	7.61	8.12	8.44	8.72
	Impact	-0.49	-0.18	0.04	0.12
Total Retail Sales of Consumer	Impact	-0.44	-0.18	0.36	0.47
Total investment in fixed assets	Impact	-0.65	-0.33	0.21	0.33
Export	Impact	-0.64	-0.23	0.23	0.28
Import	Impact	0.21	0.24	0.26	0.30
Per capita net income in rural areas	Impact	-0.19	-0.07	0.04	0.15
Per capita disposable income in urban areas	Impact	-0.18	-0.08	0.03	0.12
Consumer price index （CPI）	Impact	0.50	0.28	0.23	0.20
New job opportunities	Impact (10000 people）	-44	-16	4	15
Fiscal revenue	Impact	0.0	0.0	0.0	0.0
CO_2 emission amount	Impact	-4.41	-4.31	-4.23	-4.18
SO_2 emission amount	Impact	-4.37	-4.27	-4.19	-4.14

Eighth, emissions of both CO_2 and SO_2 decline. With the levy of carbon tax, emission amount of CO2 will decline by 4.39% in 2010, 4.29% in 2011 and 4.21% in 2012; and the emission amount of SO2 will decline by 4.36% in 2010, 4.25% in 2011 and 4.17% in 2012.

Ninth, output from high energy-consumption industries is substantially affected and the effect of structural adjustment is obvious. Simulation results show that industrial departments affected significantly by carbon tax are coal exploitation and washing, petroleum and natural gas exploitation, chemical industry, metal smelting and smelting and rolling industry with the respective output decrease by 4.96%, 4.78%, 4.36%, 3.15% and 3.08%. Please refer to Table 1.25 for the specific impact of carbon tax on the output of industrial departments.

Table 1.25 Impact of carbon tax on the output of industrial departments (%)

Departments	Impact	Departments	Impact
Agriculture	2.12	Coal exploitation and washing	-4.96
Petroleum and natural gas exploitation	-4.78	Metal mine exploitation and washing	-2.36
Non-metal exploitation and washing	-2.01	Food manufacturing and tobacco processing	-1.53
Textile	-1.46	Clothing, leather and products	-1.32
Wood processing and furniture manufacturing	-0.86	Papermaking, printing and	-0.53
Oil process, coking and nuclear fuel processing	-4.36	Chemical industry	-3.15
Non-metal minerals product industry	-2.18	Metal smelting and rolling industry	-3.08
Metal product industry	-1.23	Standard and special equipment manufacturing	2.96
Transportation equipment manufacturing	4.38	Electric, mechanical and equipment manufacturing	4.69
Communications, computer and other electronic manufacturing	4.02	Instruments and meters and other cultural and office machines manufacturing	2.03
Other manufacturing	1.38	Waste and waste material	2.52
Electricity and heating production and supply	1.97	Fuel gas production and supply	2.98
Water production and supply	1.21	Construction industry	0.53
Transportation and storage	0.28	Mail business	0.41
Information transfer, computing service and software industry	1.93	Wholesales and retail business	1.58
Accommodation and catering industry	1.01	Banking and insurance industry	1.03
Real estate industry	1.52	Renting and commercial service industry	0.33
Tourism industry	0.63	Science research	0.34
Comprehensive technical service industry	0.15	Other service industry	0.18
Education business	0.11	Health, social insurance and social welfare business	0.05
Cultural, sports and entertainment industry	0.05	Public administration and social organization	0.07

4. Simulation Scheme No. 4 with the tax rate of RMB 80 Yuan per ton

In accordance with simulation scheme, assume that the carbon tax begin in 2010. Please refer to table 1.26 for the results.

Table 1.26 Changes of the growth of main economic indicators

(compared with standard scheme) unit: %

Economic indicators		Growth rate			
		2010	2011	2012	2013
GDP	Actual value	7.51	8.13	8.49	8.80
	Impact	-0.59	-0.17	0.09	0.20
Total Retail Sales of Consumer	Impact	-0.51	-0.18	0.41	0.51
Total investment in fixed assets	Impact	-0.76	-0.33	0.29	0.38

Export	Impact	-0.65	-0.27	0.28	0.33
Import	Impact	0.27	0.29	0.31	0.33
Per capita net income in rural areas	Impact	-0.21	-0.07	0.07	0.22
Per capita disposable income in urban areas	Impact	-0.19	-0.08	0.06	0.17
Consumer price index（CPI）	Impact	0.61	0.33	0.28	0.24
New job opportunities	Impact (10000 people）	-57	-15	7	19
Fiscal revenue	Impact	-0.08	-0.07	0.10	0.21
CO_2 emission amount	Impact	-5.02	-4.89	-4.78	-4.66
SO_2 emission amount	Impact	-4.98	-4.85	-4.74	-4.62

First, the slowdown of economic growth rate is decreasing year by year. Levy of carbon tax will cause actual GDP growth rate to reduce by 0.59% in 2010 and 0.17% in 2011, and the reduction is decreasing year by year. With the impact of carbon tax on improving energy utility efficiency and technical progress, carbon tax will begin to accelerate the economic aggregate in 2012. And actual GDP growth rate will increase by 0.09% in 2012 and by 0.2 in 2013.

Second, the restriction on enterprises' investment is decreasing rapidly year by year. Levy of carbon will reduce the investment capability of enterprises with the impact of restricting investment. With the motivation and capability of investment recovery, the impact will rapidly decrease. Simulation results show that the actual growth rate of total investment in fixed assets will reduce by 0.76% in 2010 and by 0.33 in 2011. But the actual growth rate of total investment in fixed assets will increase by 0.29% in 2012 and by 0.38 in 2013. The restriction imposed on investment by carbon tax levy shows the trend of rapid decrease year by year.

Third, carbon tax has little impact on the income and the expenditure of residents. The income and expenditure of residents will reduce slightly in line with the decrease of economic growth. The actual growth rate of total retail sales of consumer will reduce by 51% in 2010 and by 0.18 in 2011; the actual growth rate of per capita net income in rural areas will reduce by 0.21% in 2010 and by 0.07 in 2011; and the actual growth rate of per capita disposable income in urban areas will reduce by 0.19% in 2010 and by 0.08 in 2011

Fourth, the export decreases while the import increases. With the downturn of output growth, the export growth rate will drop. However the rise of price of domestic fossil fuel will cause increase of export. Simulation results show that nominal export growth rate will reduce by 0.65% in 2010 and by 0.27 in 2011; and nominal import growth rate will rise by 0.27% in 2010 and by 0.29 in 2011;

Fifth, the consumer price index will rise slightly. Simulation results show that the growth rate of consumer price index will rise by 0.61% in 2010 and 0.33% in 2011 because the rise of price of fossil fuel leads to the rise of price aggregate.

Sixth, the job opportunities will drop slightly. The labor entering employment will reduce by 570 thousand people in 2010 and 150 thousand people in 2011. Results show that output decline affects the growth of job opportunities slightly.

Seventh, the fiscal revenue growth declines slightly. Simulation results show that the fiscal revenue growth rate will decline by 0.08% in 2010 and by 0.07% in 2011. The revenue from carbon tax will be RMB 362.5 billion Yuan in 2010 and RMB 370.5 billion Yuan in 2011. The tax reduction measures such as value-added tax transformation and tax reimbursement for export beginning in 2009 offset the increase of carbon tax revenue.

In addition, we estimated the impact on China's economy in the context of keeping the overall tax burden stable while levying carbon tax, with the following results:

Table 1.27 Changes of the growth of main economic indicators

(compared with standard scheme) unit: %

Economic indicators		Growth rate			
		2010	2011	2012	2013
GDP	Actual value	7.49	8.11	8.47	8.78
	Impact	-0.61	-0.19	0.07	0.18
Total Retail Sales of Consumer	Impact	-0.53	-0.20	0.39	0.49
Total investment in fixed assets	Impact	-0.78	-0.35	0.27	0.36
Export	Impact	-0.67	-0.29	0.26	0.31
Import	Impact	0.25	0.27	0.29	0.31
Per capita net income in rural areas	Impact	-0.22	-0.08	0.06	0.21
Per capita disposable income in urban areas	Impact	-0.20	-0.09	0.05	0.16
Consumer price index （CPI）	Impact	0.60	0.32	0.27	0.23
New job opportunities	Impact (10000 people）	-58	-16	6	18
Fiscal revenue	Impact	0.0	0.0	0.0	0.0
CO_2 emission amount	Impact	-5.03	-4.88	-4.77	-4.65
SO_2 emission amount	Impact	-4.99	-4.84	-4.73	-4.61

Eighth, emissions of both CO_2 and SO_2 decline. With the levy of carbon tax, emission amount of CO_2 will decline by 5.02% in 2010, 4.89% in 2011 and 4.78% in 2012; and emission amount of SO_2 will decline by 4.98% in 2010, 4.85% in 2011 and 4.74% in 2012.

Ninth, output from high energy-consumption industries is substantially affected and the effect of structural adjustment is obvious. Simulation results show that industrial departments affected significantly by carbon tax are coal exploitation and washing, petroleum and natural gas exploitation, chemical industry, metal smelting

and smelting and rolling industry with the respective output decrease by 5.23%, 5.18%, 5.01%, 4.75% and 4.32%. Please refer to Table 2-17 for the specific impact of carbon tax on the output of industrial departments.

Table 1.28 Impact of carbon tax on the output of industrial departments (%)

Departments	**Impact**	**Departments**	Impact
Agriculture	2.76	Coal exploitation and washing	-5.23
Petroleum and natural gas exploitation	-5.18	Metal mine exploitation and washing	-2.87
Non-metal exploitation and washing	-2.92	Food manufacturing and tobacco processing	-2.03
Textile	-1.96	Clothing, leather and products	-1.78
Wood processing and furniture manufacturing	-1.18	Papermaking, printing and	-0.92
Oil process, coking and nuclear fuel processing	-5.01	Chemical industry	-4.75
Non-metal minerals product industry	-2.86	Metal smelting and rolling industry	-4.32
Metal product industry	-1.76	Standard and special equipment manufacturing	3.85
Transportation equipment manufacturing	5.08	Electric, mechanical and equipment manufacturing	5.03
Communications, computer and other electronic manufacturing	4.95	Instruments and meters and other cultural and office Machines manufacturing	2.85
Other manufacturing	1.74	Waste and waste material	2.93
Electricity and heating production and supply	2.58	Fuel gas production and supply	3.67
Water production and supply	1.89	Construction industry	0.94
Transportation and storage	0.61	Mail business	0.69
Information transfer, computing service and software industry	2.67	Wholesale and retail business	2.01
Accommodation and catering industry	1.32	Banking and insurance industry	1.36
Real estate industry	1.97	Renting and commercial service industry	0.64
Tourism industry	0.76	Science research	0.41
Comprehensive technical service industry	0.21	Other service industry	0.23
Education business	0.13	Health, social insurance and social welfare business	0.07
Cultural, sports and entertainment industry	0.07	Public administration and social organization	0.08

5. Simulation Scheme No. 5 with the tax rate of RMB 100 Yuan per ton

In accordance with simulation scheme, assume that the carbon tax begins in 2010 Please refer to Table 1.29 for the results.

Table 1.29 Changes of the growth of main economic indicators (compared with standard scheme) unit: %

Economic indicators		**Growth rate**			
		2010	**2011**	**2012**	**2013**

GDP	Actual value	7.39	8.11	8.50	8.81
	Impact	-0.71	-0.19	0.10	0.21
Total Retail Sales of Consumer	Impact	-0.65	-0.21	0.43	0.54
Total investment in fixed assets	Impact	-0.91	-0.35	0.31	0.40
Export	Impact	-0.76	-0.29	0.29	0.34
Import	Impact	0.30	0.31	0.33	0.35
Per capita net income in rural areas	Impact	-0.25	-0.09	0.09	0.24
Per capita disposable income in urban areas	Impact	-0.21	-0.10	0.07	0.19
Consumer price index（CPI）	Impact	0.69	0.37	0.30	0.27
New job opportunities	Impact (10000 people）	-68	-17	8	22
Fiscal revenue	Impact	-0.02	-0.01	0.12	0.23
CO_2 emission amount	Impact	-6.12	-5.94	-5.86	-5.72
SO_2 emission amount	Impact	-6.08	-5.90	-5.82	-5.68

First, the slowdown of economic growth rate is decreasing year by year. Levy of carbon tax will cause actual GDP growth rate reduce by 0.71% in 2010 and 0.19% in 2011, and the reduction is decreasing year by year. With the impact of carbon tax to improving energy utility efficiency and technical progress, carbon tax will begin to accelerate the economic aggregate in 2012. And actual GDP growth rate will increase by 0.10% in 2012 and by 0.21 in 2013.

Second, the restriction to enterprises' investment is decreasing rapidly year by year. Levy of carbon will reduce the investment capability of enterprises with the impact on restricting investment. With the motivation and capability of investment recovery, the impact will rapidly decrease. Simulation results show that the actual growth rate of total investment in fixed assets will reduce by 0.91% in 2010 and by 0.35 in 2011. But actual growth rate of total investment in fixed assets will increase by 0.31% in 2012 and by 0.40 in 2013. The restriction on investment caused by carbon tax levy shows the trend of rapid decrease year by year.

Third, carbon tax has little impact on the income and the expenditure of residents. The income and expenditure of residents will reduce slightly in line with the decrease of economic growth. The actual growth rate of total retail sales of consumer will reduce by 0.65% in 2010 and by 0.21 in 2011; the actual growth rate of per capita net income in rural areas will reduce by 0.25% in 2010 and by 0.09 in 2011; and the actual growth rate of per capita disposable income in urban areas will reduce by 0.21% in 2010 and by 0.1 in 2011

Fourth, the export decreases while the import increases. With the downturn of output growth, the export growth rate will drop. However, the rise of price of domestic fossil fuel will cause increase of export. Simulation results show that nominal export growth rate will reduce by 0.76% in 2010 and by 0.29 in 2011; and

nominal import growth rate will rise by 0.30% in 2010 and by 0.31 in 2011;

Fifth, the consumer price index will rise slightly. Simulation results show that the growth rate of consumer price index will rise by 0.69% in 2010 and 0.37% in 2011 because the rise of price of fossil fuel leads to the rise of price aggregate.

Sixth, the job opportunities will drop slightly. The labor entering employment will reduce by 680 thousand people in 2010 and 170 thousand people in 2011. Results show that output decline affects the growth of job opportunities slightly.

Seventh, the fiscal revenue growth declines slightly. Simulation results show that the fiscal revenue growth rate will decline by 0.02% in 2010 and by 0.01% in 2011. The revenue from carbon tax will be RMB 378.2 billion Yuan in 2010 and RMB 382.6 billion Yuan in 2011. The tax reduction measures such as value-added tax transformation and tax reimbursement for export beginning in 2009 offset the increase of carbon tax revenue.

In addition, we estimated the impact on China's economy in the context of keeping the overall tax burden stable while levying carbon tax, with the following results:

Table 1.30 Changes of the growth of main economic indicators
(compared with standard scheme) unit: %

Economic indicators		Growth rate			
		2010	2011	2012	2013
GDP	Actual value	7.37	8.09	8.48	8.79
	Impact	-0.73	-0.21	0.08	0.19
Total Retail Sales of Consumer	Impact	-0.67	-0.23	0.41	0.52
Total investment in fixed assets	Impact	-0.93	-0.37	0.29	0.38
Export	Impact	-0.78	-0.31	0.27	0.32
Import	Impact	0.28	0.29	0.31	0.34
Per capita net income in rural areas	Impact	-0.26	-0.10	0.08	0.23
Per capita disposable income in urban areas	Impact	-0.22	-0.11	0.06	0.20
Consumer price index （CPI）	Impact	0.68	0.36	0.29	0.26
New job opportunities	Impact (10000 people）	-69	-18	7	21
Fiscal revenue	Impact	0.0	0.0	0.0	0.0
CO_2 emission amount	Impact	-6.11	-5.93	-5.85	-5.71
SO_2 emission amount	Impact	-6.07	-5.89	-5.81	-5.67

Eighth, emissions of both CO_2 and SO_2 decline. With the levy of carbon tax, emission amount of CO_2 will decline by 3.12% in 2010, 5.94% in 2011 and 5.86% in 2012; and emission amount of SO_2 will decline by 6.08% in 2010, 5.90% in 2011 and 5.82% in 2012.

Ninth, output from high energy-consumption industries is substantially affected

and the effect of structural adjustment is obvious. Simulation results show that industrial departments affected significantly by carbon tax are coal exploitation and washing, petroleum and natural gas exploitation, chemical industry, metal smelting and smelting and rolling industry with the respective output decrease by 6.32%, 6.25%, 6.11%, 5.91% and 5.68%. Please refer to Table 1.31 for the specific impact of carbon tax on the output of 42 industrial departments.

Table 1.31 Impact of carbon tax on the output of industrial departments (%)

Departments	**Impact**	**Departments**	Impact
Agriculture	2.97	Coal exploitation and washing	-6.32
Petroleum and natural gas exploitation	-6.25	Metal mine exploitation and washing	-3.08
Non-metal exploitation and washing	-3.29	Food manufacturing and tobacco processing	-2.38
Textile	-2.17	Clothing, leather and products	-1.94
Wood processing and furniture manufacturing	-1.38	Papermaking, printing and	-1.13
Oil process, coking and nuclear fuel processing	-6.11	Chemical industry	-5.91
Non-metal minerals product industry	-3.02	Metal smelting and rolling industry	-5.68
Change metal product industry	-1.94	Standard and special equipment manufacturing	5.12
Transportation equipment manufacturing	6.02	Electric, mechanical and equipment manufacturing	5.99
Communications, computer and other electronic manufacturing	5.48	Instruments and meters and other cultural and office machines manufacturing	3.68
Other manufacturing	2.37	Waste and waste material	3.48
Electricity and heating production and supply	3.01	Fuel gas production and supply	4.02
Water production and supply	2.69	Construction industry	1.13
Transportation and storage	1.08	Mail business	1.12
Information transfer, computing service and software industry	3.02	Wholesales and retail business	3.11
Accommodation and catering industry	2.54	Banking and insurance industry	1.98
Real estate industry	2.01	Renting and commercial service industry	1.01
Tourism industry	1.13	Science research	0.63
Comprehensive technical service industry	0.25	Other service industry	0.27
Education business	0.15	Health, social insurance and social welfare business	0.10
Cultural, sports and entertainment industry	0.10	Public administration and social organization	0.11

IX. Summary and Analysis to Carbon Tax Simulation

Theoretically, on one hand, the implementation will reduce carbon emission and protect environment and save energy, and on the other hand, it will impose additional burden to tax object. **In the short term**, levy of carbon tax will cause energy to become an expensive production element, leading to the rise of production cost, thus some enterprises will take measures to reduce production. Therefore, the demand for capital, labor and energy consumption will decline, and the income of residents will drop and unemployment will increase. **In the long run**, when energy becomes expensive, enterprises will seek to improve energy utility efficiency through investment, thus the capital-intensification level and production efficiency will improve gradually, which will offset the impact of high energy cost caused by carbon tax, and even advance long-term and stable economic growth.

CGE model quantifies the impact of carbon tax on the macro economy and all industrial departments. The calculation results validate the above theory. The main impacts of carbon tax are as the follows: **First,** the adverse impact on economic aggregate decreases gradually and will eventually accelerate economic growth. Levy of carbon tax will cause slight decline of actual GDP growth in 2010 and 2011. With the rise of price of fossil fuels, enterprises will improve energy utility efficiency through investment and productivity, thus offsetting the impact of high energy cost caused by carbon tax, and advance long-term and stable economic growth. It is estimated that carbon tax will accelerate economic growth in 2012. **Second,** carbon tax will advance enterprises to increase investment. At the beginning of carbon tax, it will restrain the investment capability of enterprises, but with the motivation and capability of investment recovery, the cost pressure will advance enterprises to expand investment rapidly. **Third,** carbon tax has little impact on the income and the expenditure of residents. The income and expenditure of residents will reduce slightly in line with the decrease of economic growth. However, with the rapid rise of economic growth, the income and expenditure of residents will recover fast. **Fourth,** the export will decrease temporarily while the import will increase. As the downturn of output growth, the export growth rate will drop temporarily, but it will go up with the increase of economic growth. The import of fossil fuel will increase sharply because of the rise of price of fossil fuel. **Fifth,** carbon tax will cause slight increase of consumer price index. The rise of fossil fuel price causes the increase of downstream products price, and eventually leads to the increase of the aggregate goods price. **Sixth,** the job opportunities will rebound significantly. The simulation results show that the new job opportunities in 2010 and 2011 will decrease slightly because the output decline affects the growth of job opportunities. Nevertheless, the demand for labor will increase rapidly. **Seventh,** the growth rate of fiscal revenue growth will decline slightly. Though the levy of carbon tax increases the fiscal revenue, the tax reduction measures such as value-added tax transformation and tax reimbursement for export beginning in 2009 offset the increase of carbon tax revenue. **Eighth,** carbon tax has obvious effect on energy conservation and emission-reduction. With the levy of carbon tax, the energy efficiency is improved

and the demand for fossil fuel declines, leading to sharp decline of major pollutants emission including CO_2 and SO_2. **Ninth,** output from high energy-consumption industries is substantially affected and the effect of structural adjustment is obvious. Simulation results show that the proportion of high energy-consumption industries such as coal mining, washing and dressing industry, petroleum and natural gas industry, petroleum processing and coking industry, nuclear fuel processing and chemical industry in national economy decreases, and the output of hi-tech industries such as common and special equipment manufacturing and information communication increases significantly.

In general, model estimation results represent the impact of levying carbon tax. However, CGE model is a general equilibrium model adjusting balance between supply and demand on the basis of market price, and it mainly represents the adjustment effect of price to market. Therefore, it is hard to quantitatively estimate the energy efficiency improvement and technical progress in disequilibrium state. The model estimation results may magnify the short-term adverse impact of carbon tax on economy. In addition, model estimation results show that in the long run, levy of carbon tax will quickly offset its adverse impact; and carbon tax will advance economic structural adjustment, energy conservation and emission –reduction, helpful to maintain stable and fast development of economy.

3 Main Conclusions and Policy Recommendations

3.1 Environmentally-related taxation reform should center on the introduction of an Environmental Tax

I. Compared with other countries in the field of environmental protection, the major problems of China's current taxation system are related to the absence of an environmental tax directly related to environmental protection, and the fact that an environmentally-related tax system has not been established, which influences the effect of environmental tax measures.

II. The major problem with the current tax-sharing system is that the fiscal difficulties of local governments, caused by an imperfect sub-provincial fiscal system, have resulted in protection of polluting enterprises and inadequate enforcement of environmental measures by local governments.

III. The defects in China's current system of environmentally-related taxes and fees are: 1. The proportions of environmentally-related tax and fees revenue in total tax revenue and GDP are lower, compared with developed countries; 2. There are no taxes directly related to pollution emissions; 3. The lack of systematic arrangements for environmentally-related taxation policies; 4. Standard pollution charges are low;

and 5. Poor enforcement of the collection of pollution charge. All of these aspects have had negative impacts on the role of the environmental taxation in the field of environmental protection.

IV. Environmental taxation is an important economic instrument and a long-term system arrangement with respect to environmental protection. Reforming the environmental taxation system, with the aim of introducing an environmental tax, will address the deficits of the existing environmental taxation system and enable China to respond to the serious current environmental situation, global climate change, and the development of a low-carbon economy, as well as facilitate China's economic growth and transformation of its development pattern.

3.2 China should establish environmentally-related taxation through introducing an Environmental Tax, reconstructing existing taxes, and improving tax policies

I. China can usefully draw on the experience of the international community regarding environmental tax with respect to: 1. Research, design and the introduction of environmental tax, based on the national situation; 2. Gradually progressing, starting with easier tasks; 3. Emphasizing the control effect of tax and focusing on regulating the effect of tax and the combination of incentive and restriction; and 4. Focusing on the coordination of tax with other measures.

II. Based on China's national situation and international reference experiences, the current thinking with respect to the establishment and improvement of environmentally-related taxation is: 1. Introduce an independent environmental tax; 2. Restructure current taxes; and 3. Improve environmentally-related taxes. The environmental taxation system should consist of three parts: environmental tax, other environmentally-related taxes and other environmentally-related taxation policies.

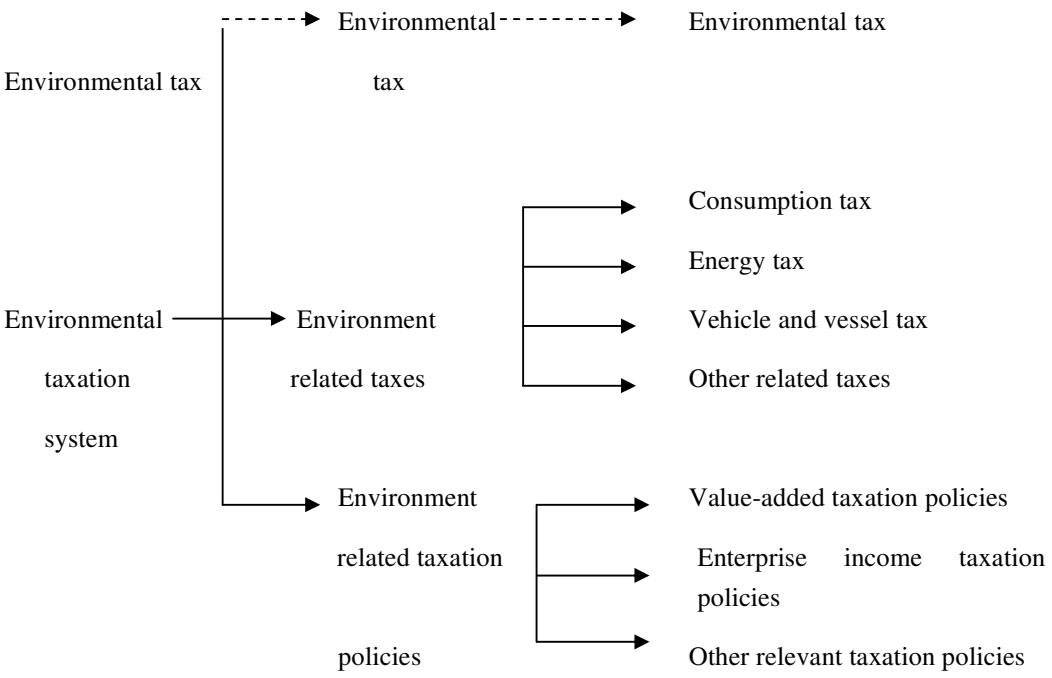

Figure 3.1 Structure of environmentally-related taxation system

3. The future challenges for China with respect to environmental protection are related to the control of waste water, control of air pollution control, solid waste pollution prevention and control, and the requirement to respond to climate change by reducing carbon dioxide emissions. Accordingly, waste water, waste gas, solid waste and carbon dioxide should be the first targets of an environmental tax in order to meet primary control goals. Carbon Tax, which has been the subject of recent discussion, could be designated as an aspect within an environmental tax based, on international experiences and China's national conditions.

Table 1.32 Scope and objects of Environmental Tax

Scope and objects of Environmental Tax		Specific contents
Emission of pollutant	Waste gas	Includes sulfur dioxide and nitrogen oxide, etc
	Waste water	Includes industrial waste water,
	Solid waste	Includes coal dust, waste residue from metallurgy and chemical industries, tailings, construction waste, etc.
Carbon dioxide emission	carbon dioxide	Includes carbon dioxide emitted from combustion of fossil fuel such as coal, natural gas, gasoline, diesel fuel.

3.3 Environmentally-related taxation system reform should progress gradually, beginning with easier tasks.

I. The future introduction of an environmental tax and improving the

environmentally-related taxation system should meet the following conditions: 1. Good economic environment at home and abroad; 2. Moderate tax burden; 3. High tax collection level, and 4. Good social environment.

II. A perfect environmental tax could not be constructed in one step. Environmentally-related taxation system reform should follow the principle of gradual progress, starting from easier tasks and falling into three phases: Phase I: On the basis of the current taxation system, improve environmentally-related taxes such as Resource Tax, Consumption Tax, and vehicle and vessel tax; and levy an independent environmental tax as soon as possible, considering China's current economic and social development. Phase II: Further improve environmentally-related taxes and tax policies and expand the scope of an Environmental Tax. Phase III: Continue to expand the scope of the Environmental Tax and optimize tax reform as part of efforts to reform the environmentally-related taxation system.

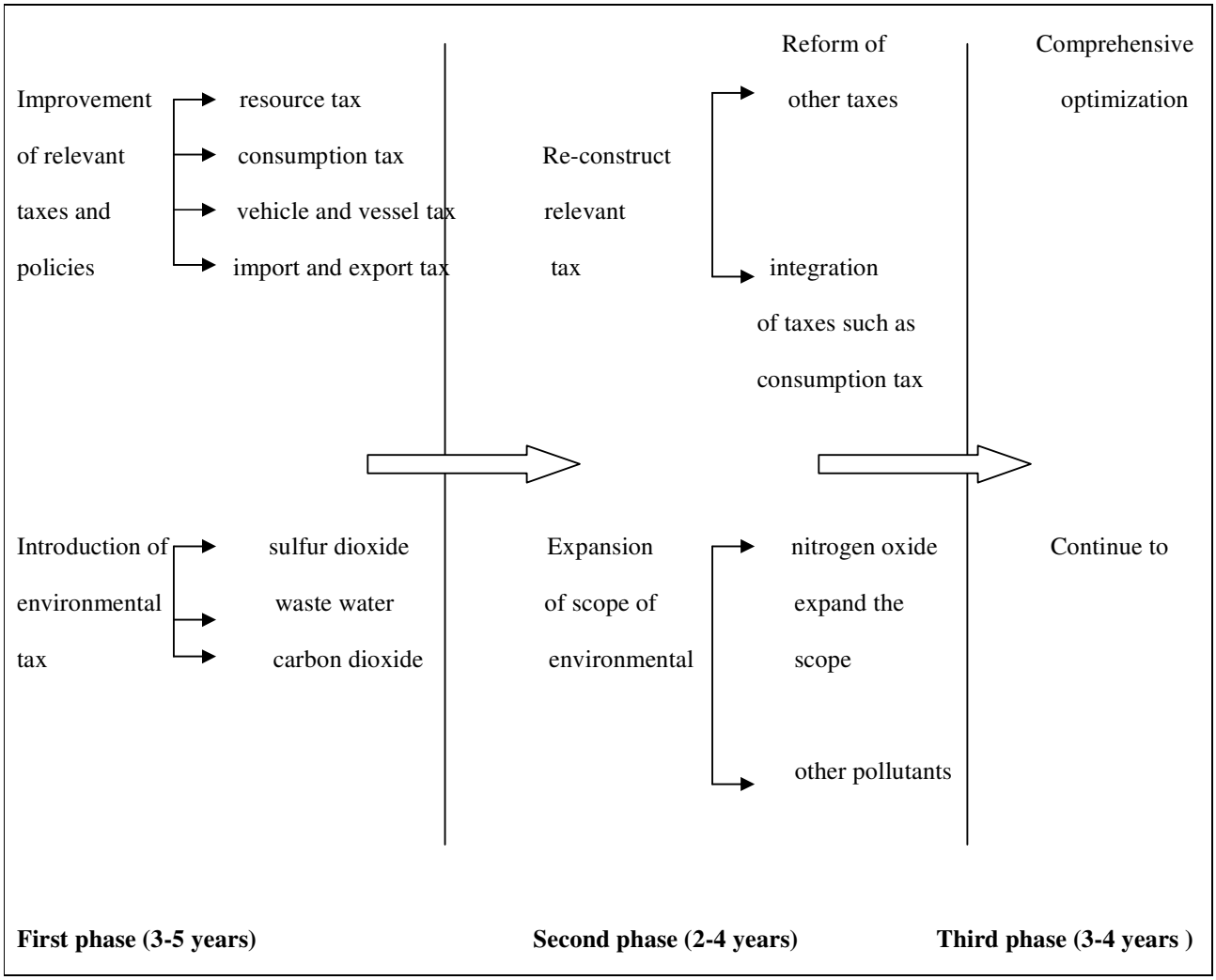

Figure 3-2 Roadmap for Environmental Taxation System Reform

3.4 Carbon tax is an important tax policy option for China to respond to climate change, advance energy-saving and emission reduction, and develop a low carbon economy

I. Carbon tax is an environmental tax imposed on carbon dioxide emission. Levying a carbon tax will play an important role in reducing carbon dioxide emissions and responding to global climate change, as well as in reducing the emission of other pollutants, such as sulfur dioxide and nitrogen oxide. In this respect, levying a carbon tax will not only realize the goals of energy-saving and emission reduction, but it will also provide policy assurance with respect to transforming China's economic development pattern.

China is now is in the apex of energy consumption and pollution emission. To achieve sustainable development, China must adopt a new pattern of industrialization and develop low carbon energy – a stance that will show China's leadership in this domain after initially dropping behind. Although taxation is not the only policy option and will not solve all problems, in a market economy, taxation is a necessary component of economic instruments.

II. The experiences of developed countries have proved that carbon tax/energy tax is an effective economic tool that helped to considerably cut CO_2 emissions, reduce environmental pollution, and improve energy efficiency. Countries that imposed a carbon tax witnessed a significant drop of fossil fuel consumption and were able to optimize their energy structure. At present, China faces great pressure in the context of international climate change negotiations. The United States has even proposed placing a "carbon tariff" on Chinese products. In this circumstance, carbon tax may be an effective economic tool for China to respond to the climate change issue, promote energy-saving and emission reduction, and develop a low-carbon economy.

III. The advantages for China of introducing carbon tax are: 1. Carbon tax meets the developing trend of responding to climate change and developing a low carbon tax; 2 The collection requirements of carbon tax are relatively low; and 3. Levying a carbon tax has no legal and departmental resistance. However, there are some sources of resistances to the levy of a carbon tax: 1. The relationship between carbon tax, resource tax, and consumption tax needs to be coordinated; 2. Carbon tax will affect energy price as well as the supply of and demand for energy; and 3. Carbon tax will affect economic growth and industrial competitive power.

3.5 Learning from international carbon tax experiences to design a reasonable carbon tax in China

I. The experience of developed countries in introducing carbon tax, the development process, and designing a system for carbon tax offer substantial insights for China, as follows: 1. A reasonable design is needed to reduce resistance when introducing carbon tax; 2. The relationship between carbon tax and other tax categories and economic measures must be coordinated; and 3. Attention is needed with respect to international tax coordination and tax cooperation.

II. The following elements are recommended in designing a carbon tax:

Table 1.33 Design of elements for carbon tax

Carbon tax elements	Basic provisions
Tax payer	The units and individuals who directly emit CO_2 to the environment due to consuming fossil fuel should pay carbon tax
Tax scope	According to related provisions, carbon tax should be levied on CO_2 directly emitted to the environment due to consuming fossil fuel during the process of manufacture, operation, and consumption.
Tax base	Emission amounts should be estimated according to the consumed amount of fossil fuel. The emission amount of CO_2 = the consumed amount of fossil fuel × the CO_2 emission coefficient The consumed amount of fossil fuel refers to the actual amount of fuel consumed in its manufacture and operation, including coal, raw oil, gasoline, diesel oil, natural gas, etc.
Tax rate	Tax should be collected according to the emission amount as a specific duty.
Tax preferences	A. Tax reduction for certain energy-intensive sectors according to the needs for economic and social development; B. Tax reduction or exemption for enterprises that reduce and recycle CO_2 through advanced technology who meet certain standards; C. Exemption for individuals whose CO_2 emissions result from coal and natural gas consumption that meet their daily needs.
Other tax elements	Other elements, such as procedures for carbon tax levy, terms of tax payment, place of tax payment, etc (omitted)

3.6 Select timely, reasonable tax rates for the introduction of a carbon tax in accordance with its environmental and economic and the economic and social situations, at home and abroad

I. The environment and economic impacts of carbon tax are as follows: 1. significant effect in energy-saving and emission-reduction. Carbon tax promotes energy efficiency and reduces the aggregate demand for fossil fuel, leading to sharp reductions of major pollutants, such as CO_2 and SO_2. 2. The adverse impact on

economic aggregate decreases gradually and will eventually accelerate economic growth. Levying a carbon tax will cause a slight decline of actual GDP growth in 2010 and 2011. With the rising price of fossil fuels, enterprises will improve energy-efficiency through investment and productivity, thus offsetting the impact of high energy costs caused by carbon tax and advancing long-term, stable economic growth. It is believed that carbon tax will accelerate China's economic growth in 2012. 3. Output from high energy-consuming industries is substantially affected and the effect of structural adjustment is obvious. Simulation results show that the proportion of high energy-consuming industries -- such as coal mining, the washing and dressing industry, petroleum and natural gas industry, petroleum processing and coking industry, nuclear fuel processing and the chemical industry – decreases in the national economy, and the output of high-tech industries -- such as common and special equipment manufacturing and information communication -- increases significantly. 4. The growth rate of fiscal revenue growth will decline slightly. Although the levy of carbon tax increases fiscal revenue, tax reduction measures (such as value-added tax transformation and tax reimbursement for export beginning in 2009) will offset the increase of carbon tax revenue. 5. The levy of carbon tax can have certain adverse impacts on enterprise investment, export, employment in short term, but this impact will gradually disappear.

II. In designing a carbon tax rate, several principles should be followed: 1. The carbon tax rate should represent the marginal cost of CO_2 emission reduction to the maximum level; 2. The impact on the macro economy and industrial competitiveness should be considered; 3. Differentiated factors should be fully considered; 4. Tax rates should be raised gradually; 5. The carbon tax rate should consider the balance between carbon tax and other taxes imposed on fossil fuel. In view of the current development phase of China's society and economy, a low tax rate with little negative impact on the economy should be used in the short term, with the rate gradually raised in order to affect the CO_2 emission behavior of taxpayers without undue affecting the international competitiveness of Chinese industry and the quality of life of the population with low income.

Based on the calculated results of the carbon tax CGE model, in order to reduce resistance to the introduction of such a tax and its negative effect on the economy, the carbon tax rate should initially be low, not higher than 15 Yuan per ton of CO_2. In this respect, three options are proposed: 1. The lowest is 5 Yuan /tCO_2; 2. A modest tax rate is 10 Yuan /tCO_2; and 3. The highest is 15 Yuan /tCO_2. After its introduction, the carbon tax rate should be increased gradually, according to the actual condition of China's social and economic development. In this respect, a dynamic adjustment mechanism for the tax rate should be established.

III. In general, a carbon tax should be levied when the following external conditions are present: a favorable macro-economic environment, a good international economic environment, and a moderate tax rate level. Given that the national economy is still recovering from the impacts of the global financial crisis and the

fact that related resource tax reform has not been carried out, a carbon tax should only be levied after macro economic growth has recovered and resource tax has been reformed. The introduction of a carbon tax might also hinge on the need of China to participate in international climate negotiation. IV. A suggested timetable for carbon tax is as follows:

Table 1.34 Timetable for carbon tax

	Timing	Remarks
The first best case: "fast scenario"	12th Five-Year-Plan period (2011-2015)	On the basis of resource tax reform, to find the right timing to introduce a carbon tax as a part of environmental taxation.
The second best case: "Slow scenario"	13th Five-Year-Plan period (2016-2020)	China cannot effectively reach its domestic target of coping with climate change if carbon tax has not been introduced by 2020.

3.7 Other stipulations and supporting measures need to be improved to facilitate the external environmental for levying carbon tax

I. The division and use of carbon tax. 1. It is recommended to transform, step-by-step, the carbon tax from a "sharing tax" to a "central tax", together with the reform of local taxes in China. As a central tax, the central government can use carbon tax to support energy-saving, the use of new energy and renewable energy sources, the development of new energy technology and other energy-saving measures. 2. It is recommended to integrate a carbon tax within the general budget, and to use and administrate the carbon tax together with other tax revenue in order to increase expenditure in energy-saving and environmental protection.

II. Establishment of a scientific, effective implementation mode. This refers to: 1. Strengthening publicity regarding carbon tax; and 2. establishing a forecasting system and a system of periodic tax rate adjustment.

III. Improvement of other supporting measures. 1. Tax collection and management capability need to be improved; and 2. Coordination between carbon tax and other policy instruments aimed at reducing CO_2 emissions, such as emission–reduction measures, developing renewable energies, and implementing an Energy Efficiency Standard.

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Chapter 2: Assessment of Current Policies for Energy Productivity in China

Abstract

Energy productivity refers to the output and quality of goods and services generated with a given set of energy inputs. It is not only about energy efficiency, but also system optimization. Higher labor productivity is caused by the increase of wages; an equal mechanism can be applied with energy productivity. Market based instruments help the optimization of resource allocation and the efficiency of energy utilization, thus achieving better energy productivity.

This paper reviews current policies for energy productivity in China, including command and control instruments, market based instruments, information publicity, and persuasion and encouragement, among which command and control and market based instruments are the major two types, with the latter one gradually becoming a major role in policy mix. In order to better achieve policy effectiveness in promoting energy productivity in China, the optimization of policy mix is recommended, enforcing the latter tendency, together with institutional and policy reform.

0 Background

Energy shortage has become a crucial issue in human development. At the present level of energy productivity, the world will only feed and accommodate 1.5 billion people at OECD's average standard of living. Energy efficiency is a popular topic in different events and occasions. It is either emphasized on improving energy supply capacity or reducing end-use consumption. Together with a dramatic increase in the supply of sustainably generated renewable energies these are the two key elements to solve the energy and climate problems. Developing economies are an increasingly dominant force in global energy demand growth while they are marching into their industrialization processes, as industrialized countries did several decades ago. Rather than primarily seeking to reduce end-use energy demand and needs, there should also be a focus on improving energy utilization in a more productive way. Energy productivity is a useful yardstick of progress and a tool to analyze the public policy by substantial system improvements and energy efficiency enhancement.

1 Definition of Energy Productivity

1.1 Energy Consumption System

End-use energy consumption includes several resources that fall into two categories, i.e. primary energy such as coal, oil, nuclear, natural gas, hydropower, biomass and so on, and secondary energy such as electricity, thermal power, gasoline and so on that are converted from primary energy. The logistic system is illustrated in Figure 1.

Specifically, energy productivity has to take into account the entire chain which also includes the needs and services. Hence, the needs like a “light, warm room” or a “cool drink” have to be considered, too, since there are different ways of providing these services. It thus goes one important step further: From primary energy via end energy to services. This allows for a much larger potential of energy productivity to be exploited.

1.2 Definition of Energy Productivity

In economics, productivity is the amount of output created (in terms of goods produced or services rendered) per unit input used. For instance, labor productivity is typically measured as output per worker or output per labor-hour. Resource productivity refers to the economic output per resource input. The Chinese GDP of 2007 divided by the amount of resources consumed in that year is the Chinese resource productivity of 2007. This can, of course, be subdivided and differentiated for different resources such as energy, water, minerals etc.

Like labor or capital productivity, energy productivity measures the output and quality of goods and services (or welfare) generated with a given set of inputs. Factors which influence China's energy productivity include: technology innovation, development and deployment, resource allocation structure, industrial structure and institutional arrangement, management and mechanisms, subsidy, price and tax structures, demand preferences (which are dependent on prices, infrastructures, institutional presetting, cultural habit, etc.

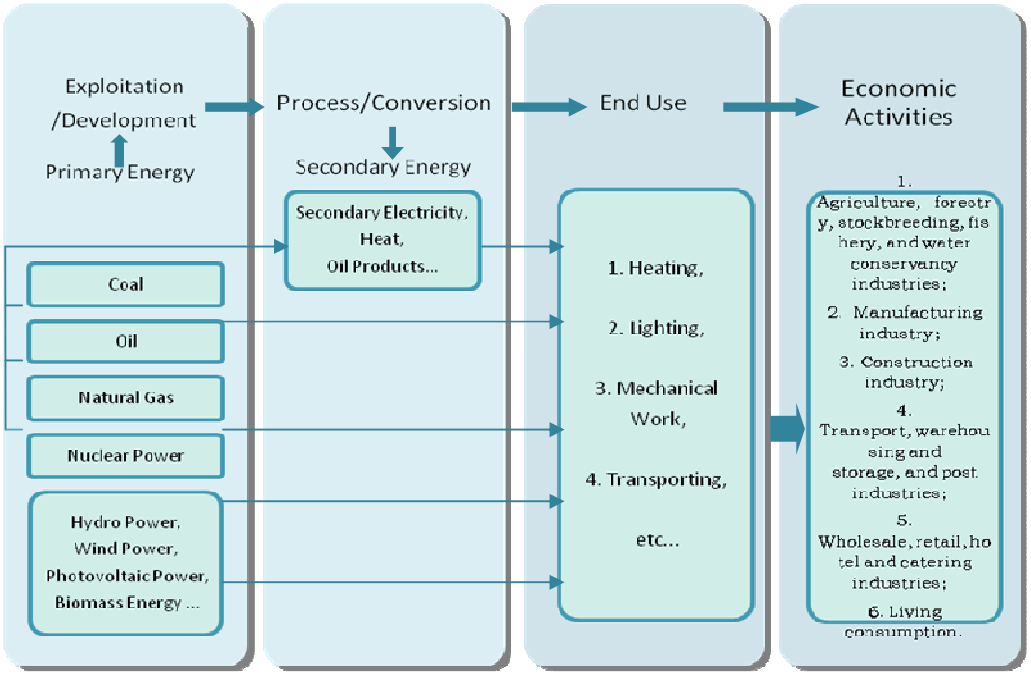


Figure 2.1 Comprehensive Energy System

The concept of energy productivity provides an overarching framework for understanding the evolving relationship between energy consumption and economic growth. Energy-productivity improvements can come either from reducing the energy inputs required to produce the same level of energy-related services or from increasing the quantity or quality of economic output without increasing energy inputs. Within each of these, there are multiple components that can change over time. Thus, emphasis of energy productivity should focus on energy efficiency improvement as well as substantial system changes.

Table 2.1 lists all kinds of policies contributing to the overall energy system of which the key policies are described and their effect analyzed. It can be found that the command and control instrument and market-based instrument support and complement each other in functions, and contribute in unity to each link from energy development and exploitation, processing conversion to final consumption. Especially in recent years, the problems related to energy resources, environment and climate are aggravating and the international community society has shown more concern. In order to deal with these problems and the global economic crisis, to stimulate green consumption and to fuel domestic demand effectively, our country issues many policies concerning energy conservation and emission reduction and sets compelling targets for energy conservation and emission reduction in “the 11th Five Year Plan”. When strengthening the financial support in implementing these policies, the government also makes full use of the functions of the market. These policies have generated some effect, and they will bring more remarkable achievements in the near future. The following sections will illustrate the relevant policies in detail.

Table 2.1 Effect analysis of policies on comprehensive energy system

Policy instruments		Development and Exploitation （primary energy）	Processing Conversion （Secondary energy）	Final Energy Consumption and Economic activities
Energy policies and effect		Coal, Oil, Natural gas, Nuclear energy、Waterpower, Wind power, Photovoltaic, Biomass	Secondary power, Heat, oil products, etc.	Agriculture, forestry, animal husbandry, fishery, water conservancy; industry; construction; transportation; warehousing and postal industry; wholesale and retail industry; accommodation and catering industry; consumption and others
Command and Control	Comprehensive Planning and Industry policies	the 11th Five-Year Plan sets the compelling target of a 20% decrease in per GDP energy consumption		
		In the period from 2006 to 2008, energy consumption per unit GDP each year is respectively 1.79%, 4.04% and 4.59% lower than previous year so as to achieve the goal reducing energy consumption per unit GDP by 20% in 2010 compared with that in 2005.		
		Medium and Long Term Energy Conservation Plan		
		The Plan focuses on following key industries including electric power industry, nonferrous metals industry, oil and petrochemical industry, etc. and key fields including transportation, construction and commercial and residential building and so on. It also contains ten key energy conservation programs for energy conservation planning from energy exploitation to final economic activities. It is expected to save 240 Mt standard coals during the period of the “11th Five Year Plan” by implementing the ten key energy conservation programs.		
		Medium and Long Term Development Plan of Renewable Energy and The 11th Five-Year Plan on Renewable Energy Development		Adjustment of Industrial Structure
		Focus on the development of hydropower, biomass, wind power, solar		In 2005 and 2007, two guiding catalogues are issued for adjustment of industrial

		power and rural renewable energy		structure
	laws, rules and regulations	Energy Conservation Law		
		The law strengthens the management of energy conservation and standardized system, establishes the responsibility system for energy conservation and supports the energy conservation activities by using public funds and requires the financial institutions to increase credit support for energy conservation programs.		
		Law of Energy, Renewable Energy Law, Mineral Resources Law, Electric Power Law, Law of the People's Republic of China on Coal Industry, Measures on Coal Ash Comprehensive Utilization Management, 1994; Measures on Coal Gangue Comprehensive Utilization Management		Regulation on energy conservation of civil buildings, Energy Saving Management Measures in Key Energy Consumption Units, Regulation on Civil Building Energy Conservation Management, etc.
				Shutting down small coal fired power plants and eliminating backward production capacity
				From 2006 to 2008, close 38.26 million KW of small coal fired power units were closed and the backward production capacity of 60.59 Mt iron making, 43.47 Mt steelmaking capacity and 140 Mt cement production capacity were eliminated

Market-based instruments	Oil pricing reform: Oil Price Comprehensive Reform Scheme (2006), Oil Products Tax Reform(2009)	Electricity pricing reform: Interim Measures on On-grid Electricity Price, Interim Measures on Transmission and Distribution Electricity Price, Interim Measures on Retail Electricity Price,	Same electricity price in urban and rural, energy efficiency labeling system, publicity system for energy consumption indicators
	Crude oil price is in consistence with the international oil market, which reflects oil prices changes in the international market. The government department in charge of price adopts macro-regulations for retail prices and allows 8% price fluctuation for oil products retail. There is price linkage mechanism within oil enterprises as well as between them and other relevant industries, and oil special proceeds are levied. In 2009, China begins reforming oil products tax and fees. The consumption tax for oil products is levied on an ad valorem, and gasoline consumption tax is increased from 0.2 RMB yuan to 1 RMB yuan.	The reform goals: Sales Price is the summation of Onto-Gird Price, Distribution Loss, Transmission and Distribution Price and Government Fund. Sales price is set by government at the basis of unified policy and multi-level management and acts as the benchmark price. There are three different categories of users, resident living electricity utility, agriculture producing utility, and industrial and commercial utility. Electricity prices to different category of users will then be fixed accordingly. Sales prices differentiate each other in the period of peak-valley, rainy-dry-season, and of different seasons and there are two forms of price adjustment: periodic adjustment and linkage adjustment.	
	natural gas price reform, subsidy for new energy and renewable energy additional price	Coal-Electricity Price Linkage Mechanism	Tax Preference Policy on Energy Conservation Products

		There are price linkage between onto-grid electricity price and coal price, sales price and onto-grid electricity price. Since 2005 , Coal Power Price Linkage has been applied twice.	to relieve the corporate income tax of programs of energy conservation and environmental protection and relieve part income tax for the investment to energy saving and environmental protection equipments
	Resource Tax	Lowering the Onto-grid price of Small Coal Fired Electricity	Energy Saving Products, citizen favoring Project(HuiMin Project)
	Present resource tax is the specific duty; the tax rate is 14-30 yuan per ton for crude oil, 7-15 yuan per ton for natural gas and 2.5-4 yuan per ton for coal. Although such tax rate has been increased, it still cannot reflect properly the current scarcity of energy resources.	Eliminating backward production capacity, improving energy productivity	To the products air-conditioners, refrigerator, washing machine, flat panel television, micro-wave oven, rice cooker, induction cooker, computer display and motor, high efficiency lightening products and cars of energy saving and renewable energy , whose energy efficiency is grade 1 or 2 higher are promoted by financial subsidies for application. In 2009, the central government invested about 600million yuan in promoting 120million lightening products of high efficiency, twice than that of 2008. It can be expected to save 6.2billion kilowatt hour electricity and reduce 6.2 Mt CO_2 and 62 kilo ton SO_2.
	Ecological compensation Mechanism		"new for old" policy on automobile and household appliance

	Basic principles: exploiters protection, destroyers recovery, beneficiaries compensation, and polluters pay. But now, the fee rate for oil, natural gas, coal and coal bed methane is 1%, which is obviously under the international level of 10% and 16%. The low fee rate reflects the undervaluation of the value of the mineral resources and the Ecological Compensation Mechanism cannot perform its full functions.		In 2009, the government allocated 2 billion yuan to conduct the "new for old" pilot on television, refrigerator, washing machine, air-conditioners and computer, and Beijing, Tianjin, Shanghai, Jiangsu, Zhejiang, Shandong ,Guangdong, Fuzhou and Changsha are selected as pilot spots.
	Renewable Energy Power Price Additional Quotas Trading System		Mandatory Procurement System of Energy Conservation Products
			Up to March 2009, Ministry of Finance and National Development and Reform Commission have issued five times the " government procurement list for energy conservation products", including energy conservation products air-conditioners, refrigerator, lightening products etc. as well as part of water saving products.
	Clean Development Mechanism, Guidelines on Credits Granting for Energy Conservation and Emission Reduction, and Green Trade Policies		

2 Current Policy System for Energy Productivity in China

Policy instruments for energy productivity in China include several policy instruments such as command and control instruments, market based instruments, persuasion and encouragement. The policy system in energy productivity is illustrated below.

2.1 Command and Control Instruments

Command and control instruments play a very important role in the Chinese policy system, including three categories of strategic planning and sectoral policies, laws and regulations, and administrative commands and guidance. These policies have strong and positive impacts on energy productivity in China.

2.1.1 Strategic Planning and Sectoral Policies

As China's highest level of guidance planning, the 11th Five-Year Plan (11th FYP), has switched its focus from fast economic development to economic development in a sound and fast way. Here "sound" refers to a sustainable and clean way, emphasizing on economic development as well as environmental protection, which can translate into energy conservation and reductions of major pollutants. Following with the 11th FYP, the government has established detailed plans specifically in energy conservation, such as the Comprehensive Working Scheme on Energy Conservation and Reduction of Pollutant Emissions, in which it set out the target of "for the year 2010 included:

Energy consumption per 10,000 Yuan GDP reduced from 1.22 tons of standard coal in 2005 to below 1 ton, down by about 20%;

Water consumption per unit of industrial value added reduced by 30%; and

Discharge of major pollutants reduced by 10%".

In 2007, the State Council released two papers planning the country's energy development, the White Book on China's Energy Conditions and Policies, and the 11th Five Year Plan for Energy Development by NDRC. These two papers portray China's energy conditions and thus summarize the energy policies already conducted and to be made in China. The essence of Chinese energy policy is to improve energy production capability, to satisfy increasing demands of social production and the elevation of people's living standards, with the emphasis on energy conservation and environmental protection, and to improve energy efficiency.

In 2004, the Medium and Long Term Energy Conservation Plan was released, one of the major outcomes of which is to implement ten key energy conservation priority programmes:

Upgrading of Low-efficiency Coal-fired Industrial Boiler (Kiln),

District Heat and Power Cogeneration,

Recovery of Residual Heat and Pressure,

Oil Saving and Substitution,

Energy Conservation of Motor Systems,

Optimization of Energy Systems,

Energy Conservation in Buildings,

Green Lighting, Energy Conservation in Government Agencies,

Building the Energy Conservation Monitoring System, and

Implementation of Technological Support Systems.

Through the implementation of these ten programmes, it is estimated that 240 Mtce can be conserved during the 11th Five-Year Plan period (2006-2010), equivalent to 550 Mt CO_2 emission reductions.

Box 2.1 Policy System
(According to importance)

1. General Guiding Planning:

1) The Eleventh Five-Year Plan for National Social and Economic Development of the People's Republic of China , 2006.3;
2) Comprehensive Working Scheme on Energy Conservation and Reduction of Pollutant Emissions, the State Council, 2007.6.3;
3) White Book on China's Energy Conditions and Policies, the State Council, 2007.12;
4) The 11th Five Year Plan for Energy Development, NDRC, 2007.4;
5) Medium and Long Term Energy Conservation Plan, NDRC, 2004;
6) Interim Regulations on Promoting Industry Structure Adjustment, 2005;
7) Industry Structure Adjustment Guiding Catalog 2005, NDRC;
8) Industry Structure Adjustment Guiding Catalog 2007, NDRC (Opinion Soliciting Draft);
9) China's National Climate Change Program, the State Council, 2007.6.4;
10) China's Specific Scientific and Technical Actions on Climate Change, MOST, NDRC, SEPA, MFA, MOF, etc. 2007.6.13;

2. Sectoral Plan and Policy:

11) The 11th Five Year Plan for Coal Industry Development, NDRC, 2007.1;
12) Coal industrial policy, NDRC, 2007.11.23;
13) Medium and Long Term Development Plan for Nuclear Power (2005-2020), NDRC, 2007.10;
14) Natural Gas Utilization Policies, NDRC, 2007.8.30;
15) Medium and Long Term Development Plan of Renewable Energy, NDRC, 2007.9;
16) The 11th Five-Year Plan on Renewable Energy Development, NDRC, 2008.3;
17) International Scientific and Technical Cooperation in Renewable and New Energy, MOST, NDRC, 2007.11.12.

These plans are focusing more on energy conservation by improving energy efficiency and by technology improvement. Since the late 1980s, the Chinese government has emphasized more on the transformation of economic development and the adjustment of economic structures, in order to reduce natural resource and energy consumption, and to improve clean production, as major components of Chinese industrial policy. There were two Industrial Restructuring Guidance Catalogs in 2005 and 2007 to improve the industrial structures. In the 2005 Catalog, over 20 sectors are sorted into three categories of encouragement, restriction, and elimination, within which 47 energy industries are encouraged, 6 are restricted, and 18 are to be eliminated. The numbers of companies listed in the encouragement, restriction, and elimination catalog of the coal sector are 14, 4 and 12 respectively. The numbers in electricity industry are 17, 2, and 3. Six items in oil and gas sectors are encouraged, and 3 are to be eliminated. At the moment, the 2007 Catalog is still in the state of opinion soliciting draft, but will generate an improved and timely energy conservation effect once it is officially released.

Specifically, in facing the challenges of global climate change, China takes a positive and responsive reaction to address the issue, being the first one in developing countries to release China's National Climate Change Program by the State Council, and later China's Specific Scientific and Technical Actions on Climate Change in 2007. As energy conservation, renewable energies and reductions of major pollutants are one of the two actions to fight climate change, namely mitigation and adaptation, by specifically addressing climate change on the national and local level, the country would achieve a significant effect in saving energy at the same time.

Besides, China has established sectoral planning and policies regarding different energy sectors, such as the coal industry, nuclear power industry, the utilization of natural gas, and renewable energies. These plans will better facilitate the implementation and application of general energy guiding plans in specific industries with corresponding policies, targets, and instruments.

2.1.2 Basic Energy Laws and Regulations

In 2007, the Energy Conservation Law was revised on the basis of its 1997 version. The revised new law came into effect on April 1, 2008. This law was revised due to the great progress in social and economic development, as well as to better ensure the achievement of the targets set in the 11th FYP of improving energy efficiency by 20%. The revised Energy Conservation Law is greatly supported by a good number of regulations and measures, as well as administrative commands. It is a great progress in various areas such as those described below.

In addition to strengthening relative regulations in industrial energy conservation, by ruling energy conservation policies in different industries and technology upgrade policies, the revised law added energy conservation articles in building, transportation, and public sectors which contribute a great portion to total energy consumption.

The revised law perfects the energy management and standards system.

Energy-saving targets responsibility and energy-saving assessment systems. The system is established to set targets for local governments and officers in charge. They will need to report to the central government about implementation effects of energy conservation and will receive negative performance assessment if they fall short of the targets.

Capital assets investment, project energy conservation assessment and censor system. With the mandatory energy conservation standards and design norms, the system is to control blind and fast development of high energy consumption industries.

Box 2.2 Legal System
(According to importance)

1) Energy Conservation Law, 2008.4.1;
2) Regulation on energy conservation of civil buildings, State Council, 2008.10.1;
3) Measures of Implementation of Energy Conservation Law in Highway and Waterway Transportation, Ministry of Transport, 2008.9.1;
4) Regulations on energy conservation in public institutions, the State Council, 2008.10.1;
5) China's Policy Outline in Energy Conservative Technologies, NDRC, MOST, 2006.12;
6) Renewable Energy Law, 2006.1.1;
7) Law of Energy (opinion soliciting draft), 2007.12.3;
8) Mineral Resources Law of the People's Republic of China, 1996.8.29;
9) Electric Power Law of the People's Republic of China, 2003.09.18
10) Law of the People's Republic of China on Coal Industry, 2003.09.18;
11) Cleaner Production Promotion Law, 2003.02.10;
12) Measures on Energy Saving Management, under revision, 2000.12.29;
13) Implementation of Construction Energy Conservation Monitoring and Management System in Office Building and Large-scale Public Buildings, the Ministry of Housing and Urban-Rural Development, 2007.10;
14) Energy Saving Management Measures in Key Energy Consumption Units (revision);
15) Regulation on Civil Building Energy Conservation Management, the Ministry of Housing and Urban-rural Development, 2006.1.1;
16) Interim Measures on Clean Production Auditing, NDRC, SEPA, 2004.10.1;
17) Measures on Coal Ash Comprehensive Utilization Management, 1994;
18) Measures on Coal Gangue Comprehensive Utilization Management, 1998;
19) Interim Regulations on Lubricant Recycle and Reuse (revision);
20) Regulation in Compilation and Assessment of "Energy Conservation Chapter" in the Feasibility Assessment Report in Fixed Assets Investment Construction Projects;
21) Air Pollution Prevention and Control Law, 2000.4.29.

System to eliminate backward high energy consumptive products, facilities and producing processes. On the one hand, the system controls the market entrance of high energy consumptive products, facilities and processes; on the other hand, it enhances shutting down the backward production facilities.

Energy management system in key energy consumption units.

Energy efficiency label management system. It is established as a legal system, declaring implementation targets and punishment measures.

Energy conservation honor and awarding system. It is an encouragement measure by establishing energy conservation models, in order to stimulate working positivism and enthusiasm in the whole society.

The revised law defines two systems: energy conservation target duty system, and energy conservation assessment and evaluation system. These two systems include energy conservation targets in the assessment of local governments and officials in charge.

The revised law improves economic policies, in regulating that central and provincial government should arrange specific funds to support energy conservation work, to carry out tax preference to listed energy conservative technologies and products, to subsidize the promotion and application of energy conservative products, to induct financial institutes to increase credit support to energy conservation projects, etc.

The revised law defines the subjects of energy conservation management and monitoring. The revised law was strengthened with 19 legal responsibilities, defines responsive punishment and increases the scale and degree of punishment.

2.1.3 Administrative Commands and Guidance

Decision on Strengthening Energy Conservation by the State Council, 2006.8.6;

Guiding Notice of the Ministry of Transport on Port Energy Conservation and Emission Reductions of Pollutants, the Ministry of Transport, 2007.12.20;

Several Opinions on Speeding up Shutting Down Small Thermal Power Plants, UNRC, 2007.1.20;

List of Backward Cement Production Facilities to be Shut Down in 2007, UNRC, 2007.12.28;

Notice of NDRC on Promoting Energy Conservation and Reduction of Pollutants in Small and Medium Companies, 2007.11.27.

2.2 Market-Based Instruments

2.2.1 Energy Pricing Mechanism Reform

Electricity Pricing Reform

Electricity Pricing Reform Development:

Since 1985, China has implemented several electricity pricing policies, such as repayment of capital with interest (RCI pricing), fuel and transportation (FT pricing),

and operation period (OP pricing). These pricing policies helped turn round the long-term power supply shortage situation and thus supported the rapid social and economic development for a certain period. However, such policies could not accommodate current power demands and the change in market structure, hindering the healthy development of the power industry. In July 2003, the Electricity Pricing Reform Scheme was proposed by NDRC and printed and distributed by the General Office of the State Council. This new round of electricity pricing reform has been started since then.

Box 2.3 Policy System

(According to importance)

1) Notice of General Office of the State Council on Printing and Distribution of Electricity Price Reform Scheme, 2003.7.9;
2) Notice of National Development and Reform Commission on Printing and Distribution of Implementation Measures of Electricity Price Reform, 2005.3.28;
3) Interim Measures on On-grid Electricity Price, NDRC, 2005.5.1;
4) Interim Measures on Transmission and Distribution Electricity Price, NDRC, 2005.5.1;
5) Interim Measures on Retail Electricity Price, NDRC, 2005.5.1;
6) Circular on Establishing Coal and Electricity Price Linkage, NDRC, 2004.12.15;
7) Circular on Establishing Coal and Heat Price Linkage, NDRC, Ministry of Housing and Urban-Rural Development, 2005.10.25;
8) Notion on promoting electricity consumption by price leverage, 1999;
9) Interim Management Measures on Burden Sharing of Renewable Energy Power Price and Fees, NDRC, 2006.1;
10) Interim Measures on Renewable Energy Power Additional Price Income Allocation, NDRC, 2007.1.

Direction and Goal for Electricity Pricing Reform:

Gradually establish an electricity pricing mechanism in the market economy system, to optimize resource allocation, to promote healthy development of the power industry, and to satisfy increasing power demands; establish a sane electricity purchase mechanism by pricing leverage, to protect the legal rights of electric power companies and consumers; and implement a price linkage mechanism between electricity and coal, and that of electricity and heat, to advocate energy conservation and improve energy efficiency.

Long-term Goal:

Along with the institutional power reform, power prices will be divided and defined as four parts: onto-grid price, transmission price, distribution price, and sales price. Onto-grid price and sales price are influenced by market competition, while transmission and distribution prices will be fixed by the government. Meanwhile, a canonical and transparent price management system should be established.

Short-term Goal:

Establish an onto-grid price mechanism adapting to moderate competition of power generation, based on the separation of power plant and grid company. Initially establish a transmission and distribution price mechanism to improve healthy development of the power grid. Link sales and onto-grid prices. Optimize sales price structures. In areas where conditions permit relatively high voltage level or electricity consumption, users purchase directly from power plants as a trial implementation.

Electricity Price Forming Mechanism:

Sales price is under government guidance, with unified policies and multi-level management. Sales price is composed of four parts: onto-grid price, transmission and distribution loss, transmission and distribution price, and government funding. An average sales price according to the sum of the four parts, is called the benchmark price which is fixed by the government. There are three different categories of utility, residential living utility, agriculture producing utility, and industrial and commercial utility. Electricity prices to different category of users will then be fixed accordingly. The principle in fixing sales prices is to establish equal burden sharing and effective power demand adjustment, as well as paying attention to public policy targets and establishing the linkage with the onto-gird price mechanism. Take full advantage of price leverage to better allocate power resources and protect the legal rights of power companies and users.

Sales Price = Onto-Gird Price + Transmission and Distribution Loss + Transmission and Distribution Price + Government Fund

Onto-Grid Price:

If participating in regional competitive power market, Onto-Grid Price = Capacity Price (fixed by government in charge) + Quantity Price (determined by market competition);

If not participating in regional competitive power market, Onto-Grid Price is fixed by government in charge.

Transmission and Distribution Loss: after grid companies purchase electricity from power plants (including those belonging to grid companies) or other grid companies, the normal loss in transmission and distribution process.

Transmission and Distribution Price = Transmission and Distribution Service Price in Public Network + Special Service Price + Assistant Service Price. (TD price is fixed by the government, with unified policies and multi-level management)

Government Funding: funding and add-ons charged by quantity, according to relative national laws, regulations or those approved by State Council or departments authorized by the State Council.

Sales Price Categorizing Reform:

Resident living power utility, agriculture producing power utility: unique quantity price;

Industry, commerce and other power utilities: two tariff electricity price= quantity price+ basic price.

Sales price adopts peak-valley, rainy-dry-season, and seasonal differentiating prices.

Sales prices adjustment: periodic adjustment and linkage adjustment.

Periodic adjustment: the government department in charge of prices adjusts sales prices every year. If annual change is small, sales price should try to keep constant.

Linkage adjustment: correlate with onto-grid price, but only applicable to industry, commerce and other users.

Coal and Electricity Price Linkage Mechanism

Link onto-grid price and coal price, and link sales price and onto-grid price, in order to reduce power plant cost and improve efficiency. But the power plant needs to assimilate 30% of the price increase.

Price linkage period is 6 months in principle. If coal price fluctuation reaches or exceeds 5%, onto-grid electricity price should be adjusted. (and electricity sales price will be adjusted according to the fluctuation of onto-grid price)

In order to relieve the coal fire power plants' operational difficulties, China has implemented two coal-electricity price linkages in the past three years. The onto-grid price of power plants was raised by 5.01 RMB cents (or 0.0501 RMB) per KWH, which released the operation pressure in power plants to a certain extent.

2005.5.1，initial coal-electricity price linkage, onto-grid price was raised by 2.52 RMB cents;

2006.6.30, second coal-electricity price linkage, onto-grid price was raised by 2.49 RMB cents.

Unique Electricity Price in Urban and Rural Areas

Lowering Small Coal Fire Plant Generation price: for those small coal fire plants which have a higher sales price than the benchmark price, their sales prices will then be lowered to the benchmark price.

Subsidy for Renewable Energy Additional Price

By nationwide burden-sharing and proper subsidies, increase the onto-grid price properly and gradually fix grid transmission and distribution prices, in order to

improve renewable energy power generation, increase sales price and adjust the structure of sales prices. Those projects within the subsidy catalog will receive 0.1 Yuan/kwh as subsidy.

Summary on Electricity Pricing Reform

Electricity pricing reform has gone through a long history together with institutional reform and market structure adjustment. At present, the coal price is connected with the international market, while the sales price of electricity is under government guidance. The goal of electricity pricing reform is to better establish an electricity system that utilizes the leverage of prices to optimize electricity resource allocation, as well as to establish a normative and transparent price management system.

The coal and electricity price linkage system was established to resolve the situation of increasing coal price and frozen electricity price. China implemented two rounds of coal-electricity price linkage to relieve the market tension, which was a progress on the way to further pricing reform. However, coal price increases faster than electricity price. Coal price almost tripled during the past seven years, while there were only two rounds of coal-electricity price linkage, raising electricity price by 5.01 RMB cents in the past 3 years. The current electricity price hasn't yet completely reflected the market situation of supply and demand; more efforts are expected to be made in pricing reform.

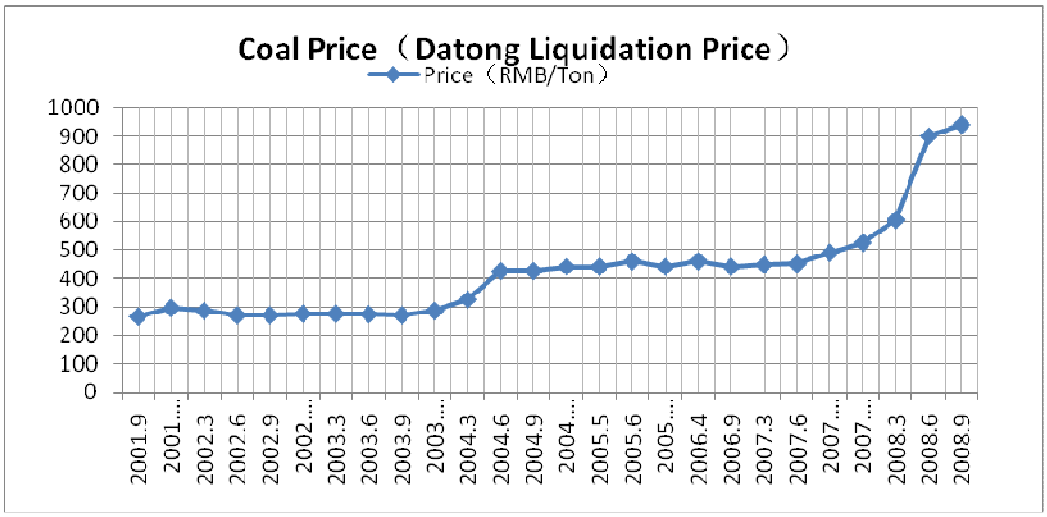


Figure 2.1 Coal Price Development in China

Due to the long-term low electricity prices, current price reform leads to price increase. On the one hand, it reflects the market condition and better allocates resources by market mechanisms with higher efficiency; on the other hand, it also becomes an economic incentive to consumers to save energy.

While increasing the price of electricity generated by conventional coal fire power plants, China is also adopting renewable energies into power generation and certain

subsidies are offered to these plants to foster its development. Being cleaner and renewable, these energy forms will achieve the same targets of emission reduction and environmental protection, as well as substituting limited fossil fuels and in the mid- and long-term will cap the electricity price in case the experience of the German success story of renewable energies is applied. Here the "merit-order" impact requires that plants are connected to the grid according to their specific costs. Once the electricity price has exceeded the rate of the feed-in-tariff-scheme; as is often the case for relatively competitive wind energy in Germany, the price for electricity will not rise anymore in the case of availability of wind energy. In Germany it is estimated around 5 billion Euros p.a. The conclusion to be drawn is that this is an important advantage of such a promotion system as fixed 20-year, legally guaranteed, technology-specific support schemes. However, it has one problem, which is that it counteracts our general approach of setting the right price signals.

Besides, the system of unique electricity price in urban and rural areas is established to secure social justice and ensure the basic living standards of the rural population. While increasing the electricity price, the government also increased the low-income population subsidy. This is very reasonable on the one hand. On the other hand we should also consider whether it is – in the mid- and long-term so wise to spend public money just for compensating the higher energy expenditures, or whether on the other hand it would not be much more effective if these higher expenditures would be avoided by spending the money in funding efficient/renewable equipment.

Oil Pricing Reform

Several Stages in Oil Pricing Reform:

On 3 June 1998, the former National Development and Planning Commission issued Crude Oil and Oil Products Prices Reform Scheme, stipulating that the crude oil transaction settlement price is determined by negotiation between the two corporations of China National Petroleum Corporation (CNPC) and China Petrochemical Corporation (Sinopec). The price is composed of the crude oil base price and a discount (or premium), within which the crude oil base price is determined by the former National Development and Planning Commission according to the previous month's international average price for similar quality crude oil , and the discount is negotiated by supplier and buyer. The prices of gasoline and diesel oil are government referential prices. The former National Development and Planning Commission fixed the retail median price by importing tax cost plus domestic proper circulation price. CNPC and Sinopec fix the retail prices with a 5 % fluctuation range on the basis of the retail median price.

Since June 2000, domestic oil products' prices started to connect with the international market. Domestic oil product prices adjusted according to the international price changes, but only referred to Singapore price at that time.

In October 2001, according to problems of an over direct and transparent connecting method and an excessive frequency of price change, oil price connection methods

were further adjusted and improved. Since 2006, the prices of oil products are determined on the basis of weighted average prices in Brent, Dubai and Minas, added by refinery cost, proper profits, domestic custom tax, and oil products circulation fees.

Current Oil Pricing Mechanism and Policy: in March 2006, General Office of the State Council printed and distributed Oil Price Comprehensive Reform Scheme, in order to further adjust oil price and reform oil pricing mechanism. The current price policy is as follows:

Crude oil price connects with international market, reflecting the international oil price changes;

Considering factors such as domestic market supply, production cost and various social endurance, government department in charge of macro-controls on retail prices, while admitting a 8% of fluctuation space for oil product retailers;

Allowance mechanism to vulnerable social groups and commonwealth industries corresponding to oil price increases;

Price linkage within relative industries, such as oil price and transport sector price (eg. taxi price) linkage;

Fiscal adjustment mechanism to oil companies' price increasing incomes: special oil profit tariff, started to charge on 26 March 2006, with the highest rate of 40%, by Decision of the State Council on imposition of special oil profit tariff;

Upstream-downstream profit adjustment mechanism within oil companies, such as crude oil price and oil products prices linkage mechanism.

Summary on Oil Pricing Reform

The process of oil pricing reform is accompanied by the institutional reform of the oil industry in China. The oil industry has gone through four major periods since the foundation of the country, from high concentration and monopoly management, to the current market competition system under government macro control. Within the periods, there were two oil circulation system reforms. The first one took place in 1994; that all the crude oil was distributed according to government plans, and the prices of crude oil and oil products were fixed by the former National Planning Commission. Since 1998, a grand pricing reform has been carried out to introduce market mechanisms and price leverage, as well as to connect domestic price with international market.

The current pricing system, although it needs further and deeper improvement, has achieved good progress in optimizing resource allocation and improving energy utilization efficiency. At present, gasoline price in China is around 1 USD per liter, while the price in EU is around 2 USD per liter and in America 1 USD. The price is

lower than that in EU but almost the same as the US. Taking income levels into account, the current oil price is higher than that in the US and EU. The prices are still under the guidance of the government, which will introduce a price change lag to the international price fluctuation. Oil and oil products prices are reflecting the international level to a large extent.

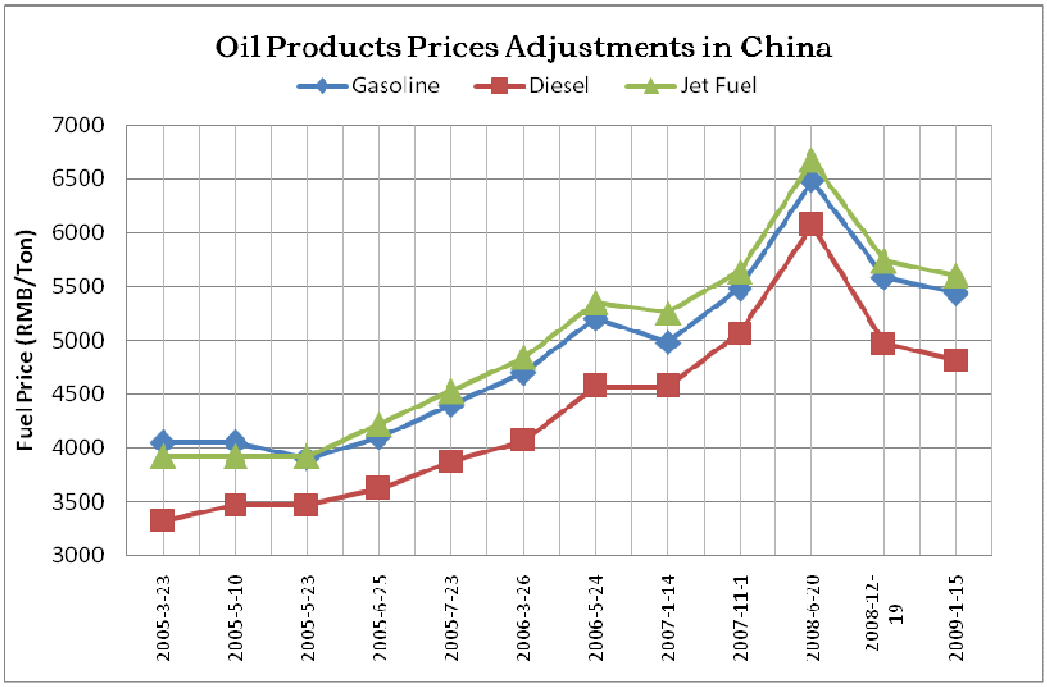
Similar to the electricity pricing reform, the oil pricing reform leads to a higher price increase. It better reflects the market situation of supply and demand, as well as international market conditions, thus optimizing energy resource allocation, and works as an economic incentive for energy conservation.

Besides, while increasing the oil prices, subsidies to agriculture production industries as well as low-income and rural population increase responsively.

Table 2.1 Oil Products Prices Adjustment

Date	**2009/1/15**		**2008/12/19**		**2008/6/20**		**2007/11/1**		**2007/1/14**		**2006/5/24**	
（RMB/ton）	**Price**	**Markup**	**Price**	**Markup**	**Price**	**Markup**	**Price**	**Markup**	**Price**	**Markup**	**Price**	**Markup**
Gasoline	5440	-140	5580	-900	6480	1000	5480	500	4980	-220	5200	500
Diesel	4810	-160	4970	-1100	6070	1000	5070	500	4570	0	4570	500
Jet Fuel	5600	-140	5740	-930	6670	1030	5640	500	5260	-90	5350	500
Date	**2006/3/26**		**2005/7/23**		**2005/6/25**		**2005/5/23**		**2005/5/10**		**2005/3/23**	
（RMB/ton）	**Price**	**Markup**	**Price**	**Markup**	**Price**	**Markup**	**Price**	**Markup**	**Price**	**Markup**	**Price**	**Markup**
Gasoline	4700	300	4400	300	4100	200	3900	-150	4050	0	4050	300
Diesel	4070	200	3870	250	3620	150	3470	0	3470	150	3320	0
Jet Fuel	4840	300	4530	300	4220	300	3920	0	3920	0	3920	0

Figure 2.2 Oil Products Prices Adjustments in China



Column: The Relation between Oil Product Price and Passenger Car Consumption

Passenger cars could be categorized into four types such as basic car, multi-purpose vehicle (MPV), Sport Utility Vehicle (SUV), and cross passenger car. These types of vehicles are what we normally call cars. According to engine displacement, passenger cars could also be categorized into micro-car (V<=1L), small-size car (1L<V<=1.6L), mid-size car (1.6L<V<=2.5L), mid-large-size car (2.5L<V<=4L) and large-size car (V>4L).

Between the year of 2008 and 2009, domestic oil product prices fluctuated in across a wide scale due to the international financial situation, international fuel price fluctuation, and domestic policies. It is a typical period to analyze the fuel price fluctuation situation. Figure 3 shows that oil product price rises to a peak in June 2008 and dropped at the end of the same year.

The consumption of passenger cars is related to the passenger car market and policy conditions. It is also influenced by the international financial crisis, as well as fuel price fluctuation.

Generally, fuel consumption of a passenger car has a positive correlation to the engine displacement. Data analysis shows that the relation between car consumption and fuel price differs to engine displacement.

Figure 2.4 Relation between Passenger Car Consumption Amount and Fuel Price

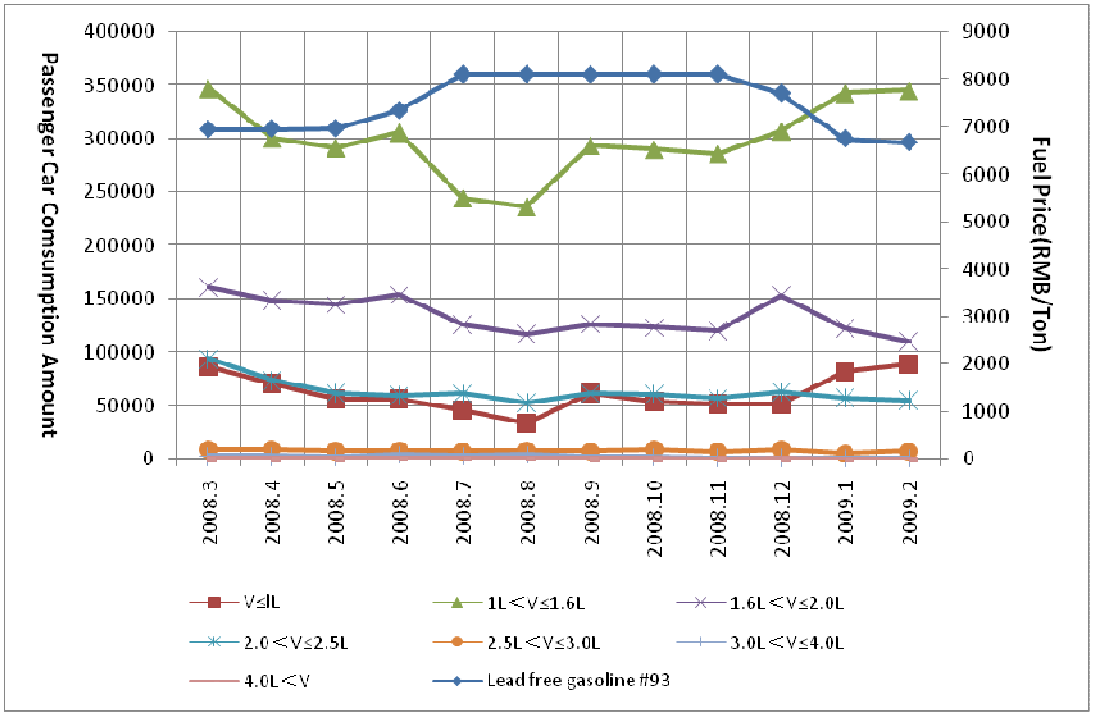


Figure2. 4 illustrates that small-size cars (1L<V<=1.6L) sell best, and have obvious negative correlation with fuel price. Micro-cars (V<=1L) are the top 2 seller, and have

relatively obvious negative correlation with fuel price. However, mid-large sized cars with displacement higher than 1.6L, have smaller sales volume and don't have an obvious correlation with fuel price. This means that small-size and micro cars with smaller displacement are more seriously influenced by fuel price fluctuation. When the fuel price rises, the sales volume of these small displacement cars, which take the largest market share, would decrease; thus the total volume of passenger cars would be controlled.

However, small displacement cars are economic, energy efficient and environment friendly, which should be promoted as the desirable passenger car consumption trend in China. Therefore, when the fuel price rises, the government issues policies to decrease the impact of increased fuel price on the sales volume of small displacement cars, such as de-rating the consumption tax of small displacement cars. In order to control the total fuel consumption of passenger cars, measures such as controlling the number of passenger cars, or decreasing per car fuel consumption could be adopted. The question should be seriously considered as to which path would be more socially and economically effective as well as sustainable..

Natural Gas Pricing Reform

On 26 December 2005, the National Development and Reform Commission issued a circular on a reform of the mechanism for establishing and increasing the price of natural gas production. The circular declared the pricing reform of natural gas. Major contents in the circular include:

Simply price category into fertilizer producing gas, industry gas, and urban gas, and gas from different gas fields are categorized into two grades.

The price is government guided. Government provides a factory reference price, with a 10% fluctuation range determined by the market.

A price linkage and adjustment system was established. Price linkage is established with substitutional energy prices, and gas prices are adjusted every year.

Gas price will gradually be increased. The two grades will achieve a unique price within three to five years.

Current gas prices are as follows:

Grade 1 Gas Price:

Fertilizer Gas: 560-710 RMB/1,000m^3

Industry Gas: 585-920 RMB/1,000m^3

Urban Gas: 560-920 RMB/1,000m^3

Grade 2 Gas Price: 980 RMB/1,000m^3

Retail Price (2007.4): 2.05-2.3 RMB/m^3

Renewable Energy

Apart from the conventional fossil fuels, renewable energies are positively promoted in China. There are various kinds of renewable energies that are under rapid development, such as solar power, wind power, hydro power, biomass, and nuclear power. The prices of renewable energies are relatively high in the early stages. The government has supported their development with abundant technological and fiscal policies. Meanwhile, with technology advancement and the increasing prices of fossil fuels, renewable energies will become more attractive and competitive.

Take the price of nuclear electricity for example. The electricity price of nuclear power varies between different nuclear power plants in China. As the domestic production rate of a nuclear power plant increases, the cost of nuclear electricity is lowered. The electricity price in Qinshan Nuclear Power Plant 2ed Phase is 0.393 Yuan/KWH, which is the lowest national nuclear electricity price. The electricity price of Dayawan nuclear power plant is 0.414 Yuan/KWH, while the average fire electricity price is around 0.387 Yuan/KWH.

2.2.2 Taxation and Fees

Definition

Tax is a distribution means of social products, in order to meet social public needs, according to social functions and is prescribed by law, compulsively and voluntarily. Tax is usually collected by taxation agencies, customs and fiscal departments, and is expended by government budget in social public needs.

Fee is a kind of expense that is charged by government agencies providing certain specific services. It is usually collected by other taxation agencies and institutions. Specific fees are collected for specific expenses.

Fuel Tax

On 18 December 2008, the State Council enacted a Notice on Implementing Oil Products Price and Tax Reform. The Notice also pointed out that it is a good time to promote price and tax reform on oil products, with the continually decreasing international oil price. The price and tax reform is also of great significance in regulating related transport fees and charges, balancing social burden, promoting energy conservation, pollutants emission reduction and industrial restructuring, as well as collecting funds for transport infrastructure construction.

The State Council decided to implement oil products price and tax reform on 1 January 2009. Meanwhile, the highway maintenance fee, sea route maintenance fee, highway transport management fee, highway passenger and freight surcharges, sea transportation management fee, water passenger and freight surcharges were all cancelled. Government loans refunding secondary highway charges will gradually be cancelled. Meanwhile, gasoline consumption tax which is included in the price as 0.2 RMB is increased to 1 RMB per liter. Diesel consuming tax is increased from 0.1

RMB to 0.8 RMB per liter. Other oil product consumption taxes per unit are also increased accordingly. Because the consumption tax is charged in fuel price, so the oil products price won't be further increased.

Resource Tax

Interim Ordinance on Resource Tax, 1993:

Table 2.2 Resource Tax Rate in 1993

Tax item	Crude oil	Natural gas	Coal
Tax rate (RMB/Ton)	8-30	2-15	0.3-2.4

Resource Tax Adjustment:

2007.2, coke: 8Yuan/ton;

2005.5, resource tax of coal: 2.5-4 Yuan/ton;

Summary

In 1993, the state council published the *Interim Regulations on Resource Tax* which was put into effect in 1994. Since its implementation several revisions have been made. Since 2004, government gradually improved the resource tax standard for resources items like coal, crude oil, natural gas and manganese ore. On 1st August, 2007, our government raised to a great extent the resource tax of lead zinc ore, bronze ore and tungsten ore. This adjustment is the greatest in degree since the start of levying on resources in 1994, reflecting our country's purpose to smooth out price and promote energy conservation.

Levying on natural resources, resource tax was designed to adjust resource rank difference revenue and reflect the compensable use of state-owned resources. Current resource tax is a specific duty, with advantages of low management cost and stable fiscal income. However, compared with the high energy prices, the low resource tax, even after adjustments, is weak in functioning as a resource rank different revenue adjustment or improving the efficiency in resource utilization.

Further reform is recommended to transfer the specific duty into ad valorem tax, and raise various tax and fee standards related to environmental protection, in order that energy prices will properly reflect resource scarcity and the cost of resource destruction and environment recovery.

Eco-compensation Mechanism

Regulation on Mine Resource Compensation Fee Levy Collection and Management, the State Council, issued in 1994 and amended in 1997.

Eco-compensation demonstration areas

Eco-compensation standards system

Summary

The mechanism aims at internalization of the external costs of ecological environment, by integrating environment pollution treatment and ecological recovery fees into the production cost of mining companies. The basic principles of the mechanism are from the Coase-Theorem as following: exploiters' protection, destroyers' recovery, beneficiaries' compensation, and polluters pay; the beneficiaries of eco-protection have the duty to pay proper compensation fees to eco-protectors. For instance, in the case of a gas transfer project from area A to area B, the gas receivers and consumers in area B have the duty to pay for compensation fees to area A.

A most important system in the eco-compensation mechanism is that of mineral resource exploitation. Eco-compensation Mechanism of mineral resources is designed to guarantee and improve the exploration, protection and proper exploitation of mineral resources, and to protect the state property right and interests of mineral resources.

The fee rates of oil, natural gas, coal, coal mine methane are 1%, apparently low compared to international levels typically within the range 10% to 16%[18]. The low fee rate underestimates the value of mineral resources, and causes poverty and inequality of the west areas of mineral regions where the compensation fee should have contributed to regional economic and sustainable development.

Thus the rate of mineral resource compensation fee is recommended to increase, transfer from specific duty to valorem duty, and to take into account the interests of local population.

Tax Preference in Favor of Energy Conservation and Pollutants Reductions

Tax preferences are provided for energy and water resource conservation, resource comprehensive utilization and relative tax preference for environmentally sound products. Enterprise income tax is deducted and exempted for companies implementing energy conservation and environmental protection projects and investing in energy conservation and environmental protection equipments.

Enterprise Income Tax Law, 2007.3.19

Article 27: three-year-deduction and three-year-exemption to the enterprise income of environmental protection and energy conservation projects;

Article 33: only 90 % of the income from enterprises with comprehensive resource utilization to produce products in accordance with national industry policies is calculated in total income for tax;

Article 34: 10 % of the investment in specific equipments of energy conservation and water saving is deducted from the total enterprise income tax payable; the equipments

[18] Resource: http://www.mlr.gov.cn/zt/hy/gtlh/gtklh/200711/t20071122_93434.htm .

should be listed in Enterprise Income Tax Preference Catalog of Energy Conservation and Water Saving Specific Equipments.

Promotion List of National Key Energy Conservative Technologies, NDRC, 2005;

National Guiding List on Clean Production Technologies in Key Industries, NDRC, 2006.

Summary

The tax preference is carried out according to the energy conservation and pollutants emission reductions goal in the 11th FYP, and functions as a supporting measure to energy conservation guidance plans such as a Comprehensive Working Scheme on Energy Conservation and Reduction of Pollutant Emissions. The technology lists for energy conservation and clean production are designed as technical guidance to industries for technological upgrades, by applying clean and energy conservative technologies, facilities and processes, thus improving energy efficiency.

2.2.3 Financial Subsidies and Government Procurement

The Chinese government has been making increasing efforts to support energy conservation and emission reduction, and its policy objective is changing gradually from supply side to demand side, that is to guide the consumers' activities and send the signals of energy conservation and emission reduction to producers through the market.

1. Financial Subsidies

The Chinese government invests substantial funds for financial subsidies in promoting products with high energy conservation efficiency including energy conservation and new energy vehicles, air-conditioners and so on and encouraging the "trade old cars and household appliances for new ones" policy. The governmental public fund will enlarge domestic demand when promoting energy conservation and emission reduction by stimulating the participation of more private capital

1) Based on the overall energy consumption level of products and the share taken by products of high efficiency and energy conservation, the government promotes the use of products with an energy efficiency rating of 1 or 2 higher. The products contain ten types such as air conditioners, refrigerators, washing machines, flat-panel TVs, microwave ovens, rice cookers, induction cooker, water heater, computer monitors and motors, and efficient lighting products, energy-conservation and new energy vehicles.

The standard of financial assistance is based on a certain percentage of the price gap between efficient energy-saving products and general products. For example, for room air conditioners of grade 2 energy efficiency, the subsidies are 300-650 yuan/Tai(set) and for that of grade 1, the subsidies are 500-850 yuan/Tai(set).

National Development and Reform Commission, Ministry of Finance jointly issued

the task of the 2009 financial subsidies to promote efficient lighting products. In 2009, the central government invested about 600 million yuan in promoting 120 million high efficiency lightening products, twice that of 2008. It can not only enhance energy conservation and emission reduction and enlarge domestic demand, but also promote enterprise development and benefit urban and rural residents. Firstly, for energy conservation and emission reduction, it is estimated to save electricity by 6.2 billion KWh and reduce CO2 by 6.2 Mt and SO2 by 62 kilo tonnes. Secondly, for consumption demand, it is expected to be enlarged to around 1.5 billion by investing in 600 million yuan of financial subsidies. Thirdly, the financial subsidies can help promote enterprise development by increasing the market share taken by domestic products and decreasing the impact the financial crisis exerting on products export. Fourthly, the financial subsidies can benefit urban and rural residents. By promoting energy conservation products, the electricity consumption will be decreased. Calculating at the electricity price of 0.5 yuan per KWh, there are about 3.1 billion yuan of electricity fees will be saved. Meanwhile, the state requires local government increase their supports for rural and poor areas to benefit people of poverty.

In January 2009, the Ministry of Finance and the Ministry of Science and Technology issued *Interim Management Measures on Financial Assistance Fund for promoting energy saving and new energy vehicles*, and selected Beijing, Shanghai, Chongqing, Changchun, Dalian, Hangzhou, Jinan, Wuhan, Shenzhen, Hefei, Changsha, Kunming, Nanchang as the pilot spots for demonstrating and promoting hybrid vehicles, pure electric vehicles and fuel cell vehicles and other energy-saving and new energy vehicle. The pilot spots also adopt fiscal policy encouraging the use of energy saving and new energy vehicles in areas of public transportation, renting, service, sanitation and postal and other public services and grant subsidies to the departments purchasing such vehicles. The central finance focuses on purchase of energy saving and new energy vehicles while local finance focuses on the relevant facilities building and maintenance.

Currently, the implementation details for widespread use of energy-efficient room air conditioners have been issued. Following the efficient lighting products, energy-saving and new energy vehicles, the air-conditioner becomes another high-efficiency energy-saving product assisted by government subsidies. The government subsidies will be gradually given to refrigerators, flat-panel TVs, washing machines, motors and other products will be gradually implemented.

2) *Imple*mentation Scheme of Promoting Domestic Demand Expansion and Encouraging Trading Old Cars and Home *Appliances for New Ones*

On June 1st, 2009, the State Council approved and published the *Implementation Scheme of Promoting Domestic Demand Expansion and Encouraging Trading Old Cars and Household Appliances* for New Ones made by National Development and Reform Commission and so on. The main points of the Scheme are: encouraging trading old cars and household appliances for new ones by subsidy; further expanding domestic demand, especially consumption, by carrying out efficient incentive

mechanisms; promoting energy conservation and emission-reduction and developing recycling economy. The *Scheme* needs to be in conformity with some of the demand expansion policies such as *Cars and Motors to the Countryside*, *Household Appliances to the Countryside*" and so on, and it will be consistent with the design of *Regulations for the Administration of Recycling and Disposing of Waste Electrical and Electronics Products*, which will be implemented in 2011. The relevant administrations should be simple enough for consumers, while guarantee the efficient use of financial funds.

The *Scheme* proposes the concrete scopes, standards and procedures of the subsidy to trade old cars and household appliances for new ones.

Since the beginning of 2009, 1 billion Yuan for scrap and substitution of old cars has been established. Besides this, 4 billion will be added for proper scrap and substitution of medium-sized, light type and mini type trucks and some of medium-sized bus and high emission vehicles which satisfy the using year limit and give them a subsidy of no more than the vehicle purchase tax of the same type.

Two billion Yuan of financial funds in 2009 will be put into pilot projects for trading old household appliances for new ones which include television, refrigerator, washing machine, air-conditioner and computer in nine areas: Beijing, Tianjin, Shanghai, Jiangsu, Zhejiang, Shandong, Guangdong, Fuzhou, and Changsha. The subsidy will be shared between central finance and local finance in the pilot areas.

3) Subsidies for New Energy and Renewable Energy, such as subsidy for Onto-grid price

For the purpose of promoting the development of new energy and renewable energy and supporting the renewable energy development goal proposed by *Medium and Long Term Energy Conservation Plan, Trial Measures for Renewable Power Price and Expense Sharing Management* was issued by National Development and Reform Commission in January in 2006 based on *Renewable Energy Law*. According to the *Measures*, onto-grid price subsidy would be available for renewable energy electricity, including wind power, biomass power (including power from direct burning or gasification of agricultural and forestry waste residues, waste incineration, landfill gas and biogas), solar power, oceanic power and geothermal power. The renewable energy power price is higher than benchmark onto-grid price of local desulphurization coal fired power generating units. This price gap will be shared in sales of grid electricity of provincial level or above. For example, onto-grid price of biomass electricity is fixed by government, and the state council department in charge of price set benchmark price for different districts. The price standard consists of 2005 benchmark onto-grid price of desulfurization coal fired power generation units and subsidy price. The subsidy price is 0.25 Yuan per kWh and will last for 15 years since the initial operation of the power generation projects.

Since 2007, 3 notifications on price subsidy for renewable power and schemes on quota trade have been continuously issued by National Development and Reform

Commission and State Electricity Regulatory Commission. The latest one is Notification on Price Subsidy of Renewable Power and Schemes on Quota and Trade from July to December, 2008, figuring out that 2 billion Yuan will be put into 222 renewable power generation projects, which will contribute 8.444 billion kWh to power grid.

On July 30th, 2007, the State Council issued *Notification on Establishing the Mandatory Government Procurement System of Energy-saving Products,* ordered that in order to save energy, protect environment and reduce government spending on energy, when financial fund used for procurement by governments at all levels, energy-saving products should be given priority while its technology and service satisfying the purchasing demand, and some of them should be mandatory purchased. It also established the *Management System of the Purchasing List of Energy-saving Products*, figuring out the category of preferred energy-saving products and mandatory products to instruct the government procurement.

Until March 2009, five volumes of *Purchasing List of Energy-saving Products* had been promulgated by Ministry of Finance and National Development and Reform Commission, which including energy-saving products such as air-conditioners, refrigerators and lighting products and some water-saving products.

Emissions Trading System and Other Market Based Instruments

Emissions Trading System

The emissions trading system of pollutants in China, aiming at environmental protection, has a long history of academic research and experimental implementation in different areas. In order to meet up with the mandatory targets set by the 11th FYP, and better achieve the national energy conservation and pollutants reduction goals, specific SO_2 and COD emissions payable allocation and trading plans have been framed and implemented. Besides this, an additional electricity price quota trading system has been carried out for the past several years to encourage and support the development of renewable energy. In recent years, an emissions trading system has been introduced for climate protection such as the establishment of an international carbon market, and CDM projects responsively for China.

Emissions Trading System of Major Pollutants (SO_2 and COD)

Designing aim of emissions trading system: reduce emissions of pollutants by economic incentives, to achieve a win-win situation between environmental protection and economic development

Compulsive energy and environmental protection targets set in the 11th FYP: 10% of major pollutants reduction by 2010 comparing with the base year of 2005. In accordance with and implementation of the 11th FYP, a National Total Amount Controlling Plan of Major Pollutants Discharge During the 11th FYP Period was framed by the Ministry of Environmental Protection and NDRC, and approved by the State Council in 2006.

Two Total Amount Controlling Plans were set on COD and SO_2 discharge within different provinces. The 10% of COD discharge reduction is 12.728 million tonnes, with 12.639 million tonnes distributed to different provinces and 89,000 tonnes for payable allocation and emission trading demonstration. The 10% of SO_2 emissions reduction target equals to 22.944 million tonnes, with 22.467 million tonnes distributed to provinces and 477,000 tonnes reserved for payable allocation and emissions trading demonstration.

Development:

In the 1980's, a pollution levy system was established. It was concentration control; since 1990, a control system of the total volume of air pollutants, discharge permits, and emissions trading was graduated established.

In recent years, emissions trading systems have been tested in demonstration areas in seven provinces: Tianjin, Jiangsu, Zhejiang, Shanghai, Shanxi, Henan, and Guangxi. SO_2 emission rights have been traded in such demonstration areas. Emission trading system of COD was also experimented in Jiangsu and Shanghai, with good effects. However, the scale and general extent of emission trading systems in China falls behind the demands of environmental protection.

Renewable Energy Power Additional Price Quota Trading System

A renewable energy power additional price quota trading system was established and first carried out in 2006 when the initial renewable energy generated electricity price subsidy and quota trading scheme was issued. It was the symbol of the official start of a burden sharing system for renewable energy power generation costs. So far, two schemes have been circulated.

Circular of 2006 on Renewable Energy Electricity Additional Price Subsidy and Quota Trading Scheme, NDRC and State Electricity Regulatory Commission, 2007.9.

Circular of January to September of 2007 on Renewable Energy Electricity Additional Price Subsidy and Quota Trading Scheme, NDRC and State Electricity Regulatory Commission, 2008.3.

Clean Development Mechanism

Measures for Operation and Management of Clean Development Mechanism Projects in China, NDRC, Ministry of Science and Technology, Ministry of Foreign Affairs, 2005.11.29.

Green Trade Policy

Circular on Export Controlling of Certain High Energy Consumption, High Pollution and Resource Intensive Products, NDRC, MOF, MOC, etc, 2005.

Cancel the Export Tax Refund of Parts of Resource Intensive Products and Lower Export Tax Refund Rate of Parts of Resource Products, Ministry of Finance, in order to restrict the export of resource- and pollutant-intensive products.

2007.7.1：2831 products were involved, taking up 37% of the total in customs tariff, within which 553 high energy consumption, high polluting and resource products including liquid petroleum gas are canceled, and the drawback rates of 15 types were lowered, including steel products, to the lowest of 5%;

2006.9.14: export drawback of 3 types of products, including coal and natural gas, are canceled, and export drawback rates of 5 types, including steel and cement, were lowered.

Green Credit System

Notion on Implementation of Environmental Protection Policies and Regulations to Prevent Credit Risks, SEPA, People's Bank of China, and China Banking Regulatory Commission, 2007.7:

For new construction projects which fail environment assessment approval or the check and accept of environmental equipments, no credit support should be offered in any form by any financial institute.

The Green credit system puts an emphasis on both energy conservation and pollution reductions.

In October 2007, China Banking Regulatory Commission published the notification of *Guidelines on Credits Granting for Energy Conservation and Emission Reduction,* making clear that banks and financial institutions cannot grant any credit supports for new established projects that must be restricted or eliminated according to national industry policies; to the present production capacity of restricted scopes which are allowed by upgraded in a certain period, the credit support can be given; to the projects must be eliminated, no new credits should be given and the credits having been granted should be return.

Bank financial institutions should trace immediately the key projects set by the state such as energy conservation projects, renewable energy projects, comprehensive utilization of resources, recycling of waste residues, cleaner production, technology development for energy conservation and emission reduction and industrialization demonstration and promotion, service system for energy conservation, environmental protection industry and so on and take comprehensive consideration of credit risk assessment, cost compensation mechanism and government support policies to satisfy selectedly the credit demand and provide financial services relevant to investment consultation, funds settlement and cash management. Under the same circumstance, bank financial institutions should give priority to the departments or projects awarded or recommended by government for their remarkable contribution to energy conservation and emission reduction.

Government Procurement

Notion of General Office of the State Council on Establishing Mandatory Government Procurement of Energy Conservative Products System, 2007.7.30;

Government Procurement List of Environment Labeled Products;

Government Procurement List of Energy Conservative Products;

2.3 Information, Persuasion, and Encouragement

Energy Efficiency Labeling System: Management Measures on Energy Efficiency Labeling, Products List of Implementing Energy Efficiency Labeling, 2008.6.1;

Energy Consumption per GDP Index Bulletin System, NDRC, 2006;

Management Measures of Green Building Assessment Labeling (Try out), 2007.8;

Energy Conservation Products Authentication Management Regulation, 1999.2.11;

Circular on encouraging energy conservative and environmental protective small displacement automobiles, NDRC, etc, 2005.12.15;

Bulletin of Energy Utilization Conditions in a Thousand Enterprises, NDRC and National Bureau of Statistics, 2007.9;

Nationwide Energy Saving Actions: Notice of the State Council on Deeply Implement Nationwide Energy Saving Actions, 2008.8.1;

Public participation: water price adjustment public hearing, etc.

3 Policy Summary, Assessment and Proposal

Firstly, government departments in charge of pricing should give earlier guidance on the energy price trend to provide the stakeholders and market with an early signal, and facilitate stakeholders to adjust and adapt themselves pro-actively according to the medium and long trends of energy prices. By doing so, it will effectively reduce the high adjustment cost, improve the operational efficiency of the overall economic system and minimize the impact caused by price fluctuation so as to promote social and economic development in a stable and smooth way.

Secondly, policies and instruments for energy productivity must be designed based on the current situation in Chinese society and policy goals, considering both present and future development needs.

Policies and instruments are designed to achieve certain goals, based on the current situation of the society. When applying Chinese policies of energy productivity, we should take into consideration the current Chinese situation that the major social contradictions lie in the backward capacity of social production and increasing material and cultural demands of the people. Therefore, the policy system is designed on the basis of strengthening the country's capability to meet up with the demands of social production and general living standards, while achieving energy conservation

and environmental protection, as well as increasing energy efficiency.

Thirdly, energy productivity policies at the current stage focus more on improving energy efficiency. Further work is needed in researching and introducing policies of system optimization and promoting renewable energies..

A good number of the policies are established to improve energy efficiency rather than considering the whole network of reform or optimization of the energy system. For example, as the highest-level guidance policy of the 11th FYP set the mandatory "energy conservation" target of reducing energy consumption per 10,000 Yuan GDP by 20% by the year of 2010, underneath there are a series of policies designed and carried out to achieve the goal of energy conservation and pollutant reductions, such as the Comprehensive Working Scheme on Energy Conservation and Reductions of Pollutants Emissions, Energy Conservation Law, and so on.

Industrial structure adjustment policy was designed to achieve a better industry structure, via shutting down a number of production processes and equipment in the category of elimination, while others are restricted to limited development or positively encouraged. One of the most important determinants is energy consumption and efficiency improvement. Structure adjustment in seven industries with surplus productivity such as electrolytic aluminum is on the agenda of the government, which is to achieve a better industry structure through system optimization.

Fourthly, command and control instruments are very well applied in China, supported by a set of comprehensive policy systems. Hence there is no substantial policy implementation and enforcement problem due to lack of capacities, suboptimal government structures or missing incentives to follow the command and control. This has been a substantial problem in Western Europe and has led to much more interest in market-based instruments.

As guided by the highest level of the 11th Five-Year Plan, which set a mandatory target to cut down by 2010 energy consumption per 10,000 GDP by 20% based on 2005 figures, clear mandatory targets which were set in various policies in different areas have been carried out. We have the White Book on China's Energy Conditions and Policies as a Medium and Long Term Energy Conservation Plan, The 11th Five-Year Plan for Energy Development, and Comprehensive Working Scheme on Energy Conservation and Reduction of Pollutant Emissions, as well as several other specific sectoral plans and polices. These policies form a comprehensive system to emphasize energy conservation and set clear detailed mandatory plans for the targets, covering various aspects in different energy industries.

Fifthly, market based instruments are becoming more and more important, are expected to play a major role in the instrument mix.

Market-based mechanisms are considered to be the key mechanisms to achieving better resource allocation and to improve energy utilization efficiency. Along with institutional and management system reform, pricing reform of major energy resources and taxation reform have taken place for the past decades. At present, coal

and crude oil prices are connected to international markets, and determined by market demand and the supply situation. The leverage of price plays its part here. Besides, electricity pricing and oil products pricing mechanisms have transformed from government instruction to government guidance, with price linkage with coal and crude oil.

Fuel tax, which has been charged since 1 January 2009, is a great progress in China's oil price reform. Fuel tax could not only improve per vehicle fuel economy which gives a strong economic stimulation to drivers to reduce their drive miles, as well as improve energy efficiency and system optimization in order to enhance energy productivity. Although the implementation of fuel tax helps domestic fuel price to be better connected to the international price, the current electricity price and oil product prices are still lower than the international average. The government sector is expected to further open the energy market to transfer to market-based determination mechanisms.

Apart from pricing mechanism reform, resource tax and eco-compensation fees are expected to be perfected and the rates to rise to proper standards, better reflecting the scarcity of the energy resource, the cost of resource destruction and environment protection, as well as behaving as an economic incentive to the consumers to achieve industrial and nationwide energy conservation. In addition, new taxes such as fuel tax are recommended to be implemented, not only to achieve higher fuel efficiency in single cars, but also a strong economic incentive to steering motorists to reduce their total driving miles, which in turn improves energy productivity by both energy efficiency and system optimization.

However, the public sector should also consider social equity and take the social system as a whole. If the energy prices are increased sharply in a short time, or the tax rates are raised by a large extent, social economic issues such as inflation, as well as agriculture production and the living standards of the low-income population should be fully taken into account. Therefore, steady yet increasing energy prices as well as taxes are recommended to achieve better energy productivity, taking full advantage of the market mechanism and the leverage of prices.

Sixthly, nationwide and continuous energy saving actions are needed.

Nationwide and continuous energy saving actions are greatly encouraged in China. A recent notice on that was issued by the State Council to advocate all the population to take actions to reduce energy consumption. Such measures could be a huge contribution in improving energy productivity. Once the concept of energy productivity is established nationwide, the ideology will have a great impact not only in daily life energy saving but also in decision making by the people in charge of various industries.

Besides, the ideology of welfare could be discussed and redefined that when we invest more and more energy to improve our living standards, do we really enjoy the multiplying piling of energy products?

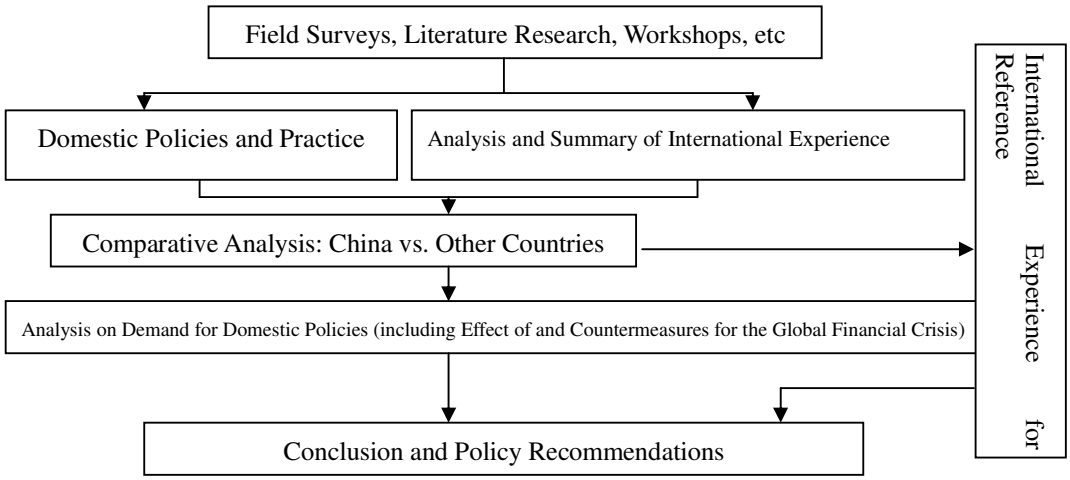
Chapter 3: A Study of the Green Credit Policy in China

0 Foreword

"Green Credit" is a concept developed in China and refers to policies, institutions, and practices that leverage on credit as a financial instrument to promote energy efficiency and emission reduction. Green Credit consists of two key dimensions: The first is the use of preferential credit policies and measures (which include loan term, interest rate and credit limit) to support initiatives or companies involved in environmental protection and energy-conservation. The second is the use of retributive measures such as loan suspension, delay in release of loan proceeds and even loan withdrawal against initiatives and companies that have violated environmental protection and energy efficiency laws and regulations. Green Credit is very similar to the international concept of sustainable finance. Although sustainable finance is more broad-based and comprehensive, both represent an increasing involvement in the delivery of social and environmental responsibilities by the financial sector, where financial institutions act either as vehicles of government initiatives or from their own environmental concerns. Green Credit is an important financial instrument that deters companies from breaching environmental laws, promotes energy efficiency and emission reduction, and hedges against financial risks.

Recent years saw Green Credit start to capture growing attention from the Chinese, especially after the promulgation of *Opinions on Implementing Environmental Protection Policies and Regulations to Prevent Credit Risks* by the State Environmental Protection Administration (SEPA), the People's Bank of China, and China Banking Regulatory Commission (CBRC) in 2007. As a highly dynamic environmental and economic policy, Green Credit has become a key market lever for promoting energy efficiency and emission reduction. It has received widespread attention and emphasis from the environmental protection and financial sectors and from the broader society, within China and also internationally.

Figure 3.1 Roadmap for the Special Topic of Green Credit



With the current financial crisis, balancing credit demand with credit security has become increasingly difficult. While capital is critical for company survival and growth, credit risk has become the most important consideration amongst financial institutions. In the meantime, with the Chinese government's adoption of an economic stimulus package, huge amounts of funds were plunged into the market, triggering a rapid expansion in the scale of credit. The newly-added 7-trillion-yuan-plus credit in Q1 2009 alone has sparked widespread concern about issues such as the orientation of credit; the imbalance of economy, environmental protection, and social benefits; and the generation of a new round of non-performing loans. However, with Green Credit, funds are channelled to initiatives and companies that generate economic, social and environmental benefits, while those that heavily pollute and damage the environment are prevented from obtaining credit. Hence, Green Credit helps ensure that China "maintains growth, restructures the economy, and promotes development".

This study – which includes field surveys, literature research, and interdepartmental collaboration – provides a detailed analysis and summary of the achievements and challenges of the Green Credit program. Foreign experiences were explored and comparative studies on local and foreign policies and practices were carried out. The study also contains policy recommendations.

1 Development and Implementation of Green Credit

1.1 Background

1.1.1 Lack of effective control of "highly polluting and high energy consumption" ("double high") sectors poses a serious challenge to environmental protection

Achievements in social and economic development over the past three decades since the country's reform and opening-up have made China one of the world's most exciting development stories. China's global GDP ranking has risen from 15th in 1978 to 4th place in 2008. Per capita GDP grew by an average of 9.1% every year, from USD 190 in 1978 to USD 2, 360 in 2008[19]. Despite the sterling performance, haphazard (*cufang xing*) economic growth, population pressure, ever-rising consumption levels, and rapid economic growth and urbanization have put the environment under tremendous stress. Environmental issues and pollution problems pose serious challenges. As such, despite a host of State-driven initiatives, China has missed the environmental goals set in its tenth Five-Year Plan.

Meanwhile, the relatively high business returns from "double high" sectors have attracted bank and private funds, despite being environmentally-and socially-detrimental. Hence, the continued robustness of these sectors negates the

[19] National Statistics Bureau of China, 2008. "Part 16 of the Series of Report on Achievements in China's Economic and Social Development During the 30 Years since Reform and Opening-up". http://www.stats.gov.cn/tjfx/ztfx/jnggkf30n/t20081117_402517351.htm (accessed on April 6, 2009).

country's efforts to become more "green". Statistics from the CBRC show that until the end of March 2007, the balance of loans extended to the "double high" sectors by the Industrial and Commercial Bank of China (ICBC), Agricultural Bank of China, Bank of China, Construction Bank of China and Bank of Communications amounted to RMB1.332639 trillion, accounting for 11% of total loan balance of the five banks. Newly-added loans to the "double high" sectors[20] by the five major banks amounted to RMB81.518 billion in 2007, representing an increase of 6.5%. By the end of May 2009, the balance of medium- and long-term loans to the "double high" sectors extended by major financial institutions reached RMB2.310892 trillion, an increase of 23.43%, year-on-year. The implementation of an economic stimulus plan is expected to provide even more impetus to the "double high" sectors.

The survey also indicates that in regions, such as Shaanxi Province, Shanxi Province, and Inner Mongolia Autonomous Region, with a large number of "double high" enterprises, huge amounts of private capital are provided through illegal money shops to support the development of small- and medium-sized "double high" enterprises. Meanwhile, considerable amounts of money are provided by small- and medium-sized banks, especially banks catering to the needs of rural areas, which fuel the development of small- and medium-sized "double high" enterprises.

If economic growth and return on investment cannot reconcile with protecting the environment, and if capital flow to the "double high" sectors and the quantum of such capital cannot be effectively controlled, existing environmental measures -- which are meant to address environmental problems as pollution and ecological degradation -- will be futile. This means that energy efficiency and pollution abatement goals will remain an elusive challenge.

1.1.2 New and innovative environmental management techniques must be developed; Green Credit provides an important inroad

Over a long period, mandatory control measures have played a key role in China's environmental management strategy. Nevertheless, the excessive use of mandatory control measures has given rise to a series of problems. With the constant development and improvement of China's market economy, the disadvantages of mandatory control measures have become increasingly evident, and can be mainly characterized as high cost, low effectiveness, and the lack of sustainability. As a result, the Chinese government began to examine its policies and instruments for environmental management, and found that it is hard to reverse the current situation of China's environmental protection merely by using administrative and legal levers. It is necessary to leverage economic means, such as the market, to propel the conversion of environmental behaviors of economic entities as a way to promote energy efficiency and emission reduction, which will be conducive to increasing the effectiveness of environmental management. To this end, Premier Wen Jiabao proposed the "three historic changes" for environmental protection, of which the third

[20] The "double high" sectors in statistics mainly refer to the industries of petroleum processing and coking, chemical engineering, building materials, metallurgy and electric power.

one is embodied in the methodology of "addressing environmental problems through comprehensive use of legal, economic, technical and necessary administrative measures rather than mere use of administrative levers". Such an orientation emphasizes the effective use of economic and environmental measures, which is targeted at improving the level of environmental protection by observing economic and natural laws.

Compared with the traditional mandatory control measures, environmental and economic instruments can be highly efficient in terms of implementation, offer flexible mechanisms, and have long-term effect. Currently, China is emphasizing the acceleration of pattern transformation of economic growth and economic structure adjustment as the primary means to sustain economic growth in order to cope with the global financial crisis. This has provided a great opportunity for the adoption of environmental and economic policies to optimize economic growth. The environmental and economic instruments lie in the adoption of economic levers, such as price, taxation, financial instruments and financial institutions to adjust economic relations of entities, which can help to protect the environment and coordinate environmental optimization and economic development. Presently, China is stepping up efforts to develop such economic policies; for example, environment taxation policies, green credit policies, environmental pollution liability insurance policies, green securities policies, green trade policies and so forth, amongst which, green credit policy has provided an important inroad.

1.1.3 Increasing Credit Risks Caused by Environmental Problems Provoked Serious Concern from the Banking Sector

With intensified efforts on energy conservation and emission reduction on the part of the Chinese government, a large number of highly-polluting enterprises have been forced to close or restrain production due to more stringent environmental supervision and management regulations, posing a negative influence on the security of credit funds of financial institutions. The increase in non-performing loans caused by environmental problems has urged banks and other financial institutions to prudently consider environment-related financial risks, and take credit management and risk control measures accordingly. Statistics of the CBRC show that by the end of March 2007, the balance of non-performing loans of five major banks extended to the "double high" sectors had totaled RMB43.709 billion, with an NPL ratio of 3.28%. Cement (RMB15.656 billion), steel (RMB11.131 billion) and electric power (RMB9.255) represent the three sectors with the largest NPL balance. Within this, the three sectors with the highest NPL ratio are calcium carbide, ferroalloy, and cement, with NPL ratios of 28.8%, 27.6%, and 20%, respectively. A survey conducted by the Ministry of Environmental Protection (MEP) on Shanxi's implementation of Green Credit shows that since the adoption of "region-based limitative ratification" policy in Lvliang city in 2007, 191 of the city's enterprises that fell short of environmental protection requirements had been closed down, resulting in bank credit risk of more than RMB600 million. Hence, the banking sector exerts a strong demand for policies

that help avert and control credit risks caused by stringent environmental supervision.

Box 3.1 Environmental and Social Risks of China's Banking Sector

In 2005, the Industrial and Commercial Bank of China, Agricultural Bank of China and the Sichuan Branch of China Development Bank made investment of RMB4 billion, RMB4.663 billion and RMB11 billion respectively with total amount of loans of RMB19.663 billion (USD2.4 billion) on the construction of Projectlof cascade hydropower station of Jinping Phase I hydropower station. The project is described as "the largest single construction project in West China financed by Chinese-funded banks."

When the plans for log mechanical transportation by floating were started at the dam of the Ertan hydropower station, environmental protection volunteers and the Ertan Sub-branch of the China Construction Bank, after joint investigation and evaluation of the forest resources at the upper reaches of the Yalong River, found out that the implementation would result in deforestation of 800,000 cubic meters annually, which would lead to irreversible ecological damage to water and soil conservation. The evaluation has resulted in the decision of government departments to terminate the construction of the log mechanical transportation project at the dam of the Ertan hydropower station.

(Source: Tao Qingmei, Environmental, social risk and liability of the banking sector)

In addition, the constant growth of China's economic strength has spurred the year-on-year increase of the country's external investment. In 2005, the total quota of external loans ratified by the Export-Import Bank of China amounted to USD20 billion. Some investment projects, however, were criticized by the international community for neglecting local social and environmental problems. Such criticism has urged Chinese investors to pay more attention to the social and environmental interests of overseas' local communities, particularly with trade and investments in African nations.

1.1.4 Common Needs between the Environmental Authorities and Banking Sector are Driving Force of Green Credit in China

Despite tightened environmental supervision and rigorous punitive measures taken by environmental departments over the past years, the highly-polluting sectors with high energy consumption have seen rapid development accompanied by serious pollution. Given this, the environmental authorities are keen to adopt comprehensive measures in collaboration with banks and other economic departments to control the development of highly-polluting sectors and enterprises with high energy consumption, as a way to reduce pollution at source.

Meanwhile, credit risk arising from China's environmental protection campaign and public pressure from overseas countries have urged the banking sector to re-examine the position and functions of environmental and social issues in managing the risk of bank loans. The Chinese government's vigorous advocacy and implementation of a scientific outlook on development have urged the banking sector to attach more importance to supporting environmental protection and promoting sustainable development of society by means of credit instruments.

It is under such political, economic, and environmental circumstances and with the active support of environmental departments and close cooperation and promotion of

financial departments that Green Credit has rapidly developed in China and received widespread attention from various circles of the society, exerting far-reaching influence. So far, Green Credit has become an important environmental and economic policy for environmental protection authorities and the banking sector to jointly crack down on environment-related illegal acts of enterprises, to promote energy efficiency and emission reduction, as well as to avoid financial risks arising from non-performing loans due to environmental mismanagement.

1.2 Green Credit – History of Development

1.2.1 Preliminary Phase (1995-2006)

To strengthen the support of financial sector for environmental protection, the People's Bank of China (PBOC) issued *Circular on Relevant Issues Regarding the Implementation of Credit Policy and Enhancement of Environmental Protection* in February 1995. This Circular requires financial departments to attach importance to the protection of natural resources and environment in offering credit, and to place make protection of ecological resources and pollution prevention a key consideration for banks to provide loans. Financial institutions at all levels are required to take into consideration the result of environmental impact assessment and evaluation results of the implementation of design, construction and operation of environmental protection facilities in parallel with that of the main construction (abbreviated as "the three concurrent implementations") when extending loans. Enterprises that fail to pass the environmental impact assessment will not be granted loans. Moreover, enterprises that fall short of the requirements of the "three concurrent implementations" will have loans suspended, or loan support for working capital will be terminated. Banks should not extend loans to enterprises and projects that do not conform to the nation's industrial policies, and loans that have already been extended to such enterprises and projects should be withdrawn. With regard to sectors that are strictly restricted by the government, loans should not be granted unless ratified by environmental protection authorities. Credit support should be provided to enterprises and projects which can promote environmental protection and are conducive to improving ecological environment. Banks may extend loans to selected enterprises based on their economic benefits and loan repayment capacity.

On April 30, 2004, the National Development and Reform Commission (NDRC), PBOC and CBRC jointly issued the *Circular on Relevant Issues Regarding Further Strengthening Industrial Policies and Credit Policies to Support the Control of Credit Risks*. In particular, this Circular indicates that credit support should be preferentially provided to projects with controllable risks within the encouraged project category; credit support should not be provided to newly-built projects which fall into the restricted and obsolete project categories; with regard to existing production capacity within the restricted category which is allowed by the government to adopt upgrade measures within a specified term, credit support can be continued in line with the

credit principle; with regard to projects that fall into the obsolete project category, all types of newly-added credit support should be terminated, and measures should be taken to withdraw the loans that have already been extended.

The SEPA and China Development Bank entered into long-term, stable and development-oriented financial cooperation as evidenced by the conclusion of the *Framework Agreement on Development-oriented Financial Cooperation* in October 2005. China Development Bank pledged to extend policy-oriented loans of up to RMB50 billion in five years to projects designated in the nation's 11th Five-Year Plan for environmental protection, and provide long-term and stable financial support to significant construction projects of environmental protection and large-scale environmentally-friendly enterprises. In the same year, the PBOC and the SEPA jointly established the cooperation mechanism that incorporates environmentally-related law enforcement information into the credit investigation management system, which refines the system framework of Green Credit policy.

Unfortunately, early Green Credit policies did not draw significant attention of environmental protection authorities nor did they receive active response and implementation from the financial departments. The reasons could be boiled down to insufficient demand of environmental departments and the banking sector for Green Credit policy, the lack of impetus to implement, and unfavorable factors, such as deficiency in restrain mechanism and difficulty in accessing information.

1.2.2 Rapid Growth Phase (Since 2006)

With China's increasing gravity of environmental protection and the great priority given by the government to energy-saving and emission reduction, the establishment of a long-term mechanism and the adoption of comprehensive measures and economic policies to promote energy saving and emission reduction have become more imperative. Under such historical circumstances, Green Credit as an indispensable part of environmental and economic policy has recaptured attention from the government, and has witnessed rapid development. Since 2006, the SEPA, CBRC, PBOC and other departments have jointly conducted policy consultations and investigations for further perfecting the Green Credit policy, and have issued a series of policy-oriented documents for further improving Green Credit, which mainly include *Guidelines on Improving and Strengthening Financial Service in the Field of Energy Saving and Environmental Protection* issued by the PBOC, *Opinions on Implementing Environment Protection Policies and Regulations and Preventing Credit Risks* jointly issued by the SEPA, CBRC and PBOC, *Circular on Preventing and Controlling Credit Risks of Highly-polluting and Highly Energy Consuming Sectors* and *the Guidance on Credit Extension for Energy Saving and Emission Reduction* issued by the CBRC. The SEPA, CBRC, PBOC and other authorities have also signed a cooperation agreement to incorporate environmental protection information into banks' credit investigation system and to promote communications and the exchange of information amongst each other.

The promulgation of the *Opinions on Implementing Environment Protection Policies and Regulations and Preventing Credit Risks* demonstrated the firm determination of environmental protection authorities and the competent departments within the banking sector to jointly promote the development of Green Credit. The promulgation is primarily targeted at strengthening environmental supervision and standardizing credit management, taking enterprises' fulfillment of environmental policies and regulations as a key consideration for credit management, and taking enterprises' compliance with environmental laws as the prerequisite for the extension of loans.

The Green Credit policy currently in force is designed in conformity with the fundamental policy framework and levers the early experience in developing Green Credit. The current policy has enriched the contents with respect to strengthening the examination of environmental performance and improving information exchange between financial and environmental protection departments, which has made the Green Credit policy more operational in its implementation. To support the implementation of the policy, the environmental protection departments, bank regulatory departments and branches of the PBOC of many provinces and municipalities entered into cooperation and jointly issued a great deal of local Green Credit policies, which have further enriched and promoted the policy and made the policy more operational. These efforts have pushed Green Credit onto the fast track.

1.3 Green Credit Policy and Operations

1.3.1 Relevant National Policies

As stated above, the People's Bank of China ("PBOC") issued the *Circular on Implementing Credit Policies and Strengthening Environmental Protection* in 1995. This Circular clarified the basic contents and form of Green Credit policy, which is of great significance to China's implementation of the policy. After that, the Green Credit policy has witnessed continuous development and improvement in its contents. Several critical documents have constituted the essential part of the policy:

(1) Opinions on Implementing Environmental Protection Policies and Regulations and Preventing Credit Risk

In July 2007, the former State Environmental Protection Administration (SEPA), PBOC and CBRC jointly issued *Opinions on Implementing Environmental Protection Policies and Regulations and Preventing Credit Risk* in a bid to perform credit control on enterprises and projects that disregard industrial policies and commit environmental offences, and to check the irrational expansion of high energy consuming and high polluting industries.

According to the *Opinions,* the cooperation and interaction should be tightened amongst the branches under SEPA, PBOC and CBRC as well as the financial institutions at all levels in order to strengthen environmental supervision and increase credit safety, bolster environmental protection by tightening up credit management,

consolidate economic constraint and supervision of corporate environmental offences, and ultimately change the situation where enterprises acting in conformity with environmental laws have to bear higher costs than those violating environmental laws.

The *Opinions* requires enterprises to tighten up environmental supervision and credit management of newly-built projects in accordance with environmental laws and regulations. Environmental protection departments at all levels should tighten examination and approval of environmental impact of construction projects, and seriously strengthen the "three concurrent implementations" management for environmentally-friendly facilities of construction projects. Financial institutions should comply with the State's administrative regulations on environmental protection of construction projects and situations reported by environmental protection departments to tighten examination, extension and supervision of loans. According to the *Opinions*, any form of credit support should not be supplemented for projects that have failed to pass environmental impact evaluation or acceptance-checking of environmentally-friendly facilities. Financial institutions at all levels should strengthen credit management and take effective measures to control loan extension and guard against credit risks when examining enterprises' application for current fund loans, based on information provided by the environmental protection departments.

The *Opinions* also indicates that environmental protection departments and financial institutions at all levels are expected to team up with each other to establish information-exchange mechanisms. Environmental protection departments should provide financial institutions with environmental information according to their authority and provisions of *Measures for the Publicizing of Environmental Information (Trial)*. The PBOC and all its branches should guide and urge commercial banks to put into practice the State's industrial policies and environmental protection policies and incorporate environmental protection information into basic database of corporate and individual credit information to ward off possible credit risks.

(2) Guidance on Credit Extension for Energy Saving and Emission Reduction

In November 2007, the CBRC mapped out *Guidance on Credit Extension for Energy Saving and Emission Reduction*, which requires financial institutions in the banking sector to adjust and optimize their credit structures in parallel with the State's economic restructuring in an effort to effectively prevent credit risks.

The *Opinions* defines the credit principle of "differential treatment", as follows:

The first is to control credit for projects falling into the categories of restriction and elimination. Financial institutions of the banking sector should not provide credit for new projects that fall into the State's category of restricted and eliminated industries. For existing production capacity that falls into the category of restricted industries, which is allowed by the State to be upgraded within a certain period of time, credit support can be continued based on the credit principle. For projects that fall into the

category of elimination, any form of newly-added credit support should be terminated in principle, and measures should be taken to recover the extended credit. For credit applicants that have high energy consumption and pollution as confirmed and published by the authorities in charge of energy conservation and emission reduction, while have not implemented effective corrective measures, the banking institutions should not issue any new credits in addition to credits related to correcting such problems, and should gradually reduce and recover any previous credits. For enterprises and loan projects on the list of backward production capacity, as published by the national and provincial development and reform commissions or other related departments, they are expected to take rational, effective measures to adjust, reduce and recover credits related to backward production capacity over time. Credits should be strictly controlled for regions on the list of "regional restricted approval" or "watershed restricted approval", as published by the national environmental protection departments. Banking institutions should not offer financing and guarantee services for construction projects in the form of current fund loans, acceptance bills or other on-book or off-book modes despite the relevant project credit procedures.

The second is to provide key support for projects encouraged by the State. Banking institutions should satisfy the credit demands for key energy-saving projects, renewable energy projects, water pollution control projects, sulfur dioxide control projects, pilot projects of circular economy, water resources conservation and utilization, comprehensive utilization of resources, waste recycling, clean production, R&D of energy-saving and emission-reducing technology as well as industrialization modeling and promotion, energy-saving technical service system and environmentally-friendly industry, and arrange financial services such as investment consultation, fund clearing and cash management. A favorable credit policy is provided for enterprises and projects that have received support from national and local financial and tax policies and have been commended and recommended by the national authorities for their obvious energy-saving and emission-reducing effects. Credit policies should vary across different regions, and preferential credit support should be available for enterprises and projects in the regions with significant energy-saving and emission-reducing effects, confirmed by energy-saving and emission-reducing indicators in all the provinces, autonomous regions and municipalities directly under the Central Government as published by related national departments.

Additionally, the *Opinions* raises rigorous demands for credit management work performed within banking institutions, as follows.

The first is that strict compliance review (this refers to the fact that it is imperative to comply with the regulations and demands like: industrial policies and market access standard, project review and approval or archive-filing procedure, pre-review for land use, review and approval of environmental impact evaluation, credit, safety and urban planning) is imposed on "six necessary conditions" for launching and constructing the projects. The minimum demand for a compliance review of project credit is that the project has passed the review and received approval from the authorities concerned,

and that the project environmental assessment matches the general demands of planning environmental assessment, and the technical and economic standards, in principle, live up to advanced standards, both at home and abroad.

The second is to strengthen the appropriation management of credit fund involved in project construction. Funds should not be appropriated in advance for pre-construction preparation and construction for projects that meet examination and approval standards of environmental assessment but fail to obtain approval. For environmentally-friendly facilities where the principal part differs in terms of the schedule of design, construction and operation, fund allocation should be suspended for the construction of the principal part of the project until the "three concurrent implementations" have been achieved. The project operating fund should not be allocated to completed projects that should receive and have not been examined and received approval of environmental assessment for completed projects. With regard to projects that are invested in and constructed by domestic enterprises abroad, the banking institutions should urge the construction enterprises to comply with related environmental protection laws and regulations in credit management, and to act upon effective international practices for assessing and controlling environmental and social risks of international financing projects.

The third is to perform categorized management. Banks with adequate conditions should conduct categorized management for the extent of environmental impact based on various loan projects. Banking institutions should demand that the construction units and even third parties of considerable importance, including contractors, suppliers and supervisors, establish and execute management systems and action plans for environmental impact as well as the communication system and monitoring, assessment and reporting (publication) system with the local community and the public, and supervise and assess the mechanism, capacity and result of environment risk control through an independent third party for projects that have seriously changed the original environmental form and caused undesirable environmental and social results, which are difficult to eliminate or easy to eliminate through relief measures. The banking institutions should pay due attention to environmental risk control of construction units if the projects can't result in any negative and obvious environmental and social results.

(3) Guiding Opinions of the People's Bank of China on Improving and Strengthening Financial Service in the field of Energy Conservation and Environmental Protection

In June 2007, the PBOC issued the *Guiding Opinions of the People's Bank of China on Improving and Strengthening Financial Service in the field of Energy Conservation and Environmental Protection*. According to the *Opinions*, all banking institutions should earnestly implement the State's environmental protection policies, tighten credit management, take examination and approval of environmental protection assessment as a consideration for credit utilization, keep a tight control on credit amounts made available for high energy consumption and high pollution

industries, and accelerate the credit withdrawal process for out-of-date production capacity and technologies. All banking institutions should conduct research on the characteristics of developing an energy-saving and environmentally-friendly industrial economy, innovate financial products and the credit management system, fully utilize the leverage of financial funds, and establish a long-term mechanism of credit support for technical innovation in the fields of energy conservation and emission reduction as well as the technical transformation of energy conservation and environmental protection. According to the *Opinions*, all PBOC branches should intensify communication and cooperation with environmental protection departments, further promote the integration of corporate environmental protection information into PBOC's corporate credit system, and start with the information concerning corporate environmental offences according to the principle of "overall planning and step-by-step implementation" to incorporate information into the corporate credit system relating to the examination and approval of corporate environmental protection, environmental protection certification, clean production auditing and reward for advanced work with respect to environmental protection.

1.3.2 Operations and Results

(1) Continuous Improvement in Information Exchange between Environmental Authorities and Banking Sector

To facilitate the efforts of the banking sector to implement Green Credit policy, the Ministry of Environmental Protection (MEP) and the CBRC concluded an information-sharing agreement in January 2008, which is the first agreement of this kind between an environmental protection department and economic department. Currently, MEP has provided CBRC with four batches of information. The CBRC has provided commercial banks with over 13,000 pieces of information concerning corporate environmental offences, which were unearthed in the special campaign of environmental protection in 2007. In March 2008, the MEP issued the *Circular on Regulating the Publication of Corporate Environmental Offences Information by the People's Bank of China's Credit System*. So far, nearly 40,000 pieces of environmental protection information have been input into PBOC's credit management system. Some commercial banks have controlled or recovered loans made to enterprises based on this information.

(2) Local Green Credit Policies

Following the promulgation of national Green Credit policies, all local branches under MEP, CBRC and PBOC have actively responded to the implementation of Green Credit policies, and have promulgated a series of more operable green credit policies at local levels. According to incomplete statistics, the environmental protection departments, banking regulatory departments and branches under PBOC in more than 20 provinces and municipalities, such as Fujian, have jointly issued local policy documents, such as administrative measures and an implementation scheme of Green Credit. For instance, Shanxi Province issued the *Circular on Several Issues*

Concerning the Implementation of National Environmental Protection Policies and Control of Credit Risk. Fujian Province issued *Circular on Fully Implementing Green Credit Policies and Integrating Corporate and Individual Environmental Protection Information into the People's Bank of China's Credit System*. As another example, Jiangsu Province issued documents demanding that the corporate environmental behavior grade -- as rated by the environmental protection department -- and the information about corporate sewage charge in arrears be integrated into the basic database of corporate credit information. Qinghai Province issued the *Circular on Several Issues concerning Information Collection and Reporting*. The Department of Environmental Protection of Henan Province designed a "blacklist" system for enterprises with environmental offences. Shenyang issued the *Circular on Strengthening Environmental Protection Examination and Approval Management of Construction Project Loans and Implementation Scheme for Enterprises Sharing the Environmental Protection Information*. Shenzhen formulated the *Administrative Measures for Integrating the Shenzhen Corporate Environmental Protection Information into the Bank Credit System*. Jiangyin designed a *Guideline for Corporate Credit Policies Based on Classified Evaluation of Environmental Protection in Jiangyin*. Recently, Hebei Province created special checkup measures for the implementation of performance assessment for Green Credit policy.

(3) Commercial Banks' Enthusiastic Response and the Implementation of Green Credit

All commercial banks have positively responded to the Green Credit policy, and they study, design, and implement related measures. According to the requirements from CBRC's *Guiding Opinions on the Credit Work for Energy Conservation and Emission Reduction*, all of the commercial banks have formulated the administrative system and measures for risk control of the internal credit environment. Some commercial banks, such as the Industrial and Commercial Bank of China and the China Construction Bank, not only built a rigorous examination and verification mechanism for project environment, but also used the "one-vote-down" system of environmental protection for credit review and approval. The commercial banks' active participation and practice enabled China's Green Credit policy to play a positive role. Currently, the country's Green Credit policy is an active environmental and economic policy that has attracted considerable attention from the whole society and environmental protection and financial sectors. This policy has developed into a critical market approach for promoting energy efficiency and emission reduction, which has attained positive results.

Table3.1: Summary Table of Some Commercial Banks' Implementation of Green Credit Policy

Institution	System construction	Major practice	Result
Industrial and Commercial Bank of China	Opinions on Promoting the Construction of Green Credit have been promulgated; The "one-vote-down" system of environmental protection for credit review and approval has been established.	Loans are not issued for projects which mismatch environmental protection policies, and the enterprises and projects on the list of "regional restricted approval" should have all the credit supports suspended before the "restricted approval" is suspended.	In 2007, this bank recovered loans from 140 customers in "high energy consumption and high-pollution industry", reclaiming a total sum of RMB 5.1 billion.
China Construction Bank	The "one-vote-down" system of environmental protection for credit review and approval, and the strict credit risk management system have been established.	Before the rectification work for environmental protection is completed, any form of new credit support will not be issued for related regions, enterprises and projects. For enterprises and projects whose rectification work can not be implemented within a short time, the existing loans will be reduced or even withdrawn as soon as possible.	
Bank of Communications	Measures of Bank of Communications for the Implementation of Green Credit Project; Operation Manual of Classification Standard for Environmental Protection Labels have been promulgated.	Bank of Communications, according to the credit clients and projects' environmental impacts, classifies all the clients into three main categories including red, yellow and green, and seven minor categories for classified management.	By the end of May 2008, it had reduced the number of risky clients by 177 following the year-beginning cut, involving a loan balance of RMB 1.835 billion.
China Industrial Bank	In 2008, China Industrial Bank announced the use of Equator Principle, becoming the first domestic bank to adopt Equator	It promoted the "energy efficiency financing" project. The sustainable financial center is especially responsible for the operation, management and	It introduced new financing products, like "energy efficiency loans". In this project, China Industrial Bank provided a loan of RMB 0.9 billion for 46

	Principle. China Industrial Bank has also created the sustainable financial center.	marketing of carbon finance, energy efficiency finance, environmental finance and other sustainable financial business.	energy-saving and emission-reducing projects in China. It was the regional winner of the 2009 FT Sustainable Emerging Markets Bank of the Year Award for the Asia Region.
Shanghai Pudong Development Bank	Cooperating with IFC, Agence Française de Développement （AFD） and other domestic and foreign financial institutions, Shanghai Pudong Development Bank has designed a series of innovative green financial service products.	It is the first domestic commercial bank to introduce the financial solution for green industry; namely, the comprehensive service solution for Green Credit, supporting good performers and punishing poor performers.	*
China Merchants Bank	It joined the green finance action of the United Nations Environment Program, and designed the action plan.	*	A total loan of RMB 8.774 billion for projects in renewable energy, clean energy and the environmental protection field was issued. Additionally, 35 enterprises, involving RMB 792 million, were placed on the list of pre-warning clients, in the first half of 2008. All of the loans, a sum of RMB 105 million, from 14 enterprises were recovered.

Notes: * The research team has not received related data and information.

(4) Great Credit supports for energy-saving and emission-reducing projects offered by banks

The implementation of Green Credit policy has urged banks to perform rigorous standards on credit management and examination of high energy consumption and high-pollution industries, resulting in a constant reduction in the volume of loans extended to restricted industries and elimination projects. By June 2008, the credit balance of five large banks to restricted industries decreased by RMB 1.022 billion from the beginning of 2008 to RMB14.905 billion, and the loan balance decreased by

RMB508 million to RMB12.767 billion. Credit and loan balances extended to eliminated industries have been decreased by RMB 141 million and RMB 124 million to RMB 364 million and RMB 358, million respectively.

In parallel with reducing and withdrawing credit for industries with higher environmental risks, banking institutions have provided great support for energy conservation and emission reduction. By June 2008, five large banks[21] had supported 595 key energy-saving and emission-reducing projects, achieving a loan balance of RMB 377.952 billion, a rise of RMB 50.694 billion over the beginning of 2008. These banks also supported 1,619 projects in the technical innovation and transformation and product promotion of energy conservation and emission reduction, achieving a loan balance of RMB 110.529 billion, a rise of RMB 15.965 billion over the beginning of 2008. The policy banks achieved a loan balance of RMB 224.058 billion for energy-saving and emission-reducing projects, and offered critical supports for an array of technical transformation projects related to energy conservation and emission reduction in the clean energy and sewage treatment system.

Table3.2 Main Commercial Banks' Loan Balances for Environmental Protection Industries (Unit: RMB 100 Million)

Bank	Statistical index	2005		2006	
		Loan balance	Proportion to the bank's total loan for the year	Loan balance	Proportion to the bank's total loan for the year
BOC（Domestic）	Public utilities	919.24	6.47%	1059.33	6.86%
CCB	Water conservancy, environment and public facilities management	759.59	3.13%	921.73	3.29%
Bank of Communications	Public utilities	518.12	7%	632.89	7%
CMBC	Public utilities	171.62	5%	265.29	7%
China CITIC Bank	Water conservancy, environment and public facilities management	208.11	7. 4%	269.15	7.3%
Industrial Bank	Water conservancy, environment and public facilities management	-	-	206.98	7%
CDB	Water conservancy, environment and public facilities management	4182.34	24%	4909.83	24%

Source of data: China Development Bank's 2007 China Industrial Annual Reports -- Environmental Protection Industry

[21] Including: Industrial and Commercial Bank of China, Agricultural Bank of China, China Construction Bank, Bank of China and Bank of Communications

In the meantime, the policy banks achieved a loan balance of RMB 224.058 billion for energy conservation and emission reduction, which are extended to mainly support the R&D of cost-effective new materials, promotion of comprehensive utilization techniques, clean energy, sewage treatment system and some other technical transformation projects in energy conservation and emission reduction. The China Development Bank provided great support for energy-saving and environmentally-friendly projects, and has increased investment in environmentally-friendly projects by 35.6%. By June 2008, a total of RMB 30 billion had been extended through the "Special Fund for Energy Conservation and Emission Reduction", of which RMB 4.5 billion was used to control pollution in Lake Tai.

Table 3.3 China Development Bank's Issued Loans Existing and Accumulated for Environmental Protection Projects from 2002 to 2006 (Unit: RMB 100 Million)

Year	2002		2003		2004		2005		2006		2007	
	Cur.	Acc.	Cur.	Acc.	Cur.	Acc.	Cur.	Acc.	Cur.	Acc.	Cur.	Acc.
Total	19.6	61.1	34.2	95.3	54.7	150	65.9	215.9	57.3	273.2	330.2	1100.6
Urban environmental infrastructures	15.5	54.2	29.2	83.3	46	129.4	56.7	186	53	239	301.7	1025.5
Industrial pollution control	4.2	6.9	5	12	86.8	20.6	9.2	29.8	4.3	34.1	24.1	59.3
Ecological protection	4	4.3	1.8	6.1	3.3	9.3	2.1	11.4	4.4	15.8	4.4	15.8

1.4 Problems and Challenges

Although China has made some progresses in its implementation of Green Credit policy, the policy is still in an embryonic stage. There are deficiencies in terms of policy design and technical support, along with a number of problems and challenges.

1.4.1 Deficiencies & Defects

(1) Deficiencies in policies and institutions hamper implementation

The policy system has some weaknesses, which can be seen in the absence of technical policies, especially the lack of technical policies related to performance evaluation standard, sector specific energy efficiency standards, and industrial environmental protection performance evaluation guide as supporting documents for Green Credit. Due to the absence of technical policies, when receiving the corporate or individual applications for loans, banks can make judgments in reference to some simple qualitative bases during the credit review, even if they can get access to the complete environmental protection information, resulting in non-unified standards and obvious randomness. Another defect resides in the financing of environmental protection projects. Given the fact that environmental protection projects have a unique characteristic, namely low or even no benefits, and commercial banks operate for profits, the environmental protection projects can not attract attention from commercial banks, resulting in a limited loan scale.

(2) Limited policy option affects policy implementation effects

China's Green Credit policy, which is typical of a top-down environmental credit policy as promoted by governments, has very strong administrative features and even causes some actors to assert that it should not be described as environmental economic policy. The main reason is that the Green Credit policy does not involve market participation in the innovation of green financial products. Green Credit policies -- whether they're encouraging and supporting or limited and forbidden -- all lack the support provided by a highly flexible and efficient market mechanism, and particularly the State's supportive funds are mainly financed through a single channel, like China Development Bank. As a result, the absence of commercial banks' participation and competition and the low fund utilization efficiency have directly affected the policy implementation effects.

(3) Insufficient information communication restricts the implementation of Green Credit policy

Although communication mechanisms between the environmental protection department and the banking regulatory departments as well as fiduciary departments have been established at national and provincial or municipal levels, a larger number of provinces or municipalities are without this information mechanism. Even those with this mechanism (at the national level) can not carry out comprehensive and timely communications. With absent and incomplete information, the banks can not easily make judgments and some enterprises with serious environmental offences can still receive loans, which not only damages the environmental protection, but also increases credit risks.

(4) Absence of supervisory, assessment and constraint mechanism prevents the mobilization of commercial banks' enthusiasm

China's Green Credit policy is a compulsory policy in terms of design, but is transformed into a more voluntary policy during its actual implementation. The main reason for this discrepancy is the absence of a supervisory and constraint mechanism. Given such an absence, the banks take their commercial interests more into consideration when the policy is executed, and still provide credit support for those enterprises and individuals which are difficult to define and there is no evidence of any problems in the short run. Furthermore, the absence of a supervisory and constraint mechanism also caused all the banks to differ in the execution of Green Credit policies, dampening their enthusiasm for implementing of such policies. In 2006, the ICBC reduced the number of loan clients in the steel and iron industry from 207 to 20, and its loan balance from RMB 10 billion to RMB 6.8 billion. Another commercial bank took an opposite measure by moving into the market from which the ICBC had withdrawn. Investigation results indicate that steel and iron enterprises in the province witnessed a loan rise from RMB 15 billion to RMB 62.5 billion during the period from 2001 to 2006, which offered a vigorous support for industrial

development with an annual growth rate of 36%[22].

(5) Inadequate abilities of environmental protection departments and financial institutions affect policy implementation

The execution of Green Credit policy is restrained by the inadequate abilities of environmental protection departments and financial institutions in their implementation of the policy. The inadequate abilities are mainly embodied in the poor capability of financial risk assessment related to environmental protection, lack of professionals and social agencies, insufficient collection and treatment capacity for Green Credit information, blocked information integration and timely exchange, inadequate human resources and management abilities, inability to support the implementation of Green Credit policy, significant regional differences, and inadequate capability of formulation and execution of the policy and ineffective promotion of Green Credit policy in backward regions.

1.4.2 Challenges Ahead

(1) Fierce competition of banking sector brings about great challenges for the implementation of Green Credit policy

The reform and development of China's banking sector have given rise to the development and expansion of many shareholding banks and local commercial banks. The former five top commercial banks, excluding the Agricultural Bank of China, have been listed on the stock market, and an increasing number of foreign-invested banks have entered the Chinese market, intensifying competition in the banking sector. The domestic and foreign market demands with the "high energy consumption and high-pollution industries" as a main player have improved the industrial situation and overall profits. The clients to be won in the highly competitive banking sector have posed great challenges for the implementation of Green Credit policy.

(2) Local protectionism hinders the implementation of Green Credit policy

Even if the Central Government has reiterated the attainment of scientific development and the establishment of correct political achievements concept, China's relatively backward political system, financial and tax system and political achievements assessment system places economic growth as the prime target of local governments and industrial development to be major source of tax revenue of local governments. Similar to other environmental protection policies, Green Credit policy has encountered interference from local protectionism, and a great many unauthorized projects have received bank loans thanks to support from local governments.

(3) Loosely controlled private capital and SMEs' unauthorized fund chains hard to cut off

[22] The case is extracted from the speech by the ICBC's representative, Lian Gong at the Senior Seminar on Green Credit Policy and Practice held at the Policy Research Center of the Ministry of Environmental Protection

Currently, China's private capital represents a huge scale, and is mostly invested in "high energy consumption and high-pollution industries" with considerable benefits and stable market returns. Investigation results in Shanxi and Inner Mongolia indicate that private capital is the main financing source for small- and medium-sized enterprises in the "high energy consumption and high-pollution industries". For example, the loan balance in these industries has come close to RMB 7.3 billion in Luliang, Shanxi, and total private credit equals or even exceeds bank credit. Private capital has issued a total loan of RMB 8 billion to RMB 10 billion in these industries. In a sense, the implementation of Green Credit policy has actually offered a channel for private capital financing. Hence, those small- and medium-sized enterprises with serious environmental offences can actually maintain their fund chains, which makes serious polluters difficult to eliminate.

(4) Small- and medium-sized banks encounter great difficulty in promoting Green Credit policy

Small- and medium-sized banks and financial institutions, which are the most vulnerable to national environmental protection policies, find it hardest to implement and promote the Green Credit policy. According to investigation data of various banks, small- and medium-sized enterprises and financial institutions are most vulnerable to national environmental protection policies, and have great difficulty in gaining credit-granting qualification for major projects. Their situation of having a decentralized customer base, low loan volume for a single project, most customers and loans concentrated in the coke industry and steel and iron industry, means that there is substantial policy risk for adjusting client composition in the short term as well as huge impact from a change in national industrial policies and environmental protection policies. Taken together, these can have great effects on bank operation, and have created large amounts of non-performing loans in a short time, resulting in huge credit risks.

(5) Huge social and environmental pressure on external investment

Presently, Green Credit is more of a domestic policy. However, the government needs to attach great importance to the "greening" of foreign investments. Recent years have seen a constant expansion of China's overseas investments. Meanwhile, China has encountered increasing criticism caused by its investment and development activities in other developing countries. For instance, China is facing social and environmental criticism for its oil development in Africa's Darfur region of and lumber development in Southeast Asia. The World Bank even publicly criticized China's neglect of local people's social and environmental benefits in its overseas investment, which negatively impacts China's image in the international community. To build a sound image in the international community, it is necessary for China to incorporate Green Credit policy into its overseas investments.

2 International Experience in Green Credit

2.1 Background and History of Development

Other countries do not refer to "Green Credit", but many names are close to this concept, such as sustainable finance, green finance, the social and environmental responsibility of the banking industry; Green Credit-related policies and practice are especially active in the United Nations, multilateral and bilateral financial institutions and OECD export credit agencies. In addition, the practice is found in some European and American countries, as well as in some emerging markets, such as Brazil.

2.1.1 Background

In a market economy, banks, especially commercial banks, are profit-driven by nature. Abroad, the introduction of Green Credit policy was also mainly propelled by external force at the outset. External forces mainly function in two ways: First, legal provisions regarding the responsibility for environmental issues affect the profitability of banks. Second, public opinion negatively impacts both the economic benefits and reputation of banks. In particular, the direct and indirect impacts of environmental issues have encouraged banks to attach importance to environmental risk issue in loan extension.

(1) The explicit legal liability investigation mechanism urges banks to pay attention to the environmental and social risks of projects

Laws can be used to stipulate the legal responsibility and joint economic compensation liability of banks for the social and environmental impact of their investment projects by defining the legal liability relationship between banks and their loan projects, and establishing an environmental liability investigation mechanism, which compels investors or lenders to consider the environmental impact and consequences of projects. A typical example is the *Comprehensive Environmental Reaction, Compensation and Liability Act* (CERCLA, or the "Super Fund Act") of the United States, which was promulgated in 1980. According to the requirements of the CERCLA, enterprises must assume responsibility for environmental pollution caused by their commercial activities and the contaminated sites must be cleaned up. With this legislation, the US Congress empowered the Federal Government to collect expenses from potential liable parties for pollution identification, assessment, and clean-up of contaminated sites. The government can also request liable parties to investigate, assess, and clean up pollution by themselves. This legislation aims to make facility owners and operators bear the loss and the cost of cleaning up contaminated sites due to the discharge of hazardous materials (Zhu Hongwei, Zhu Shengxun, 2003). The loan extending banks may assume liabilities for illegal acts of investors since the Super Fund Act provides an unusually strict and unlimited joint liability system with retrospective effect. In 1990, Fleet Factors Corp. was obliged to

take responsibility for cleaning up the polluted environment of Swainsboro Printing and Finishing Company. The verdict of this case has had a far-reaching influence on the financial sector, and banks have since incorporated environmental risks into loan risk evaluation and examination. According to a survey by the American Bankers Association, out of concerns over possible involvement of environmental legal liabilities, 62.5% of the U.S. commercial banks rejected such loan cases, 45.8% of which even totally rejected loans to highly environmentally-risky industries, such as chemical facilities, liquids to be treated, etc.

(2) Indirect economic losses arising from environmental issues urge banks to pay more attention to environmental risks

In addition to potential economic losses under the liability investigation mechanism, borrowers may suffer from a largely weakened repayment ability caused by closure, shutdown, and conversion to the production of other goods, compensation, and other reasons, which may cause indirect risks to banks. For example, in 1976, the US enacted the Resource Conservation and Recovery Act (RCRA). Under RCRA, hazardous materials were tracked and monitored "from cradle to grave" and a strict liability investigation system was set up. Additionally, participants at various stages of production, transportation, processing, storage, and disposal must register with the environmental protection authorities and follow the management regulations of the Environmental Protection Agency (EPA). RCRA authorized the federal authorities to issue a temporary or permanent shutdown ban on enterprises with violations, to give rectification orders, and to suspend or revoke the production licenses of enterprises, which increased the indirect credit risks of banks. (Zhu Hongwei, Zhu Shengxun, 2003).

After studying 56 financial authorities in seven countries including the US and others in Western Europe and Southeast Asia, the European Bank for Reconstruction and Development (EBRD) made the following conclusion in 1993: more than one third of the banks showed that they suffered losses from direct or indirect influence of environmental risks, and the most common loss was irrecoverable loans. When irrecoverable loan occurs, the lenders have to undertake the remedial cost. Moreover, such losses have been spiraling upwards, and in several cases, the loss even made an impact on the bank's stock price. In 1994, UNEP carried out a similar survey on global environmental policies and financial service institutions, and the findings turned out to be very similar to those of the EBRD.

Box 2: Inspiration from termination of the Sakhalin-2 oil and gas project

The main platform of the Sakhalin-2 oil and gas project was located in the vicinity of the predating sea area of the unique endangered species of grey whale. The 800 km-long pipeline of the project was designed to cross 24 earthquake-prone zones, 200 rivers and their tributaries (These rivers are spawning ground of the wild salmon). The project was mainly financed by the following financial institutions: six Equator Principle banks such as the European Bank for Reconstruction, Credit Suisse, JP Morgan Chase Bank, Mizuho Bank, ABN AMRO etc., and two export credit insurance institutions, with the total investment of USD22 billion; this project was expected to be put into production in early 2008.

The project was strongly protested by many non-governmental organizations soon after commencement of the construction, and with the progress of the project construction, protests by non-governmental organizations were intensified. In May 2004, the union of 39 non-governmental organizations from 15 countries advised the financial institutions which funded the project not to provide financing for the project, and gave a warning: if the project leads to the extinction of grey whales, all financial institutions funding the project would take unshirkable responsibility. In April 2005, the environmental protection organizations – the Rainforest Action Network and the Pacific Environment jointly issued a report, stating that the project directly violated the Equator Principles and was a timed environmental bomb. In September 2006, the related Russian court decided to revoke the project construction license, and the Sakhalin-2 project with 80% of the workload completed was stopped in January 2007

(Source: "The Equator Principles: Industrial Benchmark for Project Financing of Commercial Banks - Inspiration from Termination of the Sakhalin-2 Oil and Gas Project", by Chen Sheng and Feng Shouzun, *Finance Street*, June 2009).

(3) Corporate prestige damage teaches banks further on environmental and social issues

Reputational risk is an important value-driving factor for a company and has attracted widespread attention from the international banking sector. In fact, the establishment of the Equator Principles is largely attributed to the influence of public opinion. The Equator Principles were initiated by world-renowned banks following protests from international organizations and local people about their negligence in environmental and social issues in developing countries. Such protests considerably damaged the prestige of the involved banks, and such negligence also ran against the concept of environmental protection, human rights, safeguarding of equality, and sustainable development, themes that were advocated by the countries or the banks themselves. Subsequently, the banking sector took the initiative to make adjustments, formulated a host of common guidelines and standards, and used them in investment projects. Even so, some banks continued to violate these guidelines despite their commitments and got involved in a controversial project financing relationship.

2.1.2 Green Credit policy – History of Development

Banks are required to implement Green Credit policy, and their understanding of environmental issues can be divided into four stages. Different measures are adopted by banks at different stages, which are also indicative of the development course of the Green Credit policies, from a certain perspective.

(1) Defensive stage

In this stage, environmental issues were completely new to financial institutions; some financial institutions believed that their business would not generate any environmental impact while others deemed that the attention paid by banks to environmental issues may directly increase their costs or indirectly damage their interests (by damaging the profit-making ability of their clients) though they were aware of the potential environmental impact from relevant businesses. Therefore, banks typically did not response to related environmental laws and regulations were issued by the government, and even took a defensive attitude in hope of delaying or opposing such legislation. Currently, banks in developing countries are mostly in this stage.

At this initial "defensive" stage, the concept of Green Credit was mainly initiated and advocated by the United Nations and other organizations; a typical example was the introduction of the Statement by Banks on the Environment and Sustainable Development in the United Nations' 1992 Environment and Development Conference.

(2) Preventive stage

Since the 1970s, with the continued deterioration of the global environment, countries have successively incorporated environmental control and prevention work into their legal systems. A large number of international and domestic laws, regulations, and environmental standards related to environmental issues have been promulgated, and they have become increasingly stringent. On the one hand, this created more restrictions on production and the activities of enterprises and added uncertainty and risks to operational prospects. On the other hand, it made environmental risks become an important new target for risk evaluation and risk management in credit investment activities. Coupled with pressure from non-governmental organizations, the impact of environmental issues on the credit business of banks has been constantly increasing and many banks suffered great direct and indirect economic losses the reform.

In this "preventive" stage, banks typically adopt a strategy of hedging against environmental risks, pay close attention to the negative impact of environmental issues and integrate potential business income, cost, and risks into daily operations in order to reduce operational risks. Meanwhile, banks at this stage would consider their internal processes, such as environmental management and credit risk evaluation. Currently, banks in developed countries are mostly in this stage.

It is in this stage that Green Credit policy witnessed the fastest development and constant increase in influence. Relevant Green Credit policies, which were introduced at this stage, include the Equator Principles and the new OECD agreement on export credit and environmental protection. At the same time, various commercial banks started to establish internal credit management and audit systems to hedge against environment-related financial risks. For example, Barclays Bank formulated a series of social and environmental credit directives by virtue of their own advantages; the

directives involved more than 50 industries and covered all financing terms. The credit directives specified violations by enterprises of environmental laws and developed environmental risk ratings, providing strong support for loan assessment and audit of banks.

(3) Offensive stage

In the "offensive" stage, banks discovered commercial opportunities in environmental protection activities and would take some positive means to carry out environment-friendly business and actively seek win-win solutions. Banks in a few developed countries have entered this stage, such as UBS and Rabobank Group, and all banks report on their environmental activities. Carbon finance, loans for green cars, loans for energy-saving houses, and other green financial products were developed and have become instruments for banks to find commercial opportunities out of Green Credit, achieving the twin goals of profit and environmental protection.

(4) Sustainable stage

In the "sustainable" stage, banks seek the maximum sustainable rate of return rather than the highest financial rate of return; that is, all commercial activities of banks are consistent with sustainable social development, and the entire economic system develops to an ideal level, while long-term profit making ability is maintained. However, in today's society, the demand for sustainable social development is not sufficient for large banks to target reaching the sustainable stage of Green Credit, because this kind of policy would mean that many current activities of large banks could not obtain financial support, and would hence result in losses.

Therefore, to achieve a sustainable development goal, it is inappropriate to unilaterally emphasize the responsibility of banks. The government also has a responsibility in this domain. Green financial policies and products, like those developed in the UK, Japan, Germany, and other countries, which provide governmental subsidies to energy-saving and environmental protection projects, are an effective and necessary way for addressing the above deficiency.

2.2 Key Practice and Policy Measures

Although there is no internationally-accepted concept for Green Credit, there are many policies and practices in sustainable finance and self-regulated environmental principles for the banking sector, which are similar to the Chinese concept of Green Credit. In addition, a number of countries introduced green financial products through banks. Such policies and practices are broad-based, and the key practices can be summarized into four categories:

2.2.1 Green finance initiatives by the international community and international organizations

(1) The green finance initiative by the United Nations

As early as 1992, the *Statement by Banks on the Environment and Sustainable Development*, which was issued in the United Nations' Environment and Development conference, is considered to be the most outstanding contribution of the financial sector to environmental protection. The *Statement* explicitly requires the banking sector to put environmental protection at the core of financial decision-making and to play its due role (Richard Cooper, 2000). Subsequently, with support from UNEP, the targets of the banking initiative extended from banks to a wide range of financial institutions. The *Statement* was subsequently amended and in 2003, the financial institution initiative (UNEP FII) and the insurance institution initiative (UNEP III) were formally combined into the current Finance Initiative, referred to as the UNEP FI. Now, more than 200 organizations from 40-odd countries have become signatory members of the UNEP FI. The Bank of Shanghai was China's first financial institution to sign the Statement.

Table 3.4 List of all previous UNEP FI meetings

Time	Place	Topic
1994-9.26~27	Geneva	The Banking Industry and the Environment: Green Financial Market
1995-10.30~31	London	The Banking Industry and the Environment: Investment in the Field of Environment
1997-5.22~23	New York	The Finance and the Environment: Environmental and Financial Performance
1998-9.17~18	London	The Finance and the Environment: Profit and Responsibility in the 21st Century
1999-9.9~10	Chicago	The Finance and the Environment: The New Role of the Financial Industry to a Sustainable Development Race
2000-11.16~17	Frankfurt	The Globalization and Sustainability of Financial Services: Enlightenment from Environmental and Social Issues
2001-11.26~27	Santiago	Discussions on Cutting-edge Information, Cooperative Networks and Solutions
2002-3.14~15	Rio de Janeiro	Financing for Sustainable Future: Strategy, Cooperation and Opportunities
2003-10.20~21	Tokyo	Sustained Value: Financial and Sustainable Development Conference
2004-6.16	Paris	Responsible Investment Practice
2005-10.25~26	New York	Carbon Emissions Trading and Responsible Investment
2007-10.24~25	Melbourne	Sustainable Finance in Today's Global Market
2009-10.22~23	Cape Town	Financing Change, Changing Finance

(2) Multilateral and Bilateral Financial Institutions and OECD new agreement on export credit and environmental protection

The World Bank Group and other multilateral and bilateral financial institutions have

used a set of safeguard policies for more than a decade within their due diligence process. In 2006, the IFC put into effect its Sustainability Policy and the Performance Standards, tailored to private sector lending. OECD member states signed a new agreement on export credit and environmental protection in 2007. Under the agreement, export credit institutions in all member states should consider more stringent environmental protection standards when granting loans. Moreover, OECD member states should carefully evaluate government-supported export credit projects which apply for two-year or even longer repayment term, in order to determine their potential impact on the environment and their compliance with environmental standards of international institutions, especially all environmental standards of the World Bank for public sector lending, and IFC Performance Standards for private sector limited recourse projects.

(3) Other relevant policies

In addition to the above agreements and standards, which are globally-recognized, there are many codes of conduct for the financial industry which have been approved by international organizations. These codes provide effective guidance for implementing sustainable finance and Green Credit, and include: the United Nations Global Compact, London Sustainable Finance Principles, the Statement by the financial department of the World Committee for Sustainable Development of Enterprises, the principles of the World Business Council for Sustainable Development (WBCSD), the International Business Charter, comprehensive guidelines for sustainable management, and so on.

2.2.2 The industry-regulated green finance guidelines formulated by the banking industry

Due to criticism and protests from all sides with regard to environment, society, and human rights, some world-renowned banks have made efforts to reshape the bank image as well as initiate and advocate Green Credit guidelines for the banking sector with an aim to internalize risks with regard to environment, society, and human rights and assume more social and environmental responsibilities. Amongst the Green Credit guidelines, the most representative is the Equator Principles (referred to as the EPs). As a voluntary guide, the EPs were established by the world's leading financial institutions, based on the IFC Performance Standards and the World Bank Group Environmental Health and Safety Guidelines, for the purpose of managing social and environmental responsibilities.

The EPs identify ten basic principles, including (i) review and classification, (ii) social and environmental assessment, (iii) applicable social and environmental standards, (iv) action plans and management systems, (v) consultation and information disclosure, (vi) representation mechanisms, (vii) independent review, (viii) commitment terms, (ix) independent monitoring and reporting, and (x) annual reporting systems of the Equator Principles' banks. The EPs integrate eight IFC social and environmental performance standards, including (i) social and environmental

assessment and management systems, (ii) labor and working conditions, (iii) pollution prevention and control, (iv) social health and safety, (v) land use and involuntary migration, (vi) biodiversity conservation and sustainable natural resource management, (vii) local democracy and cultural heritage, and so on. Under the EPs, 62 industrial environment, health, and safety guidelines (EHS Guidelines of the World Bank Group) were formulated, which direct banks to fulfill the above social and environmental guidelines and to control financial risks during project financing.

As of July 2009, 69 financial institutions had adopted the Equator Principles (EPFIs), coming from both developed and developing countries. Their operations extend to more than 100 countries around the world, and their gross project financing accounts for some 90% of the total project financing market share. With milestone significance in the international financial development history, the EPs introduced, for the first time, minimum environmental and social standards for the sector in terms of international project financing and developed them into international practices.

2.2.3 State-driven credit subsidy policy

Since energy-saving and environmental protection projects are mostly public welfare-oriented with slow effect, long investment recovery periods and low return, most countries grant low-interest loans to such projects through policy-oriented banks or commercial banks in order to support such projects. Experience from the UK, Japan, and Germany is for a useful reference.

After the *Household Energy Conservation Law* was promulgated in the UK in 1995, governments at all levels were required to reduce energy consumption of residential buildings by 30% within 10 years, from the 1996 or 1997 level. Consequently, the British Government formulated a package of policies and measures to improve energy efficiency and stipulated that subsidized loans or interest-free (or low-interest) loans should be granted to energy-saving equipment investment and technical development projects. In 2002, of the BPD 200 million budget of the energy saving funds, 25% was used as subsidized loans, of which BPD 10 million were granted as interest-free loans.

To encourage enterprises to better harmonize environmental and economic benefits during production activities, the Japanese policy investment bank developed an environmental countermeasure implementation program in 2004. Under this program, a financing plan based on the "environmental assessment and appraisal system" was implemented, and loan targets and interest rates were determined according to environmental ratings of loan target enterprises. In 2007, in response to global climate change and with the aim of reducing CO_2 emissions, the bank launched "subsidized environmental rating loan" business, stipulating that for enterprises accepting environmental ratings and committed to reduction of CO_2 emissions by over 5% from unit production within five years would obtain further interest rate discounts on loans for CO_2 control (with a lending rate discount of 1%). The Japanese Ministry of Environment offered fiscal subsidies for low-interest loan spreads of the Japanese policy investment bank under the "subsidized environmental rating loan" framework

through fiscal funds, and the amount of subsidies in 2007 for this program reached some JPY 365 million (See Figure 3.2) (Chang Miao, Yang Liang, 2008).

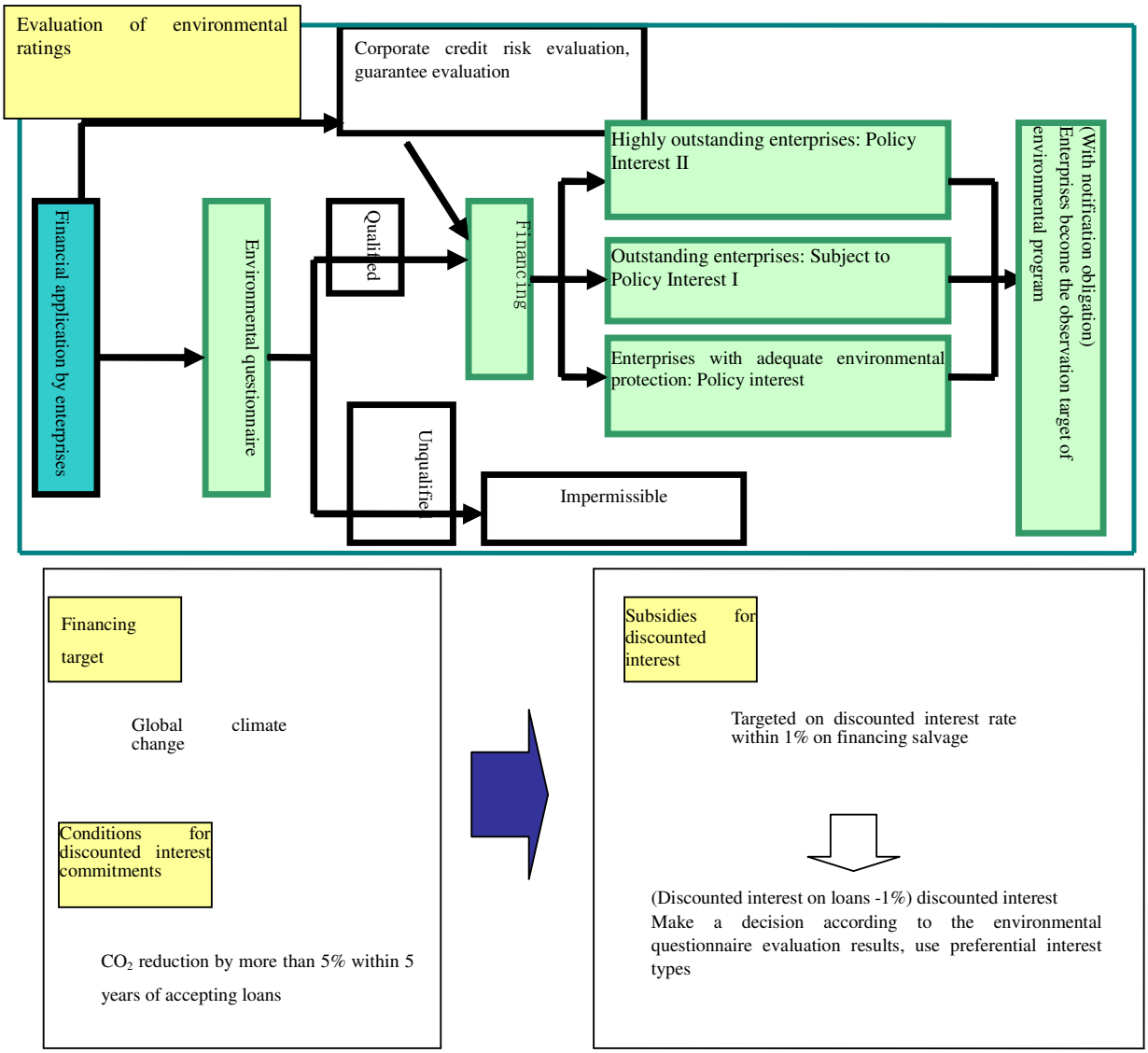


Figure 3.2 Explanations of "Discounted interest" Subsidy Program for Green Businesses

The German government utilizes the capital market and commercial banks to implement the financial subsidy policy on environmental projects through the national policy bank, KfW, giving play to government-subsidized funds with the maximum efficiency. Capital market financing is carried out through KfW, and the government is responsible for subsidizing interest for KfW financing; then, KfW develops the raised funds from the capital market into long-term and low-interest financial products and sells them to various commercial banks; commercial banks provide end customers with green financial products and services to support energy conservation and the reduction of greenhouse gas emissions through highly preferential interest rates and loan periods, after interest adjustment.

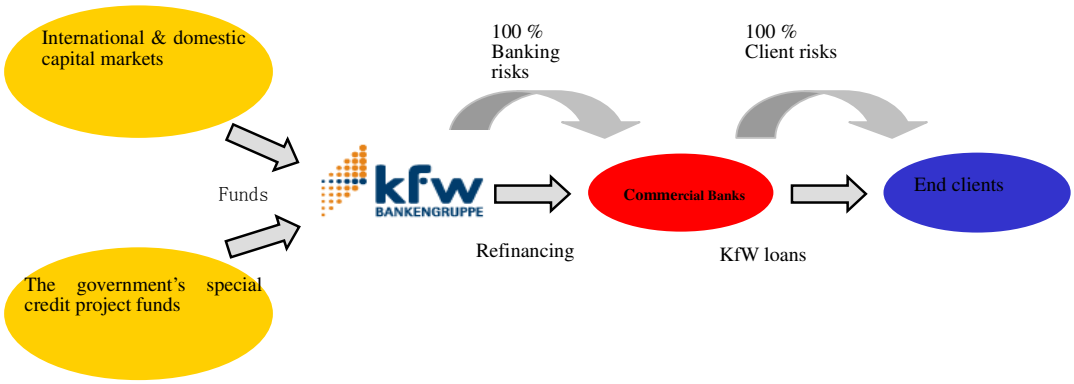


Figure 3.3 Relationships between all stakeholders under the German subsidized Green Credit policy

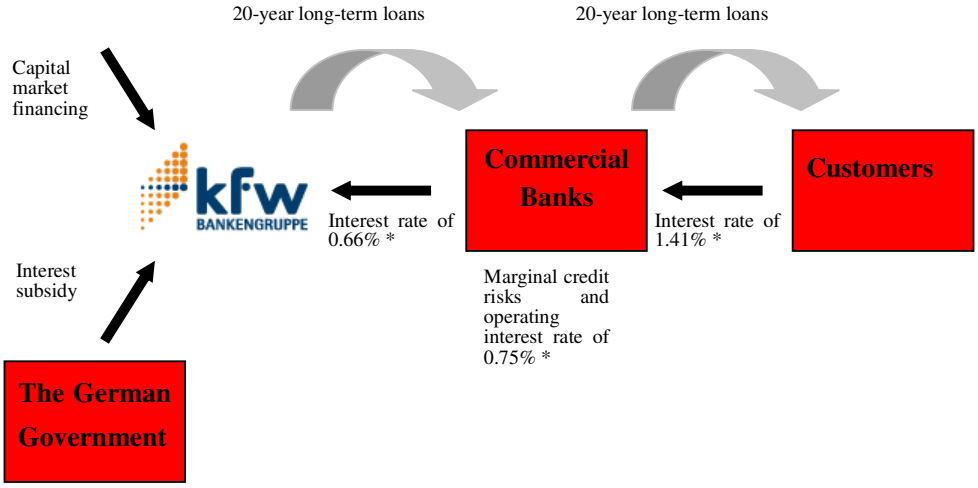


Figure 3.4 The Market Operation Mechanism under the German Subsidized Green Credit Policy

The practice of government discount interest has proved to be effective in supporting energy-saving and environmental protection projects. Through this means, the government can mobilize construction and renovation of many energy-saving and environmental protection projects using a limited amount of initiating capital. Project investors can obtain long-term, low-interest loans, and the interests of commercial banks can be guaranteed, thus forming a virtuous cycle for investment credit.

2.2.4 Innovation in green financial products

In addition, the reduction obligations and requirements vis-à-vis climate change by

the international community created a very active carbon-trading market and promoted innovation in carbon finance, energy efficiency financing, and other green financial products of the financial sector. Many banks began to actively develop appropriate financial products around the low-carbon economy and CO_2 emission reduction, and their green financial products and services for individuals and SMEs cover loans, deposits, credit cards, leasing, and other business.

Table 3.5 Establishment of Green Credit policy instruments

Means / Measure	Type	Mode	Representative bank	Main benefits
International initiative	Self-regulation of the banking industry	The United Nations Global Compact, the Equator Principles, the OECD export credit guide, the UN statement on environment and sustainable development of the banking industry	The Equator Principles banks	Increase international financing opportunities
Discounted interest, preferential interest rate	Public category	Government + Policy Banks	Japanese investment bank	Make up the investment deficiency in environmental protection from fiscal funds
		Government + Policy Banks + Commercial Banks	KfW, Japanese investment bank	
		Government + Commercial Banks	Rabobank, ABN AMRO, ING Group, etc.	
Environmental Risk Management	Internal self-regulation of banks	Carry out environmental risk evaluation and apply environmental risk management throughout the entire credit process	Citibank, Mizuho Bank	Reduce risks, improve community relations, and save costs
Innovation in financial products	Market-based means	Carbon finance, housing mortgages, energy-saving mortgage, loans with net value of houses, car loans, credit cards, deposits, green leasing , etc.	European banks, the North American banks	Develop new business, raise income

2.3 Insight and Lessons from International Experience

Green Credit, financial subsidies, and green financial products are important financial

policies in Europe, the United States, Japan, and other developed countries to support environmental protection and greenhouse gas emission reduction. With active promotion by the governments, policy instruments are diversified and products are abundant. Their successful experience in governmental green financial subsidies and the development of green financial products is a valuable reference for China.

2.3.1 Leverage market forces to promote Green Credit

The core content of Green Credit is mainly reflected in two aspects: One is to provide credit support for energy-saving environmental protection projects, and the other is to refuse or control credit support for projects that negatively impact the environment and society. According to international experience, promotion and active participation from the market are indispensable, regardless of the form. In particular, according to the experience of Germany, the fiscal support of the government to policy banks can be multiplied through market financing means, and can also bring the policy closer to end customers and improve policy efficiency through the wide participation of commercial banks. At the same time, in addition to requiring banks to undertake more environmental and social responsibility, Green Credit policy also creates new business opportunities and interests for the banking industry.

2.3.2 Green Credit guidelines lay down standards widely adopted by the international banking sector

Green Credit guidelines have become social and environmental standards, which are advocated by the international community and universally followed by the banking sector. In this respect, the policy integrity and operational ability are of high reference value for China. According to industry statistics, by early 2008, the global Equator Principles' banking business extended to more than 100 countries, and the gross project financing value accounted for over 90% of the world's total. This fully shows that Green Credit policy has become an important principle for the international banking sector. Comparatively speaking, as one of the world's most important emerging markets, China has only one bank that has joined the "Equator Principles", and the environmental protection philosophy and awareness of the domestic banking industry lag behind the international standards, which are quite advanced. Consequently, conducting training on the "Equator Principles" and related environmental protection issues to enhance environmental protection awareness and experience for the domestic banking industry become one of the key tasks in the implementation of Green Credit policy.

2.3.3 Enforcing environmental accountability is fundamental for implementing and promoting Green Credit

Enforcing environmental accountability is fundamental for carrying out Green Credit, and legislation plays a key role. If the law fails to identify the responsibility of environmental polluters, polluting enterprises would gain additional benefits, and enterprises need not worry about economic claims stemming from environmental

pollution. If banks do not need to be concerned about risks arising from the impairment or loss of repayment ability of enterprises due to environmental pollution, they would normally loosen control of auditing and supervision of credit funding. According to international experience, only when liable parties of environmental pollution are explicitly governed under legislation, can the government, enterprises, and banks be motivated to protect the environment and reduce pollution.

2.3.4 Environmental audit is an important assurance for promoting Green Credit

Due to the complexity of environmental issues and the diversity of industrial technology, relying only on banks' environmental audit departments makes it difficult to precisely define the environmental benefits of projects. The resources of environmental protection authorities are therefore urgently needed for assessing the environmental impact of projects. The Japanese and German experience shows that environmental audits can help banks identify the service targets of green financial products and is conducive to rewarding the good and punishing the bad.

2.3.5 Discounted interest and other possible methods of State support for Green Credit

Compared with European countries, China's Green Credit policy lacks variety in form, such as preferential policies to the commercial banks which carry out the Green Credit policy. The European experience of governmental participation in ecological bank-building by means of discounted interest is a valuable reference and source of learning for China. A limited amount of subsidy funds are used to boost large-scale construction of energy-saving and environmental protection projects, and funds are utilized with satisfying transparency and impartiality. Considering China's actual situation, government-driven preferential policies with regard to Green Credit can take other forms besides discounted interest. For instance, taxation exemption and reduction for commercial banks and other taxation incentives can also be used to attract more funds into the energy-saving and environmental protection field.

3. Comparative Study of International and Chinese Green Credit Policies

A big difference was found after comparing China's Green Credit and the international Green Credit-related policies and practice. On the one hand, this disparity shows that China's Green Credit policy has its own characteristics; on the other hand, this indicates a certain gap existing between China and other countries in terms of Green Credit. By comparative analysis, their respective characteristics can be identified, and the direction for further development and improvement can be clarified.

3.1 Huge Disparities between Policy-Making and Implementation Procedures

3.1.1 State-driven Chinese model

China's Green Credit policy is an environmental and financial policy, pushed by government in a top-down manner. The government's driving efforts are mainly implemented by issuing governmental documents. The related Chinese government departments have successively promulgated a series of important governmental documents on Green Credit, regulating Green Credit from the content, implementation mechanism, guarantee, and other aspects. Banks are required to implement such policies and are mostly in a passive position. In general, this top-down policy is mandatory and has had wide influence and powerful binding force. However, as the policy is designed for macroeconomic guidance, it offers little practical guidance for the implementation by commercial banks, and the operability of the policy needs to be improved.

Table 3.6 List of China's Green Credit policy documents

Year	Document name	Issuing organization
1995	Circular on Relevant Issues Regarding the Implementation of Credit Policy and Enhancement of Environmental Protection	PBOC
2004	Circular on Relevant Issues Regarding Further Strengthening Industrial Policies and Credit Policies to Support the Control of Credit Risks	NDRC, PBOC, CBRC
2005	Framework Agreement on Development-oriented Financial Cooperation	the former SEPA, China Development Bank
2006	Circular on Relevant Issues Regarding Sharing Environmental Protection Information of Enterprises (Environmental information will be incorporated into the credit investigation system of banks)	PBOC, the former SEPA
2007	Guidelines on Improving and Strengthening Financial Service in the Field of Energy Saving and Environmental Protection	PBOC
2007	Opinions on Implementing Environment Protection Policies and Regulations and Preventing Credit Risks	The former SEPA, PBOC, CBRC
2007	the Guidance on Credit Extension for Energy Saving and Emission Reduction	CBRC
2007	Agreement on Information Exchange and Sharing	MEP, CBRC
2009	Circular on Strengthening Green Credit Information Reporting and Exchange	MEP, PBOC, CBRC

At the same time, the State directly provided financial and credit fund support for energy-saving and environmental protection projects, which was mainly realized

through project application and approval and other administrative measures. The effectiveness and efficiency of fund use was not high, and in some cases, funds were even wasted.

Table 3.7 Fixed Asset Investment in Urban Construction During the tenth Five-Year Plan period (in RMB100 million)

Year	Total investment	Fiscal appropriation by the central government	Fiscal appropriation by local governments	Domestic loans	Bonds	Foreign capital utilized	Self-financing	Others Funds	Total government investment	Proportion of government investment	The proportion of domestic loans
2001	2351.62	104.92	379.06	603.42	16.79	97.77	636.38	274.45	483.98	20.58	25.66
2002	3123.22	96.29	516.88	743.81	7.31	109.63	866.27	365.7	613.17	19.63	23.82
2003	4264.06	118.91	733.41	1435.44	17.45	90.01	1350.2	398.01	852.32	19.99	33.66
2004	4650.94	62.96	938.43	1468.03	8.54	87.21	1372.9	444.99	1001.39	21.53	31.56
2005	5505.52	63.88	1050.6	1805.92	5.2	169.97	1728	453.01	1114.48	20.24	32.80
During the Tenth Five-year Plan period	19895.38	446.95	3618.37	6056.62	55.3	554.6	5953.7	1936.2	4065.32	20.43	30.44

Data Source: China Urban Construction Statistical Yearbook, China Environment Statistical Yearbook 2001-2005.

3.1.2 Equal-benefit and market-driven international model

Entirely different from that of China, the international model of Green Credit is largely characterized by the joint efforts of the government, the market, and the banking industry in promoting policy innovation and sustainable finance practices.

The role of the State or the government is mainly embodied in three aspects: First, legislation and environmental liability investigation mechanisms are reinforced to urge banks and other financial institutions to stress environmental issues. Second, the State supports social, environmental, and other public welfare projects and provides credit support through discounted interest and other financial instruments, and makes full use of the capital market to guarantee efficiency of the government subsidy policy through collaboration between the national policy bank and commercial banks. Third, the government audits the social and environmental benefits of preferential credit projects to ensure that funds are spent on environmental and other public welfare projects.

Banks and their allies formulate and innovate specific Green Credit policies with regard to credit risk prevention and the creation of a new environmental protection market. On the one hand, from the perspective of undertaking more social and environmental responsibilities, the banking sector establishes a host of Green Credit

guidelines and standards, which are highly guidance-oriented and operable. On the other hand, the banking sector gets actively involved in underwriting financial products developed for State-supported environmental, social, and other public welfare projects, and develops its own financial products to achieve a win-win goal involving both profit and public interests.

At the same time, the community's interests are fully reflected in the international Green Credit policy. For example, the Equator Principles not only incorporate the community's interests into stakeholder interests, but they also stipulate that environmental and social impact assessment must be conducted independently by a third party and that fundraisers and the community must agree on environmental and social issues. Thus, participation by social forces is fully ensured.

3.2 Disparities in Policy Significance, Goals and Nature

3.2.1 Energy efficiency is key for environmental protection in China

Based on the discussion above, China's Green Credit policy was promulgated under tremendous pressures arising from the need for energy conservation and emission reduction. The government attempted to seek more effective, market-based measures to protect the environment. Although financial risks arising from evading environmental issues by the banking sector served as a major cause for the initiation and development of the Green Credit policy, the strong political will of the Chinese government to improve environment and achieve sustainable development constituted the underlying impetus. Therefore, China's Green Credit combines the concept of finance and environmental protection. In risk evaluation, the focus is put on environmental risks in addition to general business risks, and the environmental responsibilities of enterprises are mainly examined. Additionally, supportive policies are oriented towards key projects for energy efficiency and emission reduction.

China's Green Credit policy has binding force and is mandatory, to some extent, since the drive is jointly promoted by relevant competent authorities of the government. However, as none of these regulatory documents are legally enforceable, implementation often differs greatly between banks and between the various regions. In a sense, such a problem exists in China's Green Credit policy as "being strict in provisions but loose in implementation".

3.2.2 International practice emphasizes social & environmental responsibilities of the banking sector

The international experience in sustainable finance shows that development of sustainable policies was directly advanced by mandatory emission reduction objectives (such as greenhouse gases), at home and in the international community, by a clear liability investigation mechanism or by the demand for social equity and sustainable development. In general, sustainable financial policies are more

broad-based, also covering other social interests, such as social equity, and human rights in addition to environmental interests. Sustainable financial policies are actually a complete policy system comprising a series of guidance principles, norms, and instruments for the banking sector (and countries as well) to undertake social and environmental responsibilities.

Meanwhile, banks have generally adopted sustainable financial policies, which are highly enforceable, as their internal management policies as a result of extensive participation by banks. For example, the Equator Principles and other sustainable financial policies were initiated by famous group of globally-renowned banks, which are taking leadership in environmental and social liability concepts. As fully voluntary industry-regulated principles, such policies are easy to implement. To some extent, although these internationally-accepted Green Credit-related policies do not have any mandatory force, they have better enforceability since they are "lenient in provisions but stringent in implementation".

3.3 Significant Disparities in Policy and Institutional Comprehensiveness

3.3.1 Deficient policies and institutions constrain growth of Green Credit in China

Although China's Green Credit policy has undergone constant development and improvement, the policy system is still very inadequate with respect to the nation's actual demands and in contrast to international experience. This inadequacy has restricted the role and influence of Green Credit. The inadequacy is mainly reflected in the following problems:

First, current Green Credit policies are mostly restrictive and binding in nature, and there is a dire need for incentive and subsidized preferential policies. At present, many provisions are rather conceptual, and preferential credit policies are difficult to implement due to lack of financial products and the irreconcilable interests of parties involved. Credit funds for industrial pollution control sponsored by the government even shows a decreasing trend.

Second, for binding and restrictive Green Credit policies, there are no technical policies to guide banks in developing credit risk management and control. In particular, due to the absence of environment, health, and safety guidelines and other policy documents for various industries, banks have few specific instruments and little policy guidance in risk evaluation and credit management, which impairs the effectiveness of the Green Credit policy.

3.3.2 Comprehensive policies and institutions provide impetus for growth of Green Credit internationally

Relatively speaking, international sustainable finance has the prominent advantage of

being compressive in both policies and institutions. Comprehensive policies and institutions have been established for both subsidized credit policies, which support environmental protection and other public welfare projects, and binding policies which require the banking sector to undertake more environmental and social liabilities. For example, Germany's preferential credit policy on greenhouse gas emission reduction provides good provisions on fund source, market mode of operation, customer requirements, and audit procedures, and is easy to implement. Furthermore, the Equator Principles and other restrictive policies clearly provide basic principles, performance standards, industrial environment, health, safety guidelines, project review procedures, and potential users, and they are easy for banks to implement. The comprehensiveness of policies and institutions has pushed forward the development of sustainable finance internationally.

3.4 Disparities in Policy Measures

3.4.1 Insufficiency in credit alternatives, a major impediment to efficiency of Green Credit in China

In contrast to international Green Credit policy and practice, China's Green Credit policy lacks variety, and financial product innovation has become a highly pressing task. In fact, innovation in green financial products is a tool and carrier to achieve the public welfare goal of the environment and the business goal of banks' interest rates. China's Green Credit policy mainly urges commercial banks to fulfill their environmental and social obligations, and imposes various management requirements on them. On the one hand, banks are expected to restrict loan extension to projects with high return and high pollution and high energy consumption, and provide preferential credit support for energy saving and environmental protection projects on the other hand. These policy measures bring heavy pressure to commercial banks. Green Credit has not been promoted in a manner in which comprehensive measures are taken, and the State and banks share obligations, responsibility, costs, and benefits. The current mode hampers the initiatives of commercial banks. At the same time, the State's supportive funds and credit for energy-saving and environmental protection projects are extended mainly through the administrative departments and policy banks, resulting in low efficiency and high rent-seeking risks.

3.4.2 Continued innovation of financial products catalyses sustained growth of the international financial sector

In sharp contrast to China's Green Credit policy, common practice at the international level is to use comprehensive means to advance sustainable finance and support energy-saving and environmental protection projects and the social welfare cause. For example, Germany's Green Credit support policy not only deftly reconciles the interests of the State, the policy banks, commercial banks and clients, but also succeeds in promoting green finance policy, which has significant effect on

greenhouse gas emission reduction by using various financing channels as well as promoting the development and marketing of financial products.

At the same time, banks have come to realize the tremendous business opportunities in the energy- saving and environmental protection field, and they are actively involved in the development of green financial products. For example, most major commercial banks and financial institutions in the United States and European countries participate in financial services for carbon trading and offer various carbon-related financial products, realizing the dual goals of banks' interest rates and greenhouse gas emission reduction. Innovation in financial products abounds. For example, Canada's VanCity launched a "Clean Air Auto Loan" suite of products that provide customers with a preferential loan interest rate of 3%-4%. The "Fannie Mae" of Citigroup introduced the structured Energy Efficient Mortgage product for low-income customers, including electricity-saving and other energy-saving indicators in the credit score system of loan applicants. The "environmental leasing" developed by European banks as one of the main "green" financial product areas to be invested will function in such a way that banks provide commercial clients with environmentally-friendly technologies at preferential interest rates. Innovation in financial products has greatly pushed forward the development of sustainable finance.

4. Recommendations for Improvement and Promotion of Green Credit in China

4.1 Major Conclusions

4.1.1 Preliminary China-Specific Green Credit Policy Established

Green Credit policy in China has already taken a preliminary shape. The policy is primarily focused on supporting energy-saving and emission reduction projects through credit instruments and by strengthening the examination for loan extension to highly polluting projects with high energy consumption and restricting loan extension to such enterprises. Close collaboration between MEP and the banking sector has promoted the development of China's Green Credit policy, and they also closely cooperated on aspects of policy design, information exchange, and training.

With constant deepening of the scientific outlook on development, and under the guidance and discipline of the government, an increasing number of banks have begun to undertake additional social and environmental responsibilities and have established in-house Green Credit management system and procedures. So far, China's Green Credit policy has evolved into a relatively comprehensive system from the central government to local governments, with constantly expanding connotations, and has turned out to be an important economic instrument for promoting energy

efficiency and emission reduction. Positive effects have been achieved.

4.1.2 Improvement Required for Chinese Green Credit Policy

China's Green Credit policy is far from perfect. Considerable improvement is still needed to meet the massive demands for implementing relevant work, as compared with international experiences. In stark contrast with the Green Credit policies of overseas countries, the most distinct characteristics of China's Green Credit policy are that it resorts to administrative mandatory means more than to market instruments and it fails to take full advantage of market mechanisms, which have actually affected the efficiency of policy implementation.

Furthermore, the incentive and preferential policies related to the implementation of Green Credit need to be further improved. The current policy system focuses more on the control of financial risks caused by environmental problems. As a result, the regulatory systems related to restrictive Green Credit policies are better developed, while the implementation of preferential Green Credit policies lags behind due to insufficient support from corresponding Green Credit financial products, inadequate participation of market players and low effectiveness of policy implementation.

In this regard, future efforts should be focused on reinforcing market mechanisms for the implementation of Green Credit, development of more Green Credit products and improvement in the existing policy system, especially the guiding Green Credit policies for industries, with an aim to improve the implementation mechanism and increase policy efficiency.

4.1.3 Green Credit Policy an Important Macroeconomic Facility

In the context of the global financial crisis, credit capital serves as a dominant factor for the survival and development of enterprises. In rolling out economic stimulus policies, China has injected considerable amounts of capital into the market, triggering a rapid expansion in credit scale. In the first half of 2009 alone, the credit extension has topped RMB7 trillion, sparking widespread concerns on issues like whether the Green Credit policy can be rigorously implemented, repetitive construction, excessive production capacity, and the occurrence of a new round of non-performing loans. Green Credit policy can play an important role in better guiding and promoting credit capital to projects and enterprises with positive economic, social and environmental benefits and in prohibiting highly-polluting projects or enterprises from obtaining credit support, which is conducive to fulfilling China's economic development objectives; namely, maintaining growth, adjusting structure, and promoting development.

A series of policies recently launched by the State Council to redress surplus production capacity of steel, cement and wind power industries have incorporated the enhancement of environmental supervision credit management as important macroeconomic control measures. According to these policies, efforts should be made to strengthen environmental supervision and environmental impact assessment on

regional industrial planning, which should function as a precondition for accepting and ratifying the environmental impact assessment documents of highly energy consuming projects within the region. Projects that fail to pass the environmental impact assessment can not be constructed. The policies also require the implementation of strict financial policies featuring a combination of protecting and controlling, and loan extension in accordance with the adjustment in priority industries and an economic stimulus plan as well as relevant industrial policies. It is thus clear that the Green Credit policy serves as an important instrument to realize energy efficiency and emission reduction as well as achieve effective macroeconomic control.

4.1.4 Additional Credit Support for Energy Efficient and Emission Reduction Initiatives Needed

In addition to providing guarantees for construction and normal operation of enterprises, bank credit also constitutes an important source of funds for China's energy-saving and emission-reduction drive. Statistics show that during the tenth Five-Year Plan period, loans from domestic banks accounted for 15.08% of the total investment for industrial pollution control, and accounted for 30.44% of total fixed assets investment for urban construction. Clearly, credit support is of significant importance for the nation's pursuit of energy-saving and emission-reduction.

Table 3.8 Investment for Industrial Pollution Control during the Tenth Five-Year Plan Period (In RMB 100 million)

Year	Total	Capital Within the Government Budget	Special Capital for Environmental Protection	Others Funds	Self-financing of Enterprises	Domestic loans	Foreign capital utilized	Total government investment	Proportion of government investment	The proportion of domestic loans
2001	174.48	36.35	8.32	129.81	7.49	67.11	7.23	44.67	25.60	38.46
2002	188.37	41.96	6.79	139.62	8	43.55	7.25	48.75	25.88	23.12
2003	221.79	18.75	12.38	190.66	141.94	25.1	6.78	31.13	14.04	11.38
2004	308.1	13.71	11.13	283.26	227.43	29.02	4.59	24.84	8.06	9.42
2005	458.19	7.78	20.6	429.81	361.64	38.99	7.09	28.38	6.19	8.51
During the Tenth Five-year Plan period	1350.94	118.55	59.22	1173.16	746.51	203.77	32.94	177.77	13.16	15.08

It is important to note that bank investment in industrial pollution control during the tenth Five-Year Plan period showed a visible downward trend; in this respect, the contributing ratio to the total investment descended from 38.46% in 2001 to 8.51% in 2005. Capital deficiency in industrial pollution control has maintained the bottleneck for China's energy-saving and emission-reduction work. Hence, the question of how to design green financial products to support industrial pollution control has become a

major issue for the government and the banking sector to tackle, and this should also become an important aspect for further study with respect to China's Green Credit policy.

4.2 Policy Recommendations

4.2.1 Full Comprehension of Green Credit, and Leverage its Supportive and Regulative Capacities

Currently, there is a prevailing misunderstanding that deems Green Credit policy as a credit management instrument resorting to retributive measures, which mainly include not granting credit support to the "double high" projects or tightening up management over credit extension. Actually, Green Credit policy covers not only such retributive and restrictive credit measures, but also supportive measures, such as preferential terms and subsidies to energy-saving and emission-reduction projects by credit means. Such supportive measures are of great significance for the country to fulfill China's goals related to energy-saving and emission-reduction. Due to such misunderstandings, Green Credit instruments -- which are motivating, supportive and involving subsidies -- have not received due attention in terms of development and application; the severe inadequacy in the innovation and development of policy measures and the lack of variety in green financial products have made it difficult to effectively support the work of energy-saving and emission-reduction.

Therefore, it is recommended that the government attach importance to the dual functions of Green Credit policies in terms of both supporting and regulating the economy. China must intensify its responsibilities and obligations in Green Credit policy in parallel with efforts to strengthen the social and environmental responsibilities of the banking sector and take full advantage of credit levers to curb the development of the "double high" enterprises and sectors. Emphasis should be placed on national Green Credit policies with motivating, supportive and subsidizing functions, the innovation of Green Credit products, and the reform of existing national financial and fiscal policies, which encourage and support energy-saving and emission-reduction in order to increase the efficiency of fund use and ensure its impartiality and universal adaptability.

4.2.2 Introduce Market Mechanism to Reform and Improve Energy Efficiency and Emission Reduction Policies

The Chinese government has attached great importance to energy-saving and emission- reduction. In addition to establishing special funds for this drive, the government has provided capital support to green projects through the NDRC, China Development Bank, and other institutions. Of the 4-trillion-yuan economic stimulus package, RMB 40 million is earmarked to support energy-saving and environmental protection projects, signaling vigorous efforts on the part of the government to bolster eco-friendly projects. Despite such efforts, the need for administrative approval of

projects could, to some extent, give rise to corruption, owing to the lack of market mechanisms and the low efficiency of fund use.

To increase the effectiveness, transparency, and impartiality of energy-saving and environmental protection capital, it is recommended to carry out market reform on the management and application of such capital financed by the State or by financial institutions. Specific reform measures include: First, give full play to the core function of China Development Bank, and centralize the utilization of State-supported capital. Second, use the supportive capital more as seed capital (with interest paying), and mandate China Development Bank to assume the responsibility for financing at the capital market to expand capital scale. Third, develop long-term green financial products at low interest rates and other similar products and sell the products to commercial banks by China Development Bank based on financing costs. Fourth, mandate the commercial banks to sell subsidy-oriented green financial products to the end users, after adjusting interests of such capital, which ensures certain amounts of commercial benefits of the banks. Fifth, ensure that environmental protection and other departments examine and ratify projects to determine whether they can be categorized as energy-saving and emission-reduction projects to help banks differentiate amongst projects.

The above measures enjoy several advantages. Firstly, capital can be utilized with high efficiency, and the government subsidy capital can achieve a multiplier effect by leverage. Secondly, the integration of social responsibilities with certain commercial benefits of banks can motivate commercial banks. Thirdly, service can directly reach the end users so that all energy-saving and emission-reduction projects are entitled to apply for loans, thus achieving fairness in enterprise financing. Fourth, obtaining loans depends on the assessment made by commercial banks of the profit-making and repayment ability of their clients, thus ensuring security of entire capital chain as well as avoiding corruption.

4.2.3 Improve Existing Green Credit Policies and their Operability and Enforceability

Efforts should be intensified on the following aspects to improve the policy system with the aim of remedying the existing problems and inadequacy of the Green Credit policy currently in force:

First, the formulation of industrial policies for Green Credit should be accelerated. As an important measure for macro control, Green Credit policy should be implemented according to industry-based guidance. However, since industry-based guidance for Green Credit is not available yet, the execution varies greatly among banks due to ambiguities in policy application when conducting credit extension examination. Thus, the function of restricting “double high” projects can hardly be achieved, let alone contribute to the macro control goals.

Second, strengthen the collaboration between environmental protection and banking departments. For both the supportive and retributive Green Credit policies, close

inter-departmental cooperation is needed to ensure smooth implementation and to achieve the expected effects. The environmental protection authorities can enhance the maneuverability and execution of Green Credit policies through formulating industry-based Green Credit policy, strengthening supervision of environmental law enforcement, effectively providing timely environmental protection information to enterprises, and conducting environmental protection project designation. The banking sector can support energy-saving and emission-reduction and achieve macro control through innovating green financial products, tightening up credit management and examination mechanisms, exchanging information on Green Credit in a timely manner and providing preferential green loans in a timely manner and in the full amount.

Third, establish supervision mechanisms and information disclosure mechanisms for the implementation of Green Credit in the shortest possible time. Presently, China's banking sector is still adopting an evasive and passive attitude in its implementation of Green Credit. In order to urge banks and other financial institutions to assume and fulfill their social and environmental responsibilities, it is necessary for the environmental protection sector and banking sector to establish an effective supervision mechanism for the implementation of Green Credit as soon as possible, and to publish information on enterprises that have violated relevant rules and regulation as well as on the actual performance of commercial banks and other financial institutions involved in implementing Green Credit policies.

4.2.4 Guide and Regulate Institutional External Investments, and Encourage Undertaking of Greater Social and Environmental Responsibilities

China's external investment has undergone rapid development over the past several years. Financial institutions, such as large banks and big enterprises, have substantially increased their external investment. In addition, some private SMEs and investment institutions have also contributed a considerable proportion to the country's total external investment. Because of insufficient policy guidance, some external investment projects are mainly targeted at achieving economic benefits and have overlooked environmental and social benefits. This situation has already sparked criticism from the international community. In contrast, banking sectors in other countries have been advocating social and environmental benefits for external investment projects, and have set down a specialized self-disciplinary principle for the sector (the Equator Principles) and regional investment standards (External Direct Investment Guidebook for OECD Countries).

In this regard, it is recommended that China take steps to strengthen the guidance, management, and standardization of external investment and to formulate relevant policies, in parallel with efforts to push forward the implementation of Green Credit policies. Large enterprises, banks and other financial institutions should be encouraged to adopt internationally-acceptable principles for the management of credit extension or investment. In reality, the Industrial and Commercial Bank of China, China Construction Bank, and Export-Import Bank of China are currently

reviewing and studying the feasibility and other important issues for adopting the Equator Principles. Moreover, it will be necessary to formulate special management measures and policies to green huge amounts of direct investment made by private capital and SMEs.

4.2.5 Formulate Specific Green Credit Policy to Support SME Development

The development of SMEs is an important barometer of an economy's robustness and innovation capability. In the context of the ongoing financial crisis, SMEs have encountered great difficulty in obtaining loans from banks. For those in need of energy-saving and environmental protection facilities or to upgrade equipment, the situation is even worse. The incentive policies targeted at SMEs are very likely to bring about a new round of pollution, in case no credit preferential policy is available.

In this regard, it is recommended that the Chinese government, when formulating financial policies to support the development of SMEs, impose stricter standards on the examination, approval and management of energy-saving and emission-reduction targets of SMEs, tighten up credit extension, and not grant credit support to the "double high" SMEs. Meanwhile, the government should study the implementation of special policies for SMEs that conform to relevant national industrial policies and energy-saving and emission-reduction policies, and provide credit support to SMEs which are in need of bank credit support and have great potential for development. The government should make use of energy-saving and environmental protection capital to develop tailor-made green financial products for SMEs, and provide SMEs with preferential long-term loans at low interest rates to foster their development.

4.2.6 Enhance Regulatory and Publicity Efforts, and Provide Investment Guidance for Private Capital

The "double high" sectors and regions of China subject to severe pollution are usually home to robust investment made by private capital. The investment scale of such private capital is equivalent to the credit scale of standardized financial institutions. Due to a lack of management and guidance, the investment made by private capital in "double high" enterprises results in a malfunction of the State's regulating and control policies, and the development pattern in which environmental and social benefits have been sacrificed for the pursuit of economic benefits. Therefore, efforts should be strengthened with respect to supervision and guidance for private capital when Green Credit policy is implemented among standardized institutions.

Given the profit-driven and market-oriented nature of private capital, it is necessary to strengthen the supervision of "double high" enterprises and take severe retributive measures. Such measures will help investors gain lessons from their neglect of environmental and social benefits as well as bear losses from such neglect. Leveraging on that, private investors will better realize the high environmental policy risks for hefty profits earned at the cost of environmental damage. Meanwhile, vigorous efforts to publicize environment-related credit risk should be undertaken. In

addition to publicizing national environmental protection regulations and policies, the national industrial policies, the future development trend of "double high" industries, and their influence with respect to the environmental control of enterprises and to private capital should also be publicized, in a bid to urge private investors to increase awareness of environmental risks and take a cautious attitude towards investing in "double high" projects.

Considering the significant amounts of "hot money" rushing into China, research work should be done to develop effective policies and provide corresponding guidance. With regard to enterprise reshuffle and mergers, comprehensive measures must be taken through environmental protection examination and securities supervision and in collaboration with the State's assets authorities and loan-extending banking institutions in a bid to urge investors assume and fulfill their social and environmental responsibilities.

Chapter 4: Study on Environmental Pollution Liability Insurance

Environmental pollution liability insurance is a type of insurance in which the insurance subject is the compensation liability of enterprise for the damage to a third party due to pollution accidents. It is a special kind of liability insurance, which came into being against the background of rapid economic development and growing seriousness of environmental pollution after World War II. In the relation of environmental pollution liability insurance, the insurer bears the economic compensation for and control costs of environmental pollution caused by accidents of the insured, so that the victim of the pollution can receive payment in a timely manner even the insured is incapable of making compensation for the damage.

Because of the effectiveness of environmental pollution liability insurance for its compensation for environmental damages, this insurance has become a major financial instrument in Western developed countries to address compensation liability for environmental damages by means of socialization approaches to fulfill the aim of controlling environmental risks, in short dozens of years from its emergence to development and maturity and perfection. This insurance has also become an important approach for risk management departments of enterprises with respect to managing environmental risks. Coping with environmental pollution accidents by means of insurance instruments helps to (i) provide timely economic compensation and respond quickly to environmental pollution emergencies, (ii) disperse corporate operating risks and maintain normal economic order, (iii) integrate the supervisory role of market mechanisms and improve environmental protection and management levels, and (iv) lessen burdens of the government and promote the transformation of governmental functions. Currently the environmental pollution liability insurance system has been widely-adopted worldwide, which fully demonstrates that such system is a policy lever that can be used to strengthen environmental regulation through mobilizing market forces.

In China, the environmental pollution liability insurance system is still in an initial stage of development. The available practical experience and theoretical research related to the insurance system has proved to be inadequate for a nation-wide promotion of such insurance. Further improvement will still be needed in terms of specific system design and technical standards of the insurance system. Therefore, it is of critical significance for the country to enhance environmental risk control, refine the civil compensation system for environmental tort and damages and safeguard the environmental rights and interests for citizens by means of integrating the actual situations of China and essentials from international advanced experience to serve the purpose of reasonably designing the system framework and specific measures for environmental pollution liability insurance.

1 The Necessity and Foundation for China to carry out Environmental Pollution Liability Insurance

1.1 The Necessity for carrying out the Environmental Pollution Liability Insurance in China

1.1.1 China has entered a period of frequent environmental pollution accidents

In recent years, China's extensive economic growth has gradually rendered environmental pollution and damages even more serious. The transitional development of enterprises with high pollution and high environmental risks has created a considerable amount of hidden danger, which allows environmental accidents to occur even when there is slight negligence in the prevention of environmental risks. Such a circumstance is likely to bring about property losses and casualties. Major accidents will also result in irreversible damages to animals, plants, water, soil and other ecosystems. The situation of high environmental risks not only constitutes threats to people's health and the security of property, but also imposes negative effects on sustainable economic and social development, if the situation continues.

A series of major environmental pollution accidents took place in succession in recent years in a nation-wide scale, which has caused significant losses. Statistics show that number of environmental disputes in China in 1998 reached 180,000, which increased to 250,000 in 1999 and surpassed 300,000 in 2000[23]. During the period from November 13, 2005 with the explosion at Jilin Petrochemical Co. under China National Petroleum Corporation, which polluted the Songhuajiang River, to April 17, 2006 when the sixth national environmental protection conference convened, 76 major environmental emergencies of various kinds took place, equivalent to one accident in two days in average[24]. Table 1-1 provides the statistics of environmental pollution and accidents in China in a period from 2003 to 2006[25].

China's environmental emergencies have been on the rise during recent years. In 2008, environmental emergencies under direct scheduling and handling of the Ministry of Environmental Protection (MEP) amounted to 135, a rise of 22.7 % as compared to the previous year. Specifically, major environmental emergencies amounted to 12, relatively serious environmental emergencies reached 31, and 57 cases of such

[23] Wang Canfa, The disposal of *Environmental Dispute:*, *Theory and Practice* Beijing: China Politics and Law University Press, 2002

[24] Sources: China manufacturing industry portal, website: http://www.cmwin.com/CBPResource/StageHtmlPage/905/A25620088404437905.htm, Released on Aug. 04, 2008

[25] *China Statistics Yearbook (2008)*, Beijing, China Statistics Publishing House, 2008

emergencies were triggered by safety production accidents[26]. The frequent occurrence of major environmental pollution accidents indicates that China has entered a period prone to environmental pollution accidents.

Table 4.1 Condition of environmental pollution and damage accidents in 2003-2006

Indicator	Frequency of environmental pollution and damage accidents	Water pollution (times)	Atmospheric pollution (times)	Solid waste pollution (times)	Noise pollution (times)	Other (times)	Direct economic losses from pollution (10,000 yuan)	Total indemnities and penalties for pollution accidents (10,000 yuan)
2006	842	483	232	45	6	77	13471.1	8415.9
2005	1406	693	538	48	63	64	10515.0	3082.1
2004	1441	753	569	47	36	36	36365.7	3963.9
2003	1843	1042	654	56	50	41	3374.9	2391.5

Source: *China Statistics Yearbook (2008)*, Beijing, China Statistics Publishing House, 2008

According to the major investigation results by the original State Administration of Environmental Protection on environmental risks from the nation-wide chemical and petrochemical projects in 2006 (See Table 4.2), 81% of the 7,555 chemical and petrochemical construction projects with total investment of 1.0152 trillion yuan were distributed in river water areas, populated region, and other environment-sensitive areas, 45% of such projects were major risk sources[27]. Serious environmental risks existed in the chemical and petrochemical projects in all large water areas, and clear defects were found in the corresponding prevention mechanism.

Table 4.2 Summary sheet of environmental risk investigation in chemical and petrochemical construction projects across China

Number of major risk sources	3442	Total		7555	
		National	Provincial	Municipal	County
		127	1614	3502	2512
Number of petrochemical enterprises	1122	Number of chemical enterprises		5377	
Number of newly-established enterprises	4104	Number of enterprises after expansion and technical transformation		2590	
Total investment (100 million yuan)	10151.5	Investment increment after investigation (100 million yuan)		140.5	
Number of projects in environment-sensitive areas					
Populated areas (with towns	2489	Along rivers, lakes, seas, and		1354	

[26] Communiqué on China's environmental condition in 2008, Ministry of Environmental Protection, 2008

[27] Source: Official website of the Ministry of Environmental Protection: http://www.gov.cn/gzdt/2006-07/11/content_332925.htm, 2006-07-11 (Jul. 11, 2006)

within 5 kilometers)		reservoirs	
Upstream in drinking water source reserves (10 kilometers)	280	Animal husbandry areas and fishery water areas	32
Neighborhood of scenic spots	10	Trunk streams of major rivers	535
Vicinity of nature reserves	37	Primary branches	275
Vicinity of traffic trunk lines	977	The Three Gorges reservoir area	86
Sources for the South-to-North water diversion and along the line	100		

In reality, with long-term extensive growth of the Chinese economy, a number of industries have entered a period of frequent environmental accidents, notwithstanding the chemical and petrochemical industries which have numerous hidden dangers to environmental safety. Such a situation results from the unreasonable industrial layout and structure over the past few decades, which cannot be thoroughly solved in a short time. In addition, because environmental risks exist in many aspects of production and operation of most enterprises; for example, the negligence of production plan leads to the occurrence of serious environmental pollution incidents, the employees' violations of operation rules result in environmental pollution incidents, and accidents caused by natural disasters leads to environmental pollution incidents and so forth. Such environmental risks are featured by various types and divergent causes, which cannot be completely avoided by eliminating the root cause. Furthermore, the passive remedial measures are far from adequate in curbing the current surging tendency of environmental emergencies.

In such a broad context, it is absolutely imperative for China to establish a long-term effective mechanism for the management of environmental risks. Since the administrative resources for environmental protection are currently very limited, it is hard to fulfill the purpose of preventing environmental accidents as effectively as possible merely by means of administrative regulation. For this reason, it is essential to make full use of social regulatory forces at all levels, based on the constant enhancement of government's ability of preventing and managing environmental accidents, to involve in the environmental accident prevention system as a way to effectively prevent environmental accidents, The establishment of an environmental pollution liability insurance system will enable insurance companies to strengthen their supervision of insured enterprises in order to diminish operational risks, which will serve as a major supplement to the administrative regulation, and will provide the regulatory departments with more comprehensive and accurate information, thus enhancing the prevention of environmental accidents.

1.1.2 The requirements for perfecting the compensation system for losses caused by environmental pollution damages and reducing the cost of government in handling environmental accidents

During the period from 1998 to 2005, the direct economic losses caused by environmental pollution accidents amounted to an average of 140 million yuan annually. In 2006, the amount reached 134.711 million yuan, whereas the corresponding total indemnities and penalties for compensation for pollution accidents were 84.159 million yuan[28], which was less than the direct economic losses from the accidents.

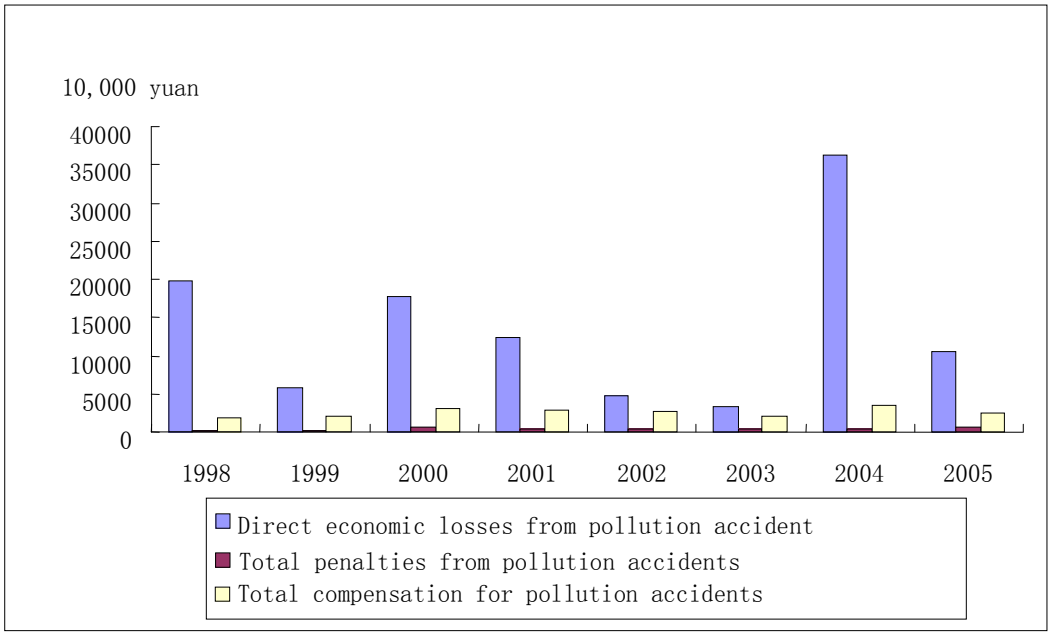


Figure 4.1 Condition of the direct economic losses and total penalties and indemnities from accidents in 1998-2005 [29]

Because the current environmental pollution compensation system is far from perfect, the total penalties and indemnities for pollution accidents are far below the direct economic losses from the accidents, let alone the compensation for potential, hidden, and long-term losses from environmental pollution accidents, it is hard for the responsible party to assume compensation liability alone. Thus, the victims of accidents will find it hard to get their deserved compensation, and the country and the society undertake the majority of environmental harm and economic losses. The adoption of socialization methods, such as the environmental pollution liability insurance, will effectively disperse the risks faced by enterprises. With the payment of an insurance premium, the influence of environmental pollution accidents on corporate operation is greatly diminished. The adoption also helps enterprises fulfill their environmental liability and helps the government reduce expenditure related to

[28] *China Statistics Yearbook (2008)*, Beijing, China Statistics Publishing House, 2008
[29] The data in 2005 excluded the losses from the accident in the Songhua River in Jilin province

environmental restoration and relief when coping with environmental accidents. In the long run, environmental pollution liability insurance is an important approach for China to improve its compensation system for losses caused by environmental pollution.

1.1.3 The needs for safeguarding the rights and interests of pollution victims and maintaining social stability

Although the laws and systems currently in force in China allow the victims of environmental pollution to seek compensation through civil tort litigation, the environmental tort cases are tried over a long period of time, as such cases usually involve a great number of professional and technical issues, and certain amount of time is needed for consequences to materialize. This has clearly increased the difficulties faced by victims to obtain compensation. Even if victims win a lawsuit, it will still be hard for them to get compensation in a timely manner due to the inadequate compensation capacity of enterprises, "the difficulty of enforcement", and so forth. Moreover, some local governments are apt to impose influence on or even obstruct the trial work of environmental cases as they are motivated to protect the local economy. Cases have occurred where the local government puts obstacles in place that block the execution of positive judgments, instead of promoting their execution.

In the face of the frequent occurrence of pollution tort incidents, it is difficult for the current laws and systems to ensure timely compensation and relief to victims. Some victims may adopt unusual measures, such as visiting a higher authority, directly blocking the production of polluting enterprises in an effort to obtain compensation in a more timely and adequate manner, which may intensify social conflict. Statistics show that environmentally-related complaints and group incidents are increasing at an annual rate of 30 %. With regard to this issue, if environmental pollution liability insurance system is implemented, the insurance companies will opportunely pay compensation to the victims of environmental pollution accidents, to avoid that the damages to victims become more lasting and complicated.

1.1.4 The need for helping reduce bankruptcy risks and safeguarding sustainable operation of enterprises

Because environmental pollution can affect broad areas, create large numbers of victims and huge indemnities, the polluting enterprises, under normal circumstances, are unable to bear all the loss generated. Even if such losses can be borne by the enterprises, the normal operation and development of enterprises will be affected by the huge amount of compensation.

High environment-related risks have become an inescapable fact for many industries. With the constant improvement in the ability and level of environmental law enforcement of China, the operating risks resulting from environmental factors have also seen a constant increase. Thus, it is imperative for enterprises to transfer or

minimize the liability risks by means of legitimate market approaches, in an effort to cope with the intense market competition. Environmental pollution liability insurance is characterized by apportioning environmental risks and losses of a certain policy holder to all policy holders through an insurance contract, thus naturally becoming an effective approach for enterprises to evade environmental risks and transfer losses. By purchasing environmental pollution liability insurance products, enterprises will be able to diminish future uncertainties by expending a small amount of ascertainable expenditure (insurance premium), thus ensuring the sustainable and steady production and operation and avoiding the situation that economic and social development is hampered due to excessive compensation burden and even bankruptcy of polluters. This constitutes the main reasons why environmental pollution liability insurance should be developed and applied.

1.2 Present development and progress of China's environmental pollution liability insurance

Environmental pollution liability insurance constitutes an important part of China's environmental economic policy system. At the end of the 20th century, pilot application of environmental pollution liability insurance was carried out in some provinces and cities. After 2007, the insurance was promoted on a nation-wide scale as one of major environmental economic policies, with some positive results attained. At the same time, such promotion aced considerable bottlenecks that hindered the development of environmental pollution liability insurance. Thus, a systematic analysis of the development and status quo of environmental pollution liability insurance in China, and the crystallization of experience and lessons from such development, can serve as a useful starting point for further improvement in the environmental pollution liability insurance system as well as supporting policies.

1.2.1 China's current situation of legislation on environmental pollution liability insurance

China has made some attempts to legislate environmental pollution liability insurance, and has provided some relevant provisions with respect to environmental pollution liability insurance on the part of national and in international contracts as well as departmental and local laws and regulations. The provisions that have been developed mainly focus on areas such as shipping, nuclear energy utilization, hazardous chemicals management, petroleum exploration and development, which laid, to a certain degree, a foundation for the implementation and promotion of environmental pollution liability insurance.

(1) Relevant provisions in domestic environmental legislation

International marine shipping industry is the first area that China's environmental pollution liability insurance has touched. China joined the *International Convention*

on Civil Liability for Oil Stain Damage (1969) in 1980, in which Article 7 clearly stipulates: "Owners of ships carrying in excess of 2,000 ton of bulk oil which are registered in a contracting state must undertake insurance or make other financial assurance". Article 28 of the *Marine Environmental Protection Law* which was formulated in 1982 provides corresponding provisions on pollution insurance: "Ships carrying more than 2,000 ton of bulk oil shall hold valid *Oil Stain Damage Civil Liability Insurance or Other Financial Assurance Certificates*, or a *Credit Certificate of Civil Liability for Oil Stain Damage*, or other financial credit assurance". The *Marine Environmental Protection Law* which was amended in 1999 further stipulates oil stain liability insurance: "Countries shall improve and implement the civil compensation liability system for ship oil stain damage and establish the ship oil stain insurance and an oil stain damage compensation fund system in line with the principle that the ship oil stain damage compensation liability is jointly undertaken by ship owners and cargo owners. Specific measures for implementing the ship oil stain insurance and the oil stain damage compensation fund system shall be provided by the State Council."

Although China has not joined the international *Convention on Third Party Liability Concerning Nuclear Energy* and the *Vienna Convention on Civil Liability for Nuclear Damage*, the principles in a written reply (with Guo Han No. [1986]44) which was given by the State Council in March 1986 on relevant liability issue for a nuclear accident in nuclear power plant were roughly the same basic principles as those stipulated in the *Vienna Convention.* The written reply was made in a bid to strengthen the management of compensation liability for damage caused by a nuclear accident. In 2007, the State Council issued a written reply (with Guo Han No. [2007] 64) to the national nuclear energy agency, which stipulates: "Operators shall assume compensation liability for casualties, property loss or environmental damage caused by nuclear accidents" and that "Operators must purchase insurance which is adequate to perform their liability limits before running a nuclear power plant or before fuel storage, transportation and post-treatment".

In addition, Article 9 of China's *Regulations on Environmental Protection and Management for Offshore Oil Exploration and Development* (1983) provides that: "Enterprises, institutions and operators engaging in offshore oil exploration and development shall purchase civil liability insurance for pollution damage or provide other financial assurance".

(2) Provisions of international environmental conventions that China has joined

Apart from the International Convention on Civil Liability for Oil Stain Damage, China joined the Basel Convention on Controlling Cross-border Transfer and Disposal of Hazardous Waste and the Protocol on Liability and Compensation Issues Concerning Damage from Cross-border Transfer and Disposal of Hazardous Waste in 1991 after ratification, both of which clearly provide for the establishment of environmental pollution liability insurance: As far as environmental pollution damage caused by cross-border transfer of hazardous waste is concerned, "the party which

shall assume the compensation liability shall conclude and maintain insurance money, earnest money or other financial assurance not less than the minimum limit within the whole liability time limit".

(3) Relevant departmental and local regulations

In recent years, China has strengthened environmental protection through financial levers. In 2006, the State Council promulgated *Several Opinions on Issues Concerning the Reform and Development of Insurance Sector*, which proposes to "Give full play to the important role of insurance in preventing damage and mitigating the impacts of disaster and disposing of disasters and accidents, incorporate insurance into disaster and accident prevention and assistance system, develop environmental pollution liability and other insurance business by means of market operation, policy guidance, government promotion, legislative compulsion, etc.", which was entitled "Vigorously develop the liability insurance and perfect the safeguarding of safe production and emergency mechanism for emergencies". In 2007, the State Council issued the *Comprehensive Work Plan for Energy Conservation and Emission Reduction*, in which Article 39 makes clear that "Research on the establishment of environmental pollution liability insurance system". In 2007, the State Administration of Environmental Protection and China Insurance Regulatory Commission jointly promulgated *Guiding Opinions on the Environmental Pollution Liability Insurance Work*, which proposes requirements for aspects such as the guiding principle, work objective, implementation and assurance mechanism for work related to environmental pollution liability insurance. For the time being, this document is the most instructional policy document concerning environmental pollution liability insurance at national level.

In parallel, many Chinese provinces and cities are taking steps to study and carry out the legislation work on environmental pollution liability insurance. In April 2008, Jiangsu Maritime Bureau, the provincial Department of Communications, the provincial Department of Environmental Protection, the provincial Bureau of Safe Production Supervision and Jiangsu Insurance Regulatory Bureau jointly promulgated the *Circular on Actively Promoting the Implementation Work for Shipping Pollution Liability Insurance*. This Circular provides that from November 1, 2008, shipping pollution liability insurance should be officially implemented for the coastal areas and inland rivers across the province. Shipping pollution liability insurance refers to insurance where ship owners or supervisors must bear economic compensation liability as the insurance subject for leakage of fuel oil, shipped oil products, chemicals, and other harmful substances on ships, or for pollution damage resulting from the leakage of fuel oil, shipped oil products, chemicals, and other harmful substances on ships that are hit by insured ships in navigable water areas. The scope for initial implementation of this insurance covered oil tankers and chemical tankers (both of which included other provincial ships) which sailed, anchored, and worked in the water areas within Jiangsu provincial administrative jurisdiction. The *Regulations of Shenyang Municipality on Preventing and Controlling Environmental Pollution from Hazardous Waste*, approved and passed by the Liaoning Provincial People's

Congress at the end of 2008, are the initial local rules which specify the environmental pollution liability insurance in the legislative form across the country. Article 8 of the Regulations indicates that: "Support and encouragement are given to insurance enterprises to establish a hazardous waste pollution damage liability insurance type and to the units which produce, collect, store, transport, use and dispose of hazardous waste to buy a hazardous waste pollution damage liability insurance type".

The relevant laws and regulations promulgated by the national and local governments create favorable conditions for the development of environmental pollution liability insurance, whereas these laws and regulations are mostly confined to shipping oil stains, dangerous chemicals, and other limited fields. For areas and industries with high environmental risks and frequent environmental accidents, such as the dangerous chemical production and transportation industry, and enterprises that discharge toxic pollutants or other dangerous waste, no laws and regulations concerning environmental pollution liability insurance are provided, and the environmental pollution liability insurance is not mentioned in the *Environmental Protection Law*, *Water Pollution Prevention and Control Law* and other basic laws. Such a legislative deficiency increased the difficulty and binding force needed to promote environmental pollution liability insurance and added risks to insurance companies in operating environmental pollution liability insurance products, which is unfavorable for the promotion of environmental pollution liability insurance in China.

1.2.2 Practice and progress of China's environmental pollution liability insurance

The implementation of environmental pollution liability insurance in China is generally divided into two phases. The first phase was in the early 1990s, which saw the introduction of environmental pollution liability insurance products in some cities. Nevertheless, the market effect was not ideal, and related insurance products were withdrawn from the market in the mid-1990s. The year of 2006 marked the beginning of the second phase, which was characterized by active efforts to promote environmental pollution liability insurance by the MEP, China Insurance Regulatory Commission and other related national administrative departments. As well, pilot implementation was carried out in more cities and industries.

(1) The first phase

In the early 1990s, the environmental protection departments and insurance companies of some cities collaborated to roll out environmental pollution liability insurance products. Dalian was the first city where such business was carried out, and the insurance product was officially put onto the market in 1991. Subsequently, other cities, like Shenyang, Changchun, and Jilin have seen the implementation of this business. (See Table 1-3).

During the first phase, environmental pollution liability insurance was not widely implemented in the country; it was mainly carried out in several cities in Northeast

China. Judging from the market response, the markets for environmental pollution liability insurance in these cities were relatively limited in scale. The insurance was bought by moreorless ten enterprises, and the number of policy holders was on the decline. There were even some cities where no enterprises bought the insurance. The implementation was basically suspended in the mid-1990s.

The first phase implementation of environmental pollution liability insurance failed to live up to expectations, which was mainly because: (i) The country had not given enough attention to environmental protection; environmental protection laws and regulations still need to be improved, and more rigorous standards must be imposed on enforcement. Judging from an objective standpoint, such a situation will not generate enough pressure on polluters. Policy conditions in this phase are inadequate for the implementation of environmental pollution liability insurance. (ii) The irrational design and development of insurance products resulted in an excessively low loss ratio and excessively high insurance premium. For example, the loss ratio was only 5.7% in Dalian in 1991-1995, and zero in Shenyang in 1993-1995, which are well below the loss ratio of some other types of insurance implemented domestically, hovering around 50% and are far below loss ratio of 70-80% in foreign insurance sector. Enterprises lost their enthusiasm for purchasing the insurance, which failed to obtain the expected effect, which led to shrinkage of sales of environmental pollution liability insurance products and eventually, to withdrawal from the market.

Table 4.3 China's promotion situation of environmental pollution liability insurance in the first phase

City	Starting time	Implementation situation
Dalian	Oct. 1991	During the four years until October 1994, there were a total of 15 policy holders, and the cumulative insurance premium income was 2.2 million yuan. During this period, insurance companies paid indemnities of 125,000 yuan only once, with the loss ratio of 5.7%.
Shenyang	Sep. 1993	PICC had a total of 10 insured enterprises in two years until September 1995, with insurance premium income of 950,000 yuan. During this period, no accidents occurred and the loss ratio was zero.
Changchun	Jun. 1992	In 1992, PICC had only l insured enterprise, with the insurance premium income of 5,000 yuan. No accidents occurred within the insured period, but the second year saw an accident, and this enterprise failed to get economic compensation due to non-renewal of the insurance.
Jilin	Oct. 1995	China Pacific Insurance Company had no insured enterprise until the first half of 1996.

(2) The second phase (2006 - present)

Since the beginning of the 21st century, the state proposed three “historic transitions” for environmental protection, which require “transition from mainly adopting administrative measures for environmental protection to solving environmental problems through comprehensive use of legal, economic, technical, and necessary measures”; this provides strategic safeguard for the implementation of pollution liability insurance and other environmental economic policies. In 2006, the State Administration of Environmental Protection put forward the objective to establish an environmental economic policy system, and at the end of 2007, the MEP and China Insurance Regulatory Commission jointly promulgated the *Guidance Opinions on Environmental Pollution Liability Insurance Work* (hereinafter referred to as "*Opinions*"), marking the entry of environmental pollution liability insurance into its second phase.

As compared with the first phase, great changes have taken place in terms of political and policy conditions for the implementation of environmental pollution liability insurance in the second phase. The proposal for the scientific outlook on development and for historic transition of environmental protection provided powerful political and strategic guarantees for the implementation of environmental pollution liability insurance; encouraged use of economic means to address environmental problems by the State and active participation of relevant administrative departments created a good policy environment for the implementation; the gradual maturity of the insurance market and the ability to develop environmentally-friendly products and public demand for safeguarding environmental rights and interests generated a favorable market environment for the implementation. During the second phase, proper conditions for the implementation of environmental pollution liability insurance were preliminarily in place.

The promotion work of the environmental pollution liability insurance in the second phase was initiated by the MEP, China Insurance Regulatory Commission, and other concerned national administrative departments. This work was incomparable in terms of participating regions, scale and the scope of participating industries in the first phase, which generated a huge influence in society. The promulgation of the *Opinions* received a quick response from most insurance companies. Environmental pollution liability insurance products were quickly launched; products of the PICC, Ping An, Pacific Insurance Company and many other insurance companies were approved by and filed in China Insurance Regulatory Commission and put onto the market.

In 2008, a national pilot work conference regarding environmental pollution liability insurance was held in Suzhou by the MEP and China Insurance Regulatory Commission, which marked the comprehensive initiation of the pilot demonstration work. Related work was carried out in pilot regions including Jiangsu, Chongqing, Hubei, Hunan, Henan, Ningbo, Shenyang, Shenzhen, Suzhou, and other provinces and cities. Preliminary decision was made to conduct pilot implementation of the insurance, which was mainly targeted at enterprises which produce, operate, store,

transport and utilize hazardous chemicals, petrochemical enterprises, which are prone to pollution accidents, enterprises which dispose of dangerous waste, landfill sites, sewage treatment plants and all kinds of industrial parks and so forth. In July 2008, Ping An (Hunan) Insurance Company paid indemnities to Haohua Chemical Company for pollution damage from accidents, which was the first indemnity case concerning environmental pollution liability insurance nationwide after the promulgation of the *Opinions*. The case drew extensive attention from Chinese society.

Latest statistics show[30] (See Table 4.4) that the pilot implementation of environmental pollution liability insurance in China is undergoing smooth progress. Relevant businesses were carried out in most provinces and cities that were involved in the pilot implementation. The provinces of Jiangsu, Hunan and the Ningbo city in Zhejiang province had the most significant progress in terms of implementation. Generally speaking, the number of insured enterprises and insurance companies participating in the pilot is on the rise; premium incomes and the total sum of underwriting rapidly increase; relevant businesses of claim settlement are being carried out in an orderly manner. These indicate that the environmental pollution liability insurance is being implemented on a wider scale in China.

Table 4.4 Related data about national pilot of environment pollution liability insurance

Region	Number of Insured Enterprises		Premium Incomes		Total Sum of Underwriting		Payment of Claims		Insurance Companies Carrying Out Relevant Businesses
	2008	2009	2008	2009	2008	2009	2008	2009	
Hubei	0	8	0	RMB 0.463mn	0	RMB 28mn	0	0	The People's Insurance Company of China (PICC)
Jiangsu	465 vessels	30 enterprises, 1,174 vessels	RMB 1.08mn	RMB 20.54mn	RMB 0.13bn	RMB 3.36bn	0	0	7 companies including PICC, Ping An Insurance Company, China Pacific Insurance Company, Yong An Insurance Company, China Continent Insurance Company, Chang An Insurance Company, Du Bang Insurance Company

[30] Investigation material of pilot implementation of provinces and cities around China for environmental pollution liability insurance by the Environmental and Relief Policy Research Center of the Ministry of Environmental Protection and China Insurance Regulatory Commission Laboratory (2009).

Liaoning	0	2	0	RMB 0.23mn	0	RMB 5.2mn	0	0	PICC
Shanghai	4	2	RMB 1.354mn	RMB 0.345mn	RMB 245mn	RMB 51mn	0	0	Huatai Insurance Company
Hunan	6	35	RMB 873,900	RMB 2.57mn	RMB 28.5mn	RMB 55.85mn	RMB 13,000	RMB 678,800	Ping An Insurance Company
Shenzhen	1	4	RMB 51,500	RMB 547,600	RMB 1.5mn	RMB 23mn	0	0	3 companies including PICC, Ping An Insurance Company and Sumsung Fire & Marine Insurance Company
Ningbo	242	346	RMB 9.172mn	RMB 16.836mn	RMB 1.62bn	RMB 2.29bn	RMB 457,500	RMB 1,076,600	5 companies including PICC, China Continent Insurance Company, China Pacific Insurance Company, Ping An Insurance Company and Taiping Insurance Company

1.3 Major characteristics of China's environmental pollution liability insurance at the current stage

China's environmental pollution liability insurance has been implemented on the basis of international experience. By absorbing advanced theory and mature practice on aspects of the design of the policy framework and modes of operation, the implementation abroad provides good guidance for the recent pilot work in China. Thanks to great differences between China and developed countries in terms of implementation foundation and conditions, China's environmental pollution liability insurance has demonstrated some gradation characteristics.

(I) Being late in development with a relatively high starting point. In the 1980s, environmental pollution liability insurance was widely implemented in Western countries. With some 30 years of development, a relatively effective legal system and standard operation mechanism have taken shape in some countries. A wide variety of insurance products targeted at different industries and various fields emerged on the market. As a consequence, a strong market capability of preventing environmental risks and compensating for pollution damages has taken shape with the support of the insurance sector. In contrast, the development of environmental pollution liability insurance started later in China. The construction of relevant laws and regulations

lagged behind Western countries, and the variety of insurance products offered by the market is relatively narrow. In spite of this, international experience is valuable for China in designing, developing and implementing environmental pollution liability insurance, which is conducive to the design of an environmental pollution liability insurance system suitable for China's situation as well as for finding solutions to problems arising from implementation.

(II) Government guidance and market orientation. The environmental pollution liability insurance is a type of economic policy that is based on the market mechanism. The design of the policy is targeted at fulfilling functions of accident prevention and damages by means of market levers. Thus, the market is the prime driving force for China's implementation of environmental pollution liability insurance at the current stage. The development aims to achieve a balance between environmental protection and the development of insurance types by adjustments of the market mechanism in the hope of bringing administrative intervention to the minimum and establishing supply-demand relations between pollution-discharging enterprises and insurance companies, in line with the principle of being voluntary and of mutual benefit. Because of the inadequacy of experience in implementing environmental pollution liability insurance and the deficiency of insurance companies with respect to product development and operating abilities, governmental guidance is indispensable for promoting environmental pollution liability insurance at the early stage. On the one hand, it is necessary to standardize the behaviors of insurance companies so that environmental pollution liability insurance can be developed and refined to serve policy objectives. On the other hand, it is necessary for the administration to actively work out preferential policies so as to guarantee the interests of market participants and facilitate the involvement of more insurance companies and enterprises.

(III) Deficiency of legislative efforts and the pilot implementation of experimental work. Looking at international experience, countries that have developed sound environmental pollution liability insurance have comparatively effective legislation, which lays the legal foundation for the development of environmental pollution liability insurance. Currently, the legislation issue has not been resolved for environmental pollution liability insurance in China, and there have been no national laws that provide definite requirements and provisions for this insurance; thus, there are no higher-level laws available to safeguard the promotion of the insurance. There are many reasons for the legislative deficiency with respect to environmental pollution liability insurance: on the one hand, China's environmental legislation work generally lags behind the realistic requirements; on the other hand, the inadequacy of practical experience creates difficulties for the legislation of environmental pollution liability insurance, and it is difficult to evaluate the influence of the implementation of the insurance on enterprises, the local economy, and the broader society. Furthermore, as a prelude to developing legislation, China typically requires experiments to be conducted in local regions and subsequently initiates legislation when sufficient practical experience is available. The nation-wide pilot implementation of environmental pollution liability insurance in 2008 aims to accumulate experience in

a progressive manner and create a relevant system by initiating experiments in appropriate locations in order to provide practical experience for the development of legislation as well as national promotion of the insurance.

(IV) A voluntary approach is preferred, with the system being gradually improved. The combination of implementation in a compulsory and voluntary manner is a major international trend in promoting environmental pollution liability insurance. The framework design for China's environmental pollution liability insurance policy requires the promotion of such a combination when relevant conditions are satisfied, with compulsory environmental pollution liability insurance implemented in industries with serious environmental pollution and high environmental risks or in environmentally-sensitive regions. For the current stage, the country puts major efforts on promoting voluntary environmental pollution liability insurance and encourages enterprises to purchase relevant insurance products on a voluntary basis. It is inadvisable to implement the compulsory environmental pollution liability insurance for the current stage for several reasons: (i) The deficiency in practical laws, (ii) The deficiency in practical experience in the market. As a type of environmental economic policy based on market mechanisms, environmental pollution liability insurance is able to address a portion of environmental problems through market control and regulation. Taking advantage of the market mechanism is a major starting point for the policy. Considering the deficiency in practical experience and the lack of market feedback about the influence of environmental pollution liability insurance on local economic development, the insured enterprises as well as the profitability of insurance companies, together with the absence of market verification of desire function of the insurance under an imperfectly-working market mechanism, it is extremely risky to promote the implementation of compulsory environmental pollution liability insurance without careful consideration. Therefore, China is now pursuing a progressive route in promoting environmental pollution liability insurance, which can be described as first initiating the implementation of voluntary environmental pollution liability insurance and developing a relevant system through practice, ultimately establishing a multi-level management set-up that combines voluntary insurance and compulsory insurance in a progressive manner.

1.4 Major problems faced by China's environmental pollution liability insurance at the current stage

It has been nearly two years since China began to implement environmental pollution liability insurance. The implementation has been positively received. A working coordination mechanism between the environmental protection departments and the insurance regulatory departments has been established. A number of environmental pollution liability insurance products have been put onto the market. The pilot implementation is progressing steadily in different parts of the country, and gradual progress has been achieved. However, generally speaking, China's environmental

pollution liability insurance is still at an initial stage. Many problems still remain with respect to establishing practical laws, standards and operation. In the face of the international financial crisis, the above problems are particularly obvious in the pilot regions, which need to be urgently solved.

First, the international financial crisis exerts great impact on China's environmental pollution liability insurance. Although the financial crisis imposed relatively less influence on the domestic insurance sector[31], the export business was greatly impacted by the crisis, giving rise to dramatically declining demands for resource-based and high-polluting products on the international market. Domestically, the production of a great number of relevant production enterprises has been suspended or semi-suspended, the majority of which are highly-polluting and highly environmentally-risky enterprises. Such enterprises are the main targets of environmental pollution liability insurance. Even those less affected by the crisis are inclined to adopt relatively prudent financial systems and will not take the initiative to buy environmental pollution liability insurance products provided that the external restrictions remain unchanged. As a result, the market demand for insurance products has seen dramatic decline. A survey of a city in Hunan province indicates that there are 23 monitored key pollution sources throughout the city, amongst which, nearly 20 enterprises have been caught up in production suspension due to the financial crisis. During the same period, the city's pilot implementation of environmental pollution liability insurance has been greatly impeded.

Second, enterprises have adopted a passive attitude towards environmental pollution liability insurance. Even if enterprises were not affected by the international financial crisis, a great number of them would take a wait-and-see attitude towards the purchase of environmental pollution liability insurance. On the one hand, the consciousness of enterprises regarding this insurance is relatively low. This type of insurance is not considered to be an effective instrument to guard against risks. Furthermore, small- and medium-sized enterprises are typically sensitive to insurance premiums and will not readily add costs for the purchase of insurance products with indefinite results. On the other hand, many enterprises have low awareness of environmental risk prevention, leaving the occurrence of pollution accidents to chance. As a result, such enterprises are reluctant to fund insurance products that can redress environmental risks. Furthermore, some large-scale chemical enterprises adopt a passive attitude towards the insurance, deem themselves financially strong enough to address compensation for environmental pollution by themselves. Additionally, they doubt the ability of domestic insurance companies to assume large compensation amounts[32].

Third, domestic insurance companies have a weak capacity to accept environmental pollution liability insurance. Although the domestic insurance sector has taken the

[31] Li Huayou etc., Impact of the Financial Crisis on part of Formulation Work of China on Environmental Economic Policy and Countermeasures, Environmental Protection, 2008 (12A)

[32] The former Administration of Environmental Protection and China Insurance Regulatory Commission, *Circular on issuing the Report on Carrying Out Environmental Pollution Liability Insurance Investigation* , 2007

environmental pollution liability insurance as a driving force for future business, their excessively inadequate operating experience and deficiency in capacity hamper the involvement of insurance companies. Moreover, because of the high amount of damages caused by environmental pollution accidents, the insurance coverage is small, compared to other types of insurance, which mainly focus on fields with high environmental pollution risks. The relatively short history of development and management – meaning that it is far from maturity – have added to the operating risks of environmental pollution liability insurance as compared with other types of commercial insurance. Compared to ordinary life insurance and property insurance, environmental pollution liability insurance has higher uncertainties in benefits and long limitation for claims, which further increases the operating risks of insurance companies. Therefore, the insurance products that are currently on the market have problems such as small coverage of insurance, narrow scope of compensation, and excessive disclaimers. Such a circumstance results in low market demand for the insurance products, which easily leads to a vicious circle.

Fourth, it is hard for the government and the relevant administrative departments to promote the insurance. The active efforts of the government and relevant administrative departments in promoting environmental pollution liability insurance have indeed played an important guiding role, which preliminarily resulted in extensive participation. With the deepening of the work, many different opinions have been raised regarding the involvement of management departments. In many provinces and cities where pilot implementations have been conducted, administrative power is the main driving force for the promotion of environmental pollution liability insurance, and notably "the involvement of enterprises in insurance is out of face-saving motives or out of fear of administrative power"[33]. The excessive amount of administrative intervention is contrary to the original idea that environmental pollution liability insurance will strengthen environmental protection through the market mechanism, which will not only fail to reverse the situation of excessive use of administrative approaches but also prove to be difficult to establish a long-term effective mechanism for the operation of environmental pollution liability insurance. Furthermore, since environmental pollution liability insurance is a profitable market product, the excessive involvement of competent administrative departments will cause some enterprises to question its fairness, which has been identified as a problem by many local environmental protection departments. This is directly related to the manner and extent of local environmental protection departments' involvement in the pilot implementation of environmental pollution liability insurance experiments, which is hard to determine in practice.

Fifth, local governments have an inadequate understanding of the environmental pollution liability insurance. Environmental pollution liability insurance represents a new environmental policy domestically. Local governments have a weak understanding of this insurance and lack knowledge about its functions and effects.

[33] China Environment Newspaper, http://www.cenews.com.cn/xwzx/fz/qt/200904/t20090430_616847.html

Furthermore, local governments fall short in systemically studying the insurance with respect to policy design, development objectives, mode of operation, and management priorities. Problems have arisen for being unaware of the aim of the State's implementation of environmental pollution liability insurance regarding aspects of promotion, work priorities, product design and so forth, which need to be urgently resolved.

1.5 Main reasons that hamper the promotion of environmental pollution liability insurance in China

Many problems came to light during the implementation of environmental pollution liability insurance in China, which is inevitable during an introductory phase. However, efforts should be made to explore the underlying reasons behind these problems, which is critical for advancing work on environmental pollution liability insurance.

(I) The liability for environmental pollution damages remains imprecise, and the implementation of environmental pollution liability insurance lacks an intrinsic motivating force. Existing provisions on the liability for environmental pollution damages remain unclear. Investigation of liability mainly depends on administrative punishment; the investigation system for civil liability and criminal liability for environmental accidents is far from perfect, and administrative punishment fines are limited. As a result, those responsible for environmental accidents only bear a small amount of loss resulting from the pollution, while the local society and local government bear the majority of damages, and the damaged environment and ecosystem are usually excluded from pollution losses. Given that the system for environmental pollution damages and liability investigation is flawed, enterprises are not only unconscious of the need to guard against environmental risks, but are also free from the compensation liability for the whole of pollution damages. Most enterprises are reluctant to incorporate environmental risk management into their operating costs. Since most enterprises perceive little need to purchase the insurance, the lack of motivation to promote environmental pollution liability insurance is understandable.

(II) Legislation is inadequate for the promotion of environmental pollution liability insurance. Environmental pollution liability insurance has been implemented in China in the absence of legislation. Currently, there are no provisions in national laws or regulations. Although the environmental protection and insurance regulatory departments at all levels have promulgated some guiding opinions or work plans, which enable, to some extent, the implementation of the insurance in specific regions and within certain scopes, the absence of legal safeguards is still a key factor that hampers the implementation of the insurance from the perspective of its long-term development. As enterprises have no legal obligation to buy the insurance, the excessive use of administrative power to promote the insurance actually runs counter

to economic policies, and is thus unfavorable for its development and functioning. Amongst the numerous problems arising from the pilot implementation of environmental pollution liability insurance, the absence of legal safeguards has proved to be most challenging problem for promoting the insurance[34]. Thus, the further legislative work for the insurance and its contents is of critical importance to improving the current system for environmental pollution liability insurance.

(III) Local experiments lack policy and the State's financial support. So far, China has no special fund in place to support the pilot implementation of environmental pollution liability insurance. Local finance serves as the major source for covering expenses needed for the pilot implementation. As one of the State's priority environmental economic policies, there should be special funding to support the pilot implementation, which not only ensures enough funds are available for the coordination, scheduling and overall arrangements of the implementation, but also provides proper subsidies to active policy holders and insurance companies. Market risks are higher during the initial stage of pilot implementation and there are more uncertainties. Therefore, only by ensuring the sound operation of involved enterprises can an increasing number of relevant enterprises be attracted to purchase the insurance. In addition, most localities that have been involved in the pilot implementation expressed the hope that the MEP will issue a document to explicitly support the local work, which would help to clarify relationships as well as coordinate relevant departments to carry out the work.

(IV) There is no incentive mechanism for insured enterprises and insurance companies, and the insurance companies face a high level of operating risk. During the initial stage of implementation of environmental pollution liability insurance, the relevant laws and policy systems are far from perfect, and it is very hard to specify the risk prevention expectation of insured enterprises and the profit expectation of insurance companies. Society's inadequate understanding and acceptance of the insurance and the limited number of insured enterprises and insurance companies involved are inconsistent with the requirements of the fundamental "great number principle" of the insurance sector. As the necessary incentive mechanism is absent, the operating risk of insurance companies are increased, to a large extent, and the competitiveness of insured enterprises will be lowered due to increased operating costs resulting from the payment of insurance premiums. In view of higher public welfare that can be achieved through environmental pollution liability insurance and the intention to encourage large-scale involvement of pollution-discharging enterprises, it is absolutely necessary to formulate feasible, preferential policies in the pilot stage to provide support to both types of enterprises.

(V) Environmental pollution liability insurance lacks applicable standards, and the pricing of insurance products and damages are short of guidance. Currently the promotion of environmental pollution liability insurance is confronted with a great number of technical problems, and the country has not established environmental risk

[34] China Environment Newspaper,http://www.cenews.com.cn/xwzx/fz/qt/200904/t20090430_616847.html

assessment measures, pollution damage identification, and compensation standards. The absence of environmental risk assessment measures creates great difficulties in identifying and quantifying environmental risks. Furthermore, the vast divergence between different industries and enterprises makes it difficult for insurance companies to price insurance products by assessing the environmental risks of enterprises. Meanwhile, due to the absence of national environmental pollution damage identification and compensation standards, insurance companies are apt to establish compensation articles that safeguard their own interests, which results in limited coverage and excessive disclaimer provisions for most insurance products. This has reduced the nature of public welfare of insurance products, with excessively obvious characteristics of profitability. Therefore, the deficiency of relevant environmental standards has affected the scope of promotion and policy objectives of environmental pollution liability insurance.

2 Summary and Evaluation of International Practical Experience of Environmental Pollution Liability Insurance

Environmental pollution liability insurance has been implemented for more than 30 years in the US, Germany, and other countries. Abundant experience has been accumulated in terms of laws and regulations, management patterns, and modes of operation, which offers a highly useful reference and is of guiding significance for China's implementation of such insurance.

2.1 The origin and development of environmental pollution liability insurance

Environmental pollution liability insurance is an innovative type of insurance that came into being following the application of liability insurance to environmental accidents. It has various names due to being applied in different fields in different countries. For example, the insurance is called "environmental damage liability insurance" in the US, and "environmental damage liability insurance and dependency cleaning liability insurance" in the UK. Since 1970s, the wave of environmental protection has swept the Western countries. In the wake of the establishment of civil environmental right theory, great advances have been made in the theory of environmental liability, with environmental pollution liability insurance booming as a result. The US was one of the early implementers of environmental pollution liability insurance. This insurance was the first to be recognized by the international insurance sector. The US has led the world in its implementation of this type of insurance. The development of environmental pollution liability insurance in the US underwent many processes, from emergence to flourishing to decline to development to prosperity, which actually mirrors the development of environmental pollution liability insurance internationally.

In the mid-1970s, a series of dangerous waste leakage incidents took place in the US, triggering an unprecedented environmental crisis. After that, the US government strengthened environmental legislation, successively promulgating the *Resource Protection and Compensation Law* (1976), the *Clean Water Act* (1987), the *Integrated Environment Response, Compensation and Liability Law* (namely Superfunds, 1980). In particular, the Superfunds were subject to "retroactive, strict, and joint" liability and the compensation provisions for clean-up expenses covered a wide field, which produce massive and complex liability risks at all levels of the US economy. A rise in environmental insurance market demand stimulated more insurers to enter this market; the environmental damage liability insurance appeared in 1977, and the US created a pollution liability insurance acceptance combination – the association of pollution liability insurance in 1982.

In the late 1980s, an insurance crisis erupted in the US environmental liability insurance industry. The implementation of Superfunds caused countless potentially liable individuals to claim from insurance companies through their liability insurance policies which had been bought decades previously. Combined with the immature technology for accepting pollution liability insurance and insufficient policy holders, the US environmental insurance market nearly collapsed in the 1980s. After the mid-1980s, most US insurance companies no longer offered new pollution liability insurance policies, and the insurance premium of remaining policies was multiplied, while the maximum damages declined substantially. Although more than 1 million companies produced, processed, or discharged harmful waste, few of them bought pollution liability insurance. Only one insurance group was still active in the environmental liability insurance market, but the maximum damages in available insurance were only USD 12.5 million, and many other insurance groups only offered pollution risk insurance with limited compensation. Insurers continually revised old insurance policies and introduced new indemnity provisions to restrict indemnities for environmental loss. From this perspective, the US environmental insurance market became rapidly worse and environmental pollution liability insurance almost disappeared entirely.

To reverse this situation, the "absolute pollution liability disclaimer" was written into standard CGL (comprehensive general liability) insurance policies in the US, with ISO1986 stipulating that: "Irrespective of unexpected or progressive pollution loss, this insurance shall not be liable for compensation for any physical injuries or property loss due to discharge of pollutants". The establishment of an absolute liability disclaimer greatly changed market conditions, and demand for environmental damage liability insurance began to increase again. In the 1990s, the environmental insurance business of insurance companies began to continuously make profit, and most of the long-term market participants could establish sufficient capital reserves. The maturity of the environmental insurance market enabled an accumulation of massive loss data, which provided the basis for risk assessment by insurance companies and reinsurance companies. As a result, the quantity of accepted environmental liability insurance and insurance types grew rapidly, with the

environmental liability insurance industry in gradual prosperity[35]. In the year 2000, a typical single environmental liability insurance policy provided total insurance of up to USD 100 million, and some even offered insurance of USD 200 million or more. Meanwhile, the introduction of reinsurers increased the insurance acceptance capacity of a single policy. Table 4.5 shows the major environmental insurers and insurance capacity of each transaction in the US in the year 2000[36].

Table 4.5 Table of major insurers and insurance capacity of a single transaction in the U.S. in 2000

Insurer	Capacity (unit: USD million)
AIG Environmental Insurance	200
Environmental Insurance Company	150
Kemper	200
Zurich-American Zurich Environmental Insurance	150
United Capital Insurance	15
Liberty	30
Chubb	10
Other (estimated value)	250

According to expert statistics from the US-based AIG Group, ACE, AIG, Chubb, XL, Zurich, Great American (joined in 2008), Seneca, and other insurance companies, which currently offer environmental liability insurance products in the US: the US environmental liability insurance market was worth some USD 2-3 billion in 2007, and was expected to grow at a rate of 10% over the coming years. Although the growth rate slowed down, as compared with previous years, innovative environmental liability insurance products were launched in succession[37].

The success and lessons of the US in the area of environmental pollution liability insurance were studied by many countries. After 1990, due to environmental pollution problems, 76 insurance companies in Italy formed a joint insurance acceptance group to accept damage liability insurance from environmental pollution, and its volume of business reached more than 90% of the total liability insurance business with a short period of time. Nowadays, large-scale transnational legislation has emerged as a trend in the environmental pollution liability insurance field. For example, the Environment Ministers of EU member states reached a consensus on an "environmental liability directive" on June 13, 2003, believing that environmental pollution incident makers in EU states should have severe punishments imposed. After this directive becomes a law of EU member states, such a law can greatly promote the development and application of the environmental pollution liability insurance system.

[35] John A. Hannah, The U.S. Environmental Liability Insurance Market–Reaching New Frontiers, 2000.5

[36] John A. Hannah, The U.S. Environmental Liability Insurance Market–Reaching New Frontiers, 2000.5

[37] Jota Shohtoku, *Green Insurance Research Team, Summary Paper* , Unpublished , International Experiences on "Green Insurance" CCICED – Task Force on Economic Instruments for Energy Efficiency and the Environment , 2009.1

Environmental pollution liability insurance systems and businesses in Western countries have entered a relatively mature stage, and have become one of the major approaches for all countries to address environmental damages problems through both socialization and the market mechanism. The establishment and development of such insurance plays an important role in promoting environmental protection work in all countries.

2.2 Major international development patterns for environmental pollution liability insurance

Due to the complex causes for environmental pollution and the particularity of environmental risk liability assumption, together with the different national situations of various countries, environmental pollution liability insurance has developed in different ways. Currently, two modes of environmental liability insurance are recognized as relatively mature internationally: compulsory environmental pollution liability insurance and voluntary environmental pollution liability insurance[38]. Some new modes have been derived in different countries according to their actual needs, but these basically fall with the scope of the two major modes.

1. Compulsory environmental pollution liability insurance[39]

Countries which have implemented compulsory environmental pollution liability insurance include the US, Germany, Russia, and Argentina, all of which have adopted compulsory insurance in limited fields, such as for domestic enterprises or equipment with bigger environmental risks. Not all enterprises are obliged to purchase insurance; for most enterprises, they can purchase appropriate insurance on a voluntary basis. In this mode, compulsory insurance is supplemented by voluntary insurance. In Germany, for example, the overwhelming majority of enterprises have purchased environment-related liability insurance, amongst which, only 5% need to purchase compulsory environmental pollution liability insurance pursuant to laws, and the remaining 95% can purchase relevant insurance products on a voluntary basis.

Compulsory environmental pollution liability insurance is realized through various forms, other than insurance. Countries that have implemented such insurance provide, by law, other forms of fund guarantees in addition to insurance, such as financial

[38] Notes: Voluntary insurance means that policy holders and insurance companies completely volunteer to conclude an insurance contract after reaching an agreement through consultation in line with the principle of equality and mutual benefits and equivalent compensation, in order to establish an insurance relationship. Compulsory insurance is also called legal insurance, meaning that according to the promulgated national relevant laws and regulations, the units or individuals within the prescribed scope must purchase insurance, regardless of their willingness. The scope of compulsory insurance is strictly limited because it reflects the state's intervention in individual desire in a sense.

[39] Notes: Such countries are not considered as those subject to the compulsory environmental pollution liability insurance that need to buy liability insurance or to furnish financial security in oil stain, nuclear energy, and other fields due to joining international conventions, such as the *International Convention on Civil Liability for Oil Stain Damages* if they have not drawn up national environmental pollution liability insurance regulations.

guarantees or assurance, funds and so forth. These are provided for enterprises to select amongst according to their own conditions, and thus, increasing to some extent, the capital flexibility for the compulsory environmental pollution liability insurance.

(1) The mode that combines insurance and financial guarantee

Compulsory environmental pollution liability insurance that combines insurance and financial guarantees is extensively applied internationally. Enterprises can fulfill legal obligations through the purchase of commercial insurance or through a guarantee provided by the government or credit institutions. The US and Germany have followed such an approach. The US *Integrated Environment Response, Compensation and Liability Law* stipulates that; "The economic certificates of compulsory environmental liability for the activities with specific environmental risks can be established through one form or a combination of several forms including insurance, guarantee, guaranteed securities or self insurance". The German *Environmental Liability Law* advocates to "adopt the system in which the compulsory liability insurance and financial guarantee or assurance are combined", and "three methods are available for providing fund guarantee, i.e. the purchase of commercial insurance contracts; the fulfillment of assurance or guarantee liability by the federal or state government; the provision of assurance or guarantee by credit institutions".

(2) The mode that combines insurance and funding

Public liability insurance in India illustrates the approach of combining insurance and special funding. India's *Public Liability Insurance Act* stipulates that: "With Approval of the central government, the following organizations can establish and maintain a special fund, and ensure sufficient indemnities for casualties and property losses resulting from accidents. This clause shall apply to such organizations as: (1) the central government; (2) the government of each state; (3) enterprises owned or controlled by the central government or a state government; (4) local management organizations". In this context, such funding is mainly applicable to state-owned enterprises and institutions.

Different management modes have been adopted by Indian state-owned enterprises and institutions and other enterprises under the public liability insurance, which allows state-owned enterprises and institutions to establish funds as a substitute for the purchase of commercial insurance. The *Detailed Rules* provide requirements for the operation of such a fund. Article 6 of the *Detailed Rules of Public Liability Insurance* provides that: "With advance approval and examination by the central government", "these specific organizations" can establish funds by making deposits in the central bank of India or its branches or other state-owned banks", "the fund is used to pay liable indemnity applied by fund owner according to the judgment by the administration department". The detailed rules for fund management stipulate that: "a Fund manager shall be appointed by the owner of the fund, and shall be reported to the central government".

2. Voluntary environmental pollution liability insurance

A relatively large number of countries implement voluntary environmental pollution liability insurance, including France and Britain. In the 1960s, France lacked professional environmental pollution damage insurance. Until the 1970s, general insurance policies of French insurance companies contained clauses that excluded coverage for losses resulting from water pollution, air pollution, noise, odors, vibration, radiation, light, and temperature changes. In 1977, the pollution reinsurance consortium (GARPOL) formed by non-French insurance companies and French insurance companies established special pollution insurance policy, and the underwriting coverage was no longer limited to occasional and sudden environmental damage accidents. As a result, the environmental damages caused by separate, repeated, or continued accidents were accepted. The environmental damage liability insurance policy proposed in Britain in 1974 provided insurance for accumulated, continued, coordinated, and hidden environmental pollution accidents. In 1970, the British government announced that acoustic shock losses caused by experimental planes must be compensated and thus, acoustic shock insurance was offered for liability for damages due to acoustic shock and other noise pollution, which remedied the technical difficulty in claim validity investigation as well as provided a solution to claim issues arising from acoustic shock risks.

Judging from the business volume of environmental pollution liability insurance of various countries, voluntary insurance is the principle part and serves as the foundation for compulsory insurance. In many countries, a system of compulsory insurance was gradually established on the basis of voluntary insurance. Presently, countries that only implement voluntary environmental pollution liability insurance are on a constant decline. The combination of voluntary insurance and compulsory insurance has been adopted by most countries, which gives better play to the effects of environmental pollution liability insurance.

2.3 The trend of international environmental pollution liability insurance

Because of the different priorities and focus areas of environmental pollution liability insurance within various countries, different modes of operation and types of products have emerged. However, when it comes to the overall development trends of the insurance, some similarities can be identified, which show the development trend of environmental pollution liability insurance.

2.3.1 Legislation is an indispensable part of an environmental pollution liability insurance system

Looking at practices across a variety of countries, legislation is an important component of environmental pollution liability insurance. In the 1970s, US

environmental legislation brought about the financial instrument of environmental pollution liability insurance to enhance environmental protection. Subsequently, various countries successively established a legal status for environmental pollution liability insurance through legislation (See Table 4.6). The modes of operation, underwriting methods, administrations, compensation liability, and priority fields were specified in a legal form, which provided binding force for environmental pollution liability insurance. Ultimately, legislation is the cornerstone for implementing environmental pollution liability insurance, which is also a key yardstick to evaluate the development level of a country's insurance system.

Table 4.6 The situation of legislation of some countries on the environmental pollution liability insurance

Country	Title of law	Promulgation time
US	Clean Air Act	1970
	Resource Protection and Compensation Law	1976
	Clean Water Act	1987
	Comprehensive Environment Response, Compensation and Liability Law (Superfund)	1980
	Oil Stain Act	1990
	Sarbanes-Oxley Act	2002
Germany	Environmental Liability Law	1991
India	Public Liability Insurance Act	1991
	Detailed Rules of Public Liability Insurance	1991
	The List of Chemicals and List of Quantity Subject to the Public Liability Insurance Act	1992
	The National Environmental Court Act	1995
Argentina	The General Environmental Law (No. 25,675 Act)	2002
	No. 177/2007 Resolution	Feb. 2007
	No. 178/2007 and 12/2007 Joint Resolution	Feb. 2007
	No. 303/2007 Resolution	Mar. 2007
	No. 1639/2007 Resolution	2007
	No. 98/2007 and 1973/2007 Joint Resolution	Dec. 2007
	No. 1398/2008 Resolution	Sep. 2008

2.3.2 Compulsory environmental pollution liability insurance represents a major development trend

Compulsory insurance represents an important development trend for environmental pollution liability insurance. Although the business volume of compulsory insurance represents a relatively low proportion in the total business volume of environmental liability insurance, its coverage is targeted at high-pollution and high-risk enterprises or facilities, which are seen as major fields for the occurrence of environmental problems, thus, imposing compulsory insurance in these fields is of significant importance both in terms of risk prevention and compensation for damages.

Currently, compulsory management is realized through the establishment of directories by countries that implement compulsory environmental pollution liability insurance. The targets of these directories are categorized into an equipment directory, a product directory and an environmental risk assessment directory, based on the actual management requirements of various countries.

(1) The practice of implementing an equipment directory is represented by Germany. The directory encompasses equipment with potential environmental risks[40]. Annex I to the *Environmental Liability Law* provides a detailed list of 96 types of equipment in 10 major categories. The types involve facilities in various fields, such as heat energy production, mining, energy, building material, metal processing, chemical, refining of pharmaceuticals, wood, pulp and paper, food, farm produce and production, storage, transportation, and waste disposal. For the equipment listed in the directory, the purchase of insurance or the provision of a financial guarantee is obligatory, in line with the law.

(2) The practice of implementing a product directory is represented by India. India's public liability insurance stems from the Bhopal pollution accident that occurred in 1984 as well as a subsequent series of dangerous chemical accidents; thus, the Indian directory mainly targets dangerous chemicals. The *Directory of Chemicals and List of Quantity Subjected to the Public Liability Insurance Act* promulgated by India falls into five major categories, including: two categories of toxic chemical substances, easy-to-react chemical substances, explosive chemical substances and inflammable chemical substances, amounting to 182 kinds of chemical substances. The quantity of harmful substances operated and disposed of by enterprises and institutions is taken as the yardstick for purchasing public liability insurance. In case the quantity exceeds the limit provided in the directory, commercial companies are obliged to buy public liability insurance, and State-owned enterprises and institutions are required to establish a special fund, under such circumstances.

(3) The practice of implementing an environmental risk assessment directory is represented by Argentina. Argentina's No.1639/2007 Resolution established calculation methods of environmental complexity for factories and services (See Box 4.1). If the environmental complexity of factories and services is above some limit, the enterprise must purchase environmental liability insurance not less than the minimum unit insurance premium.

Box 4.1 Standards for determining environmental complexity and compulsory environmental liability insurance in Argentina

Annex I to No. 1639/2007 Resolution of Argentina encodes and marks industrial and service activities by using the international industrial classification system and classifies them into three categories in the light of the size of potential risks in activities. The first category of activities has minimum potential risks, and the third category has maximum potential environmental risks, while

[40] The definition of "equipment" in the *Environment Liability Law:* Referring to factories, warehouses, and other fixed facilities, including machines, devices, transportation, and other unfixed technical facilities, and other auxiliary facilities related to the equipment or its components in space or in operating technology and to environmental impact.

the second category is in the middle.

Based on the above classification, initial environmental complexity of factories and services (NCA Initiation) is calculated. There are five factors for calculating environmental impact complexity, including: types of activities (Ru), discharged wastewater and waste (ER), unique risks in activities (Ri), scale of organizations (Di), and location of organizations (Lo). Various factors have different numerical values, and then NCA Initiation is calculated according to the following formula.

NCA Initiation=Ru + ER + Ri + Di + Lo

After calculation of the NCA Initiation, according to:

NCA=NCA Initiation + AjSP - AjSGA

Where AjSP is the control and adjustment to quantitative special risk substances, with the numerical value = 2, which is applicable to verifying industrial and service activities in which substance control exceeds the provisions in Annex II Catalogue in quantity; AjSGA is the adjustment to institutional environmental management systems, with the numerical value = 4, applicable to those valid environmental management system certificates which are issued by relevant authorized independent organizations.

NCA numerical values are derived in an integrated way according to different variables; based on environmental risks, industrial and service activities are divided into:

1. Classification I (less than or equal to 11 points, NCA≤11);
2. Classification II (12 to 25 points, 12≤NCA≤25);
3. Classification III (more than 25 points, NCA>25)

According to the provisions in Article 3 of No. 1398/2008 Resolution, "the minimum unit insurance premium is applicable to all kinds of industrial units and the units with the environmental complexity of activities (NCA) equal to or above Level 12". That is to say, if the environmental complexity is equal to or above 12 in industrial or service activities, it is a must to buy environmental liability insurance not less than the minimum unit insurance premium. Meanwhile, according to the provisions, the items included in the "dangerous substances and dangerous residue transportation" category should be directly listed in Classification III, and the enterprises under this Classification must purchase environmental liability insurance.

2.3.3 Giving provisions on liability for pollution damages and attaching more importance to environmental damage restoration expenses

Explicit provisions are provided by law in various countries regarding liability for pollution damages. These play a key role in standardizing indemnity clauses and activities with respect to environmental pollution liability insurance products. Insurers are obliged to bear corresponding indemnity liability, in line with the law. For example, the US Superfund stipulates that the liable party should undertake: "the expenses of cleaning and remedial measures of the Federal Government, State government, or Indian tribes in conformity with national accident plans; any other necessary expenses that are spent by any other persons in conformity with national accident plans; damages for impairment, destruction, and loss of natural resources, including reasonable assessment expenses for the said impairment, destruction, and loss due to this discharge; and expenses related to health evaluation or to study of health impact"[41]. The German *Environmental Liability Law* also stipulates that

[41] The Environmental and Resource Protection Committee of the National People's Congress, *Collection of World Environmental Laws* (the U.S. volume), vol.1, the Comprehensive Environmental Response, Compensation and Liability Law, Beijing: China Archives Press, December 2007, Page 52

indemnity includes expenses arising from personal injuries and death. If the equipment owner impairs the natural ecology or specific scenery, the liable party should compensate the victim for the expenses of ecological restoration and of animal-curing which have been paid and other necessary expenses that are claimed.

In creating clear liability for pollution compensation, countries have attached greater importance to the liability for environmental damage restoration. Explicit requirements and provisions on such liability are provided by laws in the US and Germany. Argentina's environmental pollution liability insurance mainly addresses the restoration of environmental damage. No. 98/2007 and 1973/2007 Resolutions stipulate that: "The coverage of the environmental damage insurance does not exclude civil environmental damage, but the civil environmental damage is subject to voluntary insurance items, and the environmental damage arising from large-area accidents must be subject to insurance". It is deemed that the role of insurance policies lies in the timely acquisition of sufficient funds to restore the damaged environment in the event of sudden or indirect colony environmental damage due to accidents, and that other liability should not be assumed, including criminal, civil, and administrative liability. Thus, the sum insured to be achieved should be neither deducted for expenses, appeal, and other reasons without a direct relationship with insurance policies nor used for other purposes. Personal and property losses due to environmental pollution should not be subject to this insurance. To obtain the relevant insurance, parties can purchase other commercial insurance for civil environmental damage, which belongs to voluntary insurance items; civil environmental damage can also be settled through judicial channels.

2.3.4 Establishment of environmental relief funds and improvement in the indemnity and relief mechanism

For the purpose of controlling operating risks, each environmental pollution liability insurance policy provides upper limits to a single indemnity and total indemnities within the insurance period, and insurance undertakes limited liability. In order to solve the problem that pollution damage goes beyond the upper limit to insurance compensation and where a policy holder is incapable of compensating for extra losses, some countries have set up an environmental relief fund.

The Indian government requires an environmental relief fund to be established when implementing public liability insurance. Article 7 of the *Public Liability Insurance Act* prescribes that: "The central government can establish environmental relief fund by means of announcements", "the funds are used as relief for persons and property losses in accidents according to judgment by the management". Paragraph 3 in Article 10 of the *Detailed Rules of Public Liability Insurance* provides: "environmental relief fund is applied in case of insufficient indemnities from the public liability insurance. With regard to sources of public environmental relief fund, Paragraph 2 in Article 4 of the *Public Liability Insurance Act* stipulates that: "Each owner must separately pay a certain sum as environmental relief fund to an insurer while paying insurance premium, and the sum is allowed not to exceed the insurance premium according to

provisions"; "insurers must hand in the money as relief fund from owners to management agencies, and if the insurers fail to do that, the money shall be complemented by collecting the land revenue or public demand from the insurers". Article 11 of the *Detailed Rules of Public Liability Insurance* provides clearly that "owners must pay money equivalent to insurance premium to environmental relief fund".

Environmental relief funds offer an effective supplement to environmental pollution liability insurance, and are an important component of the pollution damage relief mechanism, which addresses the indemnity problem through means other than insurance and other market-based compensation, recognizing the inability of policy holders to pay indemnity. As a new subject internationally, environmental relief funding is an important supplement to resolving social contradictions arising from environmental pollution and to safeguarding civil environmental rights and interests, and is therefore a very useful reference for China.

2.3.5 Main features of international environmental pollution liability insurance products

The environmental pollution liability insurance products of various countries exhibit some common features in their design. The characteristics of products, which serve a public welfare purpose, are particularly worth study regarding the following areas:

1. The gradual extension of insurance coverage. First, insurance is extended from the initial acceptance of occasional and sudden environmental accidents as well as for environmental damage due to gradual pollution. Second, numerous previous liability disclaimers are gradually included in the scope of insurance liability, following the increase in research and development capacity of environmental pollution liability insurance products. Finally, the content of compulsory insurance still concentrates on the areas of high pollution and high environmental risks, although this is under constant revision and adjustment in parallel with changes in risk conditions.

2. The establishment of upper indemnity limits. Most environmental pollution incidents feature a wide scope of influence and a high amount of indemnities. To reduce the operating risks of insurers, an upper limit has been set by various countries for indemnity payment. The Indian *Detailed Rules of Public Liability Insurance* stipulates that "in one judgment, if there are many indemnity applicants in one accident, the liable indemnity from the insurer to the insured shall not exceed 50 million rupees; if several accidents occur within one agreement term or a year, the total indemnity shall not be more than 150 million rupees, regardless of the size of losses".

3. The extension of the time limit for claims. As environmental pollution damage is not immediately evident, the reality of progressive and long-term damage has been recognized, and the time limit for claims has been extended on a reasonable basis. The environmental pollution liability insurance of the US mostly adopts a "sunset clause", which stipulates that both parties to an insurance contract agree that a maximum

period of 30 years from the invalidation date of an insurance policy shall be the longest time limit for the insured to inform the insurer of a claim. The legal time limit for claims is 10 years under Germany's environmental liability insurance.

4. The diversification of product varieties. To fulfill the diverse needs for environmental risk prevention, a wide variety of environmental liability insurance products are provided by the international insurance market. For example, in addition to environmental damage liability insurance, the US market also provides environmental damage liability insurance for contractors, professional environmental risk error and omission insurance policies, general liability insurance policy for asbestos and lead removal project contractors, and so forth. .

5. The specialization of management. In view of the complexity of environmental problems, many countries have established special institutions to handle relevant businesses. For example, Argentina has set up an environmental risk assessment team and an environmental and financial guarantee advisory committee, both of which are mainly engaged in drawing up relevant environmental standards and guidelines, and amending basic provisions of contractual clauses concerning environmental damage risk insurance policies. India has established an environmental court and a public liability insurance advisory committee, which mainly handle disputes and problems related to public liability insurance.

3 Conclusions and Policy Recommendations

3.1 Main Conclusions

(1) Environmental Pollution liability insurance has been widely used as a mature economic instrument

Environmental pollution liability insurance is a widely-used management tool of environment protection around the world. As the main way for enterprises to fulfill their environmental responsibility, environmental pollution liability insurance has performed well in terms of preventing environment risk and compensating pollution damage. After several decades of development, many countries have already built up a relatively complete system of environmental pollution liability insurance, which includes an effective law and regulatory system and diversified insurance products., As enterprisers recognize its performance in relation to their environmental responsibility, the market operation will no longer require further government assistance. In many countries, environmental pollution liability insurance has developed effectively and plays an important role in enhancing enterprises' environment protection and safeguarding victims' rights. According to international experiences, it is both necessary and feasible to promote environmental pollution liability insurance in China, and the approach of using both the law and market mechanisms, is worth serious consideration.

(2) Environmental pollution liability insurance in China faces the twin challenges of implementation and improvement; there is a critical need to respond to challenges and take opportunities to improve relevant laws, regulations, policies and standards

With increasingly environmental requirements and the trend of frequent environmental accidents，there is great market demand for environmental pollution liability insurance, but considering the imperfection of the construction of the socialist market economic system of China at the current stage, the inadequate incorporation of environmental cost into products and services as well as the severe lack of experience of employing economic means to resolve environmental problems, the market-oriented implementation of environmental pollution liability insurance is confronted with strong challenges. In general, environmental pollution liability insurance in China is at an early stage, and the market is very small. Compared with the US and Germany, supporting laws, regulations, policies and standards are still very backward, and the environmental pollution liability insurance market still lacks the necessary guidance to facilitate further development. Therefore, the key for the development of environmental pollution liability insurance in China is to establish and improve the relevant laws, policies, and standards.

(3) Duly Adjust the Environmental Pollution Liability Insurance Strategy Tailored to the Realities of the Financial Crisis

The influence of the financial crisis on the national macro-economy has not come to an end, which is very unfavorable for the promotion of environmental pollution liability insurance. Hence, appropriate adjustment to the development strategy for environmental pollution liability insurance at the current stage is needed in response to changes in the economic situation and according to the priority for national economic development. With respect to the experiments with environmental pollution liability insurance, the scale of existing experiments can be maintained, and pilot exploration can be implemented to focus on several fields and industries with high environmental risks and high frequency of accidents with the aim of intensifying efforts to solve technical problems during the pilot experience in order to enhance technical reserve，gradually improve related mechanisms and policies, accumulate experience and lessons with an aim to lay a foundation for the comprehensive implementation of environmental pollution liability insurance in the future.

3.2 Policy Recommendations

3.2.1 Establish a legal and regulatory framework to enable environmental pollution liability insurance

(1) Improve related laws and regulations specifying the division and identification responsibility of environmental damage, strengthen environmental responsibility accountability, implement the “responsible-party pays” principle for building the real

binding force of environmental liability on enterprises that can generate market demand and form the developing motivation of environmental pollution liability insurance. First, it is necessary to improve the contents of the division and identification of responsibility for environmental damage, it is recommended to clarify the liability of environmental accident makers with respect to compensation in relevant laws; in international practice, liability includes: casualties, property damage, and ecological environment recovery (or remediation) expenses. The liability provisions can be specified in a special law or in a number of laws. Second, efforts are needed to strengthen the investigation into criminal and civil liability of environmental incident makers, and various approaches should be adopted to investigate the compensation liability of incident makers by making changes to the previous method, which mainly relies upon administrative punishment. Finally, efforts are needed to enhance and implement liability investigation, so that the incident makers will conscientiously realize the legal seriousness, the requirement for compensation, and the significance of environmental risk prevention, which is of great importance to promoting environmental pollution liability insurance.

(2) Establish legislation, which is fundamental to building an effective system of environmental pollution liability insurance. The current situation, where environmental pollution liability insurance is promoted in absence of legal basis, must be urgently redressed. Efforts should be made to expedite the legal construction of environmental pollution liability insurance, and establish a legal system that favors the promotion of this type of insurance. First, it is necessary to implement legislation primarily at the national level. The contents of pollution liability insurance should be appended into special laws concerning environmental protection during their amendment, such as the Environmental Protection Law of PRC, or the Law of PRC on Prevention and Control of Water Pollution, the Law of PRC on Prevention and Control of Atmospheric Pollution, the Law of PRC on Prevention of Environmental Pollution Caused by Solid Waste, and so forth. Second, efforts should be made to elaborate detailed rules or administration measures for the implementation of environmental pollution liability insurance, which explicitly stipulate the relation between environmental pollution liability insurance and civil liability system, the scope of application of liability insurance and the limits to the subject matter, the status of a third party under the liability insurance, liability for payment by the liable insurer, the plea and reconciliation on a claim of a third party under the liability insurance, and other issues. In addition, regions with legislative rights should be encouraged to take the initiative to carry out the legislation work of environmental pollution liability insurance, map out supporting regulations, policies, and measures, and launch experiments, in order to accumulate experience for the formulation of relevant national laws.

(3) Thirdly, clear channels for third party compensation must be made available for those that have been damaged by pollution conditions. As it stands currently, third parties have an arduous task to receive compensation from the guilty party even if liability is clearly with that party.

3.2.2 Establish a policy framework to enforce environmental pollution liability insurance

(1) The launch of environmental pollution liability insurance products and the role of policies are directly related to the provision of scientific environmental standards. Therefore, the MEP should work to develop the standards and guidelines for environmental pollution liability insurance, such as a compensation standard for pollution damage, environmental risk assessment standard, and clean-up standards for contaminated sites. Based on this, the MEP should put forward applicable standards for industries like pesticides, dangerous chemical transportation, and hazardous waste disposal in various stages and categories so that the relevant activities can be implemented in accordance with certain criteria, to regulate related market subjects' behavior of environmental pollution liability insurance, and ensure that environmental pollution liability insurance functions according to policy objectives.

(2) China has little actual practice related to environmental pollution liability insurance, and enterprises have relatively weak awareness of how to prevent environmental risks. Under the current legal framework, the market foundation is inadequate for implementing the compulsory insurance in a comprehensive manner. However, in recent years, innocent victims of environmental damage have been typically unable to get compensation that is due, and the damaged environment can not be restored due to the frequent occurrence of environmental pollution accidents and the ineffectiveness of the pollution damages system. Taking this circumstance into consideration, if the voluntary insurance approach is fully adopted, it is expected that the majority of pollutant-discharging enterprises, which have low consciousness of social liability, will not purchase environmental pollution liability insurance. By combining the international development trend of environmental pollution liability insurance with China's actual situation, it is necessary to adopt an approach in which compulsory insurance and voluntary insurance are combined, and to encourage the majority of enterprises to purchase environmental pollution liability insurance on a voluntary basis. For those areas or industries with high environmental risks and serious environmental pollution, the environmental pollution liability insurance should be implemented on a compulsory basis.

The implementation of compulsory insurance is an important component for China's environmental pollution liability insurance system, and the establishment of a supporting directory is of key importance in the implementation. Considering the large number of Chinese enterprises, the wide variety of industry categories and the uneven technological levels, it is difficult to refer to the international experience of establishing directories according to equipment categories. Therefore, it is more feasible to establish a supporting directory of compulsory liability insurance according to industrial techniques. First, efforts should be made to fully analyze the economic contribution, pollution discharge, frequency of pollution accidents, technological progress, social influence and other factors of industries with high pollution and high environmental risks, study and propose the directory of industrial technology for the compulsory environmental pollution liability insurance, and

determine the techniques of industries that need to purchase compulsory environmental pollution liability insurance. According to China's industrial environmental risks and accident conditions, enterprises that produce, transport, store, and use dangerous chemicals, petrochemical, hazardous waste disposal, and other industries should be included in the scope of compulsory environmental pollution liability insurance. Second, it is necessary to study and propose technical guidelines for the establishment of the directory, specify the basic requirements for the techniques under the compulsory insurance, and standardize the indicators and parameters of procedures for the establishment of the directory and technical selection. In addition, the directory of industrial techniques under the compulsory environmental pollution liability insurance should be subject to dynamic and timely adjustment; techniques should be added to and deleted from the directory according to actual management needs, with the aim of conscientiously including techniques with higher environmental risks and greater harms in the scope of compulsory environmental pollution liability insurance.

(3) Environmental pollution liability insurance is in the public interest. Policy support from the central government is needed for the initial implementation of the insurance. Internationally, the provision of proper tax abatement and exemption is a common practice. The launch of appropriate preferential policies at the initial stage for China's implementation of environmental pollution liability insurance will not only encourage a greater number of pollution-discharging enterprises to purchase the insurance, but will also diminish the operating risks of insurance companies. Thus, the benefits of both insurers and insured enterprises are guaranteed, which is in conformity with the policy orientation of energy-conservation and emission-reduction of the State. Therefore, The MEP should collaborate actively with financial, taxation, and banking management authorities to speed up the establishment of favorable and incentive policies that support the environmental pollution liability insurance, such as giving back companies a certain proportion of their discharge fees as their premium paid to the insurers, connecting the insurance with green credit systems, tax reduction and exemption for insurances companies, and so forth. In addition, it is recommended to establish a special fiscal fund to subsidize insurers and insurants in pilot areas to put forward the environmental pollution liability insurance on a voluntary basis.

(4) It is necessary for China to establish an environmental relief fund as early as possible, which can be used for compensation where indemnity exceeds the limit of the environmental liability insurance and where policy-holders are unable to bear indemnity liability in case of preventing major environmental accidents and even environmental disasters. Environmental relief funding is chiefly aimed at safeguarding the rights and interests of victims and addressing social conflicts caused by accidents. As a result, the larger society assumes part of the losses of the victims. An environmental relief fund is a major supplement to environmental pollution liability insurance and functions as an important part of the national compensation and relief mechanism. An environmental relief fund can be established by referring to experience from overseas countries, with a wide variety of fund sources including:

part of fund transferred by the government through national finance appropriation, pollution discharge fees, fund raised through social organizations, and private donations.

3.2.3 Improve the supervision and management mechanism and establish an environmental pollution liability insurance guidance center

(1) It is important to strengthen collaboration between environmental and insurance authorities with s clear-cut division of labor to jointly establish the mechanism for investigation, loss adjustment, claims auditing, and liability verification of environmental pollution accidents. It will be necessary to strengthen the routine supervision and administration, conduct information exchange and communication in a timely manner, and establish an approval and solicitation system for environmental pollution liability insurance products to tackle problems arising from implementation of the insurance, and ensure the development of environmental pollution liability insurance in conformity with the established policy objectives.

(2) Establish an Environmental Pollution Liability Insurance Guidance Center under the administration of the MEP. The major responsibility of this center would be to: (i) Research and formulate industrial environmental risk assessment guidelines and compensation standards for damages from pollution, (ii) Formulate and adjust the industrial process directory for compulsory environmental pollution liability insurance, (iii) Research and propose fiscal and taxation policies that facilitate the implementation of environmental pollution liability insurance, (iv) Actively coordinate efforts of fiscal departments, taxation departments and other departments to carry out tax abatement and exemption policies, (v) Propose amendments to environmental pollution liability insurance products that are put onto the market, (vi) Provide guidance for insurance companies to implement compensation for damages from pollution, (vii) Draw up procedures for pollution damages compensation and identification as well as technical guidelines for environmental restoration, and (viii) Providing optimal treatment solutions for environmental restoration, which will give professional technical support to relevant authorities.

3.2.4 Strengthening Efforts in relevant Education and Capacity Building

(1) The MEP and CIRC should actively carry out nation-wide training in environmental pollution liability insurance for relevant personnel to improve their understanding of its importance so as to gain in-depth understanding of the requirements, goals, and methods of environmental pollution liability insurance and grasp the basic management skills and technical approaches.

(2) It is necessary to actively strengthen fundamental research on environmental pollution liability insurance, which includes relevant data accumulation, research on environmental standards and so forth, gradually increase the investment in the study, enhance the R&D of relevant insurance products, and promote the technical support system of environmental pollution liability insurance.

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Chapter 5: Report on International Experiences in Environmentally Related Taxes

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1. Introducing Environmentally Related Taxes: A Window of Opportunity for China

The transition from a strictly planned economy to a socialist market economy which China has undertaken has enabled impressive economic growth rates over more than two decades and has been significant for reducing poverty and increasing standards of living. Environmental challenges such as air and water pollution have nevertheless gained more prominence not only as a problematic side-effect to this economic development but also because with rising incomes preferences become stronger for protecting the environmental and amenity values. Furthermore, balanced management of natural resources as a basis for China's economy is necessary. Sustainable use of energy and raw materials will be required to avoid future bottlenecks for harmonious development and economic growth.

A number of measures have been introduced exactly to address these challenges. China's innovative legislation for a "circular economy" in particular seeks to close the material cycle loops so as to maximise on resource efficiency and effectiveness. Still, most of China's environmental legislation continues to be based on command-and-control approaches, and have not taken advantage of the dynamics of a more market-oriented approach. Targets for annual improvement in energy efficiency, for instance, are more likely to be smoothly implemented when underpinned by economic signals that provide clear benefits to improved management, than when simply imposed on enterprises.

A large number of charges and fees are already in place in China's environmental protection administration[42], but these charges and fees are mainly aiming at raising money for the provision of certain services or licenses, and are not providing effective incentives for changing behaviour or investment decisions are not well reflecting the actual external costs involved with the long-term chronic impacts of pollution. They also do not price the relative scarcity of natural resources, such as exhaustible energy carriers, and so do not convey the opportunity costs involved.

The term socialist market economy refers to a market-economy that is constrained by more than a pair of invisible hands, but by mechanisms and incentives

[42] See the Chinese contributions to the Task Force and the Interim Report

that serve to correct effectively for market failures, whether relating to social or environmental aspects. Around the world decision-makers have obtained mainly promising experiences by attaching price signals to natural resource depletion and pollution. Market-based economic instruments not only offer the prospects for better environmental protection and energy efficiency, but also entail a stronger impetus for a sounder economic development with improved competitiveness due to the pressure on enterprises to improve on innovation of processes and products. This dynamic efficiency (see below section 2) of market-based instruments can be reinforced under environmental tax reforms. A China-US Joint Economic Study, for example, shows that 16 % of costs could be reduced to achieve the 11th Five-year targets of energy-saving and pollution abatement in China's power sector by applying an emission trading system, instead of command-and-control instruments. It is likely that energy-/carbon-taxes would have similar impacts.

In 2007, the OECD Environmental Performance Review of China recommended, *inter alia,* that China,

"review *price levels* for energy, water and other natural resources so as to better reflect their scarcity value and internalise externalities; consider mechanisms to compensate or mitigate their impact on poorer sections of the population and regions that would be adversely affected by such price increases;

consider establishing an inter-ministerial group to examine how *environment-related taxes* might be restructured to help better achieve environmental policy objectives;

increase and diversify the sources of environmental finance by fuller implementation of the polluter pays and user pays principles, and increase the effectiveness and efficiency of allocating public environmental expenditure" (OECD 2007, p.176).

There is a window of opportunity for China to develop an innovative interaction between its overall social planning system and the use of government-controlled market-based instruments in the energy and environment sectors. In the first instance, it is imperative to improve energy efficiency in view of the energy requirements for continued economic development and China's position as a net importer of energy. In addition, the desire to reduce overall environmental burdens for the economy, as reflected in the 11th 5-year plan, combined with pre-existing energy taxes and environmental levies, presents a policy platform that can be extended into a coherent and effective architecture of economic incentives that allow for improvements in overall economic and social welfare. Given that the drafting phase for the 12th 5-year plan has begun, making considerations on the use of environmentally related taxes to improve long-term energy efficiency is very timely.

Over the last fifteen years, the use of environmentally related taxes has significantly increased in a number of OECD countries. The purpose of this report is, based on a brief review of this experience, to draw lessons and policy conclusions for China.

2. Why Environmental Taxes?

The regulatory ("Command and Control") approach to environmental protection, compared with the economic instruments, presents advantages and shortcomings. One advantage of regulations is that there is a long-standing experience in other fields of public concern, such as health and safety, labour and so on. In some cases existing regulatory structures and institutions can be used. Another advantage is that regulations may provide an effective means of preventing hazards and irreversible effects. Finally, regulations provide a promise as to the achievement of environmental goals on emission flows: once an emission standard is fixed, one should be sure that emissions will not exceed this limit, provided there is strong and effective enforcement.

On the other hand, regulations have a number of weaknesses[43]:

1. Enforcement often proves to be difficult or weak, mainly owing to the great number of controls, administrative requirements, staff (inspectorate, corps of engineers, lawyers and so on), legal procedures in case of non-compliance and so on. The situation varies between countries, but it is generally acknowledged that lack of staff to carry out controls and enforcement makes the probability of being caught rather small; even so, non-compliance fines are usually too low to function as a real deterrent. A low non-compliance fine multiplied by a low probability of being caught remains preferable to having to pay the marginal cost of pollution abatement.

2. Another drawback of regulations is that they may too easily be subject to bargaining and negotiations between public authorities and the private sector, possibly cheating. It is, of course, natural that while a polluting plant is seeking a licence to operate, the terms and conditions of this licence should be subject to negotiations. However, one must strike a delicate balance, and negotiations can become easily influenced and challenged by lobbies and pressure groups; *asymmetry of information* between economic sectors and regulators can also affect the regulatory process. As a matter of fact, industry often prefers to be subject to direct regulations rather than to taxes and charges, because it is much more difficult to negotiate and evade taxes.

3. A major limitation of regulation is that it is *static* and lacks incentive. Regulations and standards, laboriously negotiated, are not likely to evolve rapidly, especially when embodied into legislation. For instance, technical progress will become embodied in new regulations and standards only after a long time.

4. Finally, regulations are *costly*, not only at the enforcement level, but mainly because they are not efficient in economic terms. This is why economic instruments (in particular, taxes, charges and tradable permits) are being increasingly introduced in environmental policies.

[43] Based on Barde (2000)

The static and dynamic efficiency of taxes are key features of environmental taxes.

Box 5.1 Defining environmental taxes and charges

OECD (and IMF) defines a **tax** as a *compulsory, unrequited payment to general government*. Taxes are unrequited in the sense that benefits provided by government to taxpayers are not normally in proportion to their payments. The term *environmentally related taxes* is used by OECD to describe *any tax levied on tax-bases deemed to be of particular environmental relevance*. This implies that the *name*, or the *expressed purpose*, of a given tax is not a criterion for deciding whether or not a tax is relevant for the environment.

Charges are compulsory *requited* payments, i.e. a service is provided in proportion of the payment (for instance, sewerage charges). Charges can also be paid into specific "funds" and earmarked for specific environmental purposes, without necessarily having a direct proportionality to the service rendered.

Emission charges or taxes can be defined as a payment for each unit of pollutant discharged into the environment or for each unit of environmental damage. For instance, a thermal power plant can be charged an amount of USD 100 per tonne of carbon dioxide emitted into the atmosphere; a pulp mill or a manufacturer of dairy products can be charged USD 50 per tonne of BOD discharged into a river. The pollution tax is in fact a payment (a price) for the use of environmental resources (the atmosphere, the water, soil and so on).

Product taxes are applied to, and thus increase the relative prices of, products which create pollution when they are manufactured, consumed or disposed of. This constitutes a major part of the taxes with an environmental impact in most OECD countries. Taxes on energy (e.g. carbon and sulphur taxes on fuels) form a large category. Other examples are taxes on fertilizers, pesticides and batteries.

Polluters will react automatically to the tax by reducing emissions to the level where the unit rate of the tax and the marginal pollution abatement cost (that is, the cost of removing one additional unit of pollutant) are equal. On Figure 1 the marginal abatement cost (MAC) curve increases from right to left because the more a pollutant is abated, the higher the unit (marginal) costs. If a tax with a rate t* is imposed, the polluter will abate pollution from B to P* because beyond this level (A on MAC) it is cheaper to pay the tax than to abate emissions further.

The consequences of pollution taxes can be better understood when referring to what economists call the “optimal” level of pollution. This optimum level corresponds to the point where MAC equals marginal external (or damage) cost (MEC). Any departure from this level (point A in Figure 5.1) implies a welfare loss, because either pollution damage exceeds abatement costs (moves to the right of A on MDC) or abatement costs are higher than damage costs (move to the left of A on MAC). None of these situations is satisfactory from an economic point of view.

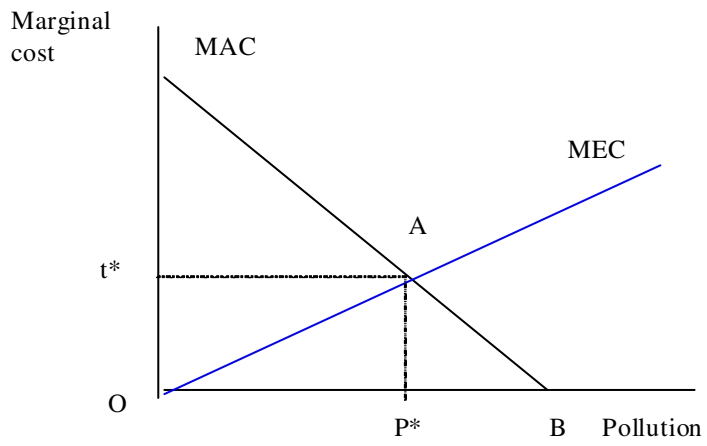

Figure 5.1

Ideally, the pollution tax should be fixed to obtain this optimal level: a tax fixed at level t* would achieve the optimal pollution level P*.. This of course implies that the marginal external/damage costs can be estimated, a condition difficult to fulfil in reality. It is interesting to see that with a tax t*, the payment of the polluter can be divided into three parts: surface P*AB, which is the total pollution abatement cost (surface under MAC); surface OAP*, which is the residual damage tax, corresponding to the residual damage OP* (surface under MEC); and surface Ot*A, that is, a "residual tax" which can be interpreted as the payment of a tax for using scarce environmental resources, or payment or a resource rent. Note that surface OAB reflects the total value of the internalized environmental costs (abatement costs plus damage costs). We can see that the tax imposes an additional burden on the polluter who pays the abatement costs (P*AB) plus the tax (Ot*AP). If an emission standard P* was imposed, the polluter would only pay the pollution abatement costs.

This feature of pollution taxes has very important financial and distributive consequences. Although the tax can minimize the global abatement costs, that is, the sum of abatement costs of all polluters (see below), individual polluters will bear heavier costs owing to the payment of the tax on top of abatement costs. This is one reason why industry is often strongly opposed to environmental taxes and charges.

Furthermore, taxes imply a financial transfer to the government which entails significant distributive consequences.

If the only virtue of taxes was automatically to achieve a given level of pollution abatement, this would not constitute a great advantage over standards and regulations. Pollution taxes have three major additional advantages

(i) Static efficiency

A key feature of taxes is that they minimise total abatement cost by equalising marginal abatement costs across polluters. This is the so-called static efficiency feature of pricing mechanisms (taxes and tradable emission permits). On Figure 5.2 three firms with different marginal abatement cost are depicted.

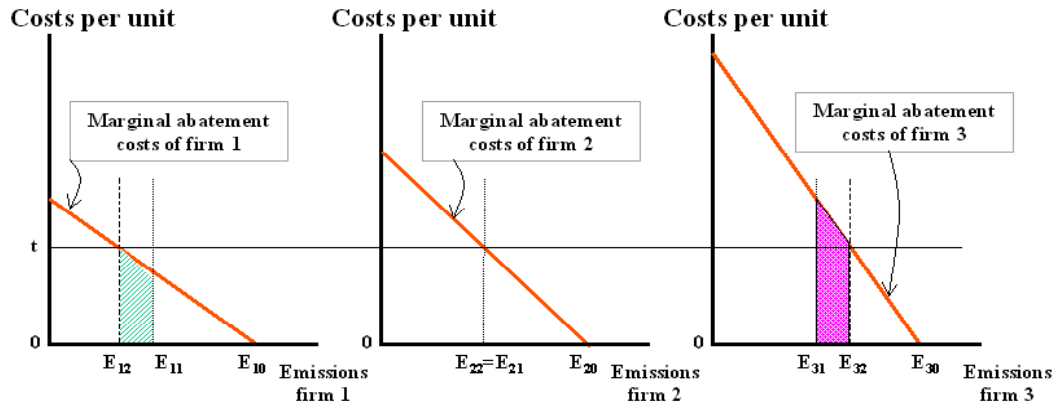

Figure 5. 2

If public authorities would like to see total emissions reduced to 50%, they could e.g. require each of the three firms to halve their emissions, or they could introduce a tax t per unit of emissions. In this simple setting, the environmental impacts of the two approaches would be identical, as would the impacts on Firm 2. However, in the tax alternative, Firm 1 would increase its abatement effort, so as to lower emissions from E_{11} to $E_{12,}$. Its abatement costs increases with the light shaded area in the figure. Firm 3 would abate less than in the case of uniform emission reductions, so that its emissions increase from E_{31} to $E_{32,}$ and its abatement costs decreases with the dark shaded area in the figure. As the distance between E_{11} and E_{12} is equal to the distance between E_{31} and E_{32}, it is obvious that the cost decreases in Firm 3 are larger than the cost increases for Firm 1, meaning that total abatement costs for society as a whole is lower when taxes are used to equalise the marginal abatement costs between the three producers.

A number of empirical evaluations of the gains obtained with taxes or tradable permits (see below) have been made; they indicate that cost savings can be substantial (for example, Tietenberg (1990) indicates a number of cases where least cost policies can be up to 22 times cheaper than command and control).

(ii) Dynamic efficiency

Taxes provide a permanent incentive to pollution abatement. Emission standards do not provide an incentive to polluters to reduce pollution beyond the standard (except in the search for a good public image or in anticipation of further tightening of emission limits). However, a tax provides a double stimulus.

First, it is a stimulus to reduce pollution when abatement costs decrease. Assume that, owing to technical progress, the marginal abatement cost is reduced from MAC1 to MAC2 (Figure 5.3). In the case of an emission standard S_1, the level of emission will remain unchanged and the polluter will save surface ABC. If, however, a tax, t, is imposed, emissions will be reduced to level S_2. The tax is also a stronger stimulus to

technical change (that is, to develop more efficient pollution abatement techniques) because technical change (shifting from MAC1 to MAC2) provides a double cost saving: abatement costs (surface ABC) and reduced tax payment.

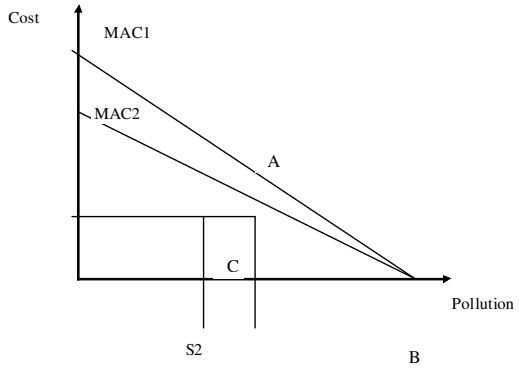

Figure 5.3

(iii) Taxes provide revenue

Taxes provide government revenue which can be added to the general government budget or earmarked for specific environmental purposes. The revenue of environmental taxes can also be used to reduce or remove existing distortionary tax provisions (see section 7).

Tradable emission permits

It is important to note that tradable emission permits share the same static and dynamic efficiency of emission taxes and are increasingly used in environmental policy, following the pioneering and early experiences in the United States in the 1980s and beyond. The most prominent examples relate to the US "SO_2 allowance trading programme" introduced in 1990, and the recent European Union carbon trading introduced in 2005. Other trading systems have been implemented in various areas in OECD countries (fisheries, water, land, NO_x, lead in gasoline, etc.). Experience indicates that these programmes have provided substantial cost savings. If auctioned, permits also provide government revenue. In most instances, permits have been, at least initially, "grandfathered", i.e. allocated freely. During the second phase of the EU carbon trading system (2008-2012) and beyond, carbon quotas will be progressively auctioned, albeit with a number of exceptions for selected industry sectors and Member States.

3. Policy Options to Introduce Environmental Taxes

Most OECD countries have undertaken significant (general) tax reforms since the end of the 1980s. Over the past fifteen years, there has been a general trend in OECD countries to reduce both personal and corporate income tax rates, accompanied by base-broadening and an increasing use of consumption taxes such as VAT. The trend to reduce income tax rates has accelerated recently, with the OECD average of marginal tax rates on high-income earners falling by 2 percentage points from 2000 to

2003, while for average workers it fell by about 1 percentage point. Meanwhile, the average corporate tax rate fell by about 3 percentage points. These developments have contributed to reductions in the OECD average tax-to-GDP ratio of about 1 percentage point.

Such reforms provide an excellent opportunity to introduce an environmental dimension in taxation, *i.e.* a "greening" of tax systems. Starting in the early 1990s, a number of countries, in particular in the EU, have implemented so called "Green Tax Reforms", which generally can (or should) consist of three complementary measures:

reduction or elimination of environmentally harmful subsidies, including direct public expenditures, "market price support" and/or exemptions and other provisions in environmentally related taxes;

restructuring existing taxes according to environmental criteria; and/or

introducing new environmentally related taxes.

3.1 Removing environmentally harmful subsidies and distortionary tax provisions[44]

Defining subsidies

Many policies providing subsidies in OECD countries are implemented in view of supporting environmentally sensitive sectors, particularly agriculture, the fishery industry, energy production, transport and heavy industries. Most of the support measures take the form of cost-reducing support (e.g. support to infrastructure, research and development, material and energy inputs, etc.) or the form of revenue enhancing support (e.g. market price support for particular products). These support measures often lead to increased use of (possibly polluting) inputs and increased production levels as prices for the finished good fall in response to declining costs (OECD, 1998). Encouraging production augmentation through such support measures increases the risk of environmental damage from production.

In the end, market and policy failures may result in a cumulative detrimental effect on the environment. On Figure 4, the marginal private cost curve MPC intersects the demand curve D so that a quantity Q0 is produced at price P0. Accounting for the external cost associated with the production increases the cost so that the marginal social cost curve MSC (including private plus external cost) intersects the demand curve at point B with a quantity Q*<Q0 produced at price P*>P0. The difference in output Q-Q* represents the *market failure*.

If a subsidy is paid to the producer, the marginal private cost curve is shifted down to MPC-SUBS. Corresponding to a quantity Q1>Q0 and a price P1<P0. The excess production represents the *policy failure*. In this particular case (other configurations

[44] *Based* on Barde & Hontakutia (2004) and OECD (2003) & (2005)

can be conceived), the market and policy failure are added up.

If the government sets a price at P2 to support the producer's income, the government may need to take specific measures to guarantee the purchase of the quantity Q3-Q2 which would otherwise not be purchased at price P2.

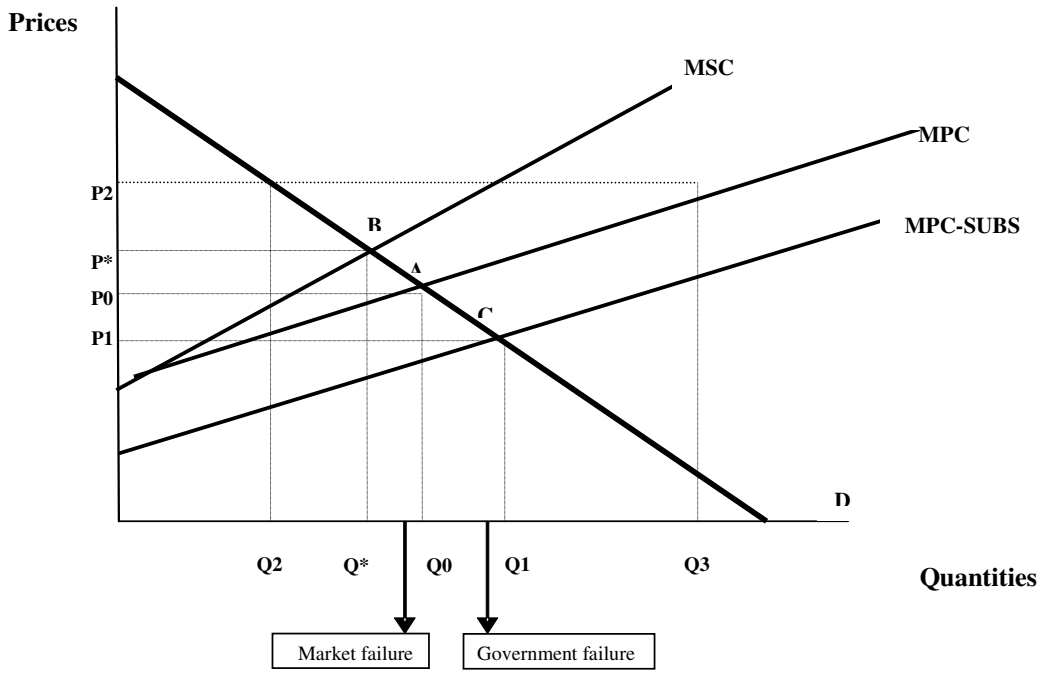

Figure5. 4 Market and government intervention failures

Long-term effects of subsidies are generally different from the short-term ones. There is no or limited technological change in the short-term or substitution between inputs or factors of production. Thus removing subsidies will reduce profits in the short term and cause marginal firms to exit from the market. Removing a long-standing subsidy will open the way to the development and application of new technologies hitherto blocked by the subsidy. The *technology lock-in effect* will disappear in the long term, thus enabling substitution between factors of production and increases in efficiency.

Box 5.2 Defining subsidies

The concept of subsidy is not straightforward. While the term "subsidy" is used in this paper, it is as common to use the terms transfers, payments, support, assistance or protection associated with governmental policies in OECD work. Sometimes these terms are used interchangeably, but often they are associated with different methods of measurement and thus different economic indicators. Subsidies have been defined to "comprise all measures that keep prices for consumers below market level or keep prices for producers above market level or that reduce costs for consumers and producers by giving direct or indirect support" [see, for example, de Moor and Calamai (1997)]. This definition is consistent with the OECD approach of defining environmentally harmful subsidies and tax concessions to include "all kinds of financial support and regulations that are put in place to enhance the competitiveness of certain products, processes or regions, and that, together with the prevailing taxation jurisdiction, (unintentionally) discriminate against sound environmental practices" (OECD, 1998). It is not necessary to make a distinction between subsidies and tax expenditures as the latter can be regarded as implicit subsidies.

Subsidies take different forms: budgetary payments or support involving tax expenditures (various tax provisions that reduce the tax burden of particular groups, producers or products), market price support, subsidised input prices, preferential interest rates. This is why the more generic terminology of "*support measures*" is often used. There is, however, no international consensus: different definitions prevail for specific purposes, fields (*e.g.* agriculture or transport) or contexts (*e.g.* international trade).

There has been much controversy over whether the *non-internalisation* of external costs should be construed as a subsidy, the argument being that, as external cost are not internalised, the environment is used "freely" by the users: in a sense, a public good is freely supplied to users. Those who object to such an expanded definition observe that the notion of a subsidy has traditionally connoted an explicit government intervention, not an implicit lack of intervention. As well, for these and more practical purposes, namely the difficulty of quantifying external costs, non-internalisation is not regarded as a subsidy in this paper except for the transport sector where this definition is currently used (Nash *et al*. 2002).

Subsidies are pervasive

Subsidies are widespread throughout OECD countries (with wide variations between countries) and worldwide. Every year, OECD countries give over USD 400 billion in subsidies to different economic and often environmentally sensitive sectors (due to the lack of data on energy and manufacturing subsidies, this figure is an underestimate). Policies providing subsidies are introduced with various purposes such as social adjustments, economic hardship, regional development, protection of specific segments of population or industry; but they can distort prices, affect resource allocation decisions and change the amount of goods or services produced and consumed in an economy. Unintended negative effects on the environment can occur that are often ignored. These potentially harmful effects on the environment should be assessed through a careful analysis. The OECD has carried outanalytical work, in particular the development of a "checklist" designed to identify those subsidies that can cause environmental harm (OECD 2005, Chapter 2).

Agricultural subsidies take the lion's share in OECD countries[45]. In 2004, estimated total support to agriculture amounted to USD 377 billion which represents 1.11% of GDP in OECD countries and of which USD 279 billion represented support to producers. Some of these support measures contribute to increasing agricultural production (e.g. price support), the use of land and water resources e.g. absence of water pricing for farmer). *Market price support*, *output payments* (per output unit produced) and *input subsidies* (such as fertiliser, pesticide, water and energy subsidies) produce the greatest impact. In general, other things being equal, the more a policy measure provides an incentive to increase production of specific commodities, the greater is the incentive for monoculture, intensification (greater yields), or bringing environmentally sensitive land into production, and the higher is the pressure on the environment (OECD 2003)[46].

Box 5.3 Environmentally related subsidies in China

"*Agriculture support* in China is relatively low, totalling 7% of gross farm receipts between 2000 and 2003 (OECD, 2005b). This was much lower than the OECD average (31%), and far below support levels in Japan (58%) and in the Republic of Korea (64%). Nevertheless, the cost to the Chinese economy is high as it represented 3.8% of GDP in 2003. This is much higher than the OECD average, and is among the highest for major agricultural producers world-wide. Support to producers is mostly provided in the form of market price support and input subsidies, which tend to be the most trade distorting and environmentally damaging forms of agricultural support, as well as providing the lowest income transfer to farmers. VAT is levied on fertilisers and pesticides at the reduced rate of 13% rather than the standard 17%. The prices of these products are also indirectly subsidised by administrative measures and low electricity charges.

Agriculture accounts for more than 70% of *water consumption* in China. Irrigation water is under-priced, which contributes to its inefficient use. Currently only about 45% of the water flowing through China's irrigation systems is effectively used. This compounds China's water scarcity.

Energy prices, notably for products and coal have been increasingly market-based since the deregulation of prices in 1993. By 1996, two-thirds of coal was priced by the market. As a result, coal prices have risen significantly. The increase in coal prices has generated conflicts with the electricity sector, where prices are still largely controlled by the NDRC. Ongoing reforms in the energy and power sectors aim to increase efficiency and lower prices by increasing competition among generators."

Source: quoted from OECD (2007) pp.190-191

[45] Except in Australia and New Zealand.

[46] During the 1990s, many OECD countries began to take steps to reduce and restructure their agricultural support policies in an effort to reduce overproduction and trade distortions, and to encourage more environmentally sound use of land, soil and water. The current reform of the EU Common Agricultural Policy is an important step in this direction. The share of market price support, output payments and input subsidies, which are potentially the types of agricultural support exerting the greatest environmental pressure has decreased marginally since the mid-1980s, and they still account for nearly 80% of the producer support in OECD countries.

Available estimates indicate that *subsidies to fisheries* in OECD countries have declined slightly from USD 6.8 billion in 1996 to 6.3 billion in 2003, representing 19% of the value of landings. Some of these subsidies are paid for R&D, surveillance, and management services, which may contribute to the sustainable management of fish resources. Yet the remaining subsidies can help develop and sustain over-capacity in fishing fleets and the over-exploitation and eventual exhaustion of fish stocks.

Water use is subsidised in many different forms such as: water abstraction charges below cost recovery, external costs and resource rents; subsidies to irrigation water (irrigation accounts for 75% to 90% of total water use in developing countries and more than one third in many OECD countries); subsidised water prices for households and industry. These support measures inflate demand for water, undermine the financial viability of the sector and add to environmental pressures *inter alia* the depletion of water resources, pollution and salinisation of soils. Here again, the potential harmful effects should be carefully analysed, *e.g.* using the OECD checklist OECD 2003 and 2005a).

Subsidies for energy production in OECD countries, intended mainly to protect domestic producers and maintain employment in given sectors. Data are lacking and estimates range between USD 20 billion and 82 billion per year; an important part goes to support coal production, a polluting fuel. However, there is a lack of up-to-date empirical data on energy related subsidies.[47]

Industry is also subsidised, although it is difficult to obtain detailed data. Environmentally harmful effects can arise when subsidies increase production levels beyond the social optimum, encourage the use of certain raw materials and greater energy consumption or result in a lock-in of inefficient technologies. There is a paucity of consistent data on industry subsidies. However, not all industry subsidies are harmful (*e.g.* R&D subsidies for the development of "clean" technologies).

Defining *transport subsidies,* is more complex. One definition compares total revenue of the sector with the total social cost of each transport mode. According to this definition, in most European countries, revenue from fuel taxes and specific road user charges roughly covers the cost of road infrastructure (Nash *et al.* 2002). However, in some cases, infrastructure costs exceed revenue, thus resulting in a subsidy. Another approach compares the price paid for using transport infrastructure and the marginal social cost associated with a specific transport mode. Some estimates indicate that, in urban areas, the prices for using cars and trucks are generally much too low: it is estimated that to cover social cost, prices should increase by up to 150% in certain urban areas (ECMT 2003).

More indirect subsidies arise from *specific environmentally harmful tax provisions* (tax rate variations or exemptions). For instance, *coal* is only taxed at all in five OECD countries, and in these countries the most important coal users are benefiting from many tax exemptions and rebates. Other types of support measure is

[47] An overview is provided by the European Environment Agency at http://www.eea.europa.eu/publications/technical_report_2004_1.

the widespread availability of tax exemptions and rebates for diesel fuel used in road transport, farming and fishing in many countries, or the tax exemption for kerosene used in international civil aviation. The OECD database on environmentally related taxes documents 1150 exemptions and special tax provisions.

3.2 Restructuring existing taxes

Many *existing* taxes could be changed so as to benefit the environment, by increasing the relative prices of the most polluting tax-bases. Since energy is one of the main sources both of pollution and of tax revenue, an "environmental" restructuring of energy taxes is essential. For instance, in most OECD countries, taxes on motor vehicle fuel can reach 80 % of the pump price. This leaves large scope for restructuring the fuel taxes on the basis of environmental parameters, such as sulphur content, as the Nordic countries, Germany, Ireland and United Kingdom have done.

Taxes on other energy products, for example fuels used for heating purposes and in industrial processes, can also be differentiated according to environmental criteria - as, for example, carbon and/or sulphur content. It is also possible to restructure taxes on motor vehicles (both one-off sales taxes and annual taxes on vehicle usage), for example according to the environmental characteristics of the fuel it uses, according to the estimated fuel consumption, and/or according to whether or not the vehicle is equipped with a catalytic converter. In Switzerland, such differentiation has now been combined with accurate metering of the number of kilometres driven by heavy vehicles.

3.3 Introducing new environmental taxes

An obvious option is to introduce *new* levies whose prime purpose is to protect the environment. These may be taxes on *emissions* (for instance on atmospheric pollutants or water pollution) or on *products* that are closely related to environmental problems. The latter are more frequent. Since the early 1990s, many environmentally related taxes have been introduced on products ranging from packaging to fertilisers, pesticides, batteries, chemical substances (solvents), lubricants, tyres, razors and disposable cameras. These were particularly applied in Central and Eastern European Countries (CEEC).[48] The OECD/EEA database provides extensive information on a large variety of such levies (over 150 taxes).

Environmental taxes in China[49]

Following fundamental tax reforms over the last two decades, a number of environmentally related taxes have been introduced in China (see table 5.1). Recently

[48] See Schlegelmilch (1999).

[49] See also: Task Force on Environmental Taxation (2009), "Implementation Plan for the Project on Environmental Taxation".

MEPA, Ministry of Finance and National Taxation Administration started to discuss the possibilities and approaches for creating new independent environmentally related taxes and integrating environmental elements into the existing tax systems. The discussion is still ongoing.

In China, revenue from transport fuels and motor vehicle taxes accounts for one third and one sixth respectively of revenues generated by environmental taxes (in OECD countries about two thirds and one quarter).

Table 5.1 Environmentally-related taxes in China

Tax	Taxable item	Tax rate (amount per unit)	Revenue 2002[a]
Fuel-related consumption tax	Gasoline		191.87
	unleaded	0.20 CNY/litre	
	leaded	0.28 CNY/litre	
	Diesel	0.1 CNY/litre	
Transport-related consumption tax	Motor vehicle tyres	10%	93.95
	Motorcycles	10%	
	Motor cars	8%, 5%, 3%	
Vehicle and vessel usage tax	Vehicle		28.93
	passenger vehicle	60-320/passenger vehicle	
	cargo vehicle	16-60/tonne	
	motorcycle	32-80/motor cycle	
	non-motorised vehicle	1.2-32/non motorised vehicle	
	Vessel		
	motorised vessel	1.2-5/net tonne	
	Non motorised vessel	0.6-1.4/net tonne	
Resource tax	Crude oil	8-30 CNY/tonne	75.08
	Natural gas	2-15 CNY/100m^3	
	Coal	0.3-5 CNY/tonne	
	Other non-metal resources	0.5-20/tonne or m^3	
	Ferrous metal ores	2-30 CNY/tonne	
	Non ferrous metal ores	0.4-30 CNY/tonne	
	Salt		
	solid salt	10-60 CNY/tonne	
	liquid salt	2-10 CNY/tonne	
Urban and township land-use tax	Large cities	0.5-10.00/m^2	76.83
	Medium-sized cities	0.4-8.00/m^2	
	Small cities	0.3-6.00/m^2	
	Mining districts	0.2-4.00/m^2	

Farmland occupation tax	1 mu[b] or less of farmland/person	2-10 CNY/m²	57.33
	1-2 mu[b] farmland/person	1.6-8 CNY/m²	
	2-3 mu[b] farmland/person	1.3-6.5 CNY/m²	
	› 3 mu[b] farmland/person	1-5 CNY/m²	
City maintenance & construction tax	City area	7%	470.82
	Country and township area	5%	
	Other area	1%	
Pollution and water charges[c]	n.a.	n.a.	84.74
Total revenue	n.a.	n.a.	608.73
% of total taxation[d]	n.a.	n.a.	*3.34*

a) In hundreds of millions of CNY
b) 15 mu = 1 ha.
c) Not a tax *per se*.
d) Including pollution and water charges.
Source: OECD (2007), based on CCICED, Task Force on Environmental and Natural Resources Pricing and Taxation.

Favourable tax rates are provided to renewable energy producers (see Table 5.2).

Table 5.2 Classification of energy taxation in China

Items	VAT	VAAT(Value-added annex tax)	Income tax
General	17%	8% of VAT	33%
Small Hydro power	6%	8% of VAT	33%
Biogas	13%	8% of VAT	15%
Wind	8.5%	8% of VAT	15%
Landfill gas	0	0	33%

Source: OECD (2009), based on Li Junfeng, Shi Jinli and Ma Lingjuan, "China: Prospect for Renewable Energy Development".

4. Green Tax Reforms in OECD Countries: Main Features[50]

Since the early 1990s, several countries, mainly in the EU, have introduced comprehensive Green Tax Reforms (GTR), in most cases, in a context of a *constant tax burden*, in the sense that new environmental taxes are offset by reductions in existing taxes (tax shift). In OECD countries, a constant tax burden seems essential for the *acceptability* of environmental taxes, although some countries which need to reduce public deficits or with relatively low tax revenue could consider a revenue-raising tax reform.

In the context of revenue neutral tax shifts a particular focus has been put in some

[50] Based on OECD 2002, 2006 and Barde & Braathen (2005).

countries on the "*double dividend*" hypothesis. The purpose of the double dividend is dual: 1) increased environmental protection through the tax increase on environmentally-relevant tax bases and 2) increased employment through reduced tax wedge on labour, in particular reduced employers' social security contributions, thus decreasing the cost of labour. All EU countries, and Norway, having implemented green tax reforms have followed this double dividend approach.

Table 5.3 OECD tax wedges on labour 2005

High		**Low**	
Belgium	57%	Korea	16%
Germany	52%	Mexico	14%
France	48%	New Zealand	19%
Sweden	48%	Australia	26%
Hungary	51%	Japan	24%
Italy	47%	Switzerland	30%
Finland	47%	Iceland	24%

Note: The tax wedge represents income tax plus employee and employer contributions less cash benefits as a percentage of labour costs. The figures in this table are for a single worker with no children earning the average production worker wage in each country.

Source: OECD.

There is controversy as to the likelihood of any double dividend. In particular, the employment dividend is subject to a number of restrictive assumptions: environmental taxes can also fall on labour through increased prices; reduced unemployment can result in increased wages, thus offsetting (part of) the reduction in labour cost (a key variable is the structure of the labour market); if taxes fall on capital, there could be "leakages" with capital moving abroad[51]. However, several studies suggest that such a double dividend does exist.[52] Other studies suggest that there is a "multiple dividend" including also the positive impacts on innovation, on ageing societies, on the fiscal structure/system and on competitiveness.[53]

Nevertheless, environmentally related taxes do provide win-win opportunities when the revenue is used to reduce other distortionary taxes or tax provisions in the economy and when well designed revenue recycling provide efficiency gains (*e.g.* for energy saving investments), while keeping the incentive effect at the margin.

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[51] For a double dividend to work, several conditions must be met, *inter alia*: the tax can be passed on to under-taxed production inputs; taxes fall heavily on non-workers; the country has international market power (the tax can be passed easily on to prices); capital is not internationally mobile and labour can easily substitute for energy (in case of energy taxes). A number of simulations (general equilibrium models) have been done; all indicate very modest employment increases; the greatest effects can be expected with cuts in social security contributions targeted to low wage / low skilled workers.

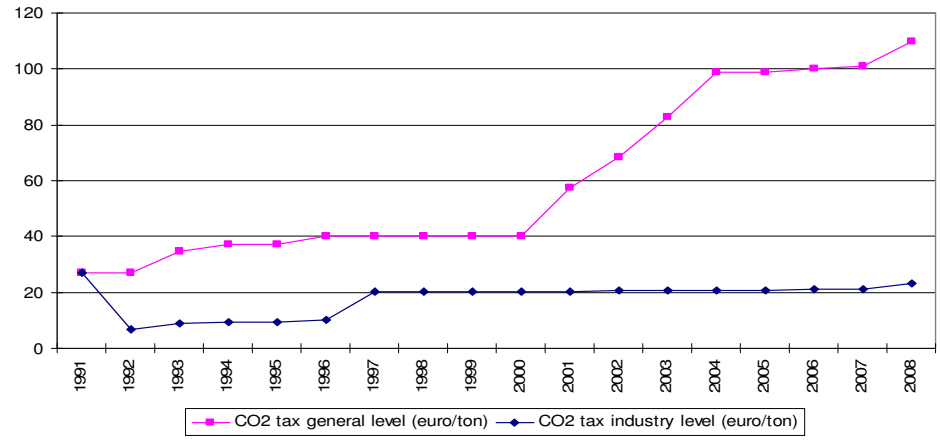
[52] See http://www.rprogress.org/publications/2001/eurosurvey_2001.pdf.

[53] See http://www.eea.europa.eu/publications/92-9167-000-6, p. 19.

Box 5. 4 Green tax reform in Sweden

In *Sweden*, a major tax reform was introduced in 1991 in a strict revenue neutral context. It was based on a significant reduction in income tax, which was offset by a broadening of the VAT tax-base and by a series of new environmental taxes, especially on carbon and sulphur. In 2001 a green tax reform was applied, resulting in a yearly tax shift of 300 million €. When a CO_2 tax of SEK 250 per tonne (23 €) was introduced in 1991, the energy taxes on industry was halved, nevertheless resulting in higher energy taxation overall. In 1993, the manufacturing sector was granted a 75% cut on the CO_2 tax and was totally exempted from the general energy tax. In 1997, the rebate to the manufacturing sector was reduced to 50%. In 2009, the rates of the CO_2 tax is 100 € per ton (21 € for industry). The sulphur tax (SEK 30 per kg (2.7 €) was imposed on peat, coal, petroleum, coke and other gaseous products. A tax differentiation is applied to three different categories of diesel oil, according to their sulphur content. Other energy-related taxes with an environmental purpose are also applied (e.g. consumer and producer taxes on electricity, tax on domestic air traffic, etc.). Sweden also has a *charge* on nitrogen oxides emissions (4 € per kg in 2009) – where all the revenue is refunded to the power plants covered by the charge, in proportion to the amount of energy they generate.

Development of the Swedish CO_2 tax, general level and industry level



Major green tax reforms have been introduced in Finland (1990), Norway (1991), Denmark (1992), Sweden (1992 and 2001), Netherlands (1992), Germany (1999).

In the *United Kingdom*, an interesting case of policy mix has been implemented. Fuel duty excises were increased by 5-6% p.a. in real terms between 1993 and 1999 (hence the nominal increase was about 6-10%), this "Road Fuel Duty Escalator" was designed to reduce CO_2 emissions and to take into account other environmental factors. A "Climate Change Levy" on energy use by business and the public sector was introduced in April 2001[54]. Industries entering into environmental agreements can get an 80% refund of the Climate Change Levy. As from 2002, firms can opt into a CO_2 emission trading scheme to meet their targets. The revenue is recycled back to industry through lower employers' National Insurance Contributions, tax breaks for investments in energy efficiency and renewable energy. The revenue of the "Landfill Tax", introduced in 1996, is also paid back through reduced employers' National Insurance Contributions; and a similar approach is taken for a new tax on the extraction of mineral aggregates.

[54] For a detailed analysis of the Climate Change Levy, see Pearce (2005).

5. The Effectiveness of Environmentally Related Taxes: Selected Examples in OECD Countries

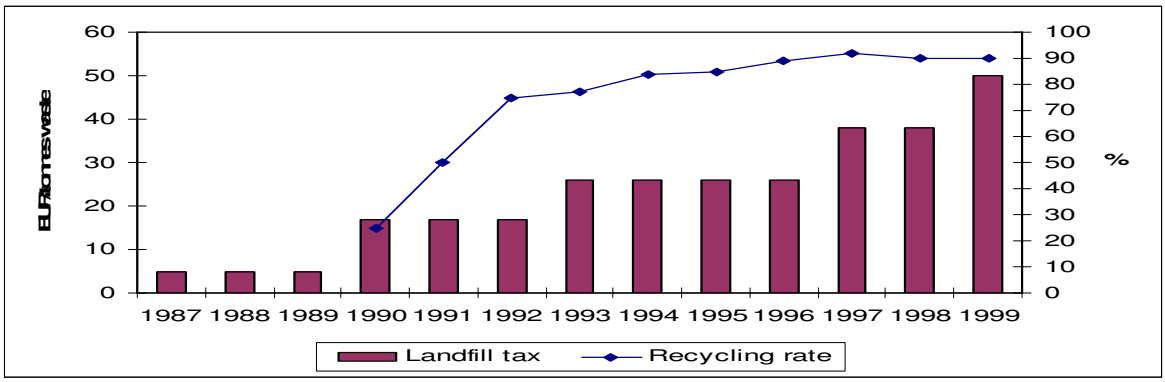
The environmental effectiveness of environmental taxes is now amply proven. Twenty years experience from OECD countries indicates that environmentally related taxes are effective and efficient. In 2006, 375 different taxes were in use in OECD countries, of which 150 were on energy and 125 transport-related. Other taxes apply to specific air and water emissions and to products such as packaging, batteries pesticides, fertilizers, lubricants, household appliances etc. Most taxes have proven to be successful, triggering significant emission reductions.

Concerning energy and transport taxes, data indicate that the price elasticity of demand for petrol or gasoline whilst relatively low in the short term (-0.15 to -0.28), is significantly higher in the long term (-0.51 to -1.07 - OECD 2000b). *This indicates that significant effects could be expected in the longer term.* Increases of oil prices caused real reduction of fuel consumption in EU countries. This underlines that green tax reforms must be seen in a medium/long term context, as it takes time to the economy to adapt to evolving market signals, in particular in terms of technical change. We present below a few examples of the effects of environmental taxes.

In *Belgium*, the tax differentiation between heavy fuels with a sulphur content below or above 1% induced a decrease in the use of the fuel with the higher sulphur content from 20% of the market in 1994 to less than 1% in 1998 (also due to a switch to natural gas). Taxes on non-reused or recycled beverage containers, disposable cameras, batteries and diverse packaging, introduced in 1993, led industry to meet all recycling and reuse targets, thus avoiding paying the taxes.

In *Denmark*, the sulphur tax caused a significant reduction of emissions by 84 per cent in the decade from 1995 to 2004, so that Denmark now has the lowest SO_2-intensity per unit of GDP in the OECD area; 0,1 kg SO_2/1000 US$ - as compared to an OECD average of 1,1 kg SO_2/1000 US$ (OECD, 2008: 35). The large reduction is mainly due to installation of desulphurisation equipment and use of low-sulphur oil. The tax on solid waste has reduced the net delivered waste to municipal sites by 26% in the period 1987-1996, and waste to smaller fills and private waste sites by 39% (1990-1996). Industrial waste, however, increased by 8%. Recycling also increased considerably: +77% for paper and cardboard, +50% for glass (Andersen, 1998).

Figure 5.5 Landfill tax and recycling rate in Denmark



In *Korea*, the volume-based waste disposal fee introduced in 1995, resulted in 2002 (compared with 1994) in a 20% decrease in the volume of household waste generated per capita, a 43% reduction in the volume of land filling or incinerated and a 146% increase in recycling.

In *Germany*, the ecological tax reform resulted in a 2-3% reduction of overall CO_2 emissions over the period 1999-2003. Together with the quadrupling of the world oil price between 1998 (8 USD) and mid 2000 (35 USD) the introduction of theenvironmental tax reform was taking place. These two facts triggered a turnaround in the transport sector. For the first time since the foundation of Germany in 1949, transport fuel sales decreased to end 2008 by about 17%. Furthermore, after decades of decrease of passenger numbers in public transport, a clear turn-around took place in 1999 since when the number of passengers increased by 3-5% p.a. The sulphur tax supplement on transport fuels triggered a shift of the entire market at the turn of the year 2000/1 towards fuels with practically no or a very low sulphur content (Schlegelmilch 2005).

The *Swedish* sulphur tax (introduced in 1991) led to a fall in the sulphur content of oil-based fuels of more than 50% *below the legal standards*. The sulphur content of light oils has then fallen below 0.076% (*i.e.* less than half the legal limit of 0.2%). The tax is estimated to have reduced emissions of sulphur dioxide by 94% compared to 1970 (Nordic Council of Ministers, 1999, and Brännlund&Lundgren, 2009). NO_x emissions decreased by 20 % and CO_2 emissions by 54 % since 1970 (Brännlund&Lundgren 2009).

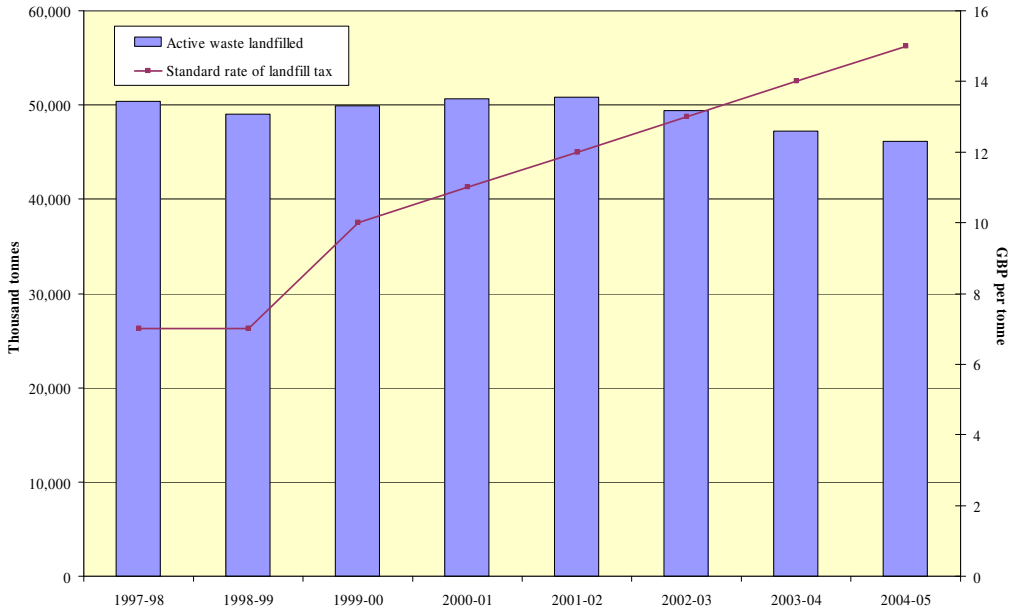
In *Finland*, it is estimated that, in the absence of CO_2 taxation, carbon emissions would have been 7% higher in 1998, if taxes had remained at the 1990 level.

In *Norway*, it is estimated that CO_2 emissions produced by mobile household combustion devices fell by 2 to 3% as a consequence of the CO_2 tax (Larsen and Nesbakken, 1997). It is also estimated that CO_2 emissions per unit of oil produced by the Norwegian oil sector fell by 1.5% due to measures taken by the industry in response to the CO_2 tax (ECON, 1994).

In most countries, the tax differentiation between *leade*d and *unleaded petrol*, combined with a series of measures such as regulations making it compulsory for service stations to offer unleaded petrol and introducing new emission standards for motor vehicles, implying the use of catalytic converters, led to a heavy fall in consumption and in the share of leaded petrol, which is now withdrawn from sale in virtually all OECD countries. The fiscal incentive greatly speeded up the process, despite slow penetration of new vehicles equipped with catalytic converters.

Figure 5.6 Sales and motor vehicle taxes in OECD Europe (Source: OECD 2006)

Figure5.7 Landfilling of active waste and the standard tax rate of the Landfill Tax in United Kingdom. 1997-98 – 2003-04.



Source: HM Revenue and Customs

6. The Case of Energy-Carbon Taxation

While taxation of energy carriers is widespread in all OECD countries, taxation of carbon/CO_2 is a more recent phenomenon which only gradually is expanding. The European Commission's Directorate General for Taxation and Customs Union publishes on its website the "Excise duty tables" which provides an overview of the general situation in individual EU member states for energy taxation.[55] Information for all OECD countries can be found in the OECD/EEA database on environmentally related taxes.[56] However, neither of the two sources provides transparent tables for CO_2/carbon taxes. The co-existence of new CO_2-taxes with pre-existing energy taxes in fact renders it rather difficult to provide general statements about the exact scope of taxation.

Energy taxes are usually product specific excise duties. It is only rarely the case that energy taxation reflects appropriately the energy carriers' different GJ-content. CO_2-taxes on the other hand are not product specific, but aim to reflect the carbon content of fuels, although often at different rates for different target groups (industry and households for instance).

For practical purposes the term "carbon-energy taxation" is normally used as a catch-all phrase to refer to the aggregate level of taxation of energy carriers. The European Commission has proposed to aim for maintaining an energy tax component as well as a carbon tax component - while energy taxation can support energy efficiency as a whole, carbon taxation provides incentives for fuel shifting. Carbon/CO_2-taxation should be regarded as a complement to energy taxation, not a substitute. The European Union has established minimum rates of energy taxation for a range of energy products for its member states.

Several countries have restructured their energy taxation system in order to integrate the carbon aspect. Slovenia, for instance, altered its pre-existing taxes of mineral oils into a tax referring only to the CO_2-content of fuels. The Netherlands, on the other hand, added a CO_2-component to the pre-existing energy tax (see also the cases of Sweden, Finland and Norway above).

Generally speaking the area of carbon-energy taxation is rather complex and it is difficult to provide a simple table for the present situation. Gasoline, for instance, is taxed at many different rates, depending on its specific properties, not only referring to lead. There are many different fuels in use, and the taxes work out differently for different user groups. Derogations can be targeted towards specific industries and are not explicit in tables referring to the general situation.

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55 http://ec.europa.eu/taxation_customs/resources/documents/taxation/excise_duties/energy_products/rates/excise_duties-part_II_energy_products-en.pdf

56 http://www2.oecd.org/ecoinst/queries/index.htm

Implicit levels of carbon-energy taxation for fossil fuels – industry

It is somewhat arbitrary what is labelled energy tax and what is labelled carbon tax. For this reason it can be misleading to compare separately energy taxes and carbon taxes. Instead we here provide an overview of the implicit levels of carbon-energy taxation for industries.

Figure 5.8

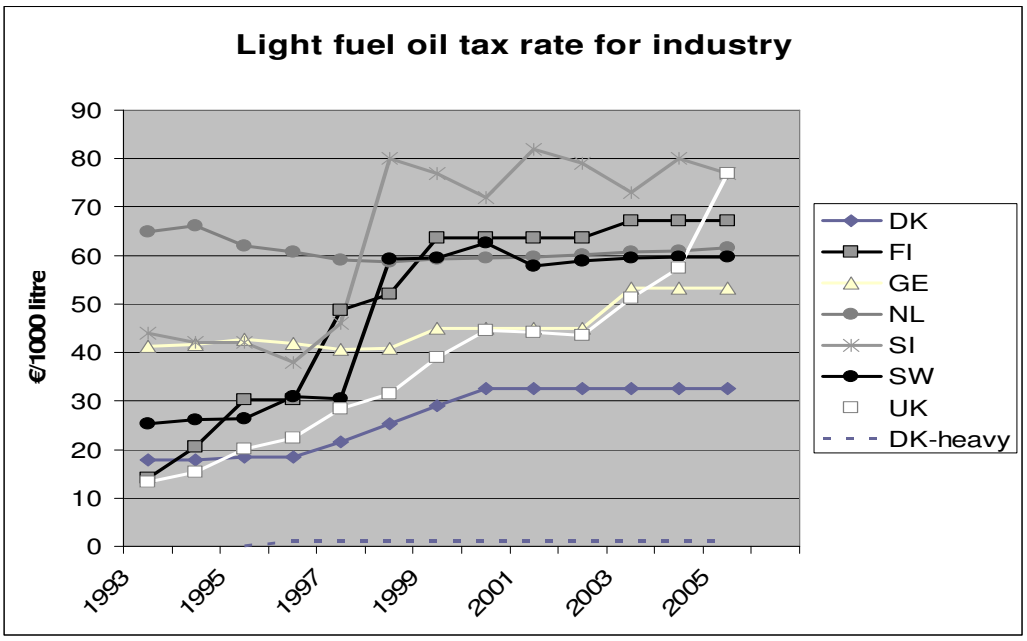


Figure5.9

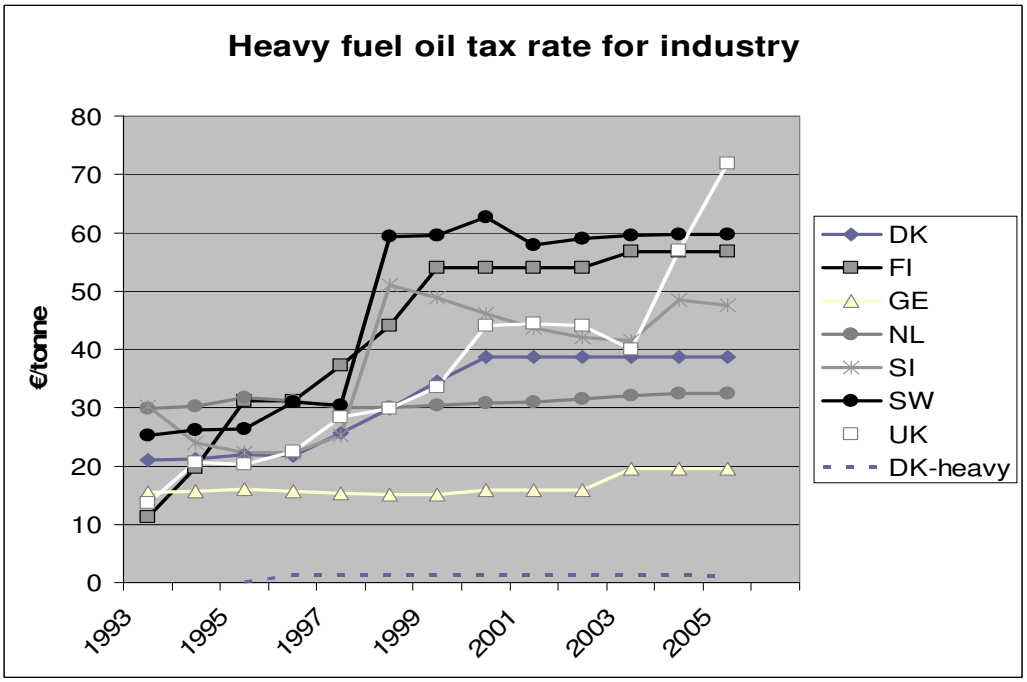


Figure 5.10

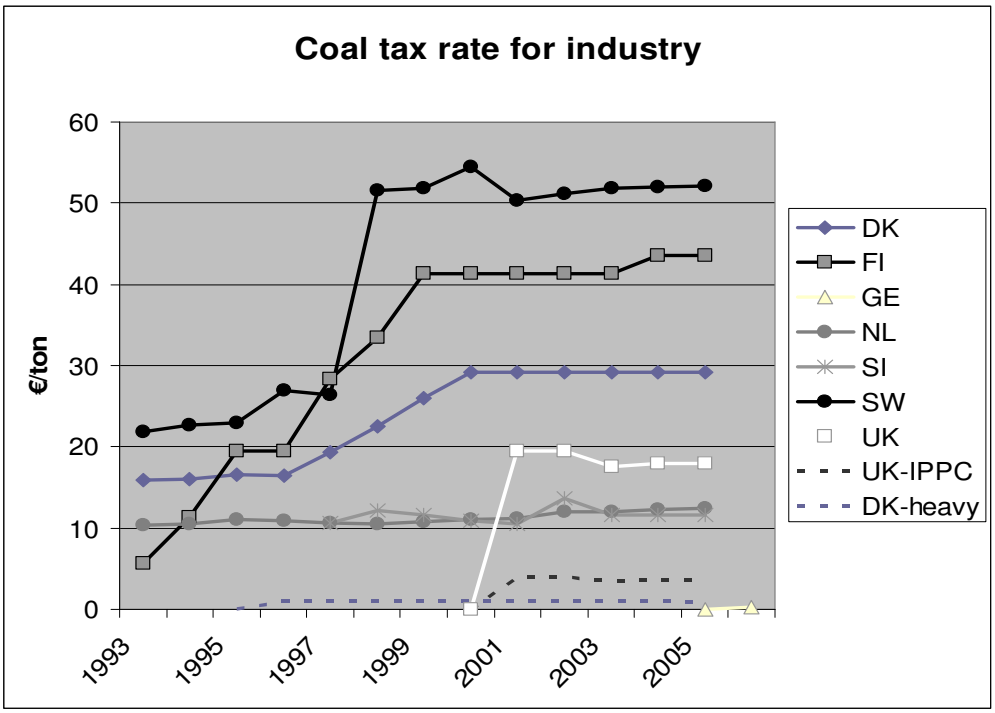


Figure5. 11

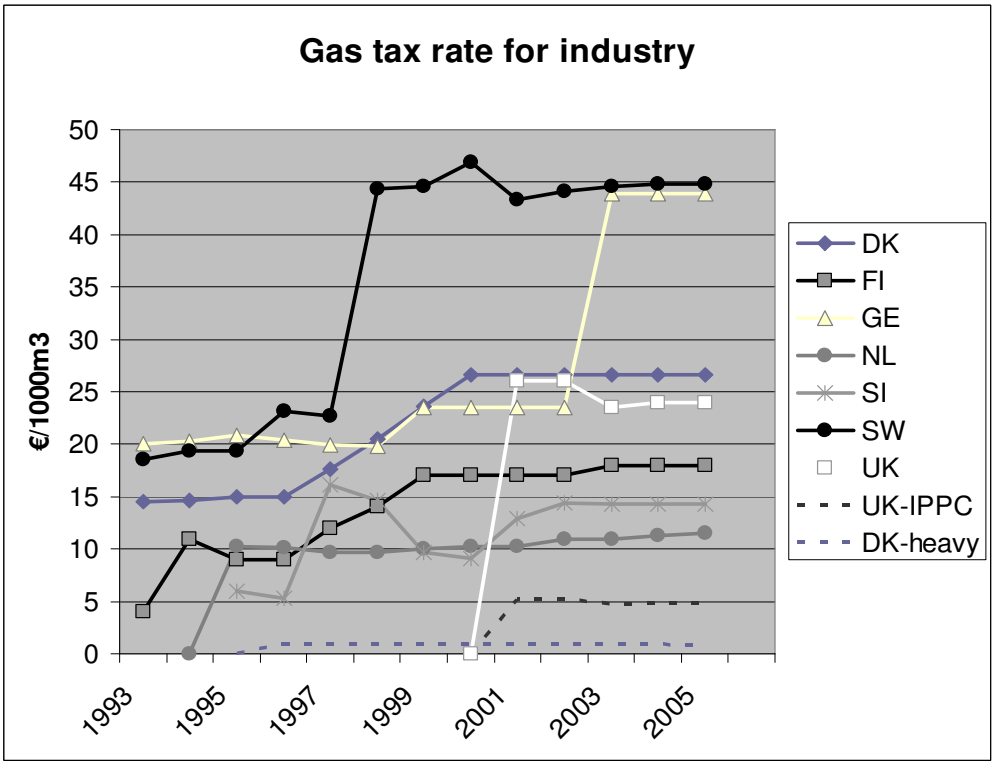
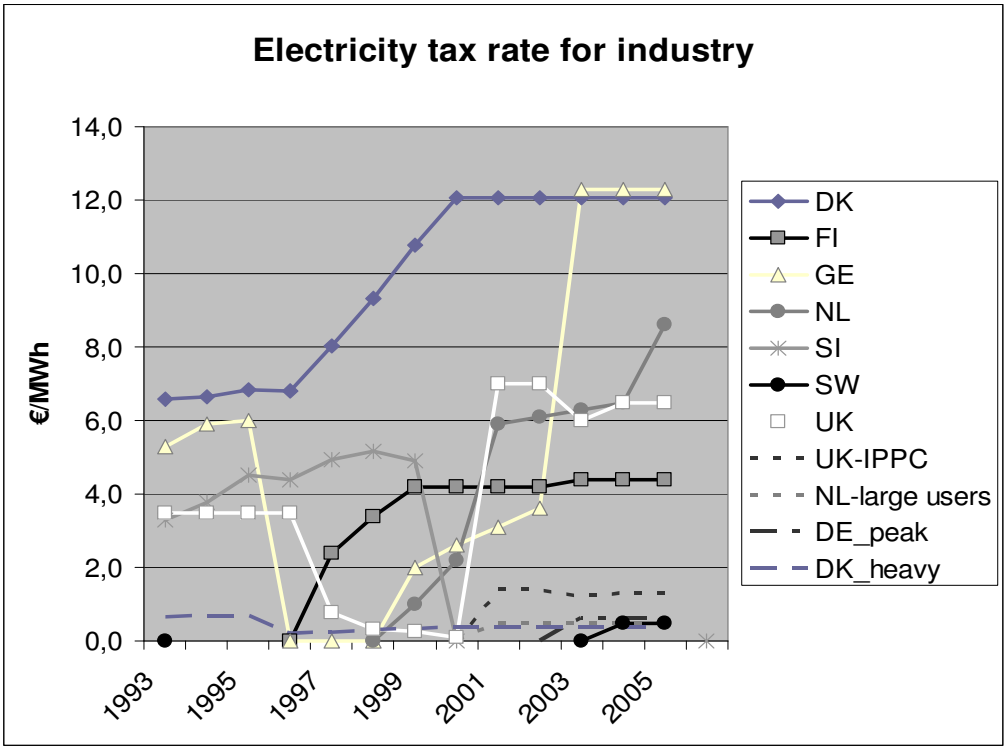


Figure5. 12



Reduced rates available for selected industries are indicated in the figures, however the schemes that allow for reductions are complex and the interested reader is referred to Andersen and Speck (2009) for a more detailed account.

Sweden has the highest tax level for three energy carriers, but for electricity which is the most important source of energy in Sweden the tax is only at the minimum level. Germany has high tax levels for gas, transport fuels and electricity, but only a symbolic tax for coal. Denmark has the highest tax rate for electricity. UK leads on tax rates for mineral oils. Slovenia has for a transition economy relatively high taxes on mineral oils, not at least it was the first Central and Eastern European Country to start an Environmental Tax Reform back in 1998, but perhaps also on the background of its considerable hydro and nuclear power resources. In fact several discrepancies indicate, on the one hand inconsistencies (e.g. rather high taxation of natural gas) on the other hand, the numerous tax breaks and exemptions provided in particular to industries. This is particularly visible when looking at actual tax revenue from different sources.

Another way to compare the carbon-energy tax rates is to analyse the implicit tax burden per tonne of CO_2 and per GJ. Table 3 provides an overview of the implicit tax rates when assessed against GJ. Alternatively table 4 shows the implicit tax rates when assessed per tCO_2.

Table 5.3 Implicit carbon-energy tax (Euro per GJ) in seven EU countries

€/GJ	DK	FI	GE	NL	SI	SW	UK	Average
Fuel oil	1,0	1,4	0,5	0,8	1,2	1,5	1,8	1,2
Coal	1,1	1,6	0,01	0,5	0,4	2,0	0,7	0,9
Gas	0,7	0,5	1,1	0,3	0,4	1,1	0,6	0,7

(*source: COMETR).*

Table 5.4 Implicit carbon-energy tax (Euro per t CO_2) in seven EU countries

€/tCO_2	DK	FI	GE	NL	SI	SW	UK	Average
Fuel oil	12,2	18,0	6,2	10,3	15,0	18,9	22,7	14,8
Coal	11,6	17,3	0,1	5,0	4,6	20,7	7,1	9,5
Gas	12,0	8,1	19,7	5,2	6,4	20,2	10,8	11,8

(*source: COMETR).*

Taxes on mineral oil tend to be higher than taxes on other fuels; this is because mineral oils have a long tradition for excise taxes. On balance coal is taxed slightly more per GJ than gas, which however is not proportional to its CO_2-content.

Only one country, Denmark, has explicitly balanced its CO_2 tax on industry around a consistent level per tonne CO_2, while industry is exempt from the energy taxes. For the other countries the figures here reflect the combined energy and carbon taxes and so it is difficult to judge whether a common CO_2 tax has been aimed for. On average, however, fuels appear to be taxed at a level of 10-15 €/tCO_2.

Impacts of carbon-energy taxation

There have been many attempts to model *ex-ante* the impact of carbon-energy taxation, trying to figure out the environmental impacts as well as the macro-economic implications. However, many economists regard the *ex-ante* modelling as speculative in nature, and to some extent dependent on the properties of the specific modelling frameworks employed. Many economic models are not capable of simulating all the relevant substitution possibilities in the energy sector, in particular not the relevant opportunities for fuel shifting as a response to carbon taxation, which require that all relevant energy carriers are well represented in the modelling framework. Also the models often use average energy prices and cannot account for the frequently discounted energy prices available to large, energy-intensive industries. In addition the long-term effect of carbon-energy taxation on innovation activities with respect to production processes and the development of new products *per se* are difficult to predict.

More reliable estimates of the impacts of carbon-energy taxation can be achieved "counterfactually" where economic models are calibrated *ex-post* to disentangle the specific effect of having added a tax to energy prices. By calibrating the model to fit the actual outcome of the macro-economic development and the related emissions it becomes possible to run the model in a scenario without the taxes added, whereby the

impact on emissions and economic parameters can be extracted. However such ex-post modelling requires the availability of a comprehensive modelling framework,.

The first such *ex-post* modelling was a study of the CO_2-tax in Norway (Larsen and Nesbakken, 1997). It found that as a result of a differentiated CO_2-tax scheme emissions had, over a period of 3 years, been reduced by 3-4% compared with business-as-usual, mainly as a result of reduced transport activities.

Other approaches to *ex-post* analysis of the impact of carbon-energy taxes have included bottom-up modelling frameworks, such as the MARKAL energy sector model, or have relied on more sectoral ad-hoc approaches to report on the implications for emissions. A report from the Nordic Council of Ministers (2001) reports on about 20 different such studies that have attempted to disentangle the effects of carbon-energy taxation.

In one of the more rigorous approaches Bjørner, Togeby and Christensen (1999) established a micro-panel database of about 5,000 companies and could, on the basis of company-specific energy consumption, establish the impacts of Denmark's CO_2-tax. In their econometric analysis they found that companies had, in a few years and in response to a modest tax level, reduced CO_2-emissions by 8 % compared to business-as-usual. Higher reductions were identified for companies that also were subject to energy savings agreements with the authorities (in average 13%).

Enevoldsen (2005) relied on a comparative approach, whereby the impacts in Denmark were carefully contrasted to developments in the Netherlands and Austria. This study also comes to the conclusions that Denmark's CO_2-tax on industrial energy consumption curbed CO_2-emissions by about 10 per cent. These high impacts may reflect that many win-win opportunities were available, as Denmark had previously refunded energy taxes on industrial energy consumption.

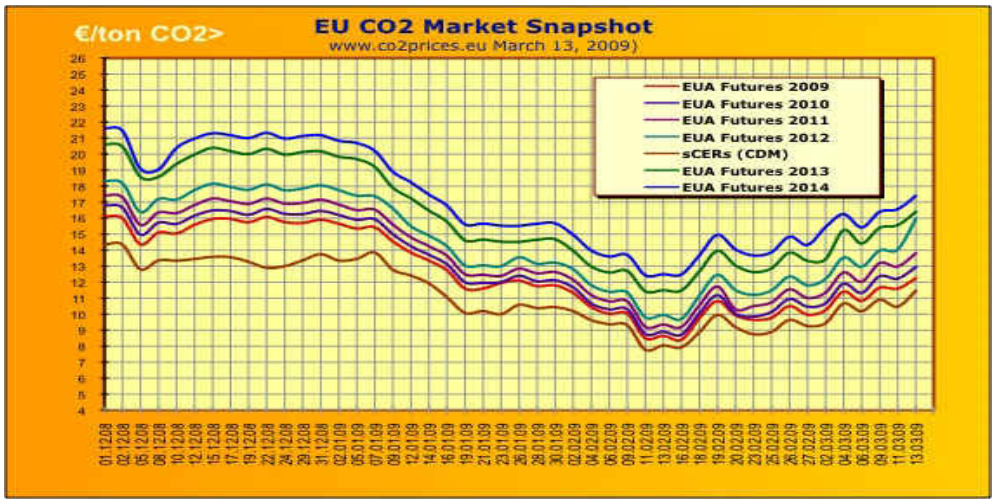
The most comprehensive *ex-post* study so far was undertaken by Cambridge Econometrics as part of the EU-funded COMETR project (Barker et. al., 2009). In this study the macro-economic model E3ME was applied to disentangle the impacts of environmental tax reforms based on carbon-energy taxation. Seven countries were included in the study, which relied on an EU-wide economic modelling framework; Germany, UK, Sweden, Netherlands, Denmark, Finland and Slovenia. As a result of the environmental tax shifts, whereby carbon-energy taxation replaced employers' social security contributions or in some countries income taxation on employees, there were implications both for CO_2-emissions and for economic activities. The magnitude of the tax shifting differed among the seven countries, with the highest share recorded for Denmark and Germany. Altogether about 25 billion Euros in taxes were shifted as a result of the ETR's in the countries mentioned (Slovenia did not introduce ETR, but exchanged excise duties with a CO_2-tax on industry).

For the years 1995-2003 the modelling framework E3ME was able to capture *ex-post* the implications, but it also made an *ex-ante* forecast for the final impact of ETR's up to year 2012, as the effects have come through more fully and for what is

the final year for compliance with the Kyoto protocol. The results differed between the countries, but on average CO_2-emissions were reduced by about 3-4% compared to business as usual. Emissions were reduced mainly as a result of energy savings, as fuel-shifting was difficult to capture. This result appeared on the basis of relatively modest rates of carbon-energy taxation, as the ETR's in many cases only added incremental tax changes on top of pre-existing tax rates.

As for the wider economic impacts, the study did not establish that they had been negative for economic growth. In fact, for five of the countries the macro-economic modelling indicated a very small positive effect on GDP in the magnitude of 0,5 per cent of GDP. Only for the UK the ETR (introduction of the climate change levy was treated as an ETR) shifted so little revenue, that no discernible macro-economic impact could be identified.

Revenue-neutrality was very important for these macro-economic results. Additional modelling showed that if the overall tax burden had been increased as a result of the introduction of carbon-energy taxes, the impact of such new taxes would have become overall negative. However, as the new tax burden was offset by lowering of other taxes, it was possible for the economies to respond by becoming more efficient. Whether this finding can be interpreted to substantiate the "double dividend hypothesis" (see also section 7) remains an issue of debate. In any case, the macro-economic impact was very small, but whether more significant tax shifts of higher order of magnitudes also would yield more significant positive impacts on GDP should not be ruled out a priori. As such the study brought the double dividend hypothesis into debate again, while underlining more strongly than before the importance of revenue neutrality.



Interplay between ETS and ETR

The introduction in EU of an emissions trading system (ETS) for CO_2 emissions has added a new dimension to taxation of carbon and energy. Emitters need to hold

and possibly purchase CO_2 allowances, even if the same emissions are also liable to taxation. As the allowances are so far not auctioned, but "grandfathered", the ETS does not generate revenue in the way that carbon-energy taxation will do under ETR. As a result the impacts of ETS cannot be mitigated by recycling revenue to lower other tax burdens in return for the allowance costs that companies will meet once the market begins to trade CO_2 (see also section 4). The macro-economic impacts of ETS are hence believed to be less favourable than the impacts of revenue-neutral ETR. This is because once allowances are traded the acquiring emitters will be facing a monetary burden that cannot be offset.

The ETS applies only to fossil fuel power generation and to certain sectors among energy-intensive industries, many other sectors including transport are not part of the ETS system. ETS-sectors are subject both to the CO_2-allowance costs as well as to carbon-energy taxation, and as a result there are complaints about alleged "double-regulation". Still, it follows that "double-regulation" only should be regarded as a "double-burden" to the extent that allowances are fully auctioned. Allowances allocated for free in fact constitute an asset, and the receiving emitters will benefit if the allowances can be traded on the market. A double burden may nevertheless materialise for those emitters that increase their emissions above the historical baseline and come in need of extra allowances.

CO_2-allowance prices have in the short period of the EU ETS proven to be relatively volatile. In the first allocation period (2006-07) the ETS market collapsed towards the end as there were too many allowances for sale on the market. In the second allocation period (2008-12) the initial CO_2-allowance price of about 20€/tCO_2 has been undermined by the financial crisis and the downturn in economic activities. In early 2009, prices dropped to less than 10€/tCO_2. The volatility of the allowance price is unfortunate, as investors in low-carbon technologies consequently face high uncertainties on the return on investments.

Recent discussions have focused on the opportunities for combining ETS and ETR. There are two positions in this debate, one well-known arguing for governments to provide an intervention ceiling for allowance prices, the "safety valve approach", another more recent for carbon taxation to provide a floor or minimum price for CO_2-emissions (Ekins, 2009). Under the safety valve, to introduce a ceiling on allowance prices, governments would have to issue additional allowances at a guaranteed price once demand for allowances cause the market price to exceed this level. The advantages of the safety valve is the certainty created in the market that the carbon price will not endanger competitiveness by exceeding pre-determined levels (the US Congress is considering a proposal for a safety valve of 12 US$/t$CO_2$).

Martin Weitzman, a famous economist specialised in the properties of prices versus quantities, has stated that "A very strong safety valve is equal to a tax. If you don't allow the price to vary very much it's the equivalent to taxing it" (Samuelsohn, 2008). Weitzman himself favours a carbon tax.

Further difficulties with ETS are caused by the free allocation principle and the

lack of auctioning. Once ETS allowances are auctioned the macro-economic implications of choosing between ETS and ETR narrow considerably. Unfortunately the EU was not able to agree on introducing full auctioning in the near future; the recent Climate Package deal will gradually introduce auctioning, but only by the year 2027 will such a system be fully implemented. Hence the differences between trading and taxing remain.

Alternatively, if a CO_2-tax is introduced to provide a price floor some of the windfall profits that otherwise accrue to the ETS traders would be returned as tax revenues, and could be recycled so as to offset the economic burdens of the grandfathered ETS. While the safety valve approach could endanger the carbon cap and drain the government for revenues, the CO_2-tax floor would combine the advantages of revenue-neutral ETR with the environmental stringency of a cap-and-trade scheme of allowances.

7. Using External Cost to Establish Appropriate Tax Rates

Environmental taxation can be quite popular with tax payers before its introduction. The basic rationale makes sense and many tax payers look forward to a reduction of their payroll taxes. The polluters are regarded as 'someone else'. However, many citizens will soon realise that they themselves also undertake activities that entail emissions and environmental burdens, and hence are facing a higher tax burden for their car, their electricity consumption and their holiday trip, for instance, than before. In consequence support for environmental taxation may diminish, and the specific environmental tax rates may soon be questioned by taxpayers that suspect fiscal motives to dominate over environmental aims. One question that is often raised is why the proceeds from environmental taxes are not returned for environmental purposes. The legitimacy 'life-cycle' of environmental tax reform has been observed in several countries and should not be underestimated.

While the general rationale for environmental tax reform remains unambiguous, it is advisable that the specific tax rates are underpinned by a clear and transparent justification.

Recall that according to basic welfare economic theory, environmental taxes play the role of reflecting external costs so as to ensure the integration of environmental concerns in the prices and transactions of the market-place (see section 2). The question about legitimacy should hence address whether the specific environmental taxes reflect the external costs of pollution and resource depletion. If an environmental tax can be reasonably demonstrated to reflect the external costs arising from economic activities it is difficult to raise discussions about fairness and legitimacy. Moreover, the closer the tax to the "optimal" level, the more economically efficient it will be, hence minimising the total social cost to society.

Methods have been developed in recent years to investigate the extent of the external costs entailed by different emissions, in particular to air but also to water.

There are considerable uncertainties related to these methods, but nevertheless they allow for approximations of the external costs related to emissions. The biggest uncertainties are with the differences in exposure that depend on the specific location of the polluting activities. Air pollution, for instance, causes higher health damages in urban areas with high population densities, than in rural locations, so emissions that reach high population concentrations will cause higher external costs. Water pollution of drinking water reserves likewise causes higher external cost where more people are affected.

Simple modelling frameworks have been established, e.g. as web-tools, to explore the external costs of air pollution[57]. More sophisticated modelling tools taking account of atmospheric chemistry are available in the framework of research institutes. Models related to water pollution are still in an early stage.

Generally these frameworks are based on the impact-pathway approach, whereby the impact of an emission is explored from its source and dispersion to the physical end-effects, e.g. reduced life expectancy or morbidity effects. The extent of these end-effects depends on the relationship between exposure and response, i.e. the exposure-response function as well as on the number exposed. The external costs in turn, depend on *the monetary values* attached to the end-effects (see European Commission, 2003 for a brief introduction to the basic methodology; see also Pearce et al in OECD, 2006).

One emission for which external costs can be established with a relatively good certainty, relatively speaking, is SO_2. This is because the health-effects of SO_2 are reasonably well described and understood in the scientific literature. SO_2 is transformed to sulphates, which belong to the mass of particles, $PM_{2.5}$. The $PM_{2.5}$ concentrations are found in epidemiological research to correlate with higher mortality rates, implying a reduced life expectancy for the exposed citizens. For each increment of $PM_{2.5}$ chronic mortality increases by 0,4-0,6 per cent. Furthermore, SO_2 itself, at peak concentrations, is seen to cause additional acute deaths. The reasons for the increased death rates, acute as well as chronic, are believed to be the way that atmospheric emissions alter the viscosity of the blood, after having entered the human body via the respiratory system, whereby strokes and heart attacks can be released. Medical research has established that sulphates enter the blood system and reduce the number of white blood cells, while causing damages to DNA and DNA-repair. Cardiopulmonary death rates, especially among the elderly, are higher in areas with high air pollution concentrations. But also the number of lung cancers is found to be higher, even among never-smokers, as air pollution has effects on the respiratory tract and system.

Preliminary calculations regarding the external costs of air pollution in *China* are presented in the draft report "Cost of pollution in China" (World Bank & SEPA, 2007). On the basis of the proposed value of a statistical life assessed at 1 million CNY for China, and on the basis of existing modelling studies, SEPA staff has

[57] http://ecoweb.ier.uni-stuttgart.de/ecosense_web/ecosensele_web/frame.php

assessed that the external cost of an emission of 1 kg. SO_2 is in the magnitude of 10-20 CNY/kgSO_2 which is well in accordance with more detailed studies adapted to Chinese circumstances (SEPA, 2006; Andersen, 2008).

In comparison to damages of 10-20 CNY/kgSO_2 the existing air pollution penalty levy is 0,2-1,2 CNY/kgSO_2 - and only for those emissions that exceed the legal standards (Zhang, 2004 pp 24-25; OECD, 2007 p 210).

When annual revenue from the SO_2 penalty levy is divided on total emissions China's effective SO_2 levy was 0,06 CNY/kgSO_2 in 2002 (emissions 20 billion kg SO_2 and revenue: 1,15 billion CNY, cf. Yang and Schreifels, 2003).

In comparison one study (Morgenstern, 2004) assesses marginal abatement costs in China to range from ½-1 CNY/kgSO_2 for major emitters (heavy industry and power plants), more than 20 times the effective SO2 penalty level, but considerably less than the costs of 1-2 €/kg SO_2 in Europe (8-16 CNY/kgSO_2) (Nordic Council, 2008).

Zhang (2004) hints that at a further problem with the SO_2 levy, which is the institutional arrangement, whereby 80 per cent of the revenue is returned to the emitters for abatement measures. This arrangement lowers the interest and sensitivity of the involved parties in the scheme and is part of the explanation for the reduced implementation and collection efficiency – in the rural provinces in particular, but also in the coastal regions of China. The collection rate for China as a whole is assessed to be about 50 per cent (OECD, 2007 p. 210), varying from 10 per cent in western to 80 per cent in eastern provinces. Under the principle of environmental tax reform only a small share of revenues (5-20 per cent) should be earmarked for abatement and technology innovation, the greater part is better recycled in respect of revenue-neutrality to lower other tax burdens.

With damage costs as high as 10-20 CNY/kg SO_2 and abatement costs as low as ½-1 CNY/kgSO_2 there seems to be scope for strengthening the present arrangement in China in a legitimate way, even at tax rates considerably lower than the external costs. Gradually and predictably increasing the tax rates has proved to be a feasible approach, not endangering competitiveness, as seen in the case of Denmark, which with an environmental SO_2-tax of 1,5 €/kg SO_2 has achieved the lowest rate of SO_2-emissions per unit of GDP in the OECD area, surpassing even Japan (OECD, 2008: 135).

While the example of SO_2 shows how a legitimate environmental tax can be considered with reference to calculations and modelling studies, it has to be acknowledged that for other emissions uncertainties are large. This applies in particular for carbon, where there is debate over the 'true' social costs of carbon emissions. And for depletion of natural resources, such as coal resources, there are methodological issues with how to apply the so-called Hartwick rule for sustainability, that need to be solved before an optimal energy tax can be established.

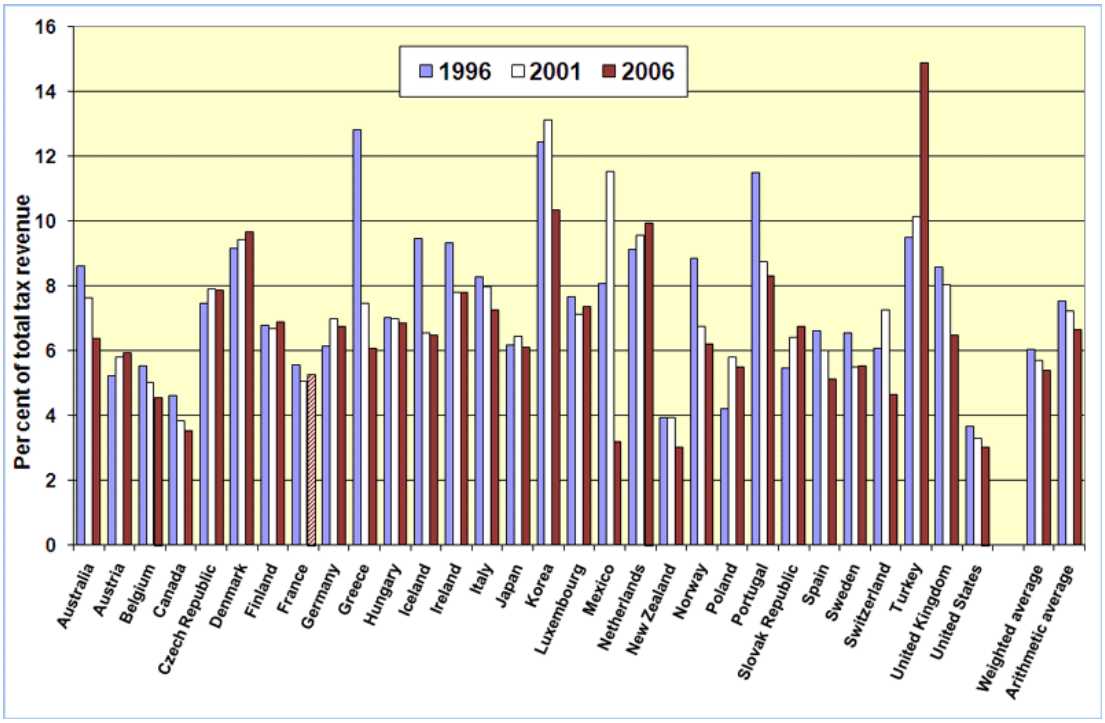
Given the difficulties to find the correct tax rate based on external cost estimates and their variation in time and space, the following principles as set out in the interim

report of the Task Force on Economic Instruments for Energy Efficiency and Environment should be observed. Tax rates should be increased in small predictable steps so that adaptation is easy and no social hardship emerges. In addition it is very important for investors to have long-term predictability of the tax level. Often the level of external costs is far higher than the abatement or substitution costs, and so it may be economically more efficient to tax at a lower tax rate than that suggested by the estimates of external costs. The rationale should be to provide the sufficient long-term incentives so as to facilitate substantial private investment in pollution abatement and energy productivity, while maintaining harmonious social and economic development.[58]

8. The Revenue of Environmental Taxes

In OECD countries, the revenue from environmental taxes represents 6-7 % of total tax revenue and 2-2.5 % of GDP (Figures 13 and 14).

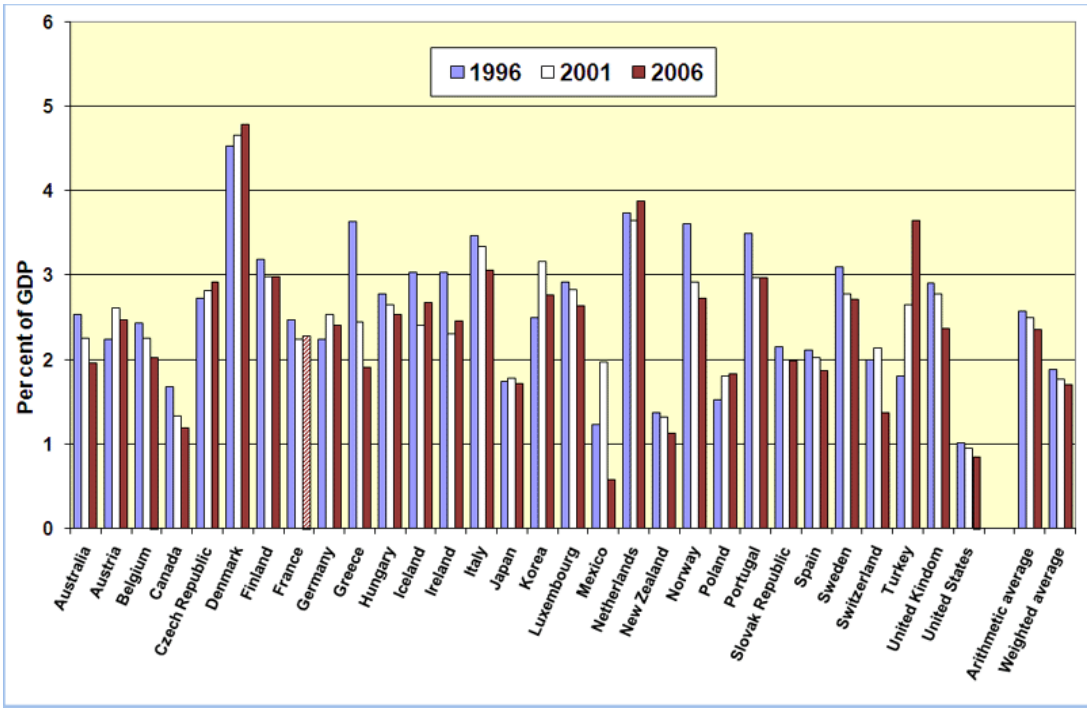
Figure 13 Revenues from environmentally related taxes in per cent of total tax revenue



Source: OECD/EEA database on environmentally related taxes.

[58] Weizsäcker, E.U. v. & Jesinghaus, Jochen (1992).

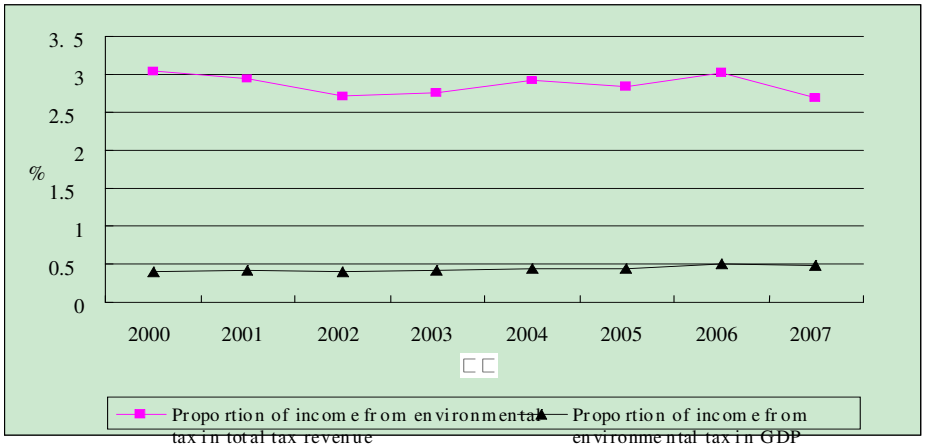
Figure 14 Revenues from environmentally related taxes in per cent of GDP



Source: OECD/EEA database on environmentally related taxes.

In China, whilst the revenue of environmental taxes is increasing rapidly, in 2007 it represented only 2.8 % of total tax revenue and 0.4 % of GDP (Task Force on Environmental Taxation 2009).

Figure 15 Environmental taxes revenue in China (revenue in % of GDP and total tax revenue)



Source: Task Force (2009)

Key features

Data on revenue should be interpreted with caution: the fact that environmental taxes rank high in some countries is not an indicator of the "greening" of the tax system nor of the effectiveness of the environmental policy; it also reflects the general structure of the tax system, for instance in countries where petrol taxes account for a high share of total tax revenue. Furthermore, limited or decreasing revenue may be an indicator of effectiveness, showing that taxes have caused changing behaviour (the so-called "biodegradability" of the tax base).

One distinctive feature is that the revenue of motor fuels and motor vehicles taxes largely dominates amounting to about 90% of all the revenues from environmentally related taxes. Very small revenues are raised on tax-bases such as heavy fuel oil, coal and coke - which typically are used in heavy industries. This implies that currently the bulk of environmental taxes is paid by households and a very small part by industry; this is due, in particular, to the large number of exemptions granted to the private (mainly energy intensive) sector.

Another feature is a slight decrease of revenue over time in OECD countries, mainly due to a reduction in motor fuel consumption and a significant increase in the share of diesel driven cars (with lower tax rates). The revenue from waste-related taxes has increased considerably. In nine OECD countries, the share of waste related taxes in the total revenue of environmental taxes increased from 0.4 % to 2.9 % (1994-2003).

The use of tax revenue: policy issues

The use of tax revenue is a crucial issue for the political "legibility" and legitimacy of taxes: what is the real purpose of the tax? What will it be used for? Several issues and options are at stake.

1. Will the overall tax burden increase, or will there be a tax shift (revenue neutrality)?

As indicated earlier, in most OECD countries (mainly EU) green tax reforms have been introduced in the context of constant tax burden, mainly through a tax shift consisting in decreasing labour-related taxes (income tax and social security contributions), whilst increasing environmental taxes (the so-called "double dividend" approach). Other tax shifts can be envisaged, such as decreasing corporate taxes. However, in different contexts, countries may choose to increase the overall tax revenue.

2. Will the tax revenue be allocated to compensation measures (e.g. to poorer segment of the population or to specific economic sectors), what type of revenue recycling?

Environmental taxes on specific commodities and resources, such as energy, water or certain consumption goods are likely to be socially regressive. For instance, in cold regions, poor segments of the population may suffer from an increase in

energy prices. The revenue of environmental taxes can be (fully or partly) used to compensate for these effects (see section 9). The revenue may also be "recycled" back to certain sectors of industry, according to specific criteria (e.g. energy efficiency, as is the case in Denmark and Sweden).

3. Will the revenue be used to finance specific environmental funds or activities?

In several instances, taxes (more often charges) are allocated to environmental funds, designed to finance specific projects such as water supply and treatment, waste management, energy savings, and local regional projects. However, the pros and cons of tax earmarking should be carefully assessed.

Box 5.5 Pros and Cons of Earmarking Taxes and Charges

Advantages	Disadvantages
Introduction of environmental taxation may be made easier as earmarking seems to draw political support.	Depending on the price elasticities, the tax revenues are likely to decline over time, and there might be a temptation to increase the tax rate above the efficient level.
In a context where environmental programmes are complementary to environmental taxes, the effectiveness of environmental policy should be enhanced, especially if taxes alone cannot achieve environmental objectives.	Might prevent governments from optimising spending composition which should be based on cost/benefit analysis and programme evaluation.
May be useful during a period of adjustment, especially for economies in transition.	In the long term, it could create inefficiencies and rigidities.
Earmarking is a necessity in the case of user charges as taxpayers expect a service in return.	

4. How to combine the effectiveness of the tax as such and the use of the revenue?

There is a delicate trade-off between an effective tax rate (i.e. that triggers changing behaviour) and earmarking the tax revenue for a similar purpose. As the tax becomes more effective, not only does the revenue decrease, but also earmarking the revenue may result in over investment and inefficiencies. This is one reason why environmental funds should have *sunset dates* to be discontinued as soon as objectives are achieved. Funds tend to survive beyond their usefulness and real purpose.

9. Implementing Environmental Taxes: Selected Policy Issues

9.1 Distributional implications of environmentally related taxes

Economic instruments, in particular environmentally related taxes, are often construed as being socially regressive. In the case of taxes (or auctioned tradable permits), the rent associated with the use of the environment is captured by the

government. Also, the distributional impact of taxes (or auctioned permits) is likely to be greater than command and control regulations, because a payment is made on top of the abatement cost (see figure 1). The type of revenue "recycling" will also influence the distributional effects. Distributional issues are quite important in the case of developing and emerging economies, where taxes on "life commodities" such as energy or water, will undoubtedly affect poor segments of the population.

The distributional effects of such taxes, especially those on energy, may be observed in three ways (Smith1998).

There will be a *direct* distributional impact related to the structure of household energy expenditure (on heating and transport) for different income brackets. The bigger the proportion of low-income household expenditure devoted to energy, the more regressive will be the impact of the tax.

Indirect distributional effects will emanate from the taxation of production inputs. The more the processes are energy-intensive, the greater will be the incidence of a tax on the goods produced. Of course, the more the products fall into the prime necessity category, the more regressive the tax will be.

Lastly, the distributional impact will be related to the *incidence* of the tax. An energy tax may affect end consumers, but it may also affect energy producers or production factors (e.g. through a fall in wages or lower return on capital). At the same time, part of the tax may be borne by energy consuming countries and another part by energy exporting countries, according to supply and demand elasticities.

In so far as many environmentally related taxes apply to mass consumption products, such as motor-driven vehicles and energy, they can have a potential substantial effect on lower-income households. Other environmental taxes on products such as detergents, fertilisers, batteries and pesticides, produce very limited revenue; whether this implies a limited distributive impact, compared to large-scale and fiscally heavier environmental taxes, such as those on energy, is an open question. Certain categories may be affected, such as farmers paying taxes on fertilisers and pesticides, and more so if they have to pay water charges according to full social costs.

Empirical evidence indicates that regressivity decreases when *indirect effects* of the price increase are taken into account. In the case of energy taxes, the degree of regressivity tends to decrease: as energy is an input into all goods and services, the incidence of the tax is attenuated once the effects on all expenditure is taken into account (OECD 2006).

The use of the tax revenue, in particular the type of "recycling" will significantly affect the distribution effects. For instance, a tax shift seeking an employment in a "double dividend" effect could reduce the possible regressivity, due to the positive employment effect. Also, a comprehensive tax reform might comprise reductions in income and/or indirect taxes, VAT etc., with possible positive distributional effects.

The distribution of improvements in environmental conditions caused by the reform should also be taken into account (see also OECD 2002b and Serret & Johnstone 2006). For example, low-income households often live in areas in large cities that would benefit the most from measures that would limit road traffic.

The distributive implications are not only "social". For example, reductions of corporate taxes to compensate for increased environmentally related tax pressure, or recycling back tax revenue to specific industry sectors will result in specific distributive effects.

Selected Empirical Evidence

There is growing evidence on the distributive implications of environmental taxes, in particular carbon-energy taxes. It indicates some, but limited, regressivity, as can be expected from any indirect tax (see Serret & Johnstone 2006). In some instances, progressive distributional effects may occur. A cross-country study on motor fuel taxes indicates a weak, but progressive impact (Barker and Kohler 1998, quoted in Serret & Johnstone 2006). A study on *Denmark* concludes that gasoline taxation and car registration fees may be progressive, while other environmental taxes are regressive (cited in Serret & Johnstone 2006). In *Denmark*, the distributional impact of taxes on water, heating and electricity seems to be of some concern. In the *UK*, the lowest income decile spends 5.6% of net household income on road fuel duty, three times more than the richest decile and more than twice as much as the average.

An analysis of the distributional effects of environmental taxes in *Germany* (1999-2003) indicates that most households are negatively impacted, with the maximum loss up 10 % of disposable income; only 8.8 % gain from the reform with a maximum gain of 0.8 %. On average, however, the loss is limited to 0.7 % of disposable income (Bork, in Serret & Johnstone 2006).

In *Norway*, environmental taxes are not found to cause any significant regressivity between high and low-income households. However, one issue of some concern is differences in impacts between regions were public transportation is available (hence a possibility exists to switch to public transports when fuel taxes increase), *vs.* regions where it is not the case.

Policy options

Basically, three types of corrective measures can be envisaged: mitigation, compensation and tax shifts.

Mitigation consists in a reduction of the rates of environmental taxes to alleviate the tax burden on specific segments of the population. This can take many forms, such as reduced tax rates for low-income groups or on specific mass consumption and indispensable commodities (e.g. heating fuels or agricultural inputs); manipulation of tariff structures (e.g. dual rate), tax exemption below certain income levels, consumption floors, below which no tax is levied. However, the outcome would be to weaken the desired environmental impact of the tax, not to speak of the administrative

complexities. Nevertheless, a large number of special tax provisions are applied in OECD countries. The EEA/OECD database indicates hundreds of provisions such as tax exemptions and reduced rates. Note that these provisions are introduced both on distributive and competitiveness grounds, to the benefit of both households and the business sectors, which makes the assessment of the strictly "social" benefit of these measures quite uncertain.

Compensation measures are basically outside the realm of the taxes as such, i.e. do not affect tax rate or structure. These are corrective measures, such as *lump sum compensation (cash transfers)*, calculated on the basis of average tax payments per household, subsidies for heat insulation of homes. In this case, compensation will have a progressive incidence on the assumption that the poorest households on average pay less tax than the richest households. Tax refunds are a typical compensation measure; for instance, the Swiss taxes on VOCs and light heating oil are refunded to households. In several countries, energy taxes are partly repaid to household and/or business in the form of subsidies for energy saving investments/expenditures. *Income-tested compensation,* where the amount paid is calculated against household income, is another option.

Tax shifts, i.e. the reduction of other taxes, such as labour and income taxes, is a widespread form of compensation. It is assumed that the regressive impact of the new environmental tax will be compensated by the reduction of other taxes. The net distributional implication of this approach is not clear, however, considering that the poorest households pay the least income tax, unlike wealthy households, who will benefit most from any lowering of income tax. According to Smith (1998), this form of compensation may even prove to be strongly regressive.

9.2 Environmental taxes and competitiveness[59]

A key issue countries face when considering green tax reform is the possible loss of international competitiveness of some sectors. Since the bulk of environment related taxes concerns energy and transport taxes, there is an obvious risk that some industries' competitiveness be hurt. This can be particularly true for China[60]. This is why these industry sectors (in particular energy intensive industries) are strongly opposed to environmental taxes; often in OECD countries an explicit threat of relocation of activities to countries that do not apply such taxes is manifested. The business community tends to promote other policy instruments, such as so-called

[59] Based on Barde and Braathen (2005) and OECD (2006).

[60] As underlined by the Task Force report : "Favorable international economic environment. China's economy is export-oriented economy, with the export being one of the troika that affect the growth of domestic economy. If the international economic environment is unfavorable and affect China's export, according to the abovementioned theory, the collection of Environmental Tax Environmental Tax will also be affected. At present, the international financial crisis has caused impact on China's export to its major trade partners, such international economic environment would also become the obstacle for starting collecting environmental tax." ("Report on Environmental Taxes Research Achievements", p.22).

"voluntary" approaches[61]. Some countries use "policy packages", whereby firms can avoid paying taxes (or are granted reduced rates) if entering in agreements comprising commitments to achieve certain emission reduction targets, cf. for example the CO_2 tax in Denmark, the Climate Change Levy in United Kingdom and the SO_2 tax in Norway. Note that the concept of competitiveness can be apprehended in different ways. For instance, one should differentiate between the competitiveness of individual companies, of sectors of the economy and of the economy of a country as a whole. Similarly, competitiveness may have a national or an international dimension (see Box 5.6).

Box 5.6. The concept of competitiveness

It is important to distinguish clearly between the competitiveness of individual companies and sectors of the economy and that of the whole economy in general. Competitiveness will have a different meaning at each level. A *company* or *sector* is competitive if it is able to compete in international markets, with a satisfactory rate of return. For *a country as a whole*, the concept of competitiveness is more complex: at the economy-wide level, correcting for market failures provides an improvement in the overall economic outcome, and what represents increased costs for one firm or industry may lead to reduced costs for others. One should also distinguish between a shorter and a longer time perspective. In the shorter run, exchange rate levels will be of importance. In the longer run, the country's ability to sustain a satisfactory wage level should also be taken into consideration. So also should its balance of payments and its ability to use its resources efficiently (including its labour resources). One definition of competitiveness, from the International Institute for Management Development (IIMD), is "the ability of a country to create added value and thus increase national wealth by managing assets and processes, attractiveness and aggressiveness, globality and proximity, and by integrating these relationships into an economic and social model" [IIMD (1996)]. When evaluating a particular policy, the effects on the economy are in general more important that the effects on certain individual sectors.

Source: OECD (1997).

The competitiveness impact of environmentally related taxes is a complex issue; it will depend on different factors such as:

The market structure: in competitive markets, taxes will result in reduced profits as firms will have no, or limited, opportunity to pass on the tax on to consumers through higher prices.

Whether taxes replace, or not, existing command and control regulations: if taxes replace pre-existing CAC, the impact on competitiveness will depend on whether this implies a cost increase or not, and whether or not the preceding regulatory requirements were devised in a cost-effective way. If efficient taxes are deployed (i.e. enabling static efficiency gains), the competitiveness impacts might be positive overall. Note, however, that in the case of emission taxes, firms must pay taxes on residual emissions in addition to the abatement cost; this explains the strong opposition of industry. In all cases, whether with taxes or CAC, there will be losers and winners. It should also be noted that, in a number of instances, taxes do not replace CAC, but come as an additional measure; a negative competitiveness impact is then more likely to occur.

Whether the tax reform is revenue neutral or not. In a revenue neutral context, the overall tax burden on the economy remains constant. As environmentally related taxes

[61] They are mostly not really voluntary but induced or forced by tax incentives or other measures.

offset other pre-existing taxes, the tax shift implies primarily a redistribution of the tax burden across the economy. Nevertheless, the tax burden will rise for some firms and sectors of the economy (e.g. energy intensive sectors, in case of a carbon tax).

The nature of the tax shift. If the revenue of environmentally related taxes is affected to a reduction of the tax wedge on labour, thus reducing labour cost, labour intensive sectors will gain competitive advantages; if the revenue is used to reduce taxes on capital, this could – in isolation – benefit capital intensive firms or sectors.

The effects of the environmental improvements. If the tax is environmentally effective, some environmental benefits may improve the competitiveness of certain firms (e.g. reduced water cleaning cost, reduced crop losses, and reduced health cost). This argument is, however, equally valid for any other policy instrument.

Selected empirical evidence

Most available studies and data show no significant impact of environmental taxes on international trade. Jaffe *et al.* (1995) examined over 100 studies on the potential effect of environmental regulations (hence not only taxes) on the competitiveness of American industry. They concluded that: "Overall, there is relatively little evidence to support the hypothesis that environmental regulations have had a large adverse effect on competitiveness, however that elusive term is defined". This conclusion is based on the following arguments: 1) generally speaking, environmental protection costs are relatively modest and in any case too low to affect competitiveness (however, this cost is likely to increase substantially in the future); 2) environmental constraints in OECD countries are comparable (which is not necessarily the case in other regions of the world). In most cases, whenever environmental constraints are less restrictive in a given country, outside investors tend to apply stricter standards than those of the host country.

The competitiveness effects of a nation-wide tax policy should be addressed at the *national level*: there will be losers and winners and gains may more than offset losses. However, competitiveness effects at the sectoral level are often, if not systematically, addressed. Recent sectoral empirical studies carried out by OECD indicate that carbon taxes (or auctioned tradable permits) can have negative impacts on certain industry sectors, in particular if such policy instruments are not applied globally, but only in certain countries or group of countries see Box5.7).

Box 5.7.Summary results from the OECD case studies on the iron and steel and cement industries

Concerns about the impact on competitiveness of environmental taxes often come to address cement and iron & steel industries, which are among the most energy- and pollution intensive of all sectors. As shown by Fitzgerald et. al. (2009) while both sectors are energy-intensive, they are not equally price-sensitive however. Cement is less internationally traded than iron&steel and for this reason less sensitive. It is the weight-to-value ratio of cement which makes it less traded. Iron & steel on the other hand counts as the most sensitive of all industrial sectors and all countries have special arrangements for environmental taxes in this sector.

"The steel case study indicated *inter alia* that an *OECD-wide* carbon tax would reduce OECD steel production in the order of –9%. The estimated reduction was much greater for the heavily polluting integrated steel mills (–12%) than for the scrap-based mini-mills (–2%). Non-OECD production would increase by almost 5%, implying a fall in world steel production of –2%. The carbon tax would induce some substitution from the use of pig iron towards more intensive use of scrap in Basic Oxygen Furnace (BOF) steel making. Scrap prices would then rise, thus weakening the competitiveness of scrap-based Electric Arc Furnace (EAF) steel producers.

A first lesson that can be drawn is that different firms within a given sector will *not* be affected in the same way by any use of economic instruments, due to the different input combinations and the resulting differences in emission profiles.

A second lesson is the importance of taking into account possible adjustments in *related markets* when considering the impacts of a given policy on a particular sector. A part of any initial burden placed on a sector is likely to be shifted backwards to input suppliers and forward to the customers. In the steel case, this is *e.g.* illustrated by the estimated impacts on scrap metal prices, and the increase in steel prices.

An OECD-wide tax would reduce OECD emissions of CO_2 from the steel industry by 19%. Despite relatively high emission intensities in non-OECD countries, global emissions from the sector would decline by 4.6%, *i.e.* more than twice the reduction in global steel production. This is due to substitution towards a cleaner input mix and cleaner processes in the OECD area.

A similar finding is made in the cement case study. In a scenario with emission trading in Annex B countries except USA and Australia, even if cement production outside this area increases in response to the policies put in place in most of the OECD-related regions, global carbon emissions in clinker manufacturing is estimated to decrease by some 32 million tonnes carbon in 2010 (around 2% in 2010, 2020 and 2030).

A third lesson is thus that, in spite of *some* element of "carbon leakage" also when policies to combat climate change are put in place on a relatively broad front, significant global reductions in carbon emissions – compared to a reference scenario – can be achieved.

Unilateral policies by single regions or countries may lead to significantly larger production decreases in the countries and sectors concerned. A fourth lesson is that – while the importance varies between different firms – the larger the group of countries that put similar policies in place the more limited the impacts on sectoral competitiveness."

Source: quoted from OECD (2006) pp 17-18.

Policy options

To address competitiveness concerns, six main policy options are open.

Revenue recycling, e.g. returning, entirely or partially the tax revenue to the affected firms, e.g. for energy saving investments or R&D in pollution control technologies. This is practised in several countries. This can also take the form of *tax refunds* for certain sectors or activities. The EEA/OECD database[62] records a number of cases of refunds applied to the business sector. While a few refunds aim at "rewarding" environment-friendly practices or processes, most other cases are designed to lighten the tax burden of industry, under specific conditions. If applying some form of

[62] http://www2.oecd.org/ecoinst/queries/index.htm

revenue recycling, one should make sure that the affected firms still have a positive incentive at the margin to reduce emissions.

Tax exemptions for specific activities, sectors or products. There is a large number of tax exemptions related to environmentally related taxes; the EEA/OECD database includes more than 1100 exemptions in OECD countries. These data must be interpreted with caution: exemptions are introduced for a number of social, environmental and economic reasons, and only part of these exemptions can be construed as directly motivated by competitiveness concerns. One approach is simply to exclude the main industries completely from the application of a tax, or for example to say that a given tax does not apply to the use of fuels as input or reduction agents in industrial processes. As mentioned earlier, the EEA/OECD database shows that about 90% of the revenue of environmentally related taxes comes from taxes on automotive fuels and motor vehicles; industry is largely exempt.

Reduced tax rates for certain sectors, products or inputs. Many countries apply reduced tax rates to industrial sectors. For instance, Sweden initially gave industry a 75% rebate on the carbon tax (and total exemption in the case of the energy tax); this rebate was reduced to 50% in July 1997. In Denmark, a 50% rebate on the CO_2 tax was granted to industry for the period 1993-1995. In Germany, electricity taxes are lower (20% of standard rate) for the production sector, and in United Kingdom, tax rates under the Climate Change Levy for energy-intensive companies are 20% of the "normal" rate.

Border tax adjustments (BTA). Environmentally related taxes place domestic producers at a competitive disadvantage if foreign competitors are not subject to similar taxes. Conceptually, BTAs can apply to both products and production processes. Imported products can be subject to similar taxes as domestically manufactured products. It is, however, more complicated to tax a product based on the way it has been produced. If domestic firms are subject to environmental taxes at the production level (e.g. input or emission taxes), applying taxes on foreign competitors implies, *i.a.* that production processes are deemed to have similar environmental effects. This type of approach can raise formidable legal and practical difficulties. However, such mechanisms do exist under the ozone depletion tax in United States and several attempts, yet in vain, were made in Europe to introduce them.

International co-ordination. The very large number of special provisions and exemptions to industry in OECD countries undermine the environmental effectiveness of environmentally related taxes. This indicates that, in the absence of international co-ordination to establish some minimum "level playing field", green tax reforms are not likely to make significant progress. Countries are still reluctant to take part in international tax co-ordination, despite the urgency of climate change policies.

One can also soften competitiveness impacts through a *gradual phasing in of taxes*. For instance, the phasing in of energy and CO_2 taxes in Denmark was designed to provide industry with clear and advanced signals enabling it to plan appropriate decisions. A similar approach is presently used in the Landfill Tax in United Kingdom,

where the tax rate per tonne standard waste increased by 1 £ per year until 2004.

9.3 Acceptance building

Environmental taxes face opposition from stakeholders for a variety of reasons, such as fear of competitiveness losses, reduced profits or possible income regressivity. For instance, the sharp increase in nominal oil prices during the early 2000s exacerbated the opposition to energy taxes in Europe. Therefore acceptance building is a key component of the implementation strategy of environmental taxes. Several measures can contribute to a better acceptance.

First, the *purpose of the tax must be clear* from the outset; in particular, the fact that the objective is to reduce a specific pollution, rather than provide government revenue. In Ireland, for instance, the introduction of a tax on plastic bags was preceded by a large public debate. In Switzerland, public information and concern on the impact of trans-alpine traffic of heavy transport vehicles took place before the introduction of the distance-based road tax in 2001. The growing public debate and evidence on global warming should help public acceptance of new instruments and constraints.

Second, the active involvement of stakeholders is crucial. Several countries have set up successfully "green tax commissions", where public and private stakeholders can meet and work together. For example, these commissions may include different government departments (e.g., finance and environment), representatives from the concerned economic sectors (agriculture, energy, transport, and industry), environmental NGOs and technical experts. These green tax commissions provide public and technical legitimacy to the tax reform. They usually have a mandate of several years, enabling them to achieve solid work and progressively build confidence and dialogue. When the tax reform is decided, these commissions may also have to monitor and assess the implementation. Countries with such commissions comprise Belgium, Canada, Denmark, Ireland, Japan, Netherlands, Norway, United Kingdom, USA, and Sweden.

Box 5. 8 The Dutch Green tax Commissions

The level of ambition, proposals and implementations/impacts of green tax commission vary considerably. One of the best examples is the Netherlands where Green Tax Commissions were set up in 1990 and again in 1995, the latter following a request by the Dutch Parliament that was implemented by the Ministry of Finance. Its task was to assess the overall provisions of the Dutch tax system and to propose how taxation could work more effectively for the environment. The major consideration in formulating proposals was environmental effectiveness, coupled to feasibility and political acceptability. Members of the Commission included environmental and tax experts, representatives from several government departments and employers' organisations, and Members of Parliament. Three reports have already been published, with English summaries made available to facilitate the international dissemination of the Commission's work. Several proposals such as the one for a carbon/energy tax were implemented in 1996.[63]

[63] See http://www.ucd.ie/gpep/research/workingpapers/pb-ep-04.pdf.

Third, green tax reforms must be *implemented gradually*. In particular, the initial introduction of environmental taxes is often followed by a gradual increase in tax rates, a widening of the application of the tax and the progressive introduction of new taxes. For instance, in Finland, the rate of the CO_2 tax was multiplied by 15 between 1990 and 1998. In Norway, the CO_2 tax is now applied to hitherto exempted sectors like domestic air transport and coastal maritime transport. In Denmark, the CO_2 tax introduced in 1992 was followed by a multi-annual "Energy Package" (1995-2002) comprising a progressive increase of the tax. The green tax reforms initiated in 1999 in Germany and the UK are gradually implemented over several years.

Earmarking tax revenue to specific environmental programmes of funds can be more "popular" than allocation to the general government budget. However, the limits and drawbacks of earmarking should be carefully assessed (see above section 7). In a similar vein, explicit compensation schemes for affected segments of the population also facilitate public acceptance.

Annex: Twelve Criteria Concerning Choice of Environmental Policy Instruments

There are many criteria concerning the choice of environmental policy instruments. As an example twelve key criteria are presented here.

1. Environmental effectiveness. The most important criterion is to what extent policy instruments will achieve environmental objectives. Certain instruments may be better adapted to specific environmental purposes. For instance, it may be more effective to impose a ban on hazardous substances rather than a tax.

2. Economic efficiency. Policy instruments should achieve goals at minimum cost to society.

3. Incentive. There should be a continuous incentive to reduce pollution and to increase technical innovation. This "dynamic efficiency" aspect is essential.

4. Flexibility. Polluters should have maximum flexibility on the ways and means to comply with environmental requirements, e.g., in the choice of abatement techniques and adaptation strategies. This flexibility is a key condition to achieve economic efficiency and environmental effectiveness.

5. Simple mode of operation. Complex regulations or economic instruments can result in poor compliance, fraud, and excessive administrative and compliance costs.

6. Cost of implementation. All components of implementation costs must be taken

into account: monitoring, licensing, enforcement etc.

7. Integration in sectoral policies. Environmental policies must be properly integrated with other sectoral policies having an environmental impact, e.g., transport, energy and agricultural policies. For instance, energy taxation must internalise environmental cost; appropriate control of pesticides and fertilisers implies removal of related agricultural subsidies.

8. Minimisation of regressive distributional effects. Policy instruments may have socially regressive impacts, e. g., by increasing the price of certain commodities (basic necessities). These distributive impacts must be mitigated and/or compensated .

9. Political acceptability depends on many factors such as the cost, simplicity, transparency, public participation, etc. Concordance with existing institutional framework is of particular relevance.

10. Economic impact. The wider economic effects of policy instruments must be carefully assessed and controlled, e.g., effects on prices, employment, competitiveness, economic growth.

11. Trade and international competitiveness are increasingly taken into account in the choice of policy instruments.

12. Conformity with international agreements. Environmental policies operate within the framework of many international conventions, protocols and agreed principles such as the Polluter Pays Principle. Trade rules must also be complied within the GATT/WTO context.

Source: Adapted from Barde, J.Ph, "Douze critères pour choisir un instrument de politique environnementale", in Ecodécision, January 1994.

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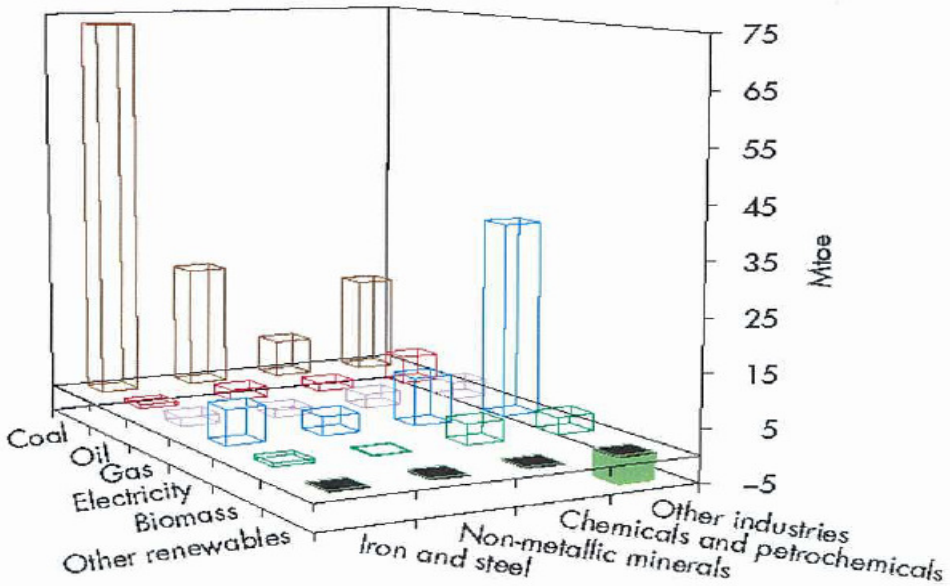
Chapter 6: Environmental Tax Reforms and Mitigation for Energy-intensive Industries: Some Lessons from European Experience

Mikael Skou Andersen

The purpose of this paper is to analyse in more detail the international experiences in applying carbon-energy taxation in two important energy-intensive sectors; iron and steel, as well as non-metallic mineral products (where cement is the most significant subsector).

In China iron and steel is the single most important industrial subsector to address in order to improve energy productivity. The net energy use per tonne of steel was 50-100 per cent higher in China than internationally in 2004 (IEA, 2007a:107). For cement the energy requirement per tonne of clinker is 20-25 per cent higher in China than in Europe (IEA, 2007a:152). According to World Energy Outlook (IEA, 2007b) China's iron and steel and cement sectors can deliver 2/3 the industrial energy savings required to comply with the IEA alternative policy scenario by the year 2030, which will reduce the projected increase in China's energy consumption by 50 per cent in 2030. While iron and steel could deliver annual energy savings of 83 Mtoe, non-metallic minerals could deliver about 30 Mtoe. While the IEA alternative scenario is in accordance with the 11th 5-year plan's aim to cut energy use per unit of GDP by 20 per cent by 2010, the averted CO_2-emissions from improved energy efficiency in these two industrials sectors in China would amount to approximately 0,3 Gt - or close to the entire reduction achieved under the EU-15 Kyoto target.

Figure 11.7: **Industrial Energy Savings in China by Fuel and Industrial Sub-Sector in 2030 in the Alternative Policy Scenario Relative to the Reference Scenario**



(From IEA, 2007b: 377)

In European countries, with the introduction ofenvironmental taxreforms (ETR) featuring carbon-energy taxation, the sectors of iron and steel as well as cement have posed a challenge despite revenue-neutral tax shifts, because these sectors, while highly energy-intensive, are not labour-intensive. The implication of this discrepancy is that at the sectoral level the introduction of carbon-energy taxes are not easily neutralised even when lowering taxes on labour. The tax shifting favours labour-intensive enterprises, so in Europe these two industrial sectors would have lost relatively more from environmental tax reform, if some special mitigation and compensation schemes had not been established.

The purpose of this paper is to review the experiences obtained in Europe with mitigation and compensation arrangements when designing the use of economic instruments for these sectors.

Before proceeding to present the schemes for environmental taxes in these key industrial sectors, a brief overview and characterisation of the available technologies are provided. The data are derived from the EU Research project COMETR which focused on the period 1995-2003. No attempt has been made to update the time-series further, as increases in international energy prices would only complicate the analysis.

Ferrous industries

Figure 6.1 provides an overview of the fuel mix in the ferrous industry in the seven

ETR-countries[64]. Most countries have a significant share of installations with basic oxygen furnaces (BOF) for which coal or coke is traditionally required. Denmark has only installations with electric arc furnaces (EAF) that rely on electricity and natural gas.

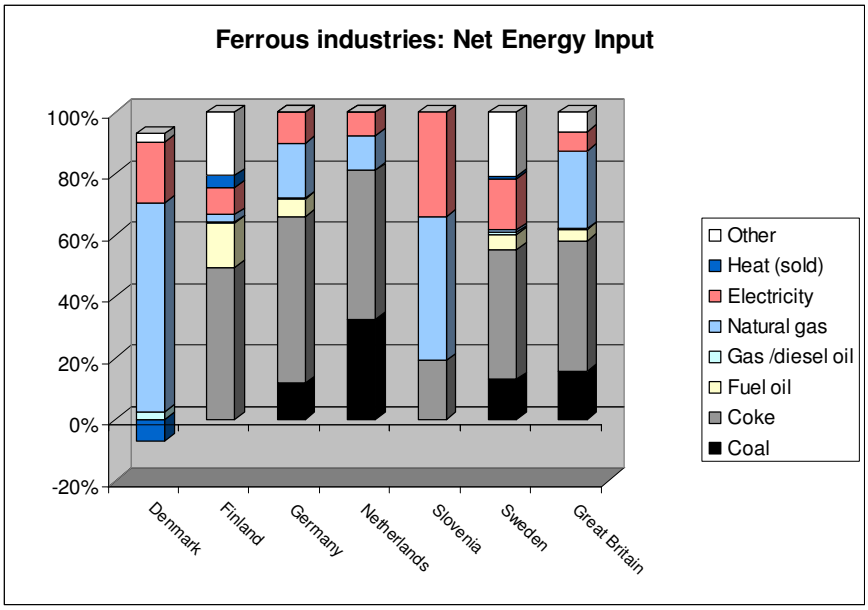


Figure 6.1 Fuel mix of ferrous industries in European ETR countries

(Source: COMETR, 2007).

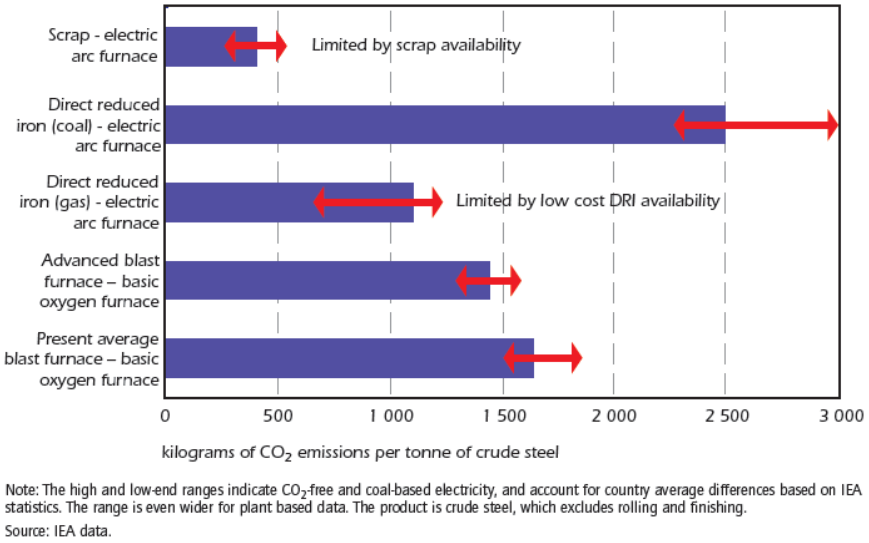


Figure 6.2: CO_2 emissions per tonne steel for different technologies (source: IEA; 2007a).

[64] Net energy input: The energy purchased by the sector from the Energy Supply Sector (or direct from other sectors), net of any autogenerated energy that it sells. It includes the energy inputs used for autogeneration (own energy production).

Figure6.2 shows CO_2 emissions per tonne of steel for different processes. Using scrap steel reduces energy use and CO_2 emissions very significantly (up to 80%), but is constrained by limited scrap availability. While in OECD countries there is plenty of scrap available, China has limited stocks to collect from. Especially for coastal regions trade would offer opportunities for gathering scrap steel. .

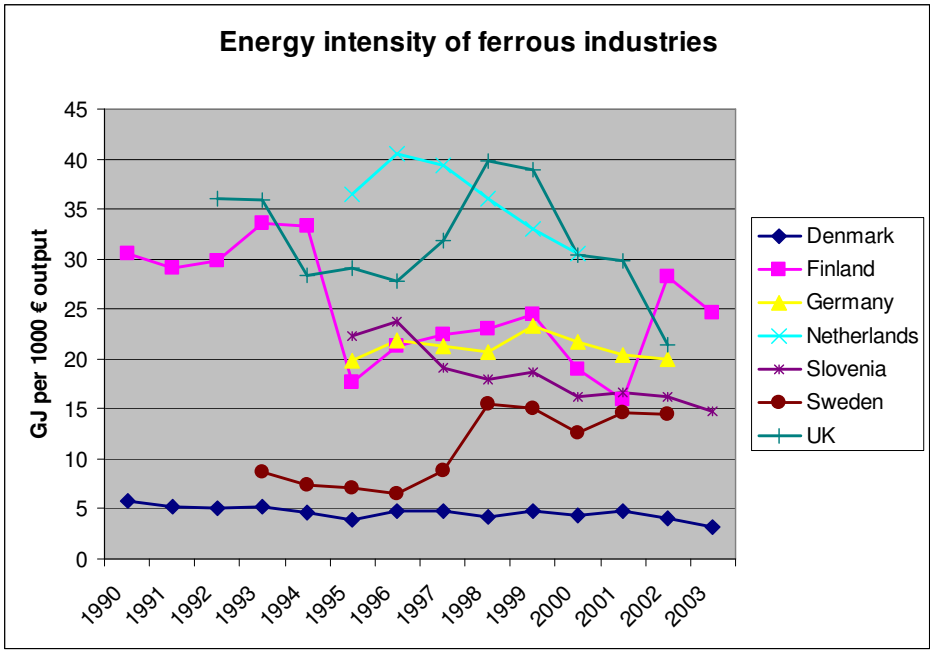


Figure 6. 3 (COMETR database, 2007).

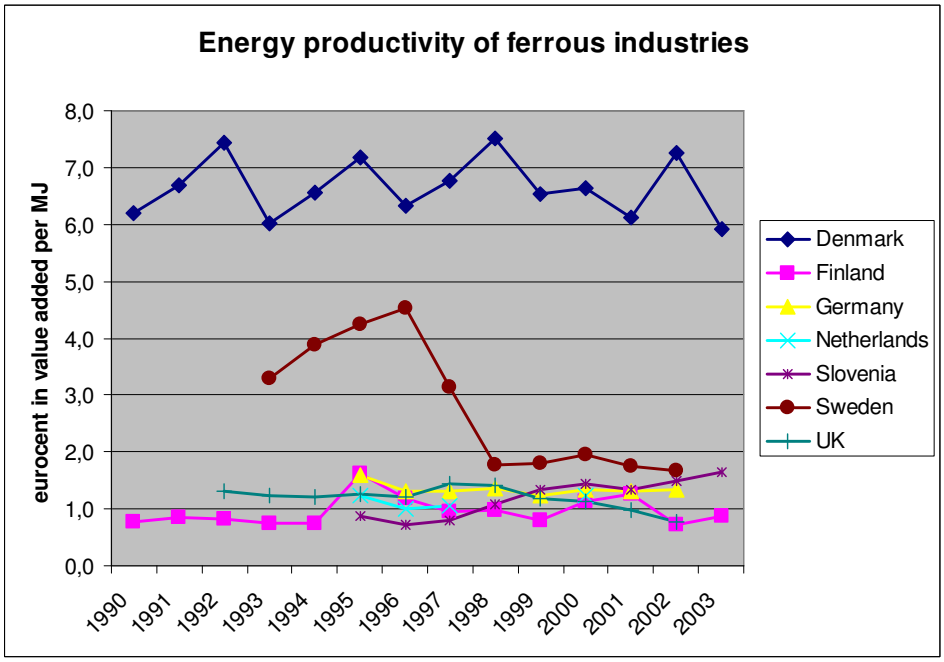


Figure 6.4 (COMETR database, 2007).

Figure 6.3 shows that energy intensities (GJ required per 1000 € output) are high in UK and the Netherlands and low in Denmark. The middle group consists of Finland, Slovenia and Germany. In Sweden ferrous industries become *more* energy intensive from the mid-1990's, which could be a result of the abolition of most energy taxes and lowering for CO_2-taxes with effect from 1994. The reason for the very low energy intensity in Denmark is presumably the combination of EAF with a high share of scrap steel.

Figure6. 4 shows conversely the energy productivity, which is about 1-2 eurocent in added value for each MJ (implying that for each kWh there will be 3,6-7,2 eurocent in value added). In Sweden the higher energy intensity leads to a sharp decline in energy productivity. Denmark has high energy productivity throughout the period, even higher than the ratio to energy intensity in other countries would suggest.

Table 6. 1 Ferrous industries (27.1-3): Carbon-energy taxation, average tax burden (in euro per GJ).

	Denmark	Finland	Germany	Netherlands	Slovenia	Sweden	UK
1990	0.04	0.06				0.95	0.08
1991	0.04	0.06				1.64	0.11
1992	0.00	0.06			0.34	1.58	0.11
1993	0.00	0.13			0.31	0.13	0.10
1994	0.24	0.26			0.39	0.14	0.09
1995	0.15	0.43	0.32	0.08	0.53	0.12	0.10
1996	0.18	0.43	0.12	0.10	0.50	0.16	0.09
1997	0.62	0.66	0.12	0.10	0.85	0.26	0.07
1998	0.68	0.38	0.12	0.10	0.86	0.24	0.06
1999	0.82	0.29	0.21	0.09	0.78	0.25	0.06
2000	0.81	0.47	0.21	0.10	0.16	0.27	0.06
2001	0.67	0.48	0.24	0.12	0.20	0.25	0.14
2002		0.28	0.27	0.12	0.22	0.26	0.13
2003		0.31		0.12	0.26	0.25	

(Source: COMETR database, 2007).

Table 6.1 provides the average tax burden per GJ, net of exemptions, for the ferrous industries. It is lower than the nominal tax rates would suggest because of the various special arrangements in place for ferrous industries in all the countries.

The highest effective tax burden is found in Denmark; here the tax burden is about 0.75 €/GJ. In the other countries the burden is considerably lower; about 0.25 €/GJ in Germany, Sweden, Finland and Slovenia - and about 0.12 €/GJ in UK and Netherlands. However, our figures for Germany overestimate the tax burden, because it was not possible to disentangle the Spitzensteuerausgleich, that is the peak tax adjustment for energy-intensive industries with increased tax burden (see below).

Hence, when contrasting energy intensity and energy productivity with the tax tables,

it becomes clear, that the lowest tax burden is found in UK and Netherlands, which have the highest energy intensity. The highest tax rate is found in Denmark, which also has the lowest energy intensity. Middle rates are found in Slovenia, Sweden and Finland, which also have mid-intensities.

While it is tempting to interpret this pattern to imply that energy intensities reflect the tax burdens, it would probably be too bold. Overall the tax burdens remain modest. The Danish tax burden of 0.75 €/GJ translates to 0.075 eurocent/MJ, which is about 1 per cent of value added per MJ (cf. figure 4). In comparison for the low tax country UK the tax burden of 0.13 €/GJ translates into 0.013 eurocent per GJ, which is also about 1 per cent of value added per MJ. And for Sweden, with 0.025 eurocent/MJ, it is also about 1 per cent. So that for this specific sector, for which so many exemptions were available (see below), the carbon-energy tax, under the present circumstances, may be more of a "harvest".

Cement

Figure 6.5 provides an overview of the fuel mix in the cement industries of the seven ETR-countries. Most countries rely heavily on coal and coke, but for UK and Netherlands the 'dash to gas' is clear. Waste and biofuels have been introduced in Slovenia and Denmark, and in Denmark the industry also supplies excess heat to district heating purposes.

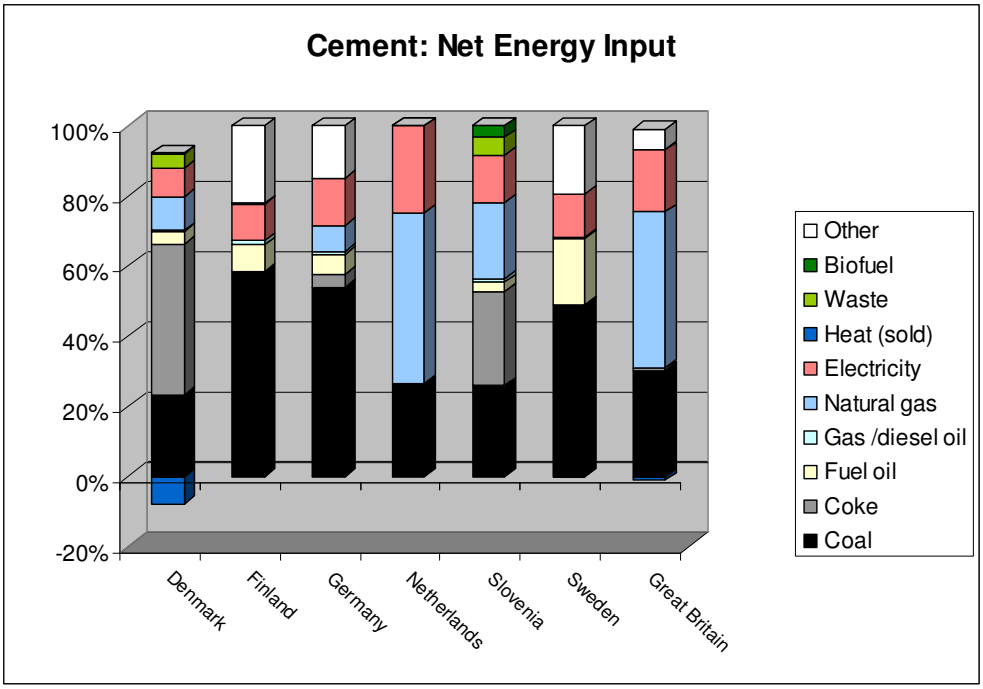


Figure6. 5 Fuel mix of cement industries in European ETR countries (Source: COMETR database, 2007).

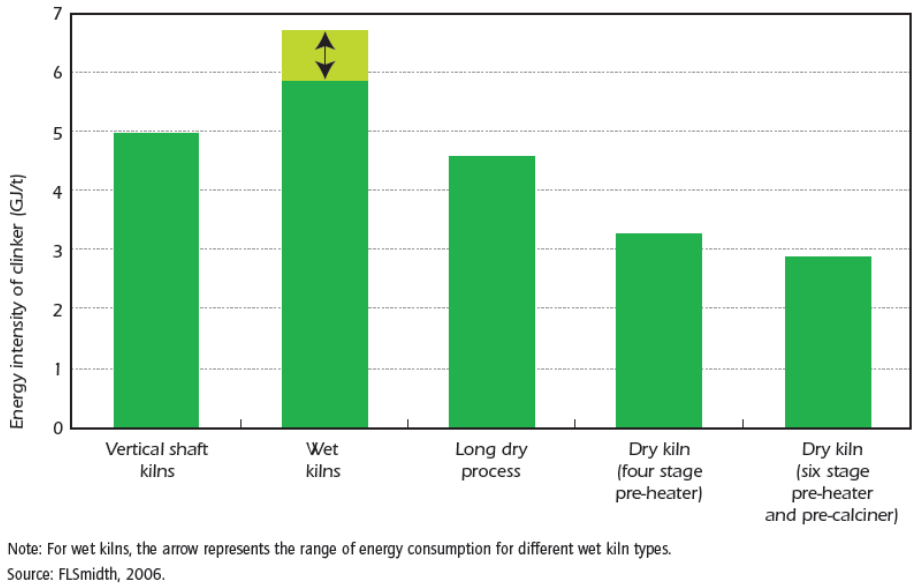


Figure 6.6 Energy efficiency of various cement clinker production technologies. Vertical shaft kilns account for 47 per cent of the production capacity in China, but are not used in Europe (IEA, 2007a).

Figure 6.7 shows that energy intensities (GJ required per 1000 € output) in cement have declined in most countries. Slovenia apparently has the lowest energy intensity, but the fuel statistics could be incomplete. Again Sweden is an exception, with increasing energy intensity, very likely for the same reason as above – the abolishment of the energy tax component for industry. Also the UK in the mid-90's experienced an increase in energy intensity, possibly as the fossil fuel levy on industry's electricity consumption was discontinued. As the UK climate change levy was announced in 1999 UK returned to improvement of its energy intensity. However, the energy intensity improvement is believed partly to reflect an autonomous trend towards improved energy efficiency. The shift from wet to dry technologies implies 20-50 per cent lower energy consumption and in Europe wet technologies are now prevailing with a share of 92 per cent (IEA, 2007a).

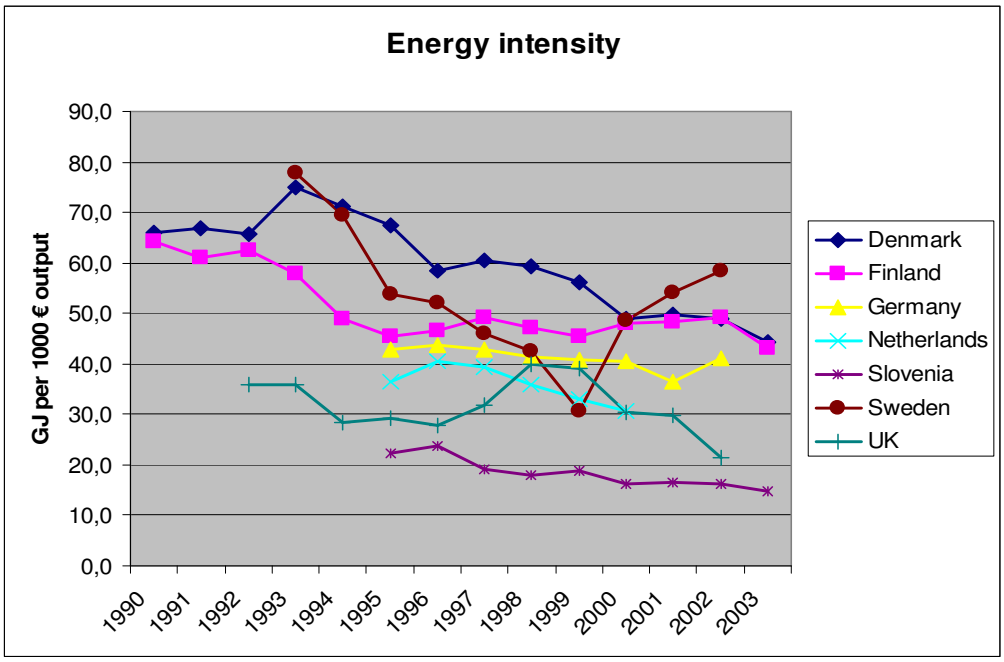


Figure 6.7 (Source: COMETR database, 2007).

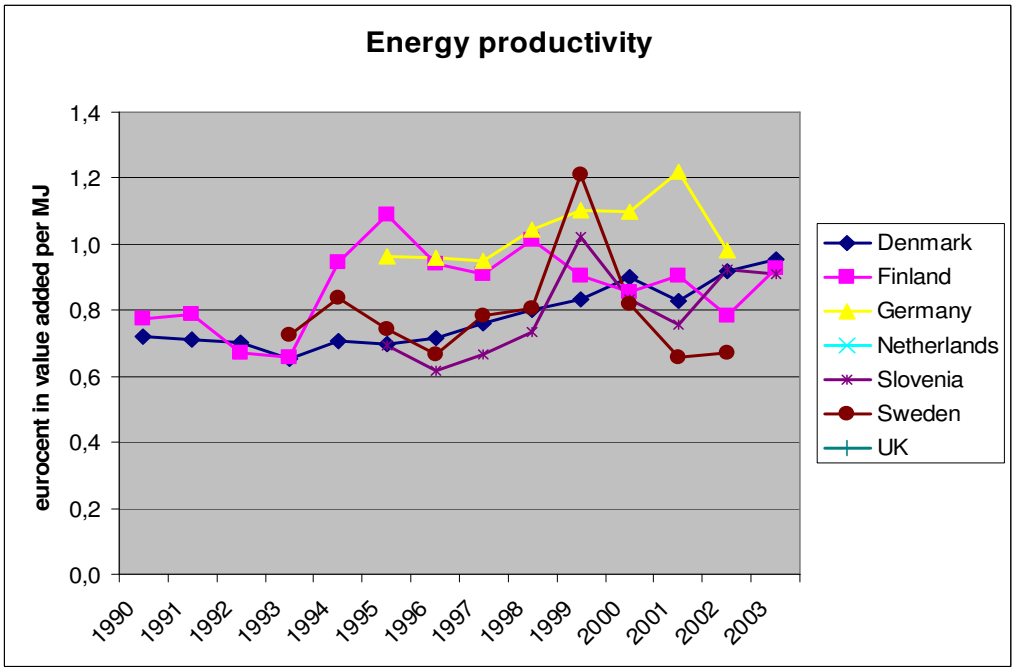


Figure 6.8 (Source: COMETR database, 2007).

Figure 6.8 shows conversely the energy productivity, which in most countries is lower for cement than for ferrous industries, with about 1 eurocent in added value for each MJ (implying that for each kWh there will be about 3,6 eurocent in value added). For Finland, Denmark and Slovenia a gradual improvement in energy productivity took place over the decade studied here, with about 4 per cent per year.

Table 6.2 Cement industries (26.5): Carbon-energy taxation, average tax burden (in euro per GJ)

	Denmark	Finland	Germany	Neth.lands[65]	Slovenia	Sweden	UK
1990	0.00	0.11				0.57	0.09
1991	0.00	0.11				0.93	0.14
1992	0.00	0.10			0.12	0.91	0.19
1993	0.00	0.17			0.15	0.17	0.19
1994	0.10	0.38			0.17	0.17	0.16
1995	0.14	0.70	0.26	0.33	0.26	0.17	0.17
1996	0.20	0.66	0.08	0.35	0.25	0.20	0.20
1997	0.14	1.09	0.07	0.34	0.61	0.38	0.05
1998	0.08	0.38	0.08	0.36	0.59	0.36	0.02
1999	0.06	0.31	0.16	0.43	0.52	0.54	0.01
2000	0.00	0.31	0.17	0.51	0.30	0.36	0.01
2001	0.23	0.31	0.20	0.73	0.32	0.30	0.17
2002		0.31	0.22	0.76	0.34	0.32	0.19
2003		0.32		0.78	0.35	0.31	

(Source: COMETR database, 2007).

Table 6.2 provides the average tax burden per GJ, net of exemptions, for the cement industries

The average tax burdens for cement are lower than the nominal tax rates would suggest because of the various special arrangements in place for energy-intensive industries in all the countries. They converge more than for ferrous industries and range from about 20 to 35 eurocents/GJ (Netherlands displays a higher figure, but it applies to non-metallic minerals as a whole). Around 1998-1999 Finland, Sweden and Denmark saw notable reductions in the average tax burdens. Altered arrangements for tax exemptions are believed to be the explanation in Finland and Sweden. In Denmark the cement industry was able to take advantage of the tax wedge between the high CO_2-tax for heat (80€/tCO_2) and the low tax rate for process energy (down to 0.5 €/tCO_2). Germany and UK on the other hand experienced a doubling or more of the tax burden following the ecological tax reform and the climate change levy respectively.

Overall the tax burdens remain modest. The average tax burden of 0.25 €/GJ translates to 0.025 eurocent/MJ, which is about 2 per cent of value added per MJ (cf. figure 8). While it is tempting to interpret the general pattern of energy productivity improvements to reflect the gradual increase of the average tax burden, it may also be related to autonomous technological trends and technology upgrades.

Methods to mitigate carbon-energy tax rates in ferrous and cement industries

The EU's Energy Taxation Directive (2003/96/EC) Art 2, no. 4 prescribes, that certain uses of energy products and electricity may be exempt from the EU minimum rates. The most important exemptions relating to the two above sectors include;

[65] Sector 26 as a whole.

electricity used for metallurgical processes,

energy for mineralogical processes

dual use of energy products (the combined use for heating and process purposes, such as in metallurgical processes),

Despite these exemptions from EU-harmonised taxes, the 7 ETR-countries have unilaterally imposed carbon-energy taxation including for ferrous and cement industries. Accompanying exemptions and mitigation arrangements for energy-intensive industries, including the above sectors, have then been introduced. Below we describe how the different countries have chosen to do so. This description leads to a discussion of which mitigation arrangements best support the complementary goals of energy productivity and competitiveness.

Reduced tax rates:

Sweden: When the carbon-energy tax burden exceeds 0.8 per cent of product sales value, the tax rates can be reduced to the EU minimum tax rates. This applies only to coal and gas. 50-60 companies benefit from the rule.

Finland: Where the carbon-energy tax burden exceeds 3.7 per cent of value added, the tax rates are reduced to the EU minimum tax rates. 10-12 companies, mainly pulp and paper, benefit from the rule.

Denmark: While the standard CO_2-tax rate is 12 €/tCO_2, energy-intensive industries are levied 3 €/tCO_2. Further reductions, down to 0.40 €/tCO_2, can be obtained if the industries accept government energy auditors and agree to a scheme of binding energy efficiency measures.

Netherlands: For electricity and gas big users can obtain reduced rates corresponding to the EU minimum energy tax rates. A consumption above 1 mio. m^3 of gas or 10 million kWh of electricity is required. About 60 per cent of industrial energy consumption is believed to benefit from the reduced rates.

Slovenia: Certain energy-intensive industries with an annual emission of more than 10 tCO_2 are allowed a deduction corresponding to their historical emission. About 150 companies are believed to make use of this rule.

Germany: In general manufacturing industries only pay 60 per cent of the nominal tax rates. And companies that as a result of the tax increase since the introduction of the ecological tax reform in 1999 experience more than 20 per cent increase in their energy tax burden, can obtain a “Spitzenausgleich” (peak adjustment). Above the peak of 20 per cent tax increase, only 5 per cent of the tax rate applies. However, the reduction is contingent upon the fulfilment of environmental agreements with targets for energy efficiency. Energy-intensive industries furthermore benefit from coal being taxed only with the EU minimum tax rate.

UK: Energy-intensive industries can pay 20 per cent of the tax rate of the climate change levy. The reduced rate can be obtained where companies make agreements for

improved energy efficiency. These agreements are negotiated between the government and sector industry associations.

EU state aid rules restrict how member states can favour energy-intensive industries. This is because an exemption from a general tax is regarded functionally as a kind of state aid. The major principle behind is laid down in the EU Treaty which requires no distortions of the internal market of the EU. Following a decision of the European Court of Justice this view of state aid applies not only to EU taxes but also to member state taxes. The EU Treaty has very strict provisions for state aid; such aid requires approval of the European Commission. In this way the EU can control to a great extent the provisions which member states try to make for energy-intensive industries. The European Commission has issued a set of guidelines for state aid for environmental activities which are important for the tax rules applying to energy-intensive industries[66]. Exemptions are deemed acceptable if they are general and non-discriminatory, but they will not be deemed acceptable if they are selective and applying only to specific firms so as to offer them special favours.

Environmental agreements

The EU guidelines on state aid determine, that energy tax rates can be reduced, where environmental commitments or agreements on energy efficiency are concluded between energy-intensive industries and the authorities.

Such arrangements have been introduced early on in Denmark (from 1996) and in Germany (initially from 1995 and linked with the energy tax from 1999) and later UK (from 2001). Sweden, Finland and Slovenia have not made use of such mechanisms. Netherlands had a very extensive system of self-commitments (so-called "covenants") in place prior to the introduction of its carbon-energy tax scheme in 1997, but the tax rates and the agreements are not directly linked.

In Denmark certain pre-specific energy-intensive industries can be entitled to reduced CO_2 tax rates if they sign an agreement with the Danish Energy Agency. Businesses entering such environmental energy savings agreements have to set up an energy management system, including an energy audit, staff training, procurement policies favouring energy efficiency, and annual progress reports. In addition, the enterprise must commit to an energy-saving target and has to enter into an agreement with the government to be eligible for a partial reimbursement of the tax. The reduction can be revoked if the obligations are not fulfilled, ie in the case of non-compliance. Bjørner and Togeby (1999) found that companies participating in the program accomplished on average 60 per cent greater energy savings than companies subject to the tax only, confirming that this feature of Denmark's program contributes to the marked impacts on energy productivity. Another powerful aspect of Denmark's carbon-energy taxation program was the earmarking of 20 per cent of the revenue during the first five years to co-finance energy-efficiency measures and upgrade production

[66] European Commission (EC), *Community guidelines on State aid for environmental protection*, [2001], OJ C 37, 3.2.2001. New guidelines were adopted in April 2008: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2008:082:0001:0033:EN:PDF

technologies.

The environmental agreement in German industry must be considered in the context of the general energy tax rate reduction (60 per cent of nominal rates). A self-commitment of German industry was announced four years (in 1995) before the ecological tax reform started in 1999. Crucial points of the ETR were the increase in energy tax rates, the introduction of an electricity tax, and a scheme of exemptions for industry. One of the reasons behind the special tax provision was the industry self-commitment which promised that German industry would reduce CO_2 emissions by up to 20 per cent (relative to business-as-usual) by 2005.

In the UK 44 climate change agreements (CCAs) were concluded with different sectors – including ferrous industries and cement - with different sites (target units or TUs) individually signed up within the sectors. The agreements set out targets related to energy use or carbon emissions over this decade, comprising a final target in 2010 and 'milestone' interim targets for 2002, 2004, 2006, and 2008. The CCL on the TUs in all the sectors with CCAs was set for the first target period (to April 2003) at 20 per cent of the rate charged on other industrial and commercial energy use. If a sector, or the individual TUs within it, met their 'milestone' targets, the sector (or the complying TUs) would be 're-certified' (ie entitled to the reduced CCL rate for the next target period, the following two years). If the target was not met, the non-complying TUs would have to pay the full rate of the CCL on their energy use in the next target period. This provides a powerful incentive for the sectors and TUs to meet their targets.

The reduction targets were negotiated between each individual industrial sector and the government (Department for the Environment, Food and Rural Affairs) and by and large were achieved. In fact, the results of the first target period showed a very considerable over-achievement by most sectors compared to their 2002 milestone targets. Overall, the results showed that 221 PJ less energy had been consumed in the CCA sectors compared to the base years, which amounts to an absolute saving of 4.3 million tonnes of carbon (in the UK Climate Change Programme, it was envisaged that the CCAs would only save 2.5 million tonnes of carbon by 2010).

An interpretation of this result is that agreements on energy savings may be effective, but it can further be assumed that one of the important reasons for the effectiveness in reducing CO_2 emissions relates to the penalty payment for non-compliance in the form of withdrawal of the special tax provisions. It was the lack of full compliance with the German self-commitment and the absence of clear rules for penalties that caused difficulties in the European Commission with the initial extension of the scheme for the *Spitzenausgleich*.

Impact on competitiveness

In the following we explore the premises of the exemptions by returning to the sectoral company perspective; what are the costs of ETR to industries and to what extent can these costs be mitigated by revenue recycling through lowering the

employers' social security contributions (SSC)? We take advantage of the COMETR database to explore the distributional implications of ETR for the various industry sectors.

From the company perspective the increased level of carbon-energy taxation is offset by two factors: 1) the revenue recycling by reducing SSC, and 2) improved energy efficiency which leads to lower energy costs per unit of output (cf. elasticities derived in Enevoldsen et al., 2007)[67].

Table 6.3 The net costs of ETR in per cent of gross operating surplus, taking into account revenue recycling to employers as well as the share of improved energy efficiency related to the increase in carbon-energy taxes. Positive figures indicate a gain, negative a cost.

	Meat	Paper	Chem.	Pharm.	Glass	Cement	Ferrous	Non-ferrous
DK_{96-02}	-0.8	0.0	-0.1	-0.1	-0.3	1.4	-2.3	-0.9
DE_{99-02}	6.9	1.2	-1.2	1.1	0.2	-0.4	-1.6	-2.1

(Source: Andersen and Speck, 2009).

Table 6.3 provides an overview of the share of ETR net expenditures at the sectoral level as a share of the gross operating surplus[68] (GOS) for Denmark and Germany; countries for which the revenue recycling data could be disaggregated to the sectoral level.

It is evident that for most sectors ETR appears to represent a cost, even when the accelerated energy efficiency improvements which can be related to the tax increases are taken into account. However, the energy productivity improvements which can be related to the tax increases are relatively minor compared with the gross energy productivity improvements that have taken place during the last decade.

Figures6.9 and 6.10 decompose for energy-intensive sectors the net effects of ETR into the gross carbon-energy tax payments, the revenue recycling and the gains from improved energy efficiency, respectively.

From the sectoral perspective the burden for energy-intensive industries is in most cases negative. Company managers in energy-intensive industries may not have appreciated the tax. Yet, the tax-induced improvements in energy efficiency – and if they focused only on the gross burden of ETR, unadjusted for the gains – have reached up to 5 per cent of the gross operating surplus for some energy-intensive industries. However, it is more appropriate to take account of the improved energy productivity. For cement and glass sectors the costs are reduced to less than 1 per cent of the gross operating surplus after revenue recycling of employers' SSC and energy efficiency improvements, while for ferrous and non-ferrous metals it appears to have reached in some cases 2 per cent of gross operating surplus. Denmark's cement sector, on the other hand, experienced a gain of more than 1 per cent of gross operating

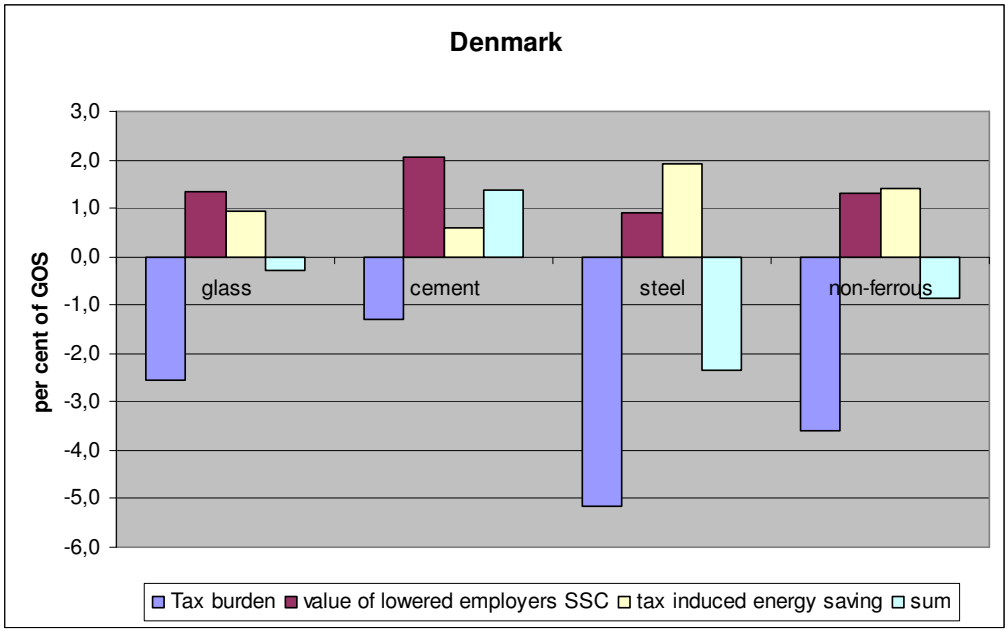
[67] Enevoldsen M.K., Ryelund A.V. and Andersen M.S., 'Decoupling of industrial energy consumption and CO2-emissions in energy-intensive industries' *Scandinavia, Energy Economics* (2007), Vol. 29 (4): 665-692.

[68] Gross operating surplus denotes the surplus of activities before consumption of fixed capital.

surplus.

The claim of the Porter hypothesis[69] is that increased carbon-energy taxation will in the longer term pressure industries to innovate both their processes and products so as to become more competitive and win market shares. Porter does not claim that energy taxation *per se* will induce sufficient energy savings to even out the increased tax burden, the implication of Porter's hypothesis is rather that companies will win on increases in market shares and *demand*.

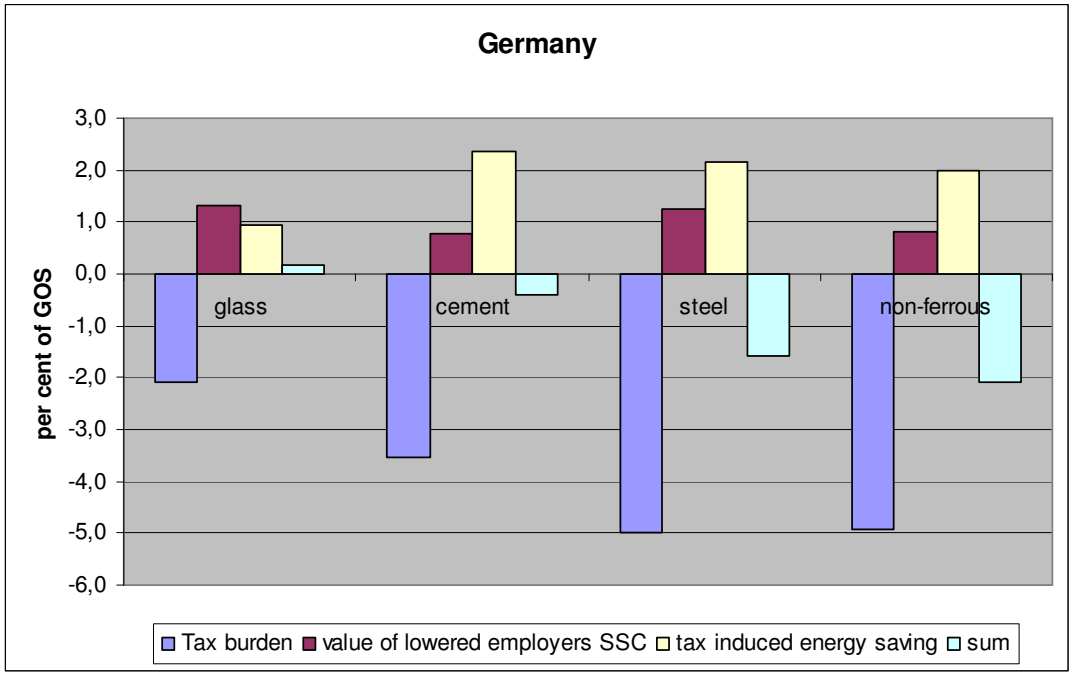
Figure 6.9 Denmark: Gross and net tax burden for energy intensive industries.



(Source: Andersen and Speck, 2009).

[69] Competitiveness, according to Harvard economist Michael Porter, depends on the capacity of a nation's industry to innovate and upgrade, and it is pressures and challenges, in particular from strong domestic rivals, that lead companies to gain advantage against the world's best competitors. Porter argued in *The Competitive Advantage of Nations* (1990) that contrary to conventional wisdom, environmental standard-setting may actually be able to encourage innovation and hence improve competitiveness (the argument is further elaborated by Porter and van der Linde (1995), see also Andersen and Ekins (2009) chapter 1).

Figure 6.10 Germany: Gross and net tax burden for energy intensive industries.



(Source: Andersen and Speck, 2009).

In the COMETR project both the E3ME modelling of the macroeconomic impacts and the panel regression analysis of the impact of energy taxes in 56 industrial sectors pointed to the existence of Porter demand effects (Andersen and Ekins, 2009). In the following we try to put the sectoral costs of ETR, cf. above, in perspective in relation to these 'Porter effects' as well as the gross energy savings attained by industries in the wake of ETR.

The gross energy savings are the costs foregone per GJ of output at the current energy prices. Bearing in mind that above only the *accelerated* energy savings that could be attributed directly to the annual tax rate increases were included, we show here the value of gross energy savings accomplished by the various sectors. The additional energy efficiency savings attained in most sectors are far higher than can be attributed statistically to the tax rate increases. As energy prices fluctuated within the traditional band over the period analysed here, changes in underlying fuel prices cannot explain the savings.

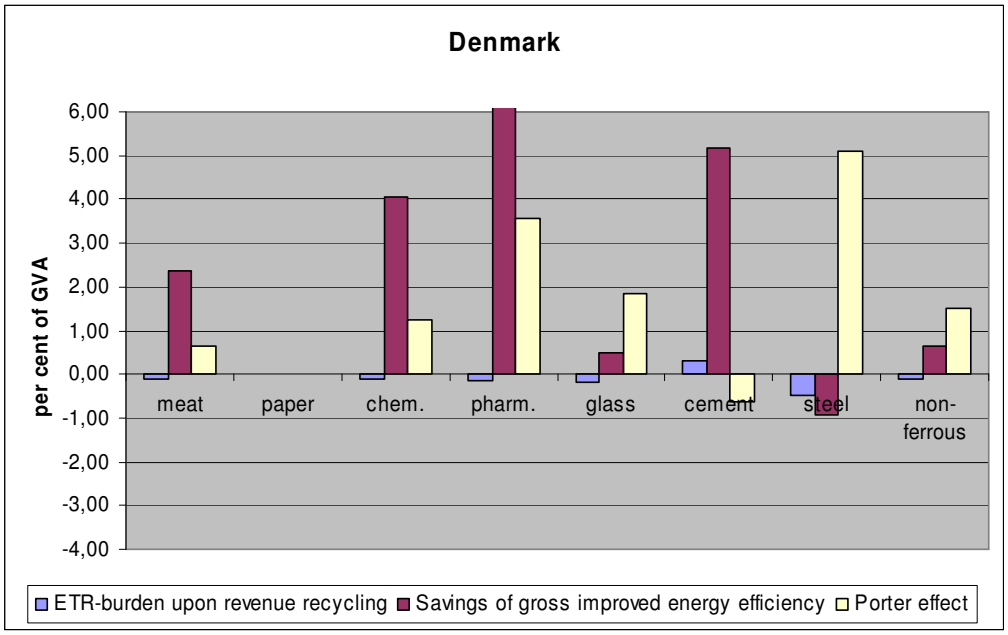
In most cases where ETR caused increased costs, these are more than offset by the gross energy savings. To some extent the gross energy savings reflect 'business-as-usual' and only those energy savings attributed to the tax rate increases should be included when accounting for the impacts of ETR, as approached above. Nevertheless the gross energy savings achieved do put the costs of ETR in an illuminating perspective.

Figures 6.11 and 6.12 provide an overview of the costs of the ETR burden relative to

the gross energy efficiency savings. It is noticeable that unlike most other sectors there has been an absence of improvements in energy productivity in the steel/ferrous industries for both Denmark and Germany. It is the same for German cement, while Danish cement shows a strong improvement.

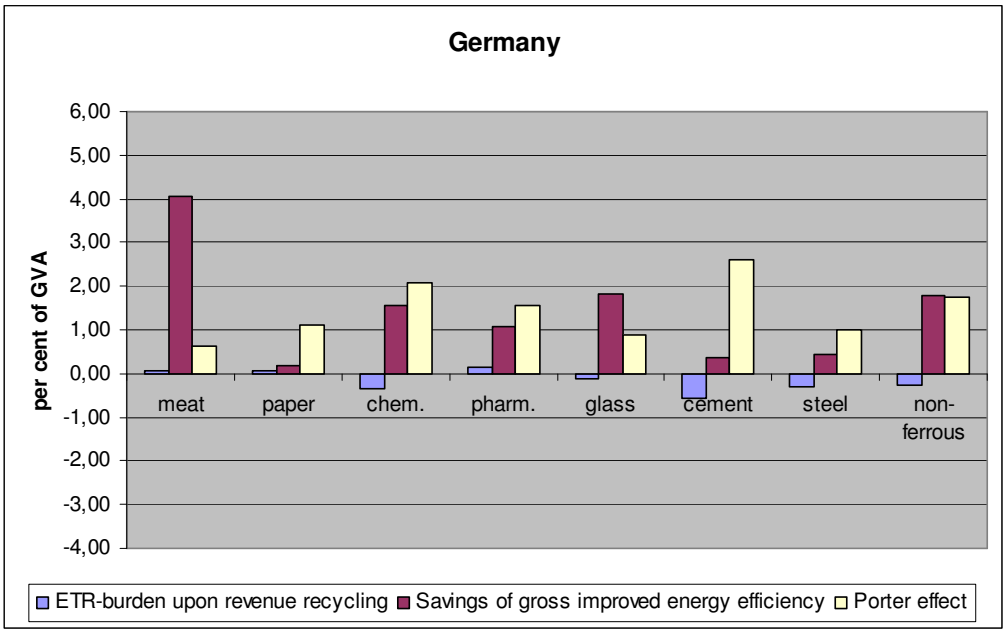
An estimate for the Porter demand effect to gross value added is provided on the basis of the relationships derived in the panel regression analysis. They indicate that the economic growth in the sectors to some extent was boosted by the tax switch. However, as a minor degree of multi-collinearity in that analysis could not be ruled out, the Porter demand effects must remain a best guess and requires further efforts with improved econometric techniques.

Figure 6.11 Denmark: ETR-burden, energy savings and Porter effects in energy-intensive industries (1996-2002)



Source: Andersen and Speck, 2009.

Figure 6.12: Germany: ETR-burden, energy savings and Porter effects in energy-intensive industries(1999-2002).



Source: Andersen and Speck, 2009.

Conclusions

The ferrous industries and the cement sector have benefitted from some of the most extensive reductions and exemptions from carbon-energy taxation. As a result the tax burden per unit of GJ and carbon has been low compared with other sectors. Although the tax rates have driven some improvements in energy productivity, it is likely that exactly for these two important sectors the accompanying policy measures, such as agreements (backed by tax payments as penalty) and recycling of revenue for technology support, may explain a great deal too. The 60% higher savings identified by Bjørner and Togeby (1999) point in this direction.

Although energy intensities in the ferrous industries declined notably, no apparent improvements have taken place in their energy productivity as such. This paradox may hinge on ferrous industries being exposed to fierce competition, preventing them from capitalising on the improved energy intensity performance. Energy productivity is a relative phenomenon, and if value added is under pressure, the decline in energy intensity simply goes hand in hand with a decline in value added. Nevertheless the physical reduction in energy consumption and carbon emissions may represent some overall welfare economic value.

For cement, which is less traded because of the unfavourable weight-to-value-ratio, the sector seems to have performed better in energy productivity, having managed to capitalise on the declines in energy intensity. In most of the countries with ETR very marked declines in energy intensities can be noticed. This trend has contributed to improving energy productivity with about 4% p.a.

The experience reviewed here is promising in terms of the prospects for lowering the energy intensity of energy-intensive industries in a relatively short time-span. Whether these improvements in turn will lead to improved competitiveness will depend on a number of factors, including the extent to which producers on the main competing markets embark on similar policies.

According to IEA (2007a) China is with its significant investments in new technology very close to and perhaps performing better in energy efficiency than USA (especially in cement), but does not reach the level of energy productivity which can be found in some parts of Europe. As indicated above existing technologies in cement and ferrous industries could deliver 2/3 of the industrial energy savings necessary to avoid a high-growth scenario for energy consumption in China. With China responsible for 42% of global pig iron production and 46% of global cement production (most of which is consumed domestically) improvements in energy efficiency in exactly these two sectors would likely also have important spin-offs for global energy price developments as well as for future global CO_2-trajectories.

The experience from Europe seems to suggest that in these highly energy-intensive industries introducing a tax switch could provide an important signal to company managers to improve energy efficiency substantially – and that momentum can be created with accompanying policy measures that address the actual technological challenges in the enterprises with advisory support, some subsidies and reduced tax rates (subject to effective penalties).

Annex table: Sector definitions in this paper, following the NACE classifications, cf. European Commission Regulation 29/2002.

Ferrous industries	Manufacture of basic iron and steel and of ferro alloys (27.1) Manufacture of tubes (27.2) Other first processing of iron and steel (27.3)
Cement	Manufacture of cement, lime and plaster (26.5)

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