International Forum On Tax and Fiscal Policies To Promote Sustainable Energy Development

November 16-17, 2005

The Great Hall of the People
Tiananmen Square
Beijing
P.R. China

Jointly Sponsored By:
Ministry of Finance
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Development Research Center of the State Council

With Assistance From:
The China Sustainable Energy Program

CONTENTS

AGENDA 1

ATTENDEE LIST 2

PRESENTER BIOGRAPHIES 3

PART I: KEYNOTE SPEECHES.. 4

1. *Optimizing Clean and Efficient Energy Technologies through Tax and Fiscal Policy* by Steven Chu, Director, Lawrence Berkeley National Laboratory; Professor of Physics, Professor of Molecular and Cellular Biology, University of California, Berkeley
2. *Fiscal Policy Recommendations for Sustainable Energy Development* by Su Ming, Vice President and Research Fellow, Research Institute for Fiscal Science, Ministry Of Finance, China
3. *Fiscal Instruments for Pollution Control: Attractions, Limitations, and Strategies* by Lawrence Goulder, Professor, Department of Economics, Stanford University

PART II: INVESTMENT IN DEMAND-SIDE ENERGY-SAVING TECHNOLOGY: A DRIVING FORCE BEHIND SUSTAINABLE ENERGY DEVELOPMNT……………………5

1. *Investment and Financing Policy Study on Sustainable Energy Development* by Zhang Hanya, Former Director, Institute of Investment Research, NDRC
2. *Integrated Resource Planning in the Context of China's Electricity Situation* by Peter Bradford, Former Commissioner, U.S. Nuclear Regulatory Commission; Former Chair, New York Public Services Commission; Senior Energy Advisor
3. *The Need to Dramatically Increase Energy Efficiency Investment in China* by Mark Levine, Director, Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory
4. *California Energy Policies That Have Catalyzed Energy Efficiency Technology* by Governor Arnold Schwarzenegger, State of California, U.S.A.

PART THREE: ENERGY PRICE REFORM: A PREREQUISITE TO SUSTAINABLE ENERGY DEVELOPMENT IN A MARKET ECONOMY……………………………………..6

1. *Energy Pricing: Policy Establishment and Systematic Reform* by Liu Shujie, Director, Institute of Economic Research, NDRC
2. *Designing Corresponding Policies for the Implementation of the Renewable Energy Law* by Wang Zhongying, Director, Center of Renewable Energy Development, Energy Research Institute, NDRC

3. *Energy-Efficiency Power Plants, (EPP) Using Fiscal and Tax Policies to Overcome DSM Barriers* by David Moskovitz, Former Chair, Maine Public Utility Commission; Director, The Regulatory Assistance Project

4. *Establishing a Public Benefits Fund To Promote Energy Efficiency and Renewable Energy* by Dai Yande, Director, Energy Research Institute, NDRC; Public Benefits Fund Research Group of the Energy Research Institute, NDRC

PART FOUR: TAX AND FISCAL POLICY: A SOURCE OF LEVERAGE IN THE PROMOTION OF SUSTAINABLE ENERGY DEVELOPMENT……………………………...7

TRANSPORTATION……………………………………………………………………..........7A

1. *Leveraging the Chinese Tax System to Promote Fuel Efficient Vehicles* by Huang Yonghe, Chief Engineer, China Automotive Technology and Research Center
2. *The Administration of Vehicle Fuel-Economy Standards: Testing, Reporting, Notification, and Labeling Systems* by Jin Yuefu, Senior Engineer, China Automotive Technology and Research Center
3. *Linking China's Fuel Excise Tax to Fuel Quality* by He Kebin, Professor, Institute of Environmental Science and Engineering, Tsinghua University
4. *International Best Practice in Fuel Tax Administration: Nexus of Problem and Solution* by Peter Gammeltoft, Environment Directorate-General, European Commission

BUILDINGS AND INDUSTRY……………………………………………………………………..7B

1. *Tax and Fiscal Policies for Energy Efficiency in Buildings* by David Goldstein, Senior Scientist, Natural Resources Defense Council
2. *Enterprise Income Tax Preferential Policy for High Efficiency Products* by Li Aixian, Senior Engineer, China National Institute of Standardization
3. *Fiscal Policies and Supervision Systems for Energy-Efficient Buildings in China* by Yu Cong, Director, Beijing Energy Efficiency Center, NDRC
4. *Tax and Fiscal Policies to Promote Industrial Energy Efficiency* by Fu Zhihua, Research Institute for Fiscal Science, Ministry of Finance

PART FIVE: ENVIRONMENTAL LEVIES: REGULATORY AND MARKET INCENTIVES FOR INVESTMENT IN ENERGY EFFICIENCY AND RENEWABLE ENERGY…………………………………………………………………………………………….8

1. *Environmental Levy Policies Promoting Clean Energy Development* by He Jiankun, Vice President, Tsinghua University
2. *Using Pollution Levies and Emissions Taxes to Promote Industrial Energy Efficiency* by Lynn Price, Lawrence Berkeley National Laboratory

3. *Emissions Levy Implementation in China* by Lu Xinyuan, Director-General, Department of Environmental Protection, Enforcement, and Inspection, State Environmental Protection Administration

4. *Energy and Environmental Tax Models From Europe and Their Link to Other Instruments for Sustainability: Policy Evaluations and Dynamics of Regional Integration* by Dörte Fouquet, Senior Partner, Kuhbier Law firm, Brussels; and Thomas Johansson, Former Energy Program Director, UN Development Program; Director, International Institute for Industrial Environmental Economics, Lund University

5. *Recommendations for China's Fuel and Energy Taxes* by Jiang Kejun, Hu Xiulian, Zhu Songli, Liu Qiang, Energy Research Institute, NDRC

6. *Reforming China's Energy Management System and Establishing a Modern Regulatory System* by Feng Fei, Director-General, The Industrial Economics Research Department, Development Research Center of the State Council

Additional Materials on CD

1. *Ending the Energy Stalemate: A Bipartisan Strategy to Meet America's Energy Challenges,* by The National Commission on Energy Policy

2. *Fiscal Instruments for Pollution Control: Attractions, Limitations, and Strategies,* by Lawrence H. Goulder, Department of Economics, Stanford University; Resources for the Future; NBER

3. *Energy and Environmental Tax Models From Europe and Their Link to Other Instruments for Sustainability: Policy Evaluations and Dynamics of Regional Integration,* by Dörte Fouquet, Senior Partner, Kuhbier Law Firm, Brussels; and Thomas Johansson, Former Energy Program Director, UN Development Program; Director, International Institute for Industrial Environmental Economics, Lund University

4. *Tax and Fiscal Policies for Promotion of Industrial Energy Efficiency: A Survey of International Experience,* by Lynn Price, Christina Galitsky, Jonathan Sinton, and Stephane de la Rue du Can, Lawrence Berkeley National Laboratory

5. *Integrated Resource Planning in the Context of China's Electricity Situation,* by Peter Bradford, Former Commissioner, U.S. Nuclear Regulatory Commission; Former Chair, New York Public Services Commission; Senior Energy Advisor

6. *Best Practices for Energy Efficiency Incentives and Their Role in Energy Policy: A Report to the China Sustainable Energy Program for Decision-makers in China,* by David Goldstein, Energy Program Director, Natural Resources Defense Council

7. *Trends in Energy Efficiency Investments in China and the US,* by Jiang Lin, Lawrence Berkeley National Laboratory

8. *Evaluation of China's Energy Strategy Options*, by Jonathan Sinton, Lawrence Berkeley National Laboratory

9. *Review of Penalties for Violations of Environmental Statutes in Selected Countries,* by Jonathan Sinton and Mark Levine, Lawrence Berkeley National Laboratory

INTERNATIONAL FORUM ON TAX AND FISCAL POLICIES TO PROMOTE SUSTAINABLE ENERGY DEVELOPMENT

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DRAFT AGENDA

WEDNESDAY, NOVEMBER 16, 2005

Moderator: William K. REILLY, Former Administrator, U.S. Environmental Protection Administration; Trustee, David and Lucile Packard Foundation; Founding Partner, Aqua International Partners, LP

9:00 am **WELCOME**

William K. REILLY, Former Administrator, U.S. Environmental Protection Administration; Trustee, David and Lucile Packard Foundation; Founding Partner, Aqua International Partners, LP
Hal HARVEY, Environment Program Director, The William and Flora Hewlett Foundation
Eric HEITZ, President, The Energy Foundation

PART ONE: KEYNOTE SPEECHES

9:15 am **EXPEDITING ENERGY SECTOR MARKET REFORMS TO PROMOTE ENERGY EFFICIENCY AND RENEWABLE ENERGY DEVELOPMENT**
ZHANG Guobao, Vice Chairman, National Development and Reform Commission (NDRC)

THE IMPORTANCE OF TAX AND FISCAL POLICIES TO PROMOTE SUSTAINABLE ENERGY DEVELOPMENT
LOU Jiwei, Vice Minister, Ministry of Finance

9:55 am **TAX AND FISCAL POLICIES FOR CLEAN ENERGY DEVELOPMENT**
XIE Fuzhan, Vice President, Development Research Center of the State Council

10:15 am **QUESTIONS AND ANSWER WITH SENIOR OFFICIALS**

10:30 am **BREAK**

10:45 am **OPTIMIZING CLEAN AND EFFICIENT ENERGY TECHNOLOGIES THROUGH TAX AND FISCAL POLICY**

Steven CHU, Nobel Laureate, Physics; Director, Lawrence Berkeley National Laboratory

11:15 am **ENHANCING INTERNATIONAL ENERGY POLICY AND TECHNOLOGY COOPERATION**

Former U.S. President George H.W. BUSH

Introduction: William K. REILLY

11:30 am **TAX & FISCAL POLICY OPTIONS FOR CLEAN ENERGY DEVELOPMENT**

SU Ming, Research Institute for Fiscal Science, Ministry Of Finance

11:55 am **FISCAL INSTRUMENTS FOR POLLUTION CONTROL: ATTRACTIONS, LIMITATIONS, AND STRATEGIES**

Lawrence GOULDER, Professor, Department of Economics, Stanford University

12:15 am **DISCUSSION**

12:25 am **PART ONE SUMMARY REMARKS**

12:30 pm **LUNCH**

PART TWO: INVESTMENT IN DEMAND-SIDE ENERGY-SAVING TECHNOLOGY: A DRIVING FORCE BEHIND SUSTAINABLE ENERGY DEVELOPMENT

Moderator: MAO Rubai, Chairman, Environmental Protection and Resources Conservation Committee, National People's Congress

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1:45 pm **INVESTMENT POLICIES TO PROMOTE SUSTAINABLE ENERGY DEVELOPMENT**

ZHANG Hanya, Former Director, Institute of Investment Research, NDRC

2:10 pm **THE IMPORTANCE OF INTEGRATED ENERGY RESOURCE PLANNING**
Peter BRADFORD, Former Commissioner, U.S. Nuclear Regulatory Commission; Former Chair, New York Public Services Commission; Senior Energy Advisor

2:35 pm **THE NEED TO DRAMATICALLY INCREASE ENERGY EFFICIENCY INVESTMENT IN CHINA**
Mark LEVINE, Director, Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory

3:00 pm **CALIFORNIA ENERGY POLICIES THAT HAVE CATALYZED ENERGY EFFICIENCY & RENEWABLE ENERGY TECHNOLOGY INVESTMENT**
Governor Arnold SCHWARZENEGGER, State of California, U.S.A.

3:15 pm **DISCUSSION**

3:35 pm **BREAK**

PART THREE: ENERGY PRICE REFORM: A PREREQUISITE TO SUSTAINABLE ENERGY DEVELOPMENT IN A MARKET ECONOMY

Moderator: MAO Rubai, Chairman, Environmental Protection and Resources Conservation Committee, National People's Congress

3:50 pm **ENERGY PRICING: POLICY CONSTRUCTION AND SYSTEMIC REFORM**
LIU Shujie, Deputy Director, Institute of Economic Research, NDRC

4:10 pm **DESIGNING POLICIES TO IMPLEMENT CHINA'S *RENEWABLE ENERGY LAW***
WANG Zhongying, Director, Center of Renewable Energy Development of the Energy Research Institute, NDRC

4:30 pm **FISCAL POLICIES TO SUPPORT ENERGY EFFICIENCY POWER PLANTS**
David MOSKOVITZ, Former Chair, Maine Public Utility Commission; Director, The Regulatory Assistance Project

4:50 pm **ESTABLISHING A PUBLIC BENEFITS FUND (PBF) TO PROMOTE ENERGY EFFICIENCY AND RENEWABLE ENERGY**
ZHANG Zhengmin, Energy Research Institute, NDRC

5:10 pm **DISCUSSION**

5:50 pm **CLOSING REMARKS**
Moderator: MAO Rubai, Chairman, Environmental Protection and Resources Conservation Committee, National People's Congress

6:00 pm **ADJOURN**

6:20 pm **DINNER**

THURSDAY, NOVEMBER 17, 2005

PART FOUR: TAX AND FISCAL POLICY: A SOURCE OF LEVERAGE IN THE PROMOTION OF SUSTAINABLE ENERGY DEVELOPMENT

Moderator: *Hal HARVEY, Environment Program Director,*

The William and Flora Hewlett Foundation

TRANSPORTATION

9:00 am **LEVERAGING THE CHINESE TAX SYSTEM TO PROMOTE CLEAN, FUEL-EFFICIENT VEHICLE DEVELOPMENT**
HUANG Yonghe, Chief Engineer, China Automotive Technology and Research Center

9:20 am **BUILDING AN ENERGY-SAVING SOCIETY AND REFINING RESEARCH ON AN ADMINISTRATIVE SYSTEM FOR AUTOMOTIVE ENERGY CONSERVATION**
JIN Yuefu, Senior Engineer, China Automotive Technology and Research

9:40 am **FUEL QUALITY STANDARDS & TAX INCENTIVES POLICIES**
HE Kebin, Professor, Institute of Environmental Science and Engineering, Tsinghua University

10:00 am **INTERNATIONAL BEST PRACTICES IN FUEL TAX ADMINISTRATION: NEXUS OF PROBLEM AND SOLUTION**
Peter GAMMELTOFT, European Commission, Directorate-General for Environment, Head of Unit C.1 "Clean Air & Transport"

10:20 am **BREAK**

BUILDINGS AND INDUSTRY

10:35 am **TAX AND FISCAL POLICIES FOR ENERGY EFFICIENCY IN BUILDINGS**
David GOLDSTEIN, Senior Scientist, Natural Resources Defense Council

10:55 am **TAX AND FISCAL POLICIES TO PROMOTE ENERGY-EFFICIENT PRODUCTS**
LI Aixian, Senior Engineer, China National Institute of Standardization

11:15 am **FISCAL POLICIES AND SUPERVISION SYSTEMS FOR ENERGY EFFICIENCY BUILDING IN CHINA**
YU Cong, Director, Beijing Energy Efficiency Center, NDRC

11:35 am **BASIC THINKING ON ECONOMIC INCENTIVE POLICIES FOR BUILDINGS ENERGY CONSERVATION**

LIANG Junqiang, Division Director, Technology Department, Ministry of Construction

11:55 am **FISCAL POLICIES FOSTERING INDUSTRIAL ENERGY EFFICIENCY**

FU Zhihua, Research Institute for Fiscal Science, Ministry of Finance

12:15 pm **PART FOUR SUMMARY REMARKS**
Moderator: Hal HARVEY, Environment Program Director, The William and Flora Hewlett Foundation

12:25 pm **LUNCH**

PART FIVE: ENVIRONMENTAL LEVIES: REGULATORY AND MARKET INCENTIVES FOR INVESTMENT IN ENERGY EFFICIENCY AND RENEWABLE ENERGY

Moderator: XIE Fuzhan, Vice President, Development Research Center of the State Council

1:45 pm **ENVIRONMENTAL LEVY POLICIES PROMOTING CLEAN ENERGY DEVELOPMENT**
HE Jiankun, Vice President, Tsinghua University

2:05 pm **INTERNATIONAL BEST PRACTICES IN ENVIRONMENTAL LEVY POLICY**
Lynn PRICE, Scientist, Lawrence Berkeley National Laboratory

2:25 pm **EMISSIONS LEVY IMPLEMENTATION IN CHINA**
LU Xinyuan, Director-General, Department of Environmental Protection, Enforcement, and Inspection, State Environmental Protection Administration

2:45 pm **TOWARD THE REALIZATION OF A FOSSIL-FREE SOCIETY BY 2020: SWEDEN'S PRACTICES FOR ENERGY SUSTAINABLE DEVELOPMENT**

Ms. Mona SAHLIN, and Minister for Sustainable Development, Sweden

Introduction: Thomas Johansson

3:05 pm **THE DESIGN FRAMEWORK AND IMPLEMENTATION STRATEGY FOR CHINA'S ENVIRONMENTAL TAXATION POLICY**
WANG Jinnan, Chinese Academy for Environmental Planning

3:25 pm **BREAK**

PART SIX: GOVERNMENT ADMINISTRATIVE REFORM: IMPLEMENTATION AND ENFORCEMENT OF SUSTAINABLE ENERGY POLICIES AS A PRECONDITION FOR EFFECTIVE INCENTIVES POLICIES

Moderator: XIE Fuzhan, Vice President, Development Research Center of the State Council

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3:40 pm **ENERGY AND CARBON TAXES FOR THE MID- AND LONG-TERM**
HU Xiulian, Professor, Energy Research Institute, NDRC

4:00 pm **REFORM OF THE GOVERNMENT ENERGY ADMINISTRATION AND REGULATORY SYSTEM**
FENG Fei, Director-General, The Industrial Economics Research Department, Development Research Center of the State Council

4:20 pm **PARTS FIVE AND SIX SUMMARY REMARKS**
XIE Fuzhan, Vice President, Development Research Center of the State Council

4:30 pm **DISCUSSION**

Moderator: Douglas OGDEN, Director, China Sustainable Energy Program

Executive Vice President, The Energy Foundation

PART SEVEN: CONCLUSION

5:10 pm **CONCLUDING SPEECHES**
MAO Rubai, Chairman, Environmental Protection and Resources Conservation Committee, National People's Congress

5:20 pm **ADJOURN**

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Presenter Biographies

George H.W. BUSH

George H.W. Bush, has had an illustrious career of public service. After serving in the U.S. Navy as a pilot during World War II, and receiving his degree from Yale University, George Bush served two terms as a Representative to Congress from Texas, was appointed Ambassador to the United Nations, Chairman of the Republican National Committee, Chief of the U.S. Liaison Office to the People's Republic of China, and Director of The Central Intelligence Agency. As Vice President of the United States under Ronald Regan, Mr. Bush was primarily focused on federal deregulation and anti-drug programs. In 1988, Mr. Bush was elected the 41st President of the United States. His Administration was marked by a number of successes in foreign policy: handling the break-up of the Soviet Union, helping to overthrow the corrupt regime of General Manuel Noriega in Panama, and initiating Desert Storm to reverse the invasion of Kuwait by Iraqi president Saddam Hussein. President Bush presided over the 1992 Earth Summit in Rio de Janeiro, where the U.S. was the first nation to ratify the goals of the United Nations Framework Convention on Climate Change, committing the U.S. to reduce greenhouse gas emissions to 1990 levels by 2000.

Steven CHU

Steven Chu is director of the Lawrence Berkeley National Laboratory, and a professor of Physics and Cellular and Molecular Biology at the University of California, Berkeley. Previously, he held positions at Stanford University and AT&T Bell Laboratories. Dr. Chu's research in atomic physics, quantum electronics, and polymer and biophysics include tests of fundamental theories in physics, the development of methods to laser cool and trap atoms, atom interferometry, and the manipulation and study of polymers and biological systems at the single molecule level.

While at Stanford, he helped start Bio-X, a multi-disciplinary initiative that brings together the physical and biological sciences with engineering and medicine. Dr. Chu has received numerous awards, including co-winner of the Nobel Prize in Physics (1997). He is a member of the National Academy of Sciences, the American Philosophical Society, the American Academy of Arts and Sciences, the Academia Sinica, and is a foreign member of the Chinese Academy of Sciences and the Korean Academy of Science and Engineering.

Dr. Chu also serves on the Boards of The William and Flora Hewlett Foundation, the University of Rochester, NVIDIA, and the (planned) Okinawa Institute of Science and Technology. He has served on numerous advisory committees, including the Executive Committee of the National Academy of Sciences Board on Physics and Astronomy, the National Institutes of Health Advisory Committee to the Director, and the National Nuclear Security Administration Advisory Committee to the Director. Dr. Chu received Bachelor of Science degrees in mathematics and physics from the University of Rochester, a Ph.D. in physics from the University of California, Berkeley, and a number of honorary degrees.

Peter BRADFORD

Peter Bradford is one of the United States's most experienced public utility regulators. He is a Former Commissioner of the U.S. Nuclear Regulatory Commission, and was Chairman of the New York State Public Service Commission from June 1987 to January 1995 and Maine Public

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Mr. Bradford currently teaches and consults on utility regulation and energy policy in the U.S. and abroad. His most recent work includes teaching energy policy at Yale University's Graduate School and Vermont Law School; consulting with the California Public Utilities Commission and The Regulatory Assistance Project; assisting with regulatory reform and national energy strategy formulation in China; and advising China's State Energy Regulatory Commission. He is a member of the China Sustainable Energy Program's Senior Policy Advisory Council and Vice-Chairman of The Union of Concerned Scientists, a leading U.S. NGO seeking practical solutions to environmental problems based on rigorous science and innovative policy. Mr. Bradford is a graduate of Yale University and Yale University Law School and author of *Fragile Structures: A Story of Oil Refineries, National Security and the Coast of Maine*.

DAI Yande

Dai Yande is the Deputy Director General of the National Development and Reform Commission's (NDRC) Energy Research Institute. He also serves as Director of the Project Management Office (PMO) of the World Bank/Global Environment Facility China Energy Conservation Project, Chairman of the Board of Directors of the China Chemical Industry Energy Conservation Technology Association, Vice-chairman of the Board of Directors of the Beijing Energy Society, and a standing member of the China Energy Research Society.

Professor Dai has researched many areas in the energy field, including energy economy, energy development strategies, energy system planning, energy system efficiency analysis, and energy management information systems. In recent years, he has served as an organizer and team leader for the *Study of Policies to Mitigate Greenhouse Gas Emissions in China*; the *China Energy Conservation Strategy Study for the 21st Century*; the *Study on China's Energy Conservation Mechanisms Transition*; the energy development strategy for the *10th Five-Year Plan*; *China's Sustainable Energy Scenarios in 2020*; and the *Study on Power System Reform and Demand-Side Management (DSM) Policy*. Professor Dai graduated from the Oil Refining Department of East China Petroleum University in 1982.

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Feng Fei is Director of the Industrial Economics Research Department and Research Fellow at the State Council's Development Research Center (DRC). After completing doctoral and post-doctoral work at Tsinghua University, Dr. Feng joined DRC in 1993. His research there focuses on industrial development policies, particularly those governing the restructuring and regulation of industrial-sector monopolies. He has participated in numerous research projects at DRC, including *Strategic Restructuring of China's Economic Structure*, *WTO's Impact on the Auto Industry*, *Reforming and Restructuring Monopolies in the Industrial Sector*, *Strategies for the Sustainable Development of China's Power Industry*, and *Reforming Power Industry Regulation in China*. Dr. Feng is also a senior consultant to several government departments and private firms. In addition to his studies at Tsinghua University, he studied public policy at Carleton University and the University of Toronto in Canada in 1994.

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Since 1998, Peter Gammeltoft has served as Head of the Clean Air and Transport Unit at the Environment Directorate-General of the European Commission, an agency whose main role is to develop new environmental legislation and ensure its implementation by Member States. His current responsibilities include developing air quality and source-related legislation—including policies regulating large combustion power plants, engines, and fuel quality—and managing the Clean Air for Europe (CAFÉ) Programme. He is also involved in environmental noise legislation, transport policy, and vehicle CO_2-emissions control. Mr. Gammeltoft previously served as Head of the Water Unit at the Environment Directorate-General of the European Commission and has worked at the Danish Environmental Protection Agency, Copenhagen Gas Works, and Roskilde University in Denmark.

David GOLDSTEIN

David Goldstein is currently Co-director of the National Resource Defense Council's Energy Program. Dr. Goldstein has worked on energy efficiency and energy policy since the early 1970s: over the past 30 years he has helped develop building and appliance energy efficiency standards currently in effect in both the United States and Russia; negotiated the agreement leading to the passage of the *National Appliance Energy Conservation Act of 1987*; designed and directed numerous energy-efficiency programs; initiated and directed research on how urban structure affects the usage of automobiles, originating the *Location Efficient Mortgage* to implement the results; and served as Founding Director of both the Consortium for Energy Efficiency and the New Buildings Institute. Dr. Goldstein received a Ph.D. in Physics from the University of California at Berkeley and is a Fellow of the American Physical Society.

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Lawrence Goulder is the Shuzo Nishihara Professor in Environmental and Resource Economics at Stanford University. He is also a Senior Fellow at Stanford's Institute for International Studies and its Institute for Economic Policy Research; a Research Associate at the National Bureau of Economic Research; and a University Fellow of Resources for the Future, a non-profit environmental and natural resource research firm located in Washington, D.C.

Dr. Goulder's research examines the environmental and economic impacts of U.S. and international environmental policies, focusing on policies to reduce greenhouse gas emissions, methods for reducing air pollution, and "green tax reform" -- substituting taxes on pollution for existing taxes on labor and capital. In other work he has examined connections between environmental policies and technological innovations, often employing a general equilibrium analytical framework that integrates the economy and the environment and links the activities of government, industry, and households. Dr. Goulder graduated from Harvard University with Bachelor of Arts in philosophy, and received his Ph.D. in Economics from Stanford University.

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Professor He's research interests include energy systems analysis, energy modeling, strategic responses to climate change, resource management, and sustainable development. He has been engaged in energy planning and energy system modeling since the early 1980s and has served as Principal Researcher for a number of key national and international research projects in the energy field. Professor He has a Bachelor of Engineering and Master of Engineering from Tsinghua University.

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Mr. Moskovitz has authored many publications on regulation, energy policy, industry restructuring, and sustainable power sector reform, and he frequently speaks at national seminars and provides expert testimony on these topics. He received his Bachelor of Science in Engineering from Purdue University and his Doctorate of Jurisprudence from Loyola University.

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Lynn Price is a Scientist at and Deputy Group Leader of the International Energy Studies Group in the Energy Analysis Department of Lawrence Berkeley National Laboratory's Environmental Energy Technologies Division. Ms. Price has authored a number of Intergovernmental Panel on Climate Change (IPCC) reports and is a lead author for the IPCC's Fourth Assessment

Report. She has worked on industrial energy efficiency projects for the State of California, U.S. Department of Energy, U.S. Environmental Protection Agency, United Nations, World Bank, and the Energy Foundation. Her current research areas include energy efficiency and the mitigation of greenhouse gas emissions in the industrial sector, international benchmarking of industrial energy use, and the effectiveness of voluntary agreements and other policy mechanisms in promoting energy efficiency in the industrial sector.

William K. REILLY

William K. Reilly was the seventh U.S. Environmental Protection Agency (EPA) Administrator, serving from 1989 to 1993 under President George H.W. Bush and heading the U.S. delegation to the landmark United Nations Earth Summit in Rio de Janeiro in 1992. Mr. Reilly's work prior to his term as EPA Administrator was equally distinguished: he was President of both the World Wildlife Fund and The Conservation Foundation, Executive Director of the Rockefeller Task Force on Land Use and Urban Growth, a member of the President's Council on Environmental Quality under President Richard Nixon, and Chairman of the Natural Resources Council of America, an association of all major conservation groups. Mr. Reilly was also the Payne Visiting Professor at Stanford University in 1993-1994. Currently, Mr. Reilly is Founding Partner of Aqua International Partners, an investment fund in the water sector in developing countries, and Chairman of the World Wildlife Fund Board of Directors. He also serves on the board of directors of The David and Lucile Packard Foundation, the National Geographic Society, ConocoPhillips, DuPont, Ionics, and Royal Caribbean International.

Arnold SCHWARZENEGGER

Arnold Schwarzenegger was sworn in as the 38th Governor of California on November 17, 2003. Governor Schwarzenegger's firm belief that economic prosperity and environmental health go hand in hand was evident during his first year in office. He created California's Hydrogen Highway by Executive Order to support the transition to a clean hydrogen transportation economy; his Oceans Action Plan will set a national standard for the management of ocean and coastal resources; and the Governor also signed historic legislation creating the 25-million acre Sierra Nevada Conservancy, California's largest.

Governor Schwarzenegger's top priorities include fulfilling his mandate from Californians to bring jobs back to the state and restore its prosperity. Upon taking office, he averted bankruptcy with measures that refinanced old debt and required the state to live within its means without raising taxes, and in 2004, he signed legislation to prevent "shakedown" lawsuits that were driving jobs and businesses out of California and blocking its path to recovery. Throughout his career, he has had a strong commitment to children. Before becoming governor, Schwarzenegger founded the Inner City Games Foundation and pushed for more funding for after school programs. He championed the After School Education and Safety Act of 2002 (Proposition 49), and as governor his settlement of the landmark Williams vs. California lawsuit contained reforms that ensure qualified teachers for every student and clean and safe school facilities with up-to-date textbooks. He has increased per pupil spending and education funding and worked hard to give local schools the power to meet the specific needs of their own communities.

SU Ming

Su Ming is Vice President and a Senior Research Fellow of the Ministry of Finance's Research Institute for Fiscal Science (RIFS). He is also a Professor at the RIFS's Graduate School, where he earned his Masters and Ph.D.; Executive Director of the Public Finance Academy; and Director of the Standing Committee of the China Rural Finance Seminar. In 1997, he received the *Government Special Award* from China's State Council, and became an academic advisor to the *Thousands of Talents Spanning Two Centuries* Program.

Dr. Su has led or participated in several international research projects, including the World Bank's "China: Anti-inflation and Macro Policies," "China's Local Taxation Reform: Objectives and Policies," and the Canadian International Development Program's "Intergovernmental Relationships during the Transition Period in China." He has also published *Policy Research on Fiscal Expenditures*, *Theories on Public Finance and Fiscal Policies*, *Fiscal Balance at Local Levels*, *Agricultural Development,* and *Financial and Economic Policies*.

WANG Zhongying

Wang Zhongying is Director of and an Associate Researcher at the Center for Renewable Energy Development, a research institute affiliated with the National Development and Reform Commission's Energy Research Institute. Prior to 1995, Dr. Wang studied conventional energy policy, energy supply and demand analysis, and energy supply modeling. His most recent research focuses on renewable-energy policy development and technology commercialization. Dr. Wang received his Ph.D. from Tsinghua University's Institute of Energy System Analysis and Technical Economy in 1989.

YU Cong

Yu Cong is Director of both the Energy Efficiency Center of the National Development and Reform Commission's Energy Research Institute (ERI) and the Beijing Energy Efficiency Center (BECon). Her research focuses on the economic effects of energy policy. In recent years, she has helped formulate China's *Energy Development Strategy to 2020* and *Medium- and Long-Term Energy Conservation Plan*. She has also helped develop *Sustainable Energy Scenarios for China* with support from the Energy Foundation and Shell Foundation. Dr. Yu has been involved in international projects on green lighting, sustainable energy strategy development, and end-use energy efficiency supported by the United Nations Development Programme, Global Environment Facility, Asian Development Bank, World Bank, and other international development organizations.

ZHANG Hanya

Zhang Hanya is a research fellow and former Director of the National Development and Reform Commission's Institute of Investment Research. He is also Dean of the Chinese Academy of Social Sciences (CASS) Investment Department, Vice Chairman of the Investment Association of China, Deputy Secretary General of the Society of Investment Study of China, Editor-General of *China Investment Magazine*; and a Standing Member of the International Project Management Association China Committee.

Dr. Zhang's research focuses on annual reviews and forecasts of the economic and investment environment in China, investment and financial system reforms in China, investment and financial policies for basic industries, and regional development planning. He also consults on economic affairs for municipal and regional governments. Dr. Zhang has widely published and has been awarded many national academic awards, including a rarely-bestowed special allowance for academic achievements awarded by the State Council. Dr. Zhang received his Ph.D. from the CASS Graduate School in 1981.

Optimizing Clean and Efficient Energy Technologies through Tax and Fiscal Policy

Steven Chu
Director, Lawrence Berkeley National Laboratory
Professor of Physics, Professor of Molecular and Cellular Biology,
University of California, Berkeley, California, USA

[Slide 1]

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Thank you for giving me an opportunity to speak about something I care deeply about: the energy problem. As a scientist who remained focused on research and education for most my life, you may wonder, "Why is he talking about some outside of his technical expertise? What does this person know about tax and fiscal policy? Has he caught the 'Nobel Disease' and is now talking about all sorts of things that he shouldn't talk about."[1]

I confess that I know very little about tax and fiscal policy. Actually I was assigned the title by the Doug Ogden of the Energy Foundation. I accepted the assignment without protest because I wanted to learn something about fiscal policy.

I have always liked to learn new things and in my science, I moved from one area of science to another every 5-10 years, making contributions here and there. I never became an "authority" of any field, except when I was in at the beginning and there was not much literature to read. On occasion, I have been asked to write a monograph on some of my forays into these areas. My excuse was that "I don't have the time": if I ever wrote a book, I would have to spend a lot of time to become familiar with all the work in the field. Thus, most of what I will say is new to me, but well known to all those who know it well.

With this apology about my talk, let me begin.

My intent is to convince America, China, and the rest of the world that we have to work as hard as possible to solve the energy problem. A few weeks ago, I was part of a briefing to a Senate meeting in Washington on a National Academy of Sciences report led by the Norm Augustine, the former CEO and Chair of Lockheed-Martin. What was unusual about this study is that a third of the 20 person committee was made up of present and former heads of major American technology companies like Intel, DuPont, Merck, and Exxon-Mobil. The remainder of the committee was presidents or past presidents of research universities, former presidential appointees, and scientists.

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[1] I am particularly sensitive to this last suspicion. I told a press interviewer on the night my Nobel Prize was announced (at 2 am in the morning, California time), I would **not** use the Nobel Prize as a platform to talk about things I know nothing about. So much about my noble intentions.

The task we were given by the United States Senate was how the United States is to prosper in the 21st century. Our core message was that we had to re-vitalize US intellectual capital in science and technology, and use this asset to maximize our ability to take laboratory discoveries into commercial innovation. Most of the report focused on how to strengthen our fundamental intellectual foundations such as the education of native citizens, the need to make the US a more welcoming country for highly talented immigrants, funding of basic research, and to create incentives for innovation.

We also talked about one specific issue - Energy. Although I was addressing American policy makers, my same words apply to leaders in China. Here is what I said:

"[I want stress] the need to develop clean, safe, secure, and sustainable energy. There are 3 reasons. 1) Our energy security is directly linked to our national security. 2) Our economic competitiveness is intimately tied to how much energy costs, and how efficiently we used it. 3) There are serious environmental concerns associated with energy usage from local pollution to global climate change. Because of these concerns, I personally believe that the energy problem is ***the single most important problem that has to be solved by science and technology in the coming decades***."

In my talk today, I will define the energy problem that faces China and the world. This is a problem which has no known solution. However, as a scientist, I am basically optimistic that we **can** find a solution to this problem and will prevail. In order to solve this problem, new science and technology has to be developed. Also, we have to take make our use of energy as efficient and environmentally friendly as possible. The challenge for this audience is to establish policies that will promote the most intelligent and efficient use of energy and to create new, non-polluting sources.

[Side 2]

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What polices should you establish? Free-market economists believe that the most efficient economic systems are incentive based, and the best incentive is personal gain. On average (but with notable exceptions), people work hardest if their labor will most directly benefit themselves, their families and friends. Free-market economists also believe this economic system is more nimble than planned economies, more conducive to innovation, and is the only way to correctly value the cost of goods and services.

[Side 3]

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However, there are down sides to free market economies that have been recognized for over a century.

- Free markets do not always account for the cost of so-called "externalities", costs not included in the market cost of a good or service. Pollution is an externality. To a city lying up stream on a river, it makes no sense for that city to invest in a water treatment plant. However, the pollution is very costly to the people who live down-stream from the polluter.

- Investments whose benefits are widely shared "public goods" will not likely be made by one sector of the economy. The best example of a public good is in national defense, and the best method of this public good is to fund it from a general tax.
- "Survival of the fittest" does not always mean "survival of the best". Some individuals or companies use unethical or predatory business practices such as bribery, price fixing, and tactics to eliminate a newer, better but smaller competitor. Regulations are needed to control selfish behavior that will be damaging to the economy as a whole. Both free market and planned economies work best if there is a strong ethical infrastructure in place. The prevalence of corrupt business practices is an extremely expensive "externality".
- Free markets do not respond well to long term problems or international/global issues. Over fishing in international waters and international pollution are two examples.

[Side 4]

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What are the external costs of energy and energy dependence? I will talk about two major externalities: the cost of energy dependence and the environmental costs.

[Slide 5]

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The United States was endowed with great oil resources and was the first country to significantly exploit these resources. For decades, we were the major oil producer in the world, and remain the third largest oil producer, behind Saudi Arabia and Russia. In 1970, the United States became a net oil importer, and in 2005, the majority of our oil is imported.

China is following the US lead. In 1995, you went from an oil exporting to oil importing country. In 15 – 20 years, the majority of your oil will be imported, with profound implications to your balance of trade and need to secure foreign access to oil. National defense is part of the external costs of energy dependence.

[Slide 6]

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The temporary cost of oil is sensitive to big fluctuations as can be seen on this slide.

[Slide 7]

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The huge spike in the cost of oil was due to the Yom Kippur War and subsequent Arab oil embargo, the overthrow of the Shah of Iran, and the Iran/Iraq war. These events affected the **supply side** of oil.

[Slide 8]

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While the price of oil in particular and of energy in general may fluctuate, the long-term trend is predictable. The reason is that we are now entering an era where the **demand side** and the global capacity to produce oil are now major factors. Unless there is a major global recession, the world consumption of energy will triple between 1970 and 2020.

[Slide 9]

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Estimates of global oil production based on projected increases in consumption and estimates of the total known and undiscovered oil researches suggest that peak oil production will likely occur somewhere between 10 – 50 years from now. As we reach this peak, the resource will become scare and the cost will sky-rocket.

[Slide 10]

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Now let me turn to the environmental costs of energy.

[Slide 11]

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Ozone, carbon monoxide, sulfur dioxide, nitrous oxides and particulate matter are having severe effects on

- The health and quality of human life,
- The premature aging of buildings, bridges and other infrastructure,
- Damage to agriculture, forests, lakes and wildlife in China.

[Slide 12]

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[Slide 13]

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Smog over cities such as Beijing and Urumchi are causing serious health problems. The New York Times reported that a recent study by a Chinese research institute found that 400,000 people die prematurely every year in China from diseases linked to air pollution.

[Slide 14]

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Clearly, regulation to control irresponsible pollution of industries is needed. This cement factory has not factored in the external costs to pollution in their economic model.

In additional to local and national pollution problems, there is an international pollution problem: carbon emissions and global climate change.

[Slide 15]

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This slide shows the average global temperature since 1860. Note that 19 of the 20 warmest years since 1860 have all occurred since 1980. Other evidence points to the last few years as some of the hottest in the last 1,000 years.

[Slide 16]

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What is the evidence that human has caused global warming? I show here the concentration of the greenhouse gases carbon dioxide, methane and nitrous oxide over the last 1000 years. The sudden rise of these gases coincides with the beginning of the industrial revolution in ~ 1750.

The baseball player and great American philosopher of the 20th century, Yogi Berra, said “Predictions are hard to make, especially about the future”. One way to trust our predictions is to see if we can predict the past.

[Slide 17]

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If we use our best climate models to predict the global change of temperature based on natural causes such as solar variations, volcanoes that change the amount of particulate matter in the air, we are unable to fit our climate simulations, shown by the grey curve, to the temperature history, shown in red. However, when we add the human generated greenhouse gases, the model simulation can fit the observations fairly well. Although there is much work that has to be done to make climate simulations more robust and trustworthy, these results strongly suggest that the climate changes we are recording are caused by humans.

[Side 18]

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Suppose we can control carbon emissions at the level targeted by the emission limits of the Kyoto Protocol. This would amount to a doubling of CO_2 in the atmosphere from a concentration of 275 parts per million to 550 ppm. Currently we are at 380 ppm. Note that most of the global warming will occur over land. The model shown here predicts that temperature in China will increase in a range of 2.5 to 5 degrees Celsius. If CO_2 rises to 4 times the pre-industrial levels, the land masses of the world could rise by 10° C. I should also note that these are predictions of yearly average changes. The models also predict that the summers will be hotter and the winters colder.

By comparison, when the average temperature dropped by only 6 ° C, the world was an ice age and half of the United States was covered with a continental glacier. We do not know what the world was like when it was 10 ° C hotter, or if it ever was that hot.

[Slide 19]

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Soil moisture and temperature are important factors in agriculture. Even at 2 times the CO_2, the great agricultural resources in the United States would be at risk. I suspect this would also be true of China, but I was unable to find predictions of soil moisture predictions of China in my Goggle search.

[Slide 20]

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The most frightening aspect of the predictions is that long-term consequences of increased CO_2 in the atmosphere. Even if we are able to greatly reduce the CO_2 emission in the next 50 years, the CO_2 levels will stabilize at a high level for hundreds of years and the average global average temperature will continue to rise.

[Silde 21]

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[side 22]

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I now turn to options that policy makers have at their disposal to reverse the current trends in our creation and use of energy. We must adopt a dual strategy that would

1) Maximize energy efficiency and minimize energy use while insuring economic prosperity.

2) Provide incentives to develop new sources of clean energy. New clean sources will mitigate total economic costs, including externalities.

[slide 23]

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The problem is that energy use is linked to economic prosperity. Developed, wealthy countries use far more energy than undeveloped, poor countries. Bangladesh is highly energy efficient, where efficiency is defined as the amount of energy used per capita. However, it also has the one of the lowest gross domestic products (GDP) of any country, and no country wants emulate Bangladesh's economy. On the other hand, the United States has the highest GDP and highest energy use per capita. Developing countries want to secure the greatest economic benefits for its citizens. Should their goal be to emulate the US and become a huge consumer of energy?

I don't think so. Remember that the cost of oil and gas will continue to rise because of the stresses on both demand and supply sides of the equation. (Coal, shale oil, tar sands, and other fossil fuels are another story, and I will return to them later in this talk.) Because of this inevitable increase in cost, the GDP will be tied to a new figure of merit: *the level of GDP per energy consumed*. In this respect, Europe, which uses two times less energy per GDP produced, and Japan, which uses 5 times less energy per unit of wealth created, are in a much better economic position to deal with higher energy costs. Why is Europe and Japan more energy efficient than the US? The reason is simple: the US was blessed with enormous oil and gas resources. We grew a robust economy with little attention paid to energy costs because energy was cheap for us. Relative to the US, Europe and Japan were energy poor and were forced to grow their economies more efficiently. As the oil and gas within US borders become depleted, we will have to adapt quickly if we are to remain competitive in the global economy. China's projected energy needs are much greater than their natural resources, and you should not follow our lead.

[Slide 24]

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As an example of that factors that you have to consider, I show the externalities associated with transportation growth in China. Between 1990 and 2000, the number of cars has grown by ~ 650%. This has put an enormous strain on oil consumption, air pollution, and traffic congestion.

[Slide 25]

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Here is a picture of afternoon rush hour traffic on Beijing's Second Ring Road just in case you forgot how hard it was to attend this workshop. □ China's pollution levels could quadruple within the next 15 years, if the growth in energy consumption and automobile use is not controlled.

There are benefits to a mobile population. Also, for better or worse, America is still held as a model economy. How can the increase of automobile be controlled so that the global benefit to China be maximized?

[Slide 26]

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There is clearly a correlation between gasoline tax and gasoline consumption. The US consumes approximately twice as much gasoline per capitia as the UK, France and Japan.

[Slide 27]

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Is it because people more in the US? They do drive slightly more. However, the biggest difference is that the average fuel efficiency 1.7 better in Europe and 1.9 time better in Japan. In terms of automobiles, **size does matter,** and smaller cars are more fuel efficient.

[Slide 28]

Traffic congestion in cities can not be solved by more roads alone. Note the relative congestion of light rail, buses and cars. Mass transit has to play a significant role in all large Chinese cities to mitigate congestion, pollution and energy consumption.

[Slide 29]

Mass transit requires a mixture of fast, underground subways (very costly) that connect over large distances integrated with either light rail (intermediate cost) or bus rapid transit (least costly). For surface transport, **rapid** is the key word. Dedicated bus lanes and the ability to alter traffic lights for bus rapid transit or light rail would be desirable. In order for a combined subway, light rail or and bus rapid transit system to succeed, the distance between stops can not be too great. Clean, fast and pleasant mass transit transportation is required in order to lure middle class people who can afford to drive.

[Slide 30]

Regulation has stimulated technology. As an example, refrigerator efficiency standards improved performance. The *expectation* of efficiency standards also stimulated industry innovation. This is also true of automobile, building, and other efficiencies.
[Slide 31]

I now turn to establishing proper incentives, dis-incentives and regulations that will produce the best sense, economically and environmentally. Proper encouragements ("carrots") and discouragements ("sticks") should also be designed to stimulate long term investments in research and development of new, potentially transforming technologies.

[Slide 32]

I live in California and the utility company that sells electricity urges their customers to conserve electricity. How did this happen? Profit to utility companies was decoupled from the amount of energy sold. Initially, US electric utility industry were a regulated monopolies where rate-of-return on investments was set by regulatory agencies. As a result, utility companies promoted the use of energy to maximize profits.

Environmental regulations and disallowances of investments by state regulators of nuclear power generation created financial stresses in utility companies, and the electrical companies were in financial trouble. California now has what is called "Least-cost Planning". Promoting energy conservation decreases the need to build more power generating plants. Also, a fair return of investment is guaranteed.

[Slide 33]

The system is not perfect, in my opinion.

- Changes in the cost of fuel are passed through to the consumer. This policy compromises incentives to the utilities companies to be more energy efficient.
- There are no incentives for utility companies to invest in long term research.
- The electricity generation and distribution industry is becoming in danger of becoming more de-integrated. Micro-economics forces can arise where the incentive to maximize profits might encourage companies to stimulate higher energy usage by selling energy intensive "services".

[Slide 34]

The carbon emission forecast is frightening. Between 2003-2030, 1.4 TW of new coal plants and 1.9 TW of new natural gas plants will be constructed. Carbon emission in the next 30 years is projected to add 3 times more CO_2 emission than the previous 250 years, and the full costs of Global climate change will be staggering. Other fossil fuel such as tar sands, shale oil, methane hydrates will be almost as bad as coal with respect to greenhouse gas emissions.

[Slide 35]

Limiting CO_2 is the biggest problem for all developed countries. Here are my opinions.

- A carbon tax or carbon cap is needed.
- Clear signals should be given that a tax or cap ***will occur*** so that companies can plan.
- Private (industrial) and public investments in renewable sources must be encouraged.
- Progressive changes in the carbon tax/cap should be initiated to stimulate research and development of alternative solutions.

[Slide 36]

Carbon Sequestration needs more research. Long term storage and environmental safety are yet to be proven. Cost is also an issue! Using present technology, sequestration costs are $100 - 300/ton of avoided carbon emissions. The US Department of Energy has a target to reduce the cost of carbon sequestration to $10 or less per net ton of avoided emissions by 2015.

[Slide 37]

So far the best candidate for long term CO_2 storage are sedimentary basins such as depleted oil gas and oil fields or basins with trapped salt water. On this slide, potential storage sites are shown in the dark and mid-grey areas. The generation of CO_2 emissions are shown with circles; the larger circle the more the generation of CO_2. For economic reasons, advanced coal power plants that convert coal to hydrogen, a cleanly burning gas, and the sequestration of the CO_2. As we build more coal plants, where these plants are built relative to storage locations will be critical is sequestration is to be economical.

[Slide 38]

There are other possible options of carbon neutral sources of energy. Nuclear fusion and nuclear fission are the first that come to mind. Currently, fusion still has a 40 - 50 year horizon before possible commercialization. Fusion has waste and proliferations issues, but I personally think it should contribute a greater fraction of our energy plans. There is a new wave of research into 3rd and 4th generation nuclear power plants with re-cycling that have the potential for 10-30 times the reduction of waste as compared to non-recycled generation. Just as important, there is the possibility of reducing radioactive lifetimes of that waste by 2- 3 orders of magnitude with fast neutron conversion.

[Slide 39]

Electrical generation using wind is a success story. The cost of wind generation at a good site is becoming comparable to the cost of generating electricity with gas.

[Slide 40]

Unfortunately, we can not store electricity on a large scale so if wind or photovoltaic generation is ever to become a large contributor, we have to learn to store electrical energy in a cost-effective way. This will most likely entail converting it into chemical energy.

[Slide 41]

Nature has found a way to convert sunlight, CO2, water and nutrients into chemical energy more than three billion years ago.

[Slide 42]

Can we improve upon the photosynthetic processes that we find in nature to raise energy, analogous to the way we modified plants to raise food? I am particularly excited about the prospect of using molecular biology to create self-fertilizing, drought and pest resistant plants that convert sunlight, CO_2, water and minimal other nutrients into rapidly growing plants. We then can develop efficient ways to convert the primary part of those plants – cellulose, lignin etc. into chemical fuels like ethanol. I estimate that a factor of 2 to 4 improvement over existing plants and conversion efficiencies could supply half of the US transportation need for oil suing 20% of our arable land.

[Slide 43]

An emerging new field called synthetic biology offers hope. One of our scientists at Lawrence Berkeley National laboratory and a faculty member of the University of California has incorporated dozens of genes into a microbe to make it produce a newly discovered anti-malarial drug called artemisinin. He has recently received a $42 M grant form the Gates Foundation to make this commercially available at a delivery cost of $0.12 – 0.25 per course of treatment.

He is now very interested in the energy problem and after he "cures" malaria, he wants to engineer a synthetic organism to produce a chemical fuel such as ethanol or methane from cellulose or possibly directly from sunlight.

[Slide 44]

Science research has the hope of creating a transforming technologies that might save the day. Let me close by stating again how important it is to solve the energy problem. Among national and international concerns, people and governments are worried about

- National security, which in intimately tied to energy security,
- Economic prosperity, which will depend on the cost of energy and how efficiently we use it, and
- The environment, from local air pollution to disruptive global climate changes.

The need to become efficient as possible and to develop sustainable, clean, CO_2 neutral energy sources are two of society's greatest challenges.

Thank you for your attention.

Fiscal Policy Recommendations for Sustainable Energy Development

Su Ming
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I. Status quo and emerging problems

In China today, there is still no system of sound fiscal policies supporting energy development. The existing ineffective and fragmented fiscal policies fail to meet the needs of energy development, and cannot meet the requirements set forth by the national strategy for energy development in the new era.

i. The government has not attached sufficient importance to energy conservation. Public investments have been uneven and limited to such fields as R&D and production (technological innovations), leaving areas like marketing, utilization, services, recovery, information dissemination, and others lacking sufficient resources.

ii. Inadequate punitive measures for use of low energy-efficiency products and pollution resulting from energy consumption.

iii. Problems obstructing energy structural optimization in the current policy system. With respect to development of electrical power, the current design of VAT has constrained the development of hydropower generation. The particularity of hydropower development lies in the fact that investments as input cost are done all at one time. This system is inefficient and the cost should be distributed across different years of usage of the dams, and should be treated as an input discount item when calculating VAT, rather than directly basing VAT on electricity sales revenues. This has put an undue burden on water power plants and directly obstructed the development of hydropower development.

iv. Inadequate restrictive policy measures regarding disordered exploitation and low extraction rates which waste energy resources.

v. The government has not fully established a corresponding policy framework for developing new energy resources and renewable energy resources.

vi. No effective measures to counter energy safety problems, especially oil safety problems, are in place.

II. Recommendations for the next step

i. Positive incentives

(1) **Increase budgets**: Public funds are not being "equally" utilized. The following key areas should be focused on: 1. Operating expenses for energy management units; 2. Energy-saving;

3. Expenditures on new energy and renewable energy resources; 4. Earmarked fiscal transfers from the central government to local governments, specifically targeting renewable and new energy resources and energy-saving objectives; 5. Expenses incurred for the industrial energy restructuring process, for their social responsibilities, and as well as funds needed for social security settlement of the employees; 6. Public investment in energy development.

(2) **National debt investments**: Investments deriving from national debt revenues normally target basic industries. In every country, energy development and saving serve as the basis for the national economy and therefore they are earmarked for a certain proportion of national debt investments.

(3) **Financial interest subsidies and other subsidies**: By means of small amounts of financial interest subsidies and other subsidies, the government can guide more social capital to areas of interest. On one hand, the interest subsidies generally work well with projects and with the manufacturers related to the supply, transfer, stock, and transport of energy products or energy saving. On the other hand, financial subsidies can be given to both manufacturers and down-stream consumers. For a specific policy, the effects will depend on whether the subsidy is made to consumers or to manufacturers. Therefore, detailed analysis is still required.

(4) **Taxation incentives and the establishment of a tax expenditure system**: Commonly used tax incentives are: 1 VAT incentives or VAT returns (This, however, calls for prudent use and abuses need to be avoided); 2. Income tax incentives; and 3. import and export tax incentives, including import tariffs and export tax refunds.

(5) **Government procurement policy**: The focus should be on supporting renewable- and energy-saving energy products.

(6) **Financial guarantee policy**: This is to expedite the development of prioritized areas based on risk investment rationale.

ii. Negative restriction measures

Extend the scope of excise duties;
Speed up the levy of fuel taxes;
Levy energy taxes;
Reform the compensation fee charges on mineral resources;
Remove fiscal subsidies to high energy-consuming firms (or industries) that cannot meet industrial policy standards.

iii. "Cross-subsidy" policy

Fiscal policy recommendations to promote prioritized areas in national energy development strategy

i. Fiscal policies to improve energy efficiency

1. **Government budgetary investments**

(1) Establish an expenditure item on energy saving when planning budgets. Arrange the corresponding funds so that it is primarily used for the R&D of energy-efficient science, technology, demonstration, popularization of energy-efficient technologies, education and training in energy efficiency, and construction of an energy-saving management and monitoring system.

(2) Consolidate budgetary investments and national-debt investments and have an overall increase in investments in energy–saving activities

(3) Establish a special fund for energy saving.

2. Corporate income tax incentives to promote energy efficiency

(1) Corporate income tax incentives to encourage production of energy-saving products

The current corporate income tax rate should be halved for certain enterprises, most particularly for those fully engaged in the production of energy–saving products. For enterprises not fully engaged in the production of energy-saving products, their revenues deriving from the production and sales of energy-saving products should also enjoy a tax rate at 50 percent of the current level. In this case, it would be necessary for enterprises to separate their revenue accounts into energy-saving products and non-energy-saving products.

(2) Corporate income tax incentives to promote the use and consumption of energy-efficient products

It is recommended that for products and equipment purchased by enterprises to reach the energy-consumption standards set by the state, a certain percentage (e.g. 15 percent) of the purchase amount should be deductible from the taxable amount. If the taxable amount of the current year is not sufficient for the deduction, the taxable amount for the following years (a maximum of 4 successive years) can be accumulated for the deduction. For energy-saving equipment that has become fixed assets for enterprises, shortened depreciation periods or accelerated depreciation should be allowed.

(3) A catalogue for *Corporate Income Tax Incentives to Promote Energy Efficiency* should be developed.

3. Government procurement policies

The authentication of energy-efficient products should be improved, and government procurement of energy-efficient products should be accelerated. The procurement process should use a centralized model for its operation, and the development of a contract supply system for energy-efficient products should be initiated. The government should dedicate more resources to ensure that enterprises are fully aware of the procurement process and incentives behind energy-efficient products.

ii. Fiscal policy recommendations to support the development of clean energy and renewable energy resources

1. Fiscal policy recommendations to promote the development of renewable energy resources

(1) Adjust and implement preferential VAT policies on renewable energy resources

In order to more vigorously develop wind power, wind power plants should receive preferential VAT treatment, at least lower than or equivalent to that of coal electricity plants. With respect to VAT incentives for hydropower plants, we suggest that: 1. VAT rates for all hydropower plants be lowered to a level that is at least equivalent to that of coal electricity plants; 2. VAT rates for micro hydropower plants should be maintained at about 3 percent.

(2) Adjust and improve corporate income tax for firms engaged in producing and marketing renewable energy resources

With respect to consolidation of corporate income taxes, consideration must be given to the development of renewable energy resources at the national level: 1. For all firms manufacturing or selling renewable energy products, a 15 percent corporate income rate should be used; 2. Investments made in renewable energy firms can be deducted by a certain amount in calculating income taxes; 3. Accelerated depreciation should be used and expenses on R&D increased.

(3) Adjust and improve import tariffs on equipment used in the production of renewable energy resources

To encourage domestic investment in renewable energy, future purchases of renewable energy equipment by domestic firms should be subject to preferential tariffs and import VAT exemptions, just as foreign-funded ones enjoy. This ensures that domestic and foreign firms are treated equally while overall renewable energy development is promoted.

(4) Clarify the directions and focuses of financial support for the development of renewable energy resources

Increase policy support for R&D in renewable energy resources as well as improve state subsidies for renewable energy resources. A greater emphasis should also be placed on renewable energy development in rural areas of China.

(5) Integrate fiscal policies with banking credit policies to support the development of renewable energy resources.

2. Fiscal policy recommendations to accelerate nuclear power development in China

Fiscal support is a necessity in accelerating the development of nuclear power in China. In light of the current stage of development of nuclear power in China, we suggest the following fiscal measures be taken:

(1) Establish earmarked funds to support nuclear power generation to allow for sufficient resources for relevant R&D activities. R&D should focus on advanced technologies and design automation. The government should share the construction risks and "initiation expenses" of the automated projects with the nuclear power plant owners, and provide appropriate amounts of subsidies for their technological development.

(2) Exempt import taxes for imported materials, components, or equipment that cannot be domestically produced.

(3) Reduce VAT on nuclear-power plants to the same level as that of micro hydropower plants (6 percent), so as to minimize the cost of nuclear power and to allow nuclear power to compete on an even playing field.

3. Fiscal policy recommendations to accelerate washed coal development in China

(1) Support R&D in basic and common clean coal technologies, as well as clean coal technology demonstration projects such as coal gas and environmentally-friendly liquid coal. These types of projects require large investments;

(2) Incentives should cover tariffs, export VAT, and financing support, as well as low-interest-rate loans or financial interest subsidies;

(3) Encourage enterprises that rely on coal to promote technological innovations, and to include clean-coal technologies into key national innovation projects so that they can enjoy energy-saving special loans, loan supports for technological innovations, etc;

(4) Encourage the implementation of a "discriminatory" fee on SO_2 emissions: Lower charges on low-emitting firms that utilize advanced technologies, while simultaneously increasing charges for firms causing environmental problems, but that are still operating within the set emission standards. Punitive measures should be taken against firms causing serious environmental problems and exceeding emission standards.

iii. Fiscal policies to promote energy structural adjustment and to ensure energy supply

1. Establish a national strategic oil reserve system

The experiences of foreign countries in establishing national oil reserves should be taken into account while still considering aspects unique to China. Foreign experience suggests the following methods for financing a national energy reserve:

(1) Establish a fund to be used exclusively for the energy reserve. Such a fund could be generated from taxes on finished oil products or set aside from existing tax revenues, such as oil consumption tax revenues.
(2) Levy other special taxes.
(3) Issue earmarked national bonds.

2. Strongly encourage state-owned energy enterprises to develop an overseas energy cooperative market

Cooperation between overseas enterprises and state-owned energy enterprises is vital and the government should play a strong role in fostering this. The government needs to not only coordinate the overseas business of its three large oil enterprises, but also streamline approval formalities and procedures. It should also provide special fiscal support in terms of financial management, investment risk funds, and taxation deduction incentives.

3. Support the development of traditional energy industries such as the coal industry

The current tax system in place for coal resources should be further adjusted and the adjusting role of the resource tax instruments should be reinforced. Taxation policies and corporate financial regulations should also be utilized to promote the safe development of the coal industry.

iv. Fiscal policy recommendations to support energy R&D and technological innovations

1. Increase budgetary investments in energy R&D.

2. Provide interest discounts for bank loans supporting enterprises' energy R&D activities.

3. Use tax incentives to support energy R&D.

v. Suggestions on reforming the central-local fiscal system for energy development

1. Based on the minimum standards for energy exploitation set by the state, the central government should return tax revenues or fee charges collected for raising, exploiting, or retraction rates to local governments. Putting these revenues back in the hands of the local governments will hopefully minimize the short-term vision and wasteful behavior of China's primary conventional fossil fuel production sites.

2. Use tax incentives to encourage large and medium-sized enterprises that consume high amounts of energy to develop and use energy-saving technology. This would prevent high energy-consuming small-sized enterprises from developing too quickly.

3. Tax revenues stemming from negative restrictive measures (Carbon tax and energy tax) should be retained as central government revenues or shared with local government, with the central government taking a majority of the money. This would reinforce the central government's control over energy production, consumption, and saving.

Fiscal Instruments for Pollution Control: Attractions, Limitations, and Strategies

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Fiscal instruments are an important item in the policy maker's toolkit for promoting efficient energy use and protecting environmental quality. These policy instruments can help bring the price of goods and services closer to their full social cost – the private cost plus the external environmental cost. This encourages cleaner production and consumption decisions, and can help societies achieve a better balance between environmental quality and other valued goods and services such as affordable transportation, food, housing, and energy.

China already makes use of these instruments -- for example, through its pollution levy system. However, exploring possible additional or modified uses of these instruments can reveal ways that the nation can protect its environment at low cost as it continues its rapid rate of economic growth.

There is a wide range of potential fiscal approaches to environmental protection and efficient energy use. These include:[2]

> **Taxes** on emissions or effluent releases (as under the pollution levy), or on goods and services associated with pollution (as with a gasoline tax)
>
> **Tax Credits** for clean consumer activities (for example, purchasing an energy-efficient refrigerator), or for clean production activities (for example, producing electricity from renewable sources)
>
> **Subsidies** to research and development toward the invention of new, clean technologies
>
> **Policy packages:** One example is green tax reform -- a combination of an environmental levy and a reduction in ordinary income or sales taxes, where the income or sales tax cut is financed by revenues from the environmental tax. Another example is an environmental tax-subsidy package --- for example, using environmental taxes to finance either subsidies to R&D or tax credits for clean producer or consumer activities.

In this brief paper I address the following questions related to the use of these various fiscal instruments:

1. What are the potential attractions and limitations of fiscal instruments?

2 Which types of fiscal instruments are best?

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[2] Another important and promising policy approach is tradable pollution allowances. I do not focus on this approach because it usually is not considered in the category of "fiscal instruments." In another paper (Goulder, 2005) I consider the relative attractions and deficiencies of pollution levies and tradable allowances for China.

3. Do fiscal instruments make conventional regulation (direct controls) unnecessary?

4. How extensively are fiscal instruments used in various countries?

5. Is it worthwhile for China to expand the use of these instruments now? Or does the "Environmental Kuznets Curve" imply is better to wait until a higher per-capita income level is attained?

1. What are the potential attractions and limitations of fiscal instruments?

In most industrialized nations, direct regulation – including energy efficiency standards, emissions quotas, and mandated technologies – is the most commonly used approach for promoting energy efficiency or controlling pollution. However, incentive-based, fiscal approaches are gaining in importance.

a. Attractions

Economists have often touted the attractions of fiscal approaches[3]. Some potential attractions include:

- Cost-effectiveness. Fiscal approaches have the potential to achieve given targets for reduced pollution or reduced energy use (energy per unit of service) at lower cost than direct regulation. To achieve pollution-reduction at the lowest cost, the marginal costs of pollution-reduction should be the same across all facilities that reduce pollution. Fiscal approaches like pollution levies or tax-breaks for pollution reductions can accomplish this, even without the regulator knowing what each facility's costs are. This is because such instruments give facilities an incentive to reduce pollution up to the point where the marginal abatement cost equals the tax benefit (the tax-payment avoided or tax-credit earned as a result of the marginal reduction in pollution). In contrast, under direct regulation the regulating authority would need to know the abatement costs of each facility to determine the pollution-reductions of each facility that would achieve an aggregate reduction at the lowest cost. Thus, a potential advantage of fiscal approaches is that they can help assure that pollution-reductions are accomplished where they can be made most cheaply.

- Innovation incentives. Taxes on emissions or tax-breaks for emissions reductions provide a continual stimulus toward technological innovation. This is the case because inventing a cleaner production method is a way of avoiding taxes or receiving a larger tax break. In contrast, under direct regulation, there often is no further incentive to innovate once the required equipment is installed or once the emissions fall within the maximum allowable amount.

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[3] For a review of potential attractions and deficiencies of fiscal approaches and other incentive-based approaches, see, for example, Stavins (2005).

- Efficient source of public revenue. Taxes on emissions allow for socially beneficial "green tax reform." Such reform substitutes taxes on "bads" like pollution for taxes on "goods" like work or investment. The revenue from pollution levies or taxes on polluting fuels can be used to finance reductions in income taxes or sales taxes. This confers economic benefits, because lower rates of income or sales taxes imply lower distortions by the tax system. It may also confer political benefits, since there may be broad support for lower income or sales taxes.

b. Drawbacks

Larger share of overall social burden often falls on polluting facilities. Policies differ in terms of the share of the total economic burden that is placed on the polluting facilities. Compared with direct controls, emissions taxes, fuel taxes, and other environmentally motivated taxes tend to place a larger share of society's total policy cost on the polluting facilities. Direct regulation such as efficiency standards and facility-level emissions caps place a smaller share of this total cost on such facilities. In nations where polluting facilities constitute a concentrated and highly mobilized political group – and this is the case in the U.S. – there may be stronger political opposition to emissions taxes and fuel taxes than to direct regulation.

However, emissions taxes and fuels taxes can be designed in such a way as to avoid putting a large share of the burden on polluting facilities. This can be accomplished by exempting "inframarginal" emissions or use of fuels from the tax.[4] Under this approach, facilities still pay the emissions tax or fuel tax "at the margin" – that is, for the last units of emissions or fuel input – but they do not need to pay tax for the first units. Economic analysis shows that this leads to the same reductions in pollution or fuel use as the simpler tax without exemptions – yet it reduces substantially the burden on the regulated facilities. In fact, this approach can entirely eliminate the loss in profit or income to polluting facilities. This can significantly reduce public opposition.

Greater visibility of the burden from regulation. The costs of regulation may be more visible under these fiscal instruments than under direct controls. Under pollution taxes, producers or consumers can be very aware of the tax-component in the price of a fuel input, produced good, or service. In contrast, under direct regulation, the higher costs necessitated by the regulation may be less obvious. For example, purchasers of automobiles may not have a good sense of the degree to which required pollution-control equipment leads to a higher price of the automobile. The greater visibility of regulatory cost in the case of pollution or fuel taxes may lead to greater public opposition to these approaches.

Quantity of emissions is left uncertain. Under fiscal approaches, regulators can predict to some degree what facilities' pollution-reduction costs will be at the margin: this will be tax rate. However, regulators generally will not be able to predict in advance the extent of pollution-reduction that will occur. This depends on every firm's technological alternatives, and on the costs of each of these alternatives. Regulators do not have all of this information. Thus, under the emissions tax, regulators can predict marginal pollution-reduction costs but will be uncertain

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[4] For an analysis of this issue, see Bovenberg and Goulder (2001) and Goulder (2000).

as to the amount of emissions reductions that the tax will induce, or the remaining amount of emissions. In contrast, under emissions quotas or systems of tradable emissions allowances, the regulator specifies the aggregate amount of emissions. The ability to reduce uncertainty about total emissions was apparently a important factor leading to the implementation of national emissions targets (rather than setting prices for greenhouse gas emissions) under the Kyoto Protocol.

Thus, while fiscal approaches have many advantages relative to direct regulation, they face some disadvantages as well. Yet some of the disadvantages can be eliminated through careful policy design – especially the problem of excessive impacts on the profits of polluting firms.

2. Which types of fiscal instruments are best?

The beginning of this paper identified a range of fiscal approaches to energy efficiency and environmental protection: taxes on pollution or pollution-related fuels, tax credits for clean production or consumption, subsidies to R&D, and policy packages.

Note that two of these general approaches – tax credits and R&D subsidies – can be viewed as "carrots" in that they reward facilities for reducing pollution or for efforts to invent new technologies for doing so. They offer a payment to the facilities. In contrast, the first approach – taxes on pollution or fuels – can be regarded as a "stick" because it penalizes facilities for producing pollution. From the point of view of social cost, which approach is best? Is it best to focus on carrots, on sticks, or on a combination of the two?

From a political perspective, it may be attractive to employ only the carrots. Tax-breaks for cleaner energy use (carrots) are a major component of the recent Energy Policy Act the U.S., as well as the Bush Administration's proposed climate-change action plan. In contrast, there is virtually no use of taxes on inefficient or pollution-intensive uses of energy.[5]

However, from an economic perspective, concentrating solely on carrots can be very wasteful. The reason is that private markets can fail in two ways, and that a combination of instruments is generally necessary to address both "market failures" most effectively.

<u>The pollution market failure</u>. Emissions taxes focus most effectively on a "pollution market failure" -- the problem of environmental externalities. The pollution generated from industrial activities is a cost to society that (absent regulation) is not borne by the polluting facility. In effect, the private cost of production (including the cost of labor, materials, and other inputs) falls short of the full social cost, which includes the environmental cost. For example, the production of electricity from coal generates a range of pollutants, including NOx compounds, sulfur dioxide, and carbon dioxide. In the absence of regulation, the health and other damages from these pollutants are not included in the price of electricity, and thus the price of electricity does not incorporate the full social cost. Under these circumstances markets fail to allocate resources efficiently – there is too much pollution in the sense that the cost of reducing pollution would be less than the benefits in the form of avoided damages from pollution. Emissions taxes

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[5] Tierney (2005) provides further discussion of this issue.

can address this problem by bringing the price of electricity in line with the full social cost. Economic analysis indicates that the environmental benefits from such taxes will exceed the costs to facilities and society in general associated with the higher prices.

The innovation market failure. A second market failure relates to innovation effort. Research and development activities, if productive, generate new knowledge. In general not all of this new knowledge can be appropriated by the individuals that undertake efforts to develop the new knowledge: some knowledge "spills over" to others, often competing enterprises. Thus, not all of the social return from investments in research and development efforts is enjoyed by the firm conducting those efforts. To put the matter another way: research and development efforts often produce a beneficial externality in the form of new knowledge enjoyed by outside parties. Economic analysis indicates that under these circumstances, the level of R&D undertaken by private firms will be insufficient from an efficiency point of view: that is, a larger amount of R&D would in general create additional social benefits (from the new knowledge) that exceed the extra cost. Under these circumstances technology-push policies – government provided research or subsidies to private research -- have an efficiency justification.[6]

Thus two market failures justify both a carrot (the R&D subsidy) and a stick (a tax on pollution externalities). The issue is not merely of academic interest. If only one of the two approaches is adopted, the costs of achieving given pollution-control targets can be significantly higher. In this connection, Goulder and Schneider (1999) find that the costs of reducing cumulative U.S. carbon dioxide emissions by 15 percent from 1995-2095 are an order of magnitude lower when both types of policy are employed, compared with the case where only a technology-push policy is used. Fischer and Newell (2005) obtain roughly similar results.

3. Do fiscal instruments make conventional regulation unnecessary?

Emissions taxes and other fiscal instruments can remove the need for some direct controls. This is particularly the case if the instruments are introduced upstream, that is, at the point involving primary inputs like fossil fuels. For example, a carbon tax, if imposed on suppliers of primary fuels, would encourage electric power generators to switch to cleaner fuels sources such as hydroelectric power, wind power, or geothermal energy. Or it could encourage the generators to switch from coal (which is relatively highly taxed per unit of energy) to natural gas (which would be relatively lightly taxed). Thus, under an (upstream) carbon tax, there is no need for direct fuel-switching requirements.

However, several types of economic activity are not easily addressed through fiscal instruments. Emissions from mobile sources such as cars and planes are difficult to monitor. Similarly, non-point sources of water pollution are virtually impossible to identify. In these cases, direct controls such as efficiency standards or mandated technologies can have an advantage over fiscal instruments. It may be easier and less costly to monitor whether a given facility has installed a "clean" type of production equipment than to monitor emissions.

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[6] Harvey (2005) offers a discussion of innovation market failures, R&D expenditure, and learning-by-doing in the context of climate-change policy.

Thus, while fiscal instruments remove the need for some direct controls, they do not eliminate it. A system involving both types of regulation is likely to be most effective in promoting energy efficiency and a clean environment. However, it does appear that in many countries – China included – social welfare could be enhanced through expanded use of fiscal instruments. I address this issue in Section 5 below.

4. How extensively are fiscal instruments in various countries?

These instruments are used very broadly in the more industrialized countries, and their use is significant and growing in developing countries. There is considerable variety across nations in the types of fiscal instruments used, and in the magnitudes of the relevant tax or subsidy rates.

Table 1 gives an idea of the extent of use of one type of fiscal instrument: environment-related taxes. It shows that in 1997 the OECD countries relied on environment-related taxes for about five and a half percent of its overall tax revenue. The U.S. relied on such taxes for about 3.4 percent of its tax revenue. In the listed countries the environment-related taxes included (1) taxes on emissions of various air and water pollutants; (2) taxes on oil, coal, natural gas, and refined fuels (e.g., gasoline and diesel fuel); (3) taxes on hazardous or toxic wastes, (4) and various taxes on goods associated with pollution (nitrogen fertilizers, motor vehicles, etc.).[7]

Of course, the fact that these instruments are used broadly does not necessarily imply they are used well. On the positive side, numerous studies indicate that administrative costs for emissions taxes and fuels taxes are considerably lower than the costs would be for comparable direct controls.[8] On the negative side, in many nations (and probably in most), the tax rates on pollution and polluting fuels are well below the marginal damages from pollution – the rate that according to economic analysis would maximize the net benefits from pollution-control. In fact, many nations employ negative rates – that is, they subsidize pollution-related goods or services. The World Bank's 1992 *World Development Report* examined fossil fuel, electricity and water prices in 22 developing countries and the United Kingdom. In all but two cases (electricity pricing by Turkey and the Philippines), subsidies caused prices to fall below cost, even before accounting for environmental externalities.

Below we discuss the tax-rate issue as it relates to China.

5. Is it worthwhile for China to expand use of these instruments *now*? Or does the "Environmental Kuznets Curve" imply it is better to wait until a higher per-capita income level is reached?

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[7] Stavins (2003) offers a detailed survey of the incentive-based instruments used in various countries for environmental protection. Incentive-based instruments include the fiscal policies mentioned in this paper, as well as tradable pollution allowances and deposit-refund systems.

[8] See, for example, Tietenberg (2004).

Using data from many countries, a number of studies have found evidence of an "Environmental Kuznets Curve" (EKC). The curve relates per-capita income to environmental quality[9], and indicates that environmental quality initially falls (or pollution rises) as per-capita increases, but environmental quality starts to improve (or pollution decreases) once per-capita income exceeds a certain threshold value. Although the estimates vary greatly, a typical threshold value is 7000-9000 U.S. dollars, or about 30,000-39,000 RMB (using exchange rates based on purchasing-power parity).[10]

Does this imply it's best for China to wait until per-capita income reaches this level before aggressively addressing energy efficiency and pollution?

a. Theory

Typical behavior is not necessarily optimal behavior. Although the EKC may indicate a typical pattern, it does not reveal what is best for a nation. Even if national environmental quality tends to begin to improve once per-capita income reaches about 7-9 thousand U.S. dollars, theoretical and empirical studies indicate that significant environmental governance should take place even at lower per-capita income. Such analysis indicates that the social benefits from earlier action (in the form of avoided environmental damages) will exceed the costs of the environmental regulation. At least two main arguments apply:

a. Without current public promotion, invention and market-penetration of new, clean technologies will occur later than what is best for society. Underlying this result are the two "market failures" mentioned in Section 2 above.

> The *innovation market failure* reflects the fact that the private reward from invention efforts falls short of the social benefit. Consequently, private markets yield insufficient incentives to invent and innovate. This provides justification for government support of research and development.
>
> The *pollution market failure* implies that, in the absence of fiscal or other forms of environmental regulation, prices of conventional, polluting production processes will be below their social cost. In the U.S., for example, the market penetration of clean, hybrid cars has been made significantly more difficult because gasoline prices have been below social cost (Parry and Small, 2005), and thus the private cost of driving conventional cars is below social cost. Under-pricing of conventional technologies puts potential new and clean production processes or technologies at a competitive disadvantage, because the new technologies have to arrive at an exceptionally low cost in order to gain a market share. Thus, environmental regulation that helps put conventional technologies at their full social cost improves the competitive potential of new technologies, encourages innovation, and speeds up the arrival of cleaner technologies.

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[9] More specifically, the curve relates per-capita income to emissions of various pollutants.

[10] The $7000-9000 figure is based on Grossman and Krueger (1995), converted to 2005 dollars.

b. No matter when the new, clean technologies arrive, in the absence of vigorous environmental policy the nation will suffer excessive environmental damage during the time-interval from the present until this arrival time. Even before the new, clean technologies are invented, there is a role for vigorous environmental policy to encourage the "clean" use of *existing* technologies (for example, fuel-switching by electric generators, or use of energy-efficient appliances by consumers).

b. Implications

Emissions taxes and tax-credits for emissions reductions. What does this imply for China's use of fiscal instruments? With regard to the first two types of fiscal instruments mentioned – taxes on emissions or on polluting fuels, and tax-credits for pollution-reduction – it suggests more vigorous use of these instruments. To maximize the net benefits (environmental benefits minus regulatory costs from environmental regulation, emissions taxes should be set equal to the marginal environmental damage from emissions. Or, if tax-credits for cleaner production are employed, the tax-credit rate should be equal to this marginal damage.[11] However, China's current pollution levy rates are significantly below this rate (Goulder 2005, Zhang *et al.* 2005).[12] For example, the statutory rate on sulfur dioxide is 0.365 RMB (or about $84 per metric tonne, using purchasing power parity) per kilogram, while estimates of marginal damages from sulfur dioxide are 3-8 times this value.[13] Raising the levy rates would produce benefits (in the form of avoided health costs and other adverse impacts on humans) in excess of the regulatory costs.

Subsidies to research and development. What are the implications for China's R&D policy? China devotes about 1.3 percent of its GDP toward R&D.[14] Of this, about a fifth is energy- or environment-related R&D.[15] Table 2 shows the R&D and other innovation-related expenditures for China and other nations. The table indicates that China devotes a smaller share of its output to innovation-related work than the other countries listed – although it should be noted that China's commitment to R&D has increased significantly in recent years and that is per-capita income is less than that of the other listed nations.

Is China's commitment to R&D sufficient to fully correct the innovation market failure? It is difficult to say with certainty. However, the following statistic may suggest an answer. Several studies suggest that, in the U.S., the annual rate of return to energy-related R&D is over

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11 If emissions limits are employed, the level of allowable emissions should be such as to equate the marginal cost of reaching that limit with the marginal environmental benefit.

12 Limited enforcement at the local level implies that the *effective* rates are considerably lower than this value.

13 Pollution levy rates taken from http://www.x-rates.com/cgi-bin/hlookup.cgi. In calculating the marginal damages for China, I multiply estimates of marginal damages in the U.S. by the ratio of China's GDP to U.S. GDP. This assumes that willingness to pay for environmental improvement is the same proportion of national income in China and the U.S.

14 http://en.chinabroadcast.cn/855/005/10/13/262@24499.htm.

15 www.863.org.cn/english/annual_report/annual_report_2002.pdf.

25 percent -- several times the market interest rate or return on private-market investments.[16] This implies that the U.S. would benefit from devoting a larger share of its resources to energy-related R&D. Yet the U.S. already devotes a larger share of its GDP to R&D than does China. This suggests (but does not prove!) that China has significant untapped R&D resources and might also benefit from an expanded focus on R&D. Currently China's R&D policy gives considerable incentives to increase R&D *inputs.* Greater rewards for R&D results might improve the productivity of given expenditures on R&D. The structure of the incentive system can be as important as the total expenditure commitment.

6. Conclusions

Fiscal policies are an important element of the policy maker's toolkit for protecting the environment and encouraging efficient energy use. They have the potential to help bring the prices of goods and services closer to their full social cost – the private cost plus the external, environmental cost. This encourages cleaner production and consumption decisions and in theory enables society's to achieve the best balance between environmental quality and other valued goods and services such as affordable transportation and housing.

These policies have several attractions relative to other instruments for promoting energy efficiency or reduced pollution. In many instances, they enable society to reach given pollution-reduction targets at lower cost than would be possible through direct controls. They also tend to be more effective than direct controls in promoting the invention of new, cleaner energy technologies. And they can provide an efficient source of revenue to the government.

But the policies have some drawbacks as well. A key potential drawback is that they often impose a larger share of the overall policy cost on the polluting facilities. However, this disadvantage can be reduced or eliminated through judicious policy design. Another potential drawback is that the costs of fiscal policies may be more visible than those of direct controls.

Both emissions-oriented policies and "technology-push" policies (subsidies to R&D) are needed to achieve pollution reduction targets or energy-efficiency targets at the lowest cost to society. R&D support directly focuses on an "innovation market failure," while emissions policies focus best on the "pollution externality." And while fiscal approaches such as pollution taxes or tax-breaks for pollution-reduction often have an advantage over direct controls for dealing with pollution externalities, direct controls such as efficiency standards or mandated technologies will have an advantage in some contexts – particularly when it is difficult to monitor emissions.

Finally, the presence of an "Environmental Kuznets Curve" does not offer a justification for China's postponing significant action to reduce pollution or encourage cleaner energy use. Even if China's per-capita income is below the critical income level beyond which, according to the EKC, environmental quality begins to improve, the nation is likely to benefit from expanded environmental protection in the present. Economic analysis indicates that in the absence of public intervention, private markets tend to generate excessive pollution in the sense that the social benefits from reducing pollution exceed the social costs of doing so. In addition, private

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[16] See, for example, Department of Energy (1997).

markets tend to yield insufficient incentives to innovate: additional expenditures on R&D can be expected to yield social benefits in excess of the costs. Public policies to encourage innovation and to discourage pollution-intensive production methods can correct these market failures.

This has implications for China's current policy. China's current pollution levy rates are below the efficiency-maximizing rates (marginal environmental damages from emissions). Higher rates could produce environmental benefits in excess of the regulatory costs. In addition, China's share of GDP devoted to R&D is fairly low relative to other nations, although the share is growing significantly. Studies of the social return to R&D suggest that an increased commitment would produce social net benefits. The nature of the R&D support may be as important as the expenditure level.

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Table 1: Contributions of Environment-Related Taxes to Overall Tax Revenues for OECD Countries in 1997

Country	Environment-Related Tax Revenue (millions of US dollars)	Total Tax Revenue (millions of US dollars)	GDP (billions of US dollars)	Environment-Related Tax Revenue as Percent of Total Tax Revenue	Environment-Related Tax Revenue as Percent of GDP
Austria	4,865	91,297	206.7	5.33	2.35
Belgium	5,715	111,411	243.6	5.13	2.35
Canada	13,242	236,225	640.0	5.61	2.07
Czech Republic	1,501	20,460	53.0	7.33	2.83
Denmark	7,780	84,233	168.4	9.24	4.62
Finland	3,963	56,526	122.5	7.01	3.23
France	30,156	635,746	1,406.0	4.74	2.14
Germany	46,382	782,305	2,114.5	5.93	2.19
Greece	4,746	40,504	120.0	11.72	3.95
Hungary	1,292	17,868	45.8	7.23	2.82
Iceland		2,377			
Ireland	2,381	25,772	78.5	9.24	3.03
Italy	37,790	515,237	1,159.5	7.33	3.26
Japan	71,388	1,202,355	4,195.3	5.94	1.70
Korea	13,333	101,880	476.9	13.09	2.80
Luxembourg	504	7,303	17.5	6.89	2.88
Mexico		67,763			
Netherlands	13,668	158,109	376.7	8.64	3.63
New Zealand	1,108	23,553	64.9	4.70	1.71
Norway	5,570	65,676	155.0	8.48	3.59
Poland	2,350	55,936	143.2	4.20	1.64
Portugal	3,670	34,919	104.3	10.51	3.52
Spain	11,964	188,355	558.6	6.35	2.14
Sweden	7,276	122,252	237.5	5.95	3.06
Switzerland	5,020	86,729	256.3	5.79	1.96
Turkey	5,846	53,007	190.2	11.03	3.07
United Kingdom	38,247	464,383	1,315.7	8.24	2.91
United States	77,333	2,299,136	8,121.0	3.36	0.95
Total	417,090	7,551,318	22,571.6	5.52	1.85

Source: **OECD**

Table 2: Science Development Indicators

Country	1987-1997 R&D Expenditure as % of GNP	1987-1997 No. of Scientists Engaged in R&D per Million	1987-1997 No. of Technicians Engaged in R&D per Million	1997 No. of Patent Applications per Million
Australia	1.80	3357	797	2342
Denmark	1.95	3259	2644	14076
Finland	2.78	2799	1996	12709
France	2.25	2659	2873	1681
Germany	2.41	2831	1472	1889
Japan	2.80	4909	827	3182
Spain	0.90	1305	343	2137
Sweden	3.76	3826	3166	9482
United Kingdom	1.95	2448	1017	2192
United States	2.63	3676	-	2342
Mid-Income Countries	2.00	2662	14439	5815
China	0.66 (1.31 in 2003)	454	233	43

Source: WU Jinglian, "Which Path for Industrialization? A Choice for China." Presentation at inaugural conference for Center for Industrial Development and Environmental Governance, Tsinghua University, Beijing, China, September 28, 2005.

Note: Approximately a fifth of China's R&D is devoted to energy or environmental-treatment technologies (www.863.org.cn/english/annual_report/annual_report_2002/pdf).

Investment and Financing Policy Study on Sustainable Energy Development

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Abstract
According to the cost estimation of China's energy investment, in order to achieve the economic development objectives of quadrupling GDP by 2020, energy investment needs to reach 18 trillion RMB by 2020（2.2 trillion USD). Investment in new energy-efficient initiatives and energy-related environmental protection will consume 40 percent of total energy investment (about 7.2 trillion RMB) with an annual investment scale of 400 billion RMB. To meet capital demand, increased government investment is required. Additionally, a more favourable policy framework must be developed to encourage investment by various non-governmental sources and their participation in sustainable energy development.

1. Improve the Government's Management of Energy Investment

(1) Reinforce enterprises' ability to auto-invest. Identify enterprises' investment position in the energy construction field.
(2) Encourage private capital investment in energy construction. Relax restrictions on private and social capital investment in energy construction. Abolish the current monopolization of the energy industry by state-owned enterprises and the stated-owned economy.
(3) Expand the use of foreign-funded sustainable energy construction.
(4) Increase the investment supervision and macro-control level of the government on the sustainable energy industry.
(5) Establish an effective information-oriented system. The construction of the state's sustainable energy investment information system should start during the "11th Five-year Plan" period. Establish a seamless sustainable energy information report system.
(6) Establish a market access mechanism for energy conservation and environmental protection.
(7) Focus China's antiquated laws and regulations on new energy and energy conservation investments. Encourage the government to accelerate new energy related investment and financing legislation.

2. Focus the Government's Investment Transfers to Sustainable Energy and Energy Conservation Construction

(1) The government's investment on energy should include new energy development, energy conservation and energy environmental protection projects that are typically less appealing to general investors.
(2) The government is encouraged to avoid direct capital input yet provide support by introducing subsidies and loan discounts. The government is also encouraged to participate in new energy and energy construction projects as well as operations activities.
(3) The government should encourage the development of new energy and energy conservation technology. Investment on industrial experiment for new energy and energy

conservation technology should be increased.

(4) Government subsidization of remote residents who utilize local new energies is another option.

3. Create a Better Financing Environment for Sustainable Energy and Energy Conservation Projects

(1) Policy banks should focus on supporting sustainable energy construction projects.
(2) Banks should provide channels for direct financing of new energy-development enterprises. Enterprises investing primarily in sustainable energy projects should be given first priority when issuing stock or enterprise bonds.
(3) The state should establish new energy development funds and guarantee funds.
(4) Strive for preferential loan support from international financial organizations for new energy and energy conservation development.

4. Increase Energy Environmental Protection Investment

(1) The state should provide funding support for environmental protection facilities of construction projects and strengthen the development and technical investment of energy environmental protection facilities in order to reduce the burden on enterprises of investment in such facilities.
(2) Encourage the development of clean energy. It is necessary to create a sound policy environment and establish an investment and financing mechanism in order to resolve capital shortage and development problems.
(3) Reduce the number of accidents and amount of pollution caused by flammable gases.
(4) Monitor urban thermoelectric construction. Provide investment subsidies and loan discounts for the projects that transform regional heat supply into combined heat & power. Invest in a thermodynamic pipeline.

5. Control Energy Conservation in Key Industries

(1) Industrial energy conservation: First, formulate the design standard for industrial equipment. Second, adopt and incorporate advanced domestic energy conservation equipment and environmental protection facilities. Third, raise the technical reform of current enterprises to save energy and prevent pollution. Fourth, restrict the construction of enterprises that have higher-than-average energy consumption.

(2) Building energy efficiency: Establish and implement effective incentives so that developers recognize the advantages of energy conservation. The government should emphasize the development and promotion of technology, materials and relevant equipment for energy conservation.

(3) Traffic energy conservation: Traffic energy conservation should strive to develop public transport such as the light rail and trolley bus to reduce the use of automobiles for trips within cities.

Integrated Resource Planning in the Context of China's Electricity Situation

Peter Bradford
Former Commissioner, U.S. Nuclear Regulatory Commission
Former Chair, New York Public Services Commission
Senior Energy Advisor

"If China converted all of its incandescent lighting to compact florescent bulbs, we would avoid the equivalent of two Three Gorges dam projects"

Xu Kuangdi, Vice Chairman, Chinese People's Political Consultative Conference; President and Academician, Chinese Academy of Engineering, China Development Forum, June 26, 2005

"There is really no good Chinese word for 'integrated"

Qian Yi, Vice Chairman, Environment and Resource Protection Committee of the NPC, China Development Forum, June 25, 2005

Without government intervention, the resource choices made by vertically integrated utilities and unconstrained markets have generally not protected the environmental and societal values affected by the electric sector or by the broader energy sector. Decisions to build and to buy have emphasized the lowest price. Such decisions have rarely been made in a context that compared the real costs of all technically feasible alternatives on a basis that included environmental impacts and the value of other societal goals. As the importance of wise electricity policy to the well-being of nations becomes increasingly clear, the principles of integrated resources planning (IRP) become uniquely important.

Under conventional processes by which electric utilities decide what to build, proponents of each project and each technology praise its benefits in the language of societal benefit. It will have the lowest costs. It will clean the skies. It will reduce the nation's import dependence. It will diversify supply and reduce risk. It will achieve regional economic goals. But rarely do the developers of any one project show convincingly that their project achieves these goals in a manner superior to other combinations of alternatives. Only through integrated resource planning can a nation or a region choose the combination of policies and investments that will achieve these benefits at the lowest total cost.

IRP supplements conventional power supply planning in three important ways. It considers demand-side options on equal terms and in direct competition with investments in expanding power generation and delivery systems. It includes consideration of societal objectives such as environmental enhancement, national security or regional economic development. And it considers the risks and uncertainties associated with each potential decision. Done well, IRP provides decision-makers with a ranking of the real value and of the real costs of different courses of action in a variety of possible scenarios some years into the future. The country can then chose the path whose value most exceeds its cost.

For a nation with the growth expectations of China, the differences between making energy policy choices wisely and making them in a haphazard fashion are immense. According to one estimate,17[1] China will spend nearly $2 trillion on its electric power system between 2001 and 2030 (about one-third on new power plants), which equates to annual expenditures of more than $60 billion per year (as compared to about $20 billion per year spent in the Chinese electric sector between 1996 and 2000). China's tenth Five Year Plan as amended contemplates adding 110 GW in the three-year period between 2003 and 2005, which is consistent with expenditures of at least $25 billion per year. Current nuclear power goals include spending $30 billion to add some 30 GW of nuclear capacity in the next 15 years, or $2 billion per year on nuclear power alone.

These capital requirements are very significant, especially given the recent trend toward increasing the energy intensity of China's economic growth. Total foreign investment in China in 2003 was slightly more than $50 billion, which was some 8% of total investment in that year. So the $2 trillion estimate for the electric sector between now and 2030 seems to contemplate that between five and ten percent of the total investment in China during that period will go into providing electric power. If the penalty for poor power supply planning is assumed to be a 10% increase in the investment required to provide electricity (a conservative assumption by the standards of the California crisis or the past U.S. experience with nuclear power), then the savings in investment to China from planning wisely (and blending that planning with market principles where desirable) will be on the order of $200 billion by 2030, or $6 billion per year, or one percent of China's total capital requirements during that period. Of course, this does not include savings in operating costs.

Integrated resource planning can be a fundamental tool for achieving these savings.

17[1] "World Energy Investment Outlook", International Energy Agency 2003. See for example, "World Energy Investment Outlook: 2003 Insights" presentation of Huriyaki Kato, Beijing, October 2003. http://www.iea.org/textbase/work/2003/beijing/6WEIO.pdf.

The Need to Dramatically Increase Energy Efficiency Investment in China

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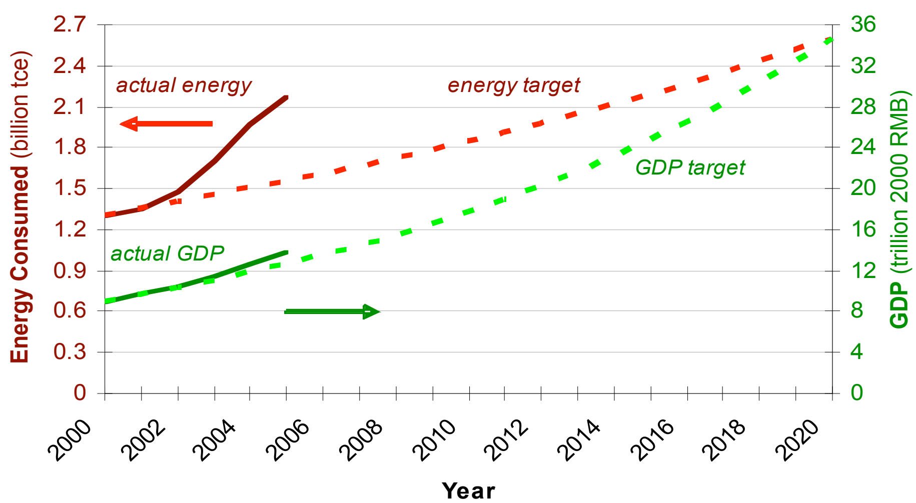
Abstract
After two decades of exemplary performance in limiting energy growth per unit GDP, China's energy usage in the past five years has grown at a rate seemingly out of the government's control. Rapid GDP growth over the past three years has not been matched by improvements in energy efficiency. In fact, the energy sector has been marred by insufficient demand-side investment and ineffective policy implementation. In order to improve energy efficiency and move towards national energy and economic goals for 2020, it is necessary to create large incentives for investment , create the governmental structures for overseeing these incentives, and empower institutions for development, implementation, and enforcement of policies at the national, regional, and local levels.

I. Review of Previous Presentation at Policy Advisory Committee (Kunming, 2004)

During the early reform period, China's bold reform policies generated an economic growth rate that was higher than then corresponding growth of energy consumption. This positive trend reversed in 2001, when growth of energy consumption began to outpace GDP growth. In addition to constraining growth and consumption, declining energy efficiency presents an unsustainable trend in China's long-term development. Figure 1, below, illustrates the departure of China's actual energy consumption from government plans through 2020.

Figure 1: Targets and realities for China's energy and GDP growth



Source: NBS, China Statistical Yearbook, various years; China Statistical Abstract 2005; growth estimates extrapolated from mid-year production data for 2005; targets announced by NDRC.

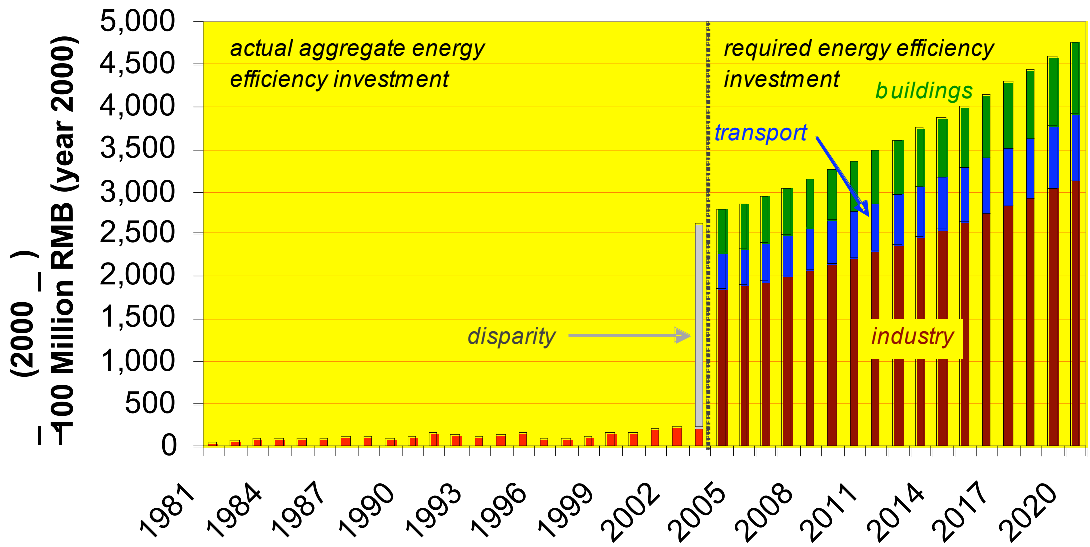
[18] The author wishes to thank Nathaniel Aden for his considerable contributions to this paper.

Local governments and energy companies have moved to address rapid energy demand growth with supply-side solutions. This previous presentation stressed measures to produce large reductions in demand growth. The major emphasis was on the need to dramatically increase investment in energy efficiency, which had declines as a proportion of total energy sector investment from 13.3% % in 1983 to 4.5 % in 2004

II. Role of Public Policy in Inducing Investment

Figure 2, below, illustrates projected investment requirements for China to meet its stated goal of quadrupling GDP while only doubling energy usage. Energy efficiency investment must be increased to 300 billion RMB in 2006, growing to 475 billion RMB in 2020.[19] It is clear that the investment requirements are dramatically higher than they have been in the past (by a factor of 12!) **A key point of the present paper is the recognition that public policies are needed to induce owners and energy consumers in all sectors to provide a large percent of the required investment.**

Figure 2: Required investment for increased energy efficiency



Source: NBS, China Statistical Yearbook, various years; China Statistical Abstract 2005; growth estimates extrapolated from mid-year production data for 2005; targets announced by NDRC; required investment calculated with **4 year payback**; NPV according to 6.5% discount rate; sector breakdowns are based on China Energy Statistical Yearbook definitions.

As the largest consumer of energy, the industrial sector in particular must receive more energy efficiency investment. The entire industrial sector must achieve a 3.5% per year reduction in energy intensity for China to meet 2020 energy goals.[20] In order to meet industry sector growth

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[19] Required investment is calculated assuming (1) a 4-yr payback on efficiency investment, and (2) GDP growth of 7%/yr and energy demand growth of 3.5%/year starting in 2006.

[20] This takes 2005 as the initial year in a 15 year process of having energy demand grow half as fast as GDP. The high growth of the 2001 period is treated as the past, as is the negative growth of the immediately preceding years.

targets, 2.3 trillion RMB must be invested in energy efficiency between 2006 and 2020. This investment is assumed to yield a favorable rate of return (a 4 year payback and a net present benefit of 5.6 trillion RMB) based on prior experience in China. It is also important to note that ~1% per year of this decline in energy intensity in industry may be brought about by the growth of light at the expense of heavy industry.

The buildings sector is the second largest consumer of energy. Tight appliance efficiency standards and labels as well as building energy codes, with effective enforcement of standards and codes, are required. The introduction of financial incentives beyond current standards and codes is also important. In order to meet buildings sector growth targets, we estimate a need for 600 billion RMB of investments in energy efficiency between 2006 and 2020. This produces a net present benefit of 1.2 trillion RMB.

The transport sector requires: tighter fuel economy standards, Bus Rapid Transit promotion through government incentives, increased rail routes/carriers and efficiency for inter-city travel, and promotion of hybrid autos through incentives for auto manufacturers. In order to meet transport sector growth targets, we estimate a need for 550 billion RMB to be invested in energy efficiency between 2006 and 2020 with a net present benefit of 1.4 trillion RMB.

III. The Next Steps

Two of the most important government actors for implementing increased energy efficiency investment are the National Development and Reform Commission (NDRC) and the Ministry of Finance (MOF). The NDRC is needed to play the crucial role in creating energy efficiency policy, to induce much of the investment, by creating an Energy Efficiency Bureau with adequate seniority, staff, and funding. The key policies include:

- Strong targets for industry (3.5% reduction of energy intensity per year) with investment incentives;
- Appliance energy efficiency standards, building energy codes, increased auto fuel economy, with effective enforcement mechanisms.
- Policy support including technical support for policy implementation (e.g., tools for labeling, technical analysis for energy efficiency in industry, monitoring of energy efficiency in all sectors); measurements for policies implementation and enforcement (e.g., appliance testing) and local level (e.g., building and industry monitoring); and strengthening the national network of Energy Conservation Centers.

Suggestions for the MOF include: Create an Office that rapidly develops and executes:

- a major energy efficiency investment strategy;
- promulgation of direct incentives to bring forth investment in industry are essential;
- for industry, a 15% incentive for investments in energy efficiency would amount to 25 B RMB in 2006 growing to 44 B RMB in 2020. Such incentives should be provided to key sectors and factories to assist them in reaching and exceeding targets.

- for buildings and transportation; a 15% for incentives for buildings and auto manufacturers and 33% investment in BRT (with the remainder from municipalities) would amount to ~ 27 B RMB in 2006 and ~48 B RMB in 2020

For the proposed program to work, it will be necessary for the Energy Efficiency Bureau of NDRC to work very closely with a comparably powerful Office within the MOF. It is only through the combined authorities of the two agencies, with strong support from senior leaders and substantial budgets, that the proposed program can be achieved.

The reform period (1980-2000) showed that energy efficiency was essential to achieve economic goals (Deng Xiaoping). The current leadership recognizes the same imperative. The Communiqué of the 5th Plenary session of the 16th Central Committee of CPC, Oct 11, 2005 by Premier Wen Jiabao provides a very specific and extremely ambitious goal for energy demand in the next five years: "the energy use per unit of GDP also known as ratio of total energy use to GDP must be reduced by 20 pct from 2005 [by 2010]."

IV. Conclusions

China has a history of 20 years (1980-2000) of exceptional control of energy demand. However, energy demand has been out of control since 2001. To solve this problem, a much greater amount of investment capital must be devoted to energy efficiency—12 times current investment. This is a daunting increase in energy efficiency investment, required over a short period of time; it is, however, less than 50% of supply investment and much of it can be achieved through policies rather than direct investment. The problem is urgent and rapid development of governmental organizations, policy, investment incentive programs, implementation mechanisms, etc, is necessary. In the absence of such dramatic increases in energy efficiency policies (and rigorous enforcement) and investment incentives, it is difficult to envision China being able to make a transition to a sustainable energy path. The consequences of not doing these activities are: exacerbation of environmental problems; much higher costs of new supply; distortion of capital markets that will make macroeconomic goals very difficult to achieve.

California Energy Policies That Have Catalyzed Energy Efficiency Technology

Arnold Schwarzenegger
Governor of the State of California, U.S.A

Expected Remarks

1. California and China share a common vision, that strong economic growth and environmental protection are compatible.
2. Strong energy and environmental policies encourage companies to innovate and profit from new technologies.
3. In California, strong environmental requirements, and incentives for clean technologies, have led to profits and jobs.
4. China and California lead the world in developing policies that will bring about a new era of low-carbon technologies that reduce the threat of global warming while growing the economy and providing work for our growing populations.
5. China adopted last spring a Renewable Energy Law that sets a target of 10% renewable energy by 2020—120 gigawatts—which will be a remarkable achievement.
6. I too share this vision. California leads the U.S. in renewable energy. I have accelerated our commitment so that 20% of California's electricity will come from renewables in 2020, and I have approved a target to go to 33% by 2020.
7. China has adopted building codes to make all new buildings 50% more efficient than the buildings of the 1980s.
8. I too share this vision. All California state buildings, which are already the most efficient in the U.S., will go further, and become 20% more efficient by 2015.
9. China has adopted efficiency standards for refrigerators, air conditioners, lighting, and other appliances that could avoid 10% of residential electricity by 2012.
10. I recently approved the most aggressive appliance efficiency standards in the U.S., which will double energy savings over the next decade, and avoid the need for 10 large power plants, cut carbon emissions by 9 million tons per year by 2013, and deliver $10 billion in consumer savings over the next decade.
11. In California, electric utilities are now required to invest in energy efficiency whenever it is cheaper than building new power plants.
12. California is also the first U.S. state to regulate motor vehicle greenhouse gas emissions. We expect to cut these emissions from new passenger vehicles by 30% by 2016.
13. While the rest of the U.S. increased its per capita energy use 50% over the last 30 years, California has grown its economy faster while keeping its energy use completely flat.
14. During those 3 decades, California improved its energy use per dollar of economic output by 40%—five times more than the U.S. average.
15. We achieved this through state energy efficiency policy programs that have cost 2-3 cents per kilowatt-hour, less than half the cost of the avoided generation. State efficiency programs have delivered over $3.4 billion in net benefits to our economy.
16. California-style conservation programs could reduce China's electricity consumption growth by 10 percent over the next decade. That would save enough electricity to avoid

building 26 coal-fired power plants, and at one-quarter the cost of what it would take to build those plants.

17. California businesses are directly benefiting from our state energy efficiency programs. Every year, major California companies including Disney, the Gap, Qualcomm, Johnson & Johnson, Cisco, and Intel are all saving between $1.4 million and $30 million each due to energy efficiency. This helps their competitiveness, their profits, and helps add jobs and growth for our state.
18. Going forward, California offers China a partnership to co-develop policies to drive private investment into energy-efficient, low-carbon technologies. This partnership has already begun. In September, the California Energy Commission and our largest electric utility, Pacific Gas & Electric entered a Memorandum of Understanding with Beijing and Jiangsu Province to develop "demand-side management" programs to encourage China's electric utilities to invest in energy saving equipment to save more energy more cheaply than can be produced by new power plants.
19. California will provide the time and assistance of our state personnel from the California Air Resources Board, California Energy Commission, and the Public Utility Commission to help develop policies to commercialize advanced energy efficiency technologies.
20. This policy cooperation will serve as the foundation for robust business ties, economic growth, profits, and new jobs both here in China and in California.
21. China and California share a vision of a clean environment with vibrant, growing, productive, profitable economies. Let us join hands to secure a clean and productive future for our children.

Energy Pricing: Policy Establishment and Systematic Reform

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1. Recommendations for National Energy-Pricing Policy and System Reform

The Chinese government has never clearly declared its energy pricing policy. We suggest that an ideal pricing policy would be one with the following three parts: (1) balancing sustainable energy and state competitiveness, (2) setting energy prices that reflect true costs, and (3) combining a competition mechanism with a supervisory system and "external" control.

1.1 Balancing sustainable energy and state competitiveness

China's improved social and economic state has led to booming energy consumption; domestic resources are insufficient to sustain anticipated economic growth. Energy conservation and the development of new and renewable energies are essential for China's sustainable energy development.

A high "energy-consuming economy" is not necessarily an economy with high "energy waste." China has a relatively high energy-consuming economic structure, mainly due to many industries' poor labor quality and low scientific and technology levels. Foreign capital investment and China's export products are concentrated in manufacturing industries characterized by high energy consumption per unit GDP. The economic structure of high energy consumption in China is a natural result of current international labor division.

In addition, China is still considered a developing country, with coal as its major energy resource. Thus, China's energy supply structure cannot be directly compared to those of developed countries. In taking environmental protection measures, we must consider not only environmental benefit but also the capacity of China's economy and energy structure to bear energy supply costs and energy structure change.

We must first and foremost promote energy conservation, and support the development of new and renewable energies, giving China a more sustainable energy future. At the same time, we must maintain China's economic competitiveness, and accept that China's economic structure is characterized by high energy consumption and coal use. We must not blindly pursue decreases in energy consumption per unit GDP and larger scale development of renewable energy.

1.2 Setting energy prices that capture true costs

China's energy price policy should promote energy conservation and support renewable energy development while ensuring China's sustained economic competitiveness. The way to do so is to set a rational energy pricew that reflects true costs.

China's current energy price does not reflect the full costs incurred by society. Current energy pricing fails to internalize external costs: it does not include the total value of consumed natural resources and the cost of environmental damage. Only when energy prices reflect both internal and external (such as environmental and resource) costs will energy consumption shift to a rational level that can actually be borne by society.

1.3 Introducing competitive mechanisms, creating an energy price supervision system, and strengthening "external" control of the energy Industry

1.3.1 Increasing competitive mechanisms

First, competition in the energy industry and the market determination of energy prices should be allowed to increase. Competition is the most effective method to strengthen enterprises' external constraints and increase consumers' choices, thus economizing resources and saving energy. Traditional competitive industries in China have basically shaken off state planning, and their prices are market-determined.

The coal and oil industries are traditionally competitive industries. The government should remove market obstacles and introduce competitive mechanisms. The natural gas and power industries are traditionally categorized as natural monopoly industries. Each industry can be separated into two parts: (1) transmission and (2) other activities. Recent theoretical research and practice, in China and abroad, has shown that while the transmission of natural gas and power still have many features of a natural monopoly, the latter activities can be a competitive business.

As long as relevant conditions are met, it is possible to establish a competitive market structure and price formation mechanism determined by supply and demand in these areas. To further introduce competitive mechanisms into China's energy field, a competitive market structure needs to be established, an overall policy reform plan needs to be created, and visionary leaders must take charge of the reforms.

1.3.2 Creating a market-based energy price supervision system

In the past, there was virtually no economic supervisory system in China. Direct control and orders from superiors in the planned economy are completely unrelated to supervision in the market economy. In a monopoly such as China's current energy industry, the more diverse the economic interests involved and decisions that need to be made are, the more necessary such a modern supervisory system becomes to balance the economic interests of buyers and sellers based on objective procedures and rules.

In China's power industry, "the factory and the network" have been separated. Technical connections within the electric-power system remain unchanged, but there have been great changes in economic relationships. In this setting, it is impossible to improve the industry's efficiency and maintain the security and reliability of the electric-power system unless a modern supervision system is established. In building a modern energy price supervision system, we must establish energy price supervisory agencies, improve regulation systems, and form a system of checks and balances among involved parties.

1.3.3 Strengthening "external" control of the energy industry

"External" control in the energy industry refers to the influence of resources and the environment. To strengthen such external control, energy price policy must internalize both "external costs" and "external profits."

Internalize external costs. The basic approach for internalizing external resource costs is to have resource prices enter the market. The right to utilize state-owned resources must be granted through standardized bidding invitations. Additionally, a scientific resource tax and charge system must be established. For example, resource tax rates should accord with product prices, and resource taxation levels should be based not on output, but on the amount of occupied resources.

The basic method of internalizing environmental costs is to establish an environmental tax and charge system, in which emission charges are higher than the cost of adopting environmentally friendly processes. Also, in energy industries still under government price supervision, if resource and environmental expenditures costs increase, energy prices should be raised correspondingly to internalize resource and environmental costs.

Internalize external profits. The development and utilization of renewable energies, like wind, biomass, tidal, and solar energy, could reduce the exploration for and consumption of fossil fuels, not only saving non-renewable energies but also protecting the environment.

The methods for internalizing such external benefits are as follows:

(1) Provide government subsidies in order to address the cost difference between renewable and general energies. Subsidy levels can vary for each institution but the market should decide prices.

(2) Require energy distribution enterprises to purchase some renewable energy at its real cost.

Method (1) is better used for industries operating in competitive markets, while method (2) is more suitable for industries that are monopolies. Regardless of which method is adopted, because of China's large size and unbalanced economic and social development, the cost energy should be increased by a small "additional" amount in order to distribute the cost difference between renewable and general energy

2. Pricing Policies and System Reform of Major Energy Industries

2.1 Main points in coal pricing policy and systematic reform

Currently, major problems in coal pricing are the "double standard" in electricity and coal prices – the price of coal used for power generation is lower than coal used for other uses –; the resulting "bad pass for good;" prices rising through other means; and the instability of electricity and coal provision in "key contracts".

These problems can be solved by taking the following measures:

(1) Perfect the *Coal-Electricity Price Linkage Mechanism*, a way to allow the price of coal used in electricity generation to rise, passing rising coal costs onto electricity end users. This mechanism is already established, but has problems that need to be addressed.

(2) Use bid invitations and allocations of rail transport capacity for power-generating coal "key contracts." A lack of rail capacity makes it impossible for both parties exchanging "key contract" power-producing coal to freely choose their trade partner. This situation is similar to power transmission network blockages in a competitive power market.

2.2 Main points in oil pricing policy and systematic reform

The main problems in gas pricing are that gasoline and diesel fuel prices are still controlled, prices disjointed from domestic market supply and demand, and the relationship between prices and taxes irrational.

One of the solutions in the near future is to create an indirect linkage between refined oil product prices and the international market. That is, change the previous price of international raw oil, shipping fees, insurance on the sea, the normal price difference between the raw oil and refined oil in the international market, and the imported duties of refined oil. Another solution is to change the price adjustment boundary. The current price adjustment boundary is 8 percent of the weighted average of the monthly international market price change. We suggest this price adjustment boundary is changed to being either a certain degree of change in average price, or a certain level of rise or fall in daily price over ten consecutive trading days in the international market. The purpose of this change is to strengthen the guiding function of price adjustment and increase the risk of speculating, so as to reduce the possibility of the market becoming unbalanced. For a long-term solution, permission needed to enter the wholesale and retail of refined oil products, introduce competitive mechanisms, and increase the proportion of relevant taxes in the consumer price should be loosened.

2.3 Main points in natural gas pricing policy and systematic reform

There are three major problems in natural gas pricing:

(1) Pricing control methods lack flexibility and cannot quickly respond to energy supply and demand changes.
(2) User classification is often incorrect, creating a serious "cross-subsidization" problem.
(3) There is a lack of unified standards for the monitoring of sales prices.

To solve these problems, we recommend the following changes:

(1) Establish a natural gas price adjustment mechanism that links the price of natural gas to the cost of substitute energy.
(2) Set the well and gate station price structure according to gas supply costs.
(3) Unify standards to match sales price composition.

2.4 Main points in electricity tariff policy and systematic reform

China's current electricity tariff policy attracts investment to the electricity generation industry, and promotes some energy conservation. However, current general power supply still cannot meet current demand, and short-term energy supply adjustment measures are inadequate and fail to target energy conservation as a solution. While there is increasing support for renewable energy, there is no systematic framework for supporting its development.

Several measures can be taken to improve electricity-pricing policies:

1. Electricity tariff levels should not be kept steady but rather adjusted to reflect true changes in electricity cost. The Coal-Electricity Price Linkage Mechanism should be revised according to the principle that we call *Keeping Road and Bridge Separate with Disparate Functionality*.

2. User electricity prices should reflect the generation cost.

3. Internalize external costs. Emission charges should be set substantially higher than the cost of meeting government-stipulated environmental requirements for the power generation sector. If enterprises have already taken environmental measures, such as the installation of

desulphurization units, policies should be established that allow them to recover the installation and operation costs of such equipment.

4. Promote the trial of “major clients’ direct purchase.”
5. Take the domestic situation into account when designing an electricity market model.
6. Gradually introduce competitive mechanisms.
7. Regulate and consolidate electricity-tariff-generated government funds supporting energy conservation and renewable energy development, such as supply-side management.
8. Establish a non-uniform renewable energy electricity tariff policy to reflect regional development levels.

Designing Corresponding Policies for the Implementation of the *Renewable Energy Law*

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The *Renewable Energy Law* was passed on February 28, 2005, during the 14^{th} Meeting of the Standing Committee of the Tenth National People's Congress (NPC). It will go into effect on January 1, 2006. The rules set forth in the *Renewable Energy Law* are designed to be overarching principles adaptable to each of China's regions and provinces. Efficient implementation of this law depends on the development of corresponding administrative rules and codes, and of technology standards. According to a letter issued by the General Office of the Standing Committee of NPC, the Energy, Pricing, Construction and Standardization Departments of the State Council should study and draft these corresponding administrative rules and codes, and technology standards. The drafting of these corresponding regulations should be finished by the date stipulated in the *Renewable Energy Law.*

There are a total of 12 such regulations that must be set when the *Renewable Energy Law* goes into effect, January 1, 2006. They are as follows:

1. Article 2, paragraph 2 requires set hydropower regulations.
2. Article 6, paragraph 1 requires a study of technology standards for renewable energy resource investigation and the subsequent establishment of standards.
3. Article 7, paragraph 1 requires a study of national mid and long-term targets (in terms of total volume) for the development and use of renewable energy; paragraph 2 requires that relevant State Council departments, along with local governments in each province and municipality (including the municipality directly under the Central Government), develop local renewable energy development mid and long-term targets.
4. Article 8, paragraph 1 stipulates the development of a national plan for renewable energy development and use (the Energy Authority of the local governments in each province, municipality, and the municipality directly under the Central Government should be responsible for the local renewable energy development and use plan).
5. Article 10 requires a study and the establishment of guidelines for industrial renewable energy development.
6. Article 11, paragraph 1 requires a study and the establishment of technology standards on renewable energy power grid connection and of national standards on renewable energy technology and products.
7. Article 17 requires a study and the establishment of economic technology policies and technical criteria for using solar power systems in buildings.

8. Article 18, paragraph 3 requires a study and the establishment of concrete methods for providing financial support for renewable energy projects in rural regions.
9. Article 19 requires a study and the establishment of grid-connected renewable power prices.
10. Article 20 requires a study and the implementation of cost-sharing methods for nation-wide grid-connected renewable energy.
11. Article 24 requires a study and the implementation of a management method for the Renewable Energy Development Special Fund.
12. Articles 25 and 26 require a study and the establishment of concrete rules for the use of government subsidies and favorable tax policies for renewable energy.

In sum, the *Renewable Energy Law* provides a legal framework for renewable energy development in China. This framework is based on several principles:

(1) The State will establish national mid and long-term targets for the total volume of renewable energy to be developed and used. National and local renewable energy development plans will then be formulated to provide the means for meeting these targets.

(2) The State will determine feed-in tariff rates for renewable electricity generated from renewable sources. A feed-in tariff is a fixed price, set by the government or determined through competitive bidding, at which grid companies are required to purchase electricity generated from renewable sources.

(3) The difference between the higher renewable energy purchasing price, and the fossil-fuel-generated electricity fixed price, will be shared by all consumers.

The current approved version of the *Renewable Energy Law* does not include a quota system. According to suggestions for revision made by the NPC's Law Committee during the first review of the *Renewable Energy Law*, the Energy Authority of the State Council should establish a quota system for power generators to ensure that China reaches its national renewable energy development target.

Considering the legal framework outlined by the *Renewable Energy Law* and the requirement of the General Office of the Standing Committee of NPC that the additional measures be implemented, the areas requiring the most immediate attention are the following:

- The national target and development plan.
- The grid-connecting electricity price (feed-in tariff).
- A cost-sharing mechanism.
- The Renewable Energy Development Special Fund.

If these regulations can be established before the end of 2005, the *Renewable Energy Law* can be effectively implemented starting January 1, 2006. The other measures outlined in the 12 requirements listed above are not prerequisites for the primary regulations and can be implemented step-by-step.

Energy Efficiency Power Plants, (EPP)
Using Fiscal and Tax Policies to Overcome DSM Barriers

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Increased energy efficiency is a top priority for China. Energy efficiency is highly cost-effective but there are many barriers that prevent residential, commercial, and industrial customers from investing in more efficient appliances, buildings, motors, and processes. China needs to develop and implement new policies to overcome these barriers. China has made good progress in many areas but still needs to adopt effective policies to integrate energy efficiency policies in power sector reform. The Energy Efficiency Power Plant provides a way to address these barriers.

Energy efficiency programs can take many forms:

- **Governments can establish high energy efficiency standards.** Energy efficiency standards are an established approach that is being used extensively in China. Standards, however, only eliminate the least efficient products. Even with stringent energy efficiency standards and effective enforcement, substantial amounts of cost-effective opportunities remain.

- **Governments can use taxing and spending powers to encourage energy efficiency**. This approach has been used successfully in some states in the US and a few other countries. In China, the very large financial demand on the government to provide basic services, such as infrastructure, health care, education, and safety, already strains government resources to the limit.

- **Energy Service Companies (ESCOs) can deliver energy efficiency services and be paid for their services out of customer savings.** This approach has also been used successfully internationally and in China. The ESCO industry, however, is relatively small and its services are generally focused on the most financially strong commercial and industrial customers. ESCOs can be far more effective if their services are part of a larger, organized set of utility energy efficiency programs.

- **Power sector reform can require and encourage electric utilities to invest in energy efficiency as one way to meet their service obligations.** This approach has been highly successful in the US and internationally. Utilities around the world have designed and delivered very large amounts of energy efficiency at about half the cost of meeting demand with conventional power plants.

The "**Efficiency Power Plant**" (EPP) focuses on the fourth option. It is a concept designed for China's conditions, adapting well-proven methods to finance and implement electric utility energy efficiency efforts.

What is an Energy Efficiency Power Plant (EPP)

Everyone is familiar with conventional power plants (CPP); A CPP in China may be a 300 MW coal-fired power plant that operates for 6000 hours a year.
Each kWh a CPP:

- burns about 350 grams of coal,
- emits 3, or more, grams of sulfur dioxide, and
- costs between 35 and 40 fen.

CPPs produce kWhs while EPPs fill the same need by saving kWhs. An EPP is group of specific energy efficiency programs designed to substitute for a CPP. The EPP will save 300 MW of capacity and savings will be produced for about 6000 hours per year. An EPP provides the utility with the equivalent of a (CPP) in terms of capacity and energy– and does so faster, at lower cost and with no pollution.
Each kWh saved by the EPP:

- burns no fuel,
- emits no pollution, and
- costs about 10 fen

With the right fiscal policies, the EPP can be financed and paid for very much like one would finance and pay for a CPP.

How large is an EPP and how much will it cost?

International experts from the Natural Resources Defense Council, (NRDC), Optimal Energy, and others have been working for over a year with Jiangsu government officials and DSM experts from the State Grid Company's DSM Instruction Center to develop a full portfolio of energy efficiency options. Thus far they have identified more than 15 GWs of capacity savings and 42,000 GWhs of annual energy savings by the 10^{th} year of a program. The cost of these savings is about ¼ the cost of conventional supply-side options. The EPP pilot consists of an aggregation of a few of the high priority energy efficiency programs.
The EPP was originally designed to be comparable to a very large conventional power plant, approximately 600 MW. Because of concerns about adverse electricity price impacts, the first EPP has been reduced to 300 MW in the first two years as shown below.

Jiangsu Province Efficiency Power Plant										
	Electricity Savings (at Generation Voltage)									Weighted Average Savings Lifetime (Yrs)
	Energy (GWh/yr)					Peak Demand (MW/yr)				
Incremental annual	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Lifetime Savings (GWh)**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	
New Cooling/Lighting Equipment	26	121	274	486		16	66	139	241	14
Industrial Motor Drive Systems	141	334	551	821		35	84	138	205	13
Residential Appliances*	64	103	153	234		41	59	84	122	9
Total Initiatives	**230**	**558**	**978**	**1,541**		**93**	**209**	**361**	**568**	**13**
Cumulative annual										
New Cooling/Lighting Equipment	26	147	420	907	12,531	16	82	221	463	
Industrial Motor Drive Systems	141	475	1,025	1,846	23,998	35	119	256	462	
Residential Appliances*	64	166	320	553	4,808	41	101	184	306	
Total Initiatives	**230**	**788**	**1,765**	**3,306**	41,337	**93**	**301**	**662**	**1,230**	

* Residential Appliances does not include cooling, which is counted in the New Cooling/Lighting Equipment initiative.

The smaller EPP is very cost-effective. The average cost per kWh saved is about one-third the cost of conventional coal-fired supply.

Detailed studies in the US for a large number of utilities showed that DSM like those included in the EPP consistently reduces utility costs and average customer bills. Likewise, the initial study of the EPP shows the reduction in utility costs of roughly 3 RMB for each 1 RMB of EPP investment.

While it is simple to calculate that the cost of the 300MW EPP requires about 0.0008 RMB per kWh of retail sales, determining the net impact of the EPP on electricity prices is complex and involves an analysis of DSM's impacts on the utility's marginal costs and revenues. Under some conditions DSM leads to small price increases and under other conditions DSM leads to small price decreases.

In Jiangsu, the alternative to an EPP is to add another 300 MW conventional power plant. New coal plants in Jiangsu cost about 38 fen/kWh. New gas power plants cost over 40 fen/kWh, and new nuclear plants cost even more. All of these conventional options cost more than Jiangsu's average generation cost. Consequently, acquiring these conventional power plants instead of the EPP will also raise electricity prices. We believe that electricity prices in Jiangsu will increase more without the EPP than with it. It is also clear that with an EPP, the air will be cleaner, coal supply will be less strained, and power shortages will be less likely.

Why is an EPP being proposed?

The main purposes of the EPP are:

- To address remaining DSM barriers, especially to test DSM financing and funding methods;
- To test the applicability of best international practices in DSM program design, delivery, and evaluation to conditions in China;
- To demonstrate how EPPs can be integrated in utility planning and acquisition, and
- To determine the feasibility of building many EPPs.

Fiscal Issues - Funding and repayment

The lack of a stable, predictable, and adequate DSM funding mechanism has been the major impediment to large-scale DSM implementation in China. International experience provides two basic options.

1. **Public Benefits Fund:** A PBF is collected through a defined surcharge on electricity prices or electricity generators. In most states and countries that use PBFs, they are simply a mechanism to collect revenues in an equitable manner to continue funding important public benefits programs that might be lost in a restructured utility environment.
2. **Utility cost recovery:** Many utilities in the US and other countries treat DSM costs as just another element of the cost of electricity service – like salaries, generation costs, and wires. The level of utility spending on DSM is generally determined through an Integrated Resource Planning (IRP) process that compares the cost of DSM to supply-side options. The relative costs and availability of DSM and supply-side options determine how much spending is directed toward each. For example, California recently adopted an IRP planning process that requires utilities to buy all available DSM that costs less than about 3 cents/kWh.

These two approaches account for 93% of DSM funding in the US. The remaining 7% is funded through taxes and other sources of government funds.

The lack of an adequate and stable DSM is one of China's greatest barriers to DSM.

There are two approaches used by utilities to recover DSM costs in electricity prices as discussed in the second example above. These are (1) expensing and (2) capitalizing and amortizing.

- Expensing treats DSM expenditures as an operating cost. These costs are recovered in prices as they are incurred. Because they are expensed, DSM costs are not externally financed.
- Capitalizing and amortizing recognizes that DSM spending produces long-term savings based on the lifetime of the DSM measures installed. DSM expenditures are capitalized and recovered over a period of years. In this approach DSM can be financed internally or externally.

Most US utilities recover DSM costs through capitalizing and amortizing DSM costs. This is the preferred method for three reasons.

- Capitalizing is consistent with the pricing principle of matching costs and benefits. The benefits are delivered over a period of time and the costs reflected in prices should match that time period.
- Capitalizing reduces any possible increase in prices caused by rapidly increasing DSM spending.
- Capitalizing allows DSM to be internally or externally financed like other utility expenditures. This also allows DSM expenditures to be increased more rapidly to meet demand.

The EPP concept essentially capitalizes DSM costs. With an EPP, DSM costs can be financed externally and spread over the life of the DSM investment. This approach is very similar to the way CPPs are financed and repaid.

Incorporating DSM in power sector reform

The severe power shortage of the last few years has highlighted the need for increased energy efficiency and the need for an improved utility planning process. China is still in the process of power sector reform and coordinating improved power planning processes and energy efficiency policies with power sector reform would benefit China greatly. International experience provides a proven approach that fits well with the EPP.

The steps are clear:

1. **Adopt Integrated Resource Planning.** Peter Bradford's talk explains how a key feature of IRP is the equal treatment of demand and supply-side options to meet customer demands at the lowest total cost. Ten fen/kWh EPP's would take priority over more expensive and polluting CPPs.

2. **Make IRP and DSM the obligation of power suppliers.** Planning is not only a government function. The grid companies need to have a clear role in planning and in the implementation of plans. Making IRP a utility function means making it the utility's obligation to acquire both demand and supply resources.

3. **Equalize the treatment of supply- and demand-side resources**. A 300 MW EPP can meet electricity demand just as well as a 300 MW CPP. Yet, under current policies the utility can recover the cost of 40 fen/kWh power supply bought to meet customer demand but it cannot recover the cost of 10 fen/kWh energy efficiency investment. This discourages least-cost solutions to China's energy needs. This policy must be reformed for IRP to succeed.

Replicating the EPP

The EPP provides a policy and fiscal framework to deliver energy efficiency. Once tested, the EPP can be replicated many times and in many places. Studies in Jiangsu show that with the right fiscal policies more than 50 EPPs can be built over the next two years. Clearly China can build many hundreds of EPPs. Each EPP will help meet China's energy needs and save China's economy many billions of RMBs.

Next Steps

There are a few critical next steps beginning with the most general and ending with the most specific.

- China needs to adopt the central IRP principle of minimizing the total cost of meeting China's energy needs by optimizing supply and demand side options. Government oversight of the power sector needs to be organized to implement this principle efficiently and effectively.
- China needs to integrate DSM and energy efficiency in power sector reform and in the government's oversight of the power sector. DSM should be made part of the Grid Company's business model by making recovery of energy efficiency investment and purchases from EPPs at least as certain and as profitable as purchases from CPPs.

- Jiangsu's pilot EPP has very strong support from all key provincial stakeholders. The EPP should be a high priority pilot. It should be approved as soon as possible and other provinces should be encouraged to experiment with similar approaches.

Establishing a Public Benefits Fund To Promote Energy Efficiency and Renewable Energy

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1. What is a Public Benefits Fund?

A Public Benefits Fund (PBF) is a special policy to support certain public goods that do not receive enough support through reliance on market competition. It usually supports environmental protection, poverty relief, and technology development.

Energy efficiency and the development of renewable energy are two significant public benefits related to social welfare. Supporting energy efficiency and the development of renewable energy will reduce society's energy costs, benefit the economy, and improve the environment.

Market competition alone will not bring about significant improvements in energy efficiency and growth in renewable energy use. China has enormous energy savings potential, but there are currently many market barriers to its realization: high investment needs, technical risk, and lack of energy-savings information. The development of renewable energy is a relatively late arrival in China with outdated technology and huge expense. Renewable energy cannot directly compete with conventional energy in the current competitive energy market.

The proposed Public Benefits Fund will support energy conservation and the development of renewable energy, two key social public benefits. The PBF may be generated from financial funds and other sources, as well as from energy consumers.

2. International Experience in PBFs

(1) Background

Many nations have established PBFs to promote energy efficiency and the development of renewable energy. These countries and their citizens stand to benefit from increased energy efficiency and the development of renewable energy in numerous ways: supporting energy efficiency and renewable energy development will (1) improve energy efficiency and renewable energy technology; (2) decrease energy costs; (3) increase the international competitiveness of the national economy; (4) decrease energy demand; (5) diversify the energy supply structure; (6) improve national energy supply security; (7) promote the utilization of clean energy; (8) decrease fossil fuel consumption and related emissions; (9) improve the local environment; (10) decrease greenhouse gas emissions; (11) contribute to the improvement of the global environment; and (12) help the government promote an image of social responsibility .

(2) Introduction to International PBFs

Presently, PBFs are established in 19 countries: the U.S., Australia, Austria, Brazil, Denmark, France, Germany, Italy, India, Japan, New Zealand, Korea, Sweden, Spain, Holland, England, Ireland, Belgium, and Norway. In the United States, renewable energy is supported by PBFs in 15 states. Annual financing has reached $250 million USD. Energy efficiency is supported by PBFs in 22 states and annual financing has reached $1 billion USD.

Methods of fund raising are diverse in countries where PBFs are established. In the United States, PBFs are established by imposing additional electricity fees called System Benefits Charges (SBC). This method has also been adopted by other nations.

In Australia, Denmark, Sweden, and Japan, PBFs have been established by imposing a diesel tax along with general government revenue. In Holland, a PBF was established by imposing an energy (or ecological) tax on electricity and natural gas. In the United Kingdom, a PBF has been established by imposing a global climate change tax (energy tax) and wires charge (a kind of additional electricity charge) along with general government revenue. Although there are various ways to finance PBFs, financing always comes from local energy producers and energy consumers.

(3) Effects of International PBFs

PBFs have definitely promoted energy efficiency and the development of renewable energy in the international experience. In the United States, evaluations conducted by relative agencies on 40 typical energy efficiency projects supported by PBFs have shown that the PBFs' total investment of $250 million USD have yielded 20 billion kWh in energy savings and the energy efficiency cost is only 1.25 cent per kWh. This yielded a power investment savings is $3.1 billion USD; for each $1 invested, $12 was saved (cost-effectiveness ratio of 12:1. In addition, PBFs have helped improve the market share of high-energy-efficiency household appliances, high-energy-efficiency lighting equipment, and new energy-saving residential buildings.

From 1986 to 1998, the investment in PBFs to support energy efficiency in Brazil was $260 million USD, yielding an accumulated energy savings of 5.3 billion kWh (about 1.8% of all the power consumption in Brazil).

Practices in Japan, the U.S., and U.K. supporting renewable energy have been quite successful. From 1994 to 2001, Japan supported a 300 MW grid-connected solar photovoltaic (PV) project, supporting distributed renewable energy power generation. The total installed capacity increased from 1.9 MW in 1994 to 115 MW in 2001. Additionally, the U.S. adopted an auction combining production incentive methods supporting large-scale renewable energy power generation. Three hundred million US dollars were used from the PBF. The projected installation capacity of renewable energy power generation will reach about 2000 MW, of which wind power may exceed 1600 MW.

3. Necessity and significance of establishing a PBF in China

Guaranteeing public benefits to its entire citizenry is an important function of government, but energy efficiency and the development of renewable energy have not received enough policy support in China. The result is that neither the scale nor the level of development can satisfy national economic needs:

(1) Renewable energy development and utilization is still on a small scale. Installed wind power totals less than 1 million kW, accounting for about 0.2 percent of total national power generation capacity.

(2) National economic policies supporting energy efficiency have weakened and the special energy conservation fund, the 3-E fund, has been canceled. After the cancellation, China did not establish new energy conservation financial mechanisms for collecting funds to support energy efficiency.

To meet the long-term national goal of *Building a Well-off Society in an All-Around Way*, increase energy efficiency, and develop renewable energy, the government must formulate and implement comprehensive financial, pricing, tax, and investment policies supporting energy efficiency and renewable energy development. To do so, we suggest that the government establish a PBF supporting energy efficiency and renewable-energy development.

The benefits of establishing a PBF are the following:

a. Promote energy efficiency and realize China's tremendous energy-savings potential.

In 2004, China's total energy consumption reached 1970 Mtce. Because of the coal-based energy mix and extensive economic growth, the current energy utilization efficiency in China remains quite low and energy-savings potential based on technical feasibility may be as much as several hundred Mtce. Long-term, future energy demand is projected to rise dramatically in the coming years: according to the forecasting analysis results, energy demand in 2020 under the "Business-As-Usual" scenario will be over 3200 Mtce. Adopting more aggressive energy-saving policies, however, may decrease this figure to 2400 Mtce. In order to realize this energy-savings potential of 800 Mtce, policies that support energy efficiency and optimize the energy mix should be adopted. Increasing energy savings can reduce energy demand by 60%. It is imperative to establish new energy efficiency incentive policies to promote energy efficiency. International experience shows that establishing a PBF is an effective measure

b. Accelerate renewable–energy development.

Sustainable development is a growing development trend worldwide. Developed countries such as the U.S., Japan, and the U.K., as well as developing countries including India and Brazil, have tried to build clean and diversified energy supply structures. For China, whose energy mix is based on coal, in order to build a well-off society, it is necessary to support renewable energy and incorporate it into China's national energy strategy. Because renewable energy has a lack of commercial competitive power under current market conditions, it is important to increase investment in renewable energy. The timely establishment and the proper use of a PBF will help accelerate the development of renewable energy.

4. Recommendations for China's PBF framework

Considering both international and domestic experience, we recommend the establishment of a PBF that has the following framework:

(1) Sources of the fund.

a. A surcharge on electricity fees: electricity consumers will be charged a special surcharge per kWh of electricity they use.

b. Pollution discharge levied on thermal power plants: levy a certain proportion of pollution discharging fee on thermal power plants.

c. Special financial allocation: alter the allocation criteria for the existing power fund. For example, take out 10 to 20 percent of the agricultural power fund, and make it a source of the PBF.

Based on investigation of the feasibility of fund raising from different sources, stability of the funding sources, possible scale of funding, and impact on related industries and departments, we suggest an electricity surcharge fee be a priority option for financing the PBF. The other methods can be used as alternative options for funding the PBF.

(2) Applications of the fund

a. While focusing on the spread and application of electric power savings and renewable generation, use and extend existing, well-established, or good commercial prospective energy efficiency and renewable energy technology.

b. Research, development, demonstration, and application of new energy-savings and renewable generation technologies.

c. Energy efficiency and the development of renewable energy.

d. The establishment and development of energy efficiency and renewable energy products and service markets.

(3) Arrangements for the fund.

a. Support both energy efficiency and renewable energy. Because energy efficiency needs a high level of support, we recommend 60-70% of the funds be used for incentives supporting energy efficiency. The other 30-40% of the fund should promote the development of renewable energy.

b. Provide equal consideration to central and local governments. A certain proportion of the fund should be allocated by the central government. Due to the economic and social disparities between different regions in China, the centralized application of the fund by the central government is beneficial to energy efficiency and optimization of renewable energy development within China and will improve the effectiveness of the fund. On the other hand, consideration must be given to the benefits of local government in terms of the fund arrangement and application. Local governments should be given proper responsibility for using the fund, so as to enable the fund arrangement to be more flexible and more focused. This will help to raise the overall effectiveness of the fund arrangement.

c. Give consideration to both fairness and efficiency. Based on this principle, we should give consideration to both urban and rural areas, and make use of a competition mechanism in distributing the PBF, so as to utilize the fund more effectively.

(4) Fund management framework.

In order to ensure the fund is applied effectively, we suggest that government departments choose a managing agency. Because the funding source is energy use and the target supported by the PBF—energy efficiency and the development of renewable energy–are related to energy, this government department's function should be related to energy, electric power, or energy saving management.

Considering the orientation of government managing functions, reforming and reducing the government's management of detailed matters and intervention, we suggest the following guide for the management of the PBF:

(1) The government department responsible for the fund should be in charge of its overall management.

(2) The Ministry of Finance (MOF) should be in charge of the operation, application, and supervision of the fund.

(3) A professional social intermediate agency should conduct the detailed management and operation for the fund.

If this kind of management framework is adopted, the government can effectively exert macro-control of the application of the fund arrangement, and eliminate detailed matters. At same time, the government should establish mutual support, mutual restriction, and supervision between the management and operation of the fund, which will guarantee the fair and equitable use of China's new PBF.

Leveraging the Chinese Tax System to Promote Fuel Efficient Vehicles

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Summary
Rapid economic development and increasing oil demand in China have resulted in an oil shortage that is becoming more and more serious. The primary oil security and environmental protection issues currently challenging China are the following:

(1) The conflict between oil supplies and oil demand.
(2) Vehicular exhaust is becoming the dominant source of air pollution in mega cities.
(3) Rapidly increasing vehicle numbers are increasing air pollution from vehicular exhaust.

Based on these facts, in order to decrease vehicular exhaust, it is necessary to introduce a large number of environmentally friendly vehicles to the market. This will improve the quality of the environment while allowing the economy to continue its current rapid development.
In order to leverage a tax system to encourage the development of fuel-efficient and environmentally friendly vehicles, it is important to understand the current situation. At present, there are 24 types of taxes in China. Based on their functions, these taxes can be roughly divided into seven categories:

(1) Circulation
(2) Resource
(3) Income
(4) Special purpose
(5) Property and act
(6) Agricultural
(7) Tariffs

Taxes applicable to motor vehicles mainly include the value added tax (VAT), excise tax, vehicle purchase tax, and vehicle usage tax. In addition, import cars are also subject to tariffs. Among these taxes, the VAT and excise taxes are circulation taxes. The vehicle purchase tax is a special purpose tax, and the vehicle usage tax belongs to the property and act tax. Current motor vehicle taxes can be divided into nine taxes in three charging phases: acquisition (excise tax, VAT, Tariff), owning (purchase tax, new vehicle test fee, license and plate fee), and usage (vehicle and vessel usage tax, road maintenance fee, insurance).

The primary taxes are as follows:
(1) VAT

According to the *Interim Rules and Regulations of the People's Republic of China on VAT*, all motor vehicle products are subject to a 17 percent VAT.

Excise Tax

As provided in the *Interim Rules and Regulations of the People's Republic of China on Excise Taxes*, an excise tax will be levied on sedans, SUVs, passenger vehicles with up to 22 seats, and motorcycles (see Table 1).

Table 1 Excise tax rates for automobile products in China

Targets		Unit	Tax Rate
Sedan	Exhaust amount≥2.2L	Vehicle	8%
	1.0L≤Exhaust amount <2.2L	Vehicle	5%
	Exhaust amount <1.0L	Vehicle	3%
SUV	Exhaust amount≥2.4L	Vehicle	5%
	Exhaust amount <2.4L	Vehicle	3%
Passenger vehicle (≤22seats)	Exhaust amount≥2.0L	Vehicle	5%
	Exhaust amount <2.0L	Vehicle	3%

Vehicle Acquisition Tax

As prescribed in the *Interim Rules and Regulations of the People's Republic of China on Vehicle Acquisition Tax*, the vehicle acquisition tax is set at 10 percent for all motor vehicles, motorcycles, tramcars, trailers, and farming wagons.

Vehicle and Vessel Usage Tax

According to the *Interim Rules and Regulations of the People's Republic of China on Vehicle and Vessel Usage Tax*, the vehicle and vessel usage tax will be collected on an annual basis. (See Table 2)

Table 2 Vehicle and vessel usage tax amounts

Items	Taxation Standard	Annual Tax (RMB)	Remarks
Passenger vehicle	Per vehicle	60-320	Including tramcar
Goods vehicle	Per net ton	16-60	
Two-wheel motorcycle	Per vehicle	20-60	
Tri-car	Per vehicle	32-80	

Road Maintenance Fee

Road maintenance fees are collected on a monthly basis. The rates charged vary regionally. In most provinces the range is 100-300 RMB per month, although some provinces may charge *more than* 300 RMB per month. On the whole, the current tax system cannot effectively discourage the production, sale, and usage of motor vehicles. A low-rate excise tax is charged to auto manufacturers, a purchase tax is charged based on the price of vehicles, and a low vehicle and vessel usage tax is charged. The current tax system cannot discourage the usage of vehicles with high emissions and fuel consumption. Another problem is that the taxes in acquisition and owning are relatively expensive compared to the taxes in usage.

Currently, China has the following requirements for vehicle fuel efficiency and emission:

- Fuel Economy Standards

China adopted the *Fuel Consumption Limits for Passenger Cars* in 2004 which sets the fuel consumption limits for M_1 passenger vehicles powered by spark ignited engine or compression ignition engine, with a maximum speed faster than or equal to 50km/h and a maximum designed mass up to 3,500kg. The limits are divided into 16 groups based on mass, subject to two phases of enforcement. For newly certified vehicles, the first phase starts on July 1, 2005, while the second phase goes into effect January 1, 2008. For vehicles still in production, the first phase starts on July 1, 2006, while the second phase goes into effect on January 1, 2009.

- Emission Standards

  China will implement different emission requirements for light-duty vehicles (M1, M2 and N1 vehicles with maximum mass up to 3.5 T) and heavy-duty vehicles in different phases. For light-duty vehicles, Euro IV emission requirements will be implemented starting July 1, 2010. From January 1, 2006, sales and registration of light-duty motorcycles which meet Phase I requirements for type approval in GB18176 will be discontinued.

Enhancing energy efficient and environmentally-friendly automobile development results from the need to implement related industrial policies and to promote energy efficiency and clean vehicle development. It is imperative to enhance a product's structural readjustments and to meet the demand for special-purpose vehicles through taxation policies. Therefore, adjusting the tax system will have significant effects on encouraging the development of fuel-efficient and environmentally-friendly vehicles. The purpose of instituting a taxation policy system for energy efficiency and environmental protection is (1) to encourage the development of fuel-efficient/clean vehicles and cleaner fuels and (2) to restrict the sales of high-energy-consumption and high-emission motor vehicles. At the same time, preferential policies should be applied to vehicles that comply with national requirements ahead of schedule in a bid to accelerate the development of clean and energy-efficient Chinese automobile products. Conversely, high punitive taxes should be levied on vehicles that fail to comply with the national requirements to restrict their production. Therefore, based on the current situation of the tax system in China, we suggest the following:

1. Adjust the excise tax for vehicles to encourage the production and usage of fuel-efficient and environmentally-friendly vehicles.
2. Adjust the purchase tax based on vehicle's fuel efficiency and emission.
3. Decrease the excise tax for clean fuels to encourage the production and usage of clean fuels.
4. Adjust the tax system related to vehicles such as increasing taxes in the owning and usage phase.
5. Adopt and implement fuel economy submission, fuel-efficiency labeling, and fuel economy publication systems as soon as possible.

The Administration of Vehicle Fuel-Economy Standards: Testing, Reporting, Notification, and Labeling Systems

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1. Overview

Ever since China's reform and opening up period, and the Communist Party of China's (CPC) increased focus on the two "fundamental transformations," China has made solid progress toward changing economic growth modes, and saving and utilizing natural resources.

However, the extensive economic mode has not been fundamentally changed. Compared with advanced international benchmarks, the problems of high resource consumption, excessive waste, and heavy environmental pollution still exist. Along with rapid economic growth and population expansion, China faces more acute shortages in fresh water, land, energy, and mineral resources, with environmental pressure mounting.

The "11th Five-Year Plan" period is critical to the building of a middle-class society and to the acceleration of socialist modernization. It is imperative to coordinate the relationship between social and economic development, population, resources, and the environment, further transform economic growth modes, and speed up the establishment of an energy-saving society. China should lower resource consumption and save resources in the field of production, construction, circulation, and consumption, boost resource utilization rates, minimize waste, and create more economic and social benefits.

2. Directives for Automotive Energy Conservation issued in the State Council's Notice for Constructing an Energy-Saving Society

The State Council is calling for the following to be done:

1. Push forward the implementation of the national standard *Passenger Vehicle Fuel Consumption Limits*, and limit the production of gas-guzzling cars.
2. Research and formulate the *Light Commercial Vehicle Fuel Consumption Limits Standard*.
3. Research and formulate financial and taxation polices to encourage vehicles that have small engines and consume less gas; research and reform the financial and taxation system; impose fuel taxes at the appropriate time; and refine consumption taxation systems.

3. China is in urgent need of an efficiency administrative system and relevant regulations for automotive energy conservation

While China is now ready to establish the relevant regulations, it still needs to establish a series of additional regulations to manage the energy conservation of automotive products. These systems may form China's management system for automotive energy conservation and the government can use such systems to manage the energy conservation of automotive products.

4. Components of China's automotive fuel economy administrative system

a). Basic Evaluation System

The basic evaluation system includes 4 standard regulations: *GB/T19233 Light Vehicle Fuel Consumption Testing Methods*, *GB19578 Passenger Vehicle Fuel Consumption Limits*, *Light Commercial Vehicle Fuel Consumption Limits*, and *Light Vehicle Fuel Consumption Labels*. The first two of these have already been formulated. The third, *Light Commercial Vehicle Fuel Consumption Limits* (oil consumption limits for M_2 and N_1 vehicles weighing less than 3.5 tons), is currently being formulated. Standards in *Light Vehicle Fuel Consumption Labels* are still being researched and the formulation work will be formally launched next year.

GB/T19233 Light Vehicle Fuel Consumption Testing Methods sets the basic method for evaluating all light-duty vehicles made in China or imported from abroad. Before the implementation of this standard, all fuel consumption data was based on assessments made by carmakers themselves (the optimal oil consumption data at the optimal constant velocity of 40km/h and 60km/h). In 2003, we formulated *GB/T19233 Light Vehicle Fuel Consumption Testing Methods*. This standard provides a unified standard for the evaluation of new vehicles' fuel consumption. This makes it possible to compare the fuel consumption of similar vehicles made by different manufacturers.

GB19578 Passenger Vehicle Fuel Consumption Limits is a mandatory standard that provides minimal requirements for passenger vehicle fuel consumption in China. The government can use this standard as a ruler to formulate a series of related policies and systems.

To implement this standard, the government should consider imposing mandatory requirements (like those for other standards) that must be satisfied before production, sale, and import. Alternatively, financial and taxation policies could be used to impose penalties, e.g. levy punitive taxes to eliminate negative impacts due to the lack of mandatory measures without affecting consumers' demand for special products. With respect to these two systems, different governmental authorities may have different considerations. However, the combination of mandatory standards and taxation policies offers the best solution.

The above two standards have been formulated, and *Light Commercial Vehicle Fuel Consumption Limits* and *Light Vehicle Fuel Consumption Labels* are now being formulated. These regulations will work as China's basic evaluation system for vehicle fuel economy. Only with the establishment of this system can the following regulations be formulated and refined.

b). Reporting System

Currently, China manages automotive products through public "bulletins" (together with 3C management).

To speed up the progress of China's automotive energy conservation management, it is imperative to establish an "Automotive Fuel Consumption Reporting System" which includes the following contents and functions:

1. By improving China's "bulletin" management, the automotive fuel consumption reporting system will minimize the corporate and managerial burden.
2. Establishing a vehicle fuel consumption database will facilitate the creation of government policies, the formulation of plans, and the establishment of energy saving systems.
3. With the system in place, we can pursue macro-control by forecasting vehicles that do not comply with consumption limits and adjust vehicle-related taxes (consumption tax and vehicle purchase tax, etc.) in China. This will help establish China's taxation system related to automotive energy conservation. Such a taxation adjustment system not only helps conserve energy, but also increases tax revenues.
4. The reporting system will help China make medium- and long-term automobile fuel consumption forecasts.

c). Notification System

We can raise awareness of fuel consumption in the automobile manufacturing industry by implementing vehicle fuel consumption notification systems, as well as provide reference data to consumers purchasing vehicles, encouraging the purchase of energy-efficient vehicles and strengthening the consumer's awareness of energy conservation. It can also smooth the transition to the management of fuel consumption by law in China. This is a generally adopted international practice.

The notification system requires carmakers to test cars according to *GB/T19233 Light Vehicle Fuel Consumption Testing Methods*, and post fuel consumption data for vehicles exhibited and sold at specific venues (exhibition centers, automobile dealerships, information- promoting places, and other locations) pursuant to *GB19578 Passenger Vehicle Fuel Consumption Limits*. Such requirements are mandatory, and carmakers are prohibited from posting data acquired through some other testing methods so as to avoid confusing consumers or posting misleading information.

The "China Automotive Fuel Consumption Guides" will be published and distributed on a periodic and timely basis to distribute fuel consumption information for all vehicles on the market to consumers and carmakers. These guides will be made as part of governmental effort or undertaken by government-designated organizations under the guidance of the government.

The "China Automotive Fuel Consumption Guides" shall be used as to distribute vehicles' compliance with mandatory limits and their taxation situation. Such information will also facilitate the departments of finance and taxation's formulation of consumption taxes, vehicle purchase taxes, and other taxes concerning automotive energy conservation.

The "China Automotive Fuel Consumption Guides" can also be used to help formulate the "Energy Conservation Product (Equipment) Catalogue," which must be released per State Council mandate.

A China automotive energy conservation website will also be established, so as to deliver car (including imported car) fuel consumption information to consumers rapidly and timely, guiding their vehicle purchases.

d). Labeling System

Vehicle fuel consumption labels are also an important way of distributing information.

Car fuel consumption labels are labels that provide requisite product information to consumers, e.g. fuel consumption levels, operating costs, energy efficiency, or other key features. When purchasing cars, consumers need easy-to-understand information regarding energy efficiency, price, reliability, ease-of-use, operating cost and other features in order to make informed decisions. Such information will influence consumers' purchasing behavior. Car fuel consumption labels should be mandatory.

The labeling system also requires the establishment of the accompanying "Car Fuel Consumption Label Technical Regulations" to meet the requirements of management departments and service organizations, for example, with respect to registration, filing for reference, use, supervision, and penalties.

The "Car Fuel Consumption Label" requires the formulation of standards regarding the label's format, content, paste location, and other implementation details.

The label can also facilitate tax collection. The label will record car models' compliance with consumption limits, which determine whether a consumer needs to pay a punitive vehicle purchase tax or consumption tax and how much tax should the consumer must pay.

5. Problems that need to be solved when establishing these systems

a) Financial support from the government to publish and distribute "China Automotive Fuel Consumption Guides" (this work is funded by the Japanese and U.S. governments).
b) Coordinating the management of different government departments to implement all the policies successfully. For example, it must be decided whether the information in "China Automotive Fuel Consumption Guides" should be reported in "bulletins" or whether new reporting channels need to be established.
c) The tax information in "China Automotive Fuel Consumption Guides" can be used by the tax authorities when collecting vehicle purchase taxes. This necessitates coordination between the Ministry of Finance and the State Administration of Taxation.
d) The State Council shall prescribe powers and responsibilities to the department in charge of automotive energy conservation through legislation. The government should issue decrees regarding vehicle energy conservation in order to push for the implementation of vehicle energy conservation policies and avoid unnecessary problems.
e) Vehicle energy conservation management will also increase tax revenue. Financial and

taxation departments must be involved in and strengthen this management.

f) We must treat vehicles produced domestically and imported vehicles the same. In terms of national treatment, domestic vehicles are left far behind imported vehicles. As a result, domestic carmakers have voiced strong opposition. Government must refine vehicle energy conservation standards and strengthen their implementation through coordinated and enhanced management measures.

Linking China's Fuel Excise Tax to Fuel Quality

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China is facing a very serious air pollution problem. According to Air Quality Monitoring statistics done in 2004 across 47 cities in China, particulate matter (PM) concentrations have decreased since 2003 while the proportion of nitrogen oxide (NO_x) and sulfuric dioxide (SO_2) in ambient air have been increasing. This can be explained mostly by the dramatic increase of vehicles in cities. For this reason, mobile source emissions represent a much greater percentage of the air pollution found in urban areas. The air pollution in most cities has gone from being a fuliginous-style pollution to vehicle-fuliginous combined air pollution. This is also reflected by the ever increasing NO_x and O_3 concentrations found in cities which demonstrate serious vehicle emissions.

Research in other countries has shown that strictly enforced emissions standards for new vehicles are the most effective way to control vehicular pollution. At the same time, corresponding fuel quality standards are needed. Sulfur content is the most important factor in fuel standards. Only when fuel standards are used in conjunction with emissions standards will the standards be fully effective. In China, sulfur concentrations in fuel are not well controlled and there are no standards in place which meet either Euro III or Euro IV emissions standards.

It is becoming more and more important for China to set strict fuel quality standards. Using fuels that are low in sulfur has two benefits. First, using low-sulfur fuels directly reduces emissions: using low-sulfur gasoline leads to reductions in HC, CO and NO_x, using low-sulfur diesel leads to reductions in PM and ultra-fine PM. Second, using low-sulfur fuels enables the use of advanced technologies in vehicles: vehicles running on gasoline can use lean-burn technology and diesel vehicles can use advanced tailpipe emission control technologies.

There are significant barriers to the use of low-sulfur fuels in China: constructing low-sulfur fuel production facilities requires high initial investments, high-quality fuels are expensive, and customers tend to purchase cheaper fuels. European experience shows that tax incentives are very useful measures to encourage low-sulfur fuels.

This study compared two scenarios: the first was the scenario that fuel sulfur content in China was made to meet European standards, the second was the scenario that fuel quality standards continued to lag behind emission standards. Calculations show that the first scenario effected the greatest emissions reduction. The ratio of total reduction to emission amounts in 2004 of NO_x, CO, HC and PM is 0.5, 4.2, 3.6 and 4.2, respectively. The emission amounts in scenario 2 are more than 16 percent less than emissions amounts in scenario 1. However, Scenario 2 poses problems with respect to fuel management. Plans promoting low-sulfur fuel are urgently needed in China. We recommend that the government establish fuel quality standards to match current vehicle emission standards.

International best practice in fuel tax administration: Nexus of problem and solutions

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EU situation

Taxes have a potentially positive environmental impact. Energy taxes, transport taxes and taxes on pollution and resources are increasingly used by EU Member States, and evidence of their environmental effectiveness is developing. The present paper focuses on motor fuel taxes, which have been applied in Europe for a long time. Typically, fuel taxes have been used both as a revenue-raising instrument and as a means to influence consumers' behaviour through side effects such as increasing the (marginal and average) cost of driving, potentially promoting the shift to alternative modes of transport, and helping to introduce new fuels.

Fuel taxes are charged on motor fuels by reference to the quantity of product released for consumption. The Community excise system (Directive 2003/96/EC) provides minimum rates of excise duty that Member States must comply with. Additionally, Member States must apply only one rate of duty to each product category (unleaded petrol, diesel etc.). Deviation from the general principles is possible under an agreed procedure. The duty is charged as a specific amount per quantity of product. Some Member States charge additional fuel taxes for environmental objectives, and are usually calculated as a function of the level of harmful emissions such as carbon dioxide, sulphur, etc.

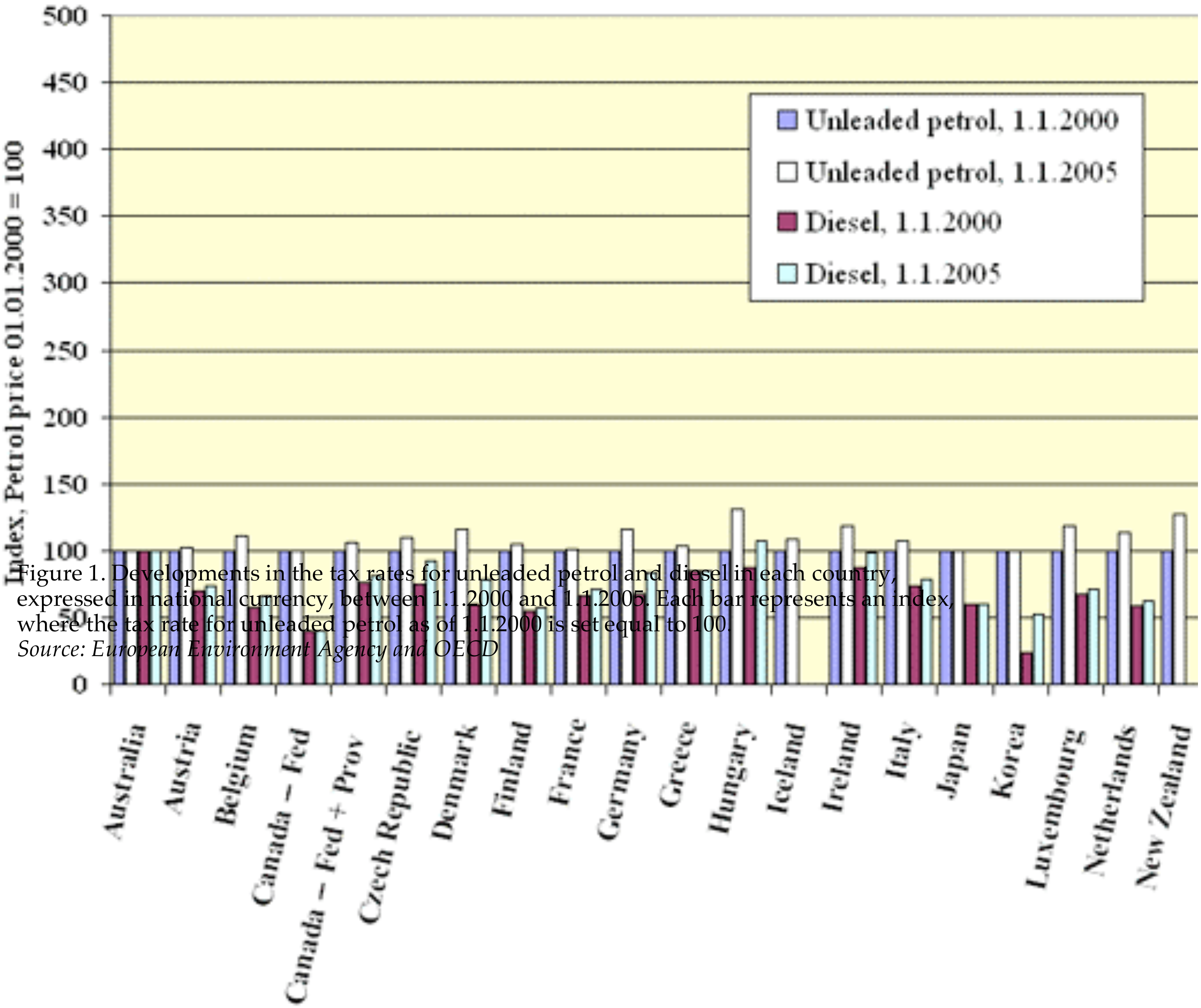


Figure 1. Developments in the tax rates for unleaded petrol and diesel in each country, expressed in national currency, between 1.1.2000 and 1.1.2005. Each bar represents an index, where the tax rate for unleaded petrol as of 1.1.2000 is set equal to 100.
Source: European Environment Agency and OECD

The impact of raising fuel taxes on fuel consumption will depend on how sensitive consumers are to price changes. Traditionally motor fuels like petrol and diesel have been considered to be products with a small elasticity, meaning that the impact of fuel taxes on the consumption levels would remain limited. Short run elasticities have been estimated[21] around
-0.12, which would imply that a 10% increase in petrol prices would decrease petrol

[21] Hanly, M., Dargay, J. & Goodwin, P. (2002). Review of Income and Price Elasticities in the Demand for Road Traffic. Report 2002/13 (London: ESRC Transport Studies Unit, University College London) (available in full in pdf format at: http://www.cts.ucl.ac.uk/tsu/elasfinweb.pdf).

consumption by only 1.2 %. However, in the long run elasticities have been estimated around -0.45. While it is worth stressing that even estimations of long run elasticities for fuel are low compared to elasticities on most other products, it should also be underlined that elasticities will be variable amongst EU Member States, depending notably on the availability of alternative modes of transport to passenger cars.

Furthermore, it is also important to bear in mind that fuel consumption does not only depend on fuel prices but also on factors such as population, GDP, etc. These other factors have been so important that the underlying trend of fuel consumption has been increasing, despite progressive increases in fuel taxes.

Tax differentiation: Examples of unleaded and low sulphur fuels

Another important feature of fuel taxation is the introduction of tax differentiations, which has a very high potential to influence consumer behaviour since different types of fuels are essentially identical products to consumers. If one type of fuel costs only a little less than another, it will quickly gain a larger market share.

Getting rid of lead…

All EU Members, and many other European countries, applied a tax differentiation for leaded and unleaded petrol. This measure is generally reported to have been very successful in stimulating the market penetration of unleaded petrol. This differentiation can be regarded as a pure incentive element within a primary fiscal tax.

For example, Germany introduced as early as 1985 fiscal incentives to phase out lead in petrol. From a 89% market share in 1986, leaded petrol fell to only 3% in 1996, and 0.4% in 1997 (at the end of August 1996 production of leaded petrol was discontinued in Germany, and in 1998 it disappeared completely from the market).

Sweden is also a particularly illustrative example of the use of fiscal incentives to improve fuel quality. While in the late 1980s, about 80% of total atmospheric lead emissions originated from traffic, Sweden adopted a three step approach to phasing-out leaded petrol: firstly by gradually reducing the lead content of petrol in the 1970s, then incentivising the production of unleaded gasoline by introducing differentiated taxes for leaded and unleaded gasoline (and gradually increasing the differentiation), and as a third and final step research was carried out in order to introduce an additive able to replace lead for cars with older technologies. The graph below illustrates the efficiency of this 3 step approach, with particular emphasis on the second step as recognised by the Swedish Environmental Agency according to which *"without doubt the main reason for the rapid changeover to unleaded petrol was the introduction of differential taxation*" (Swedish EPA report, 1997).

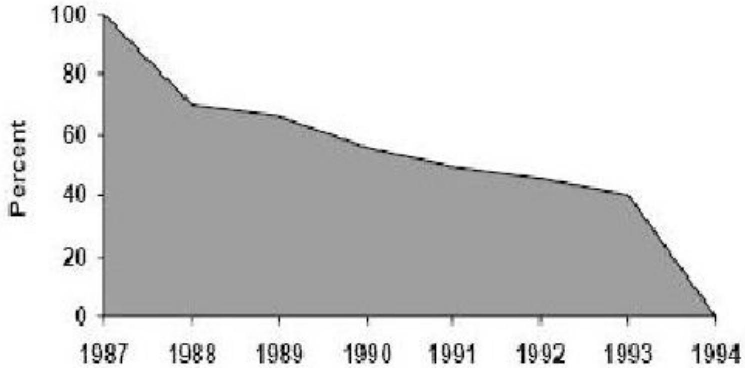


Figure 2. Evolution of the Swedish market share of leaded gasoline further to the introduction of a tax differentiation in 1986

…and of sulphur…

Some EU countries also have introduced lower excise tax rates for other types of cleaner motor fuels, such as low-sulphur fuels. Ahead of the 2005 (50 ppm) and 2009 (10 ppm) compulsory EU deadlines, many EU Member States have introduced incentives to promote these fuels since they can significantly reduce emissions from traffic and facilitate the development and use of more efficient engine technology (they can furthermore be used in all types of automobiles as no technical modifications are required).

In the United Kingdom, this diffentiation lead to a 43% market share by February 1999 for what was at the time considered "ultra low" sulphur Diesel (ULSD – 50ppm), and a 100% share as early as August 1999, two years after the introduction of the differentiation in August 1997 (see figure 3).

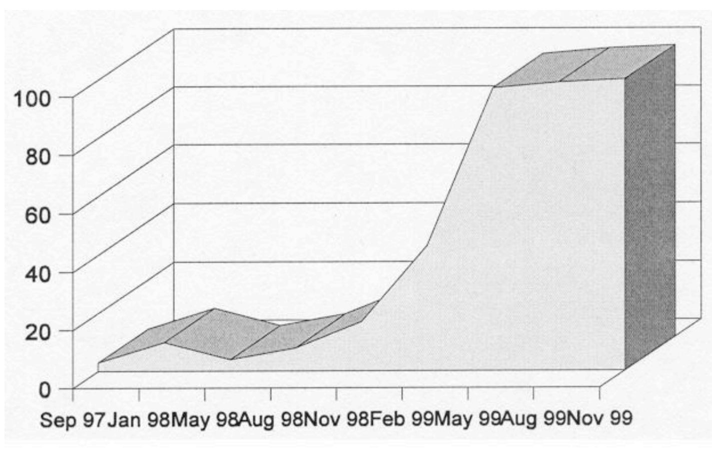


Figure 3. Evolution of the UK market share of Low- Sulphur Diesel (50ppm) further to the introduction of a tax differentiation in August 1997
Source: HM Customs and Excise, Using the tax system to encourage cleaner fuels: The experience of Ultra-Low Sulphur Diesel, November 2000

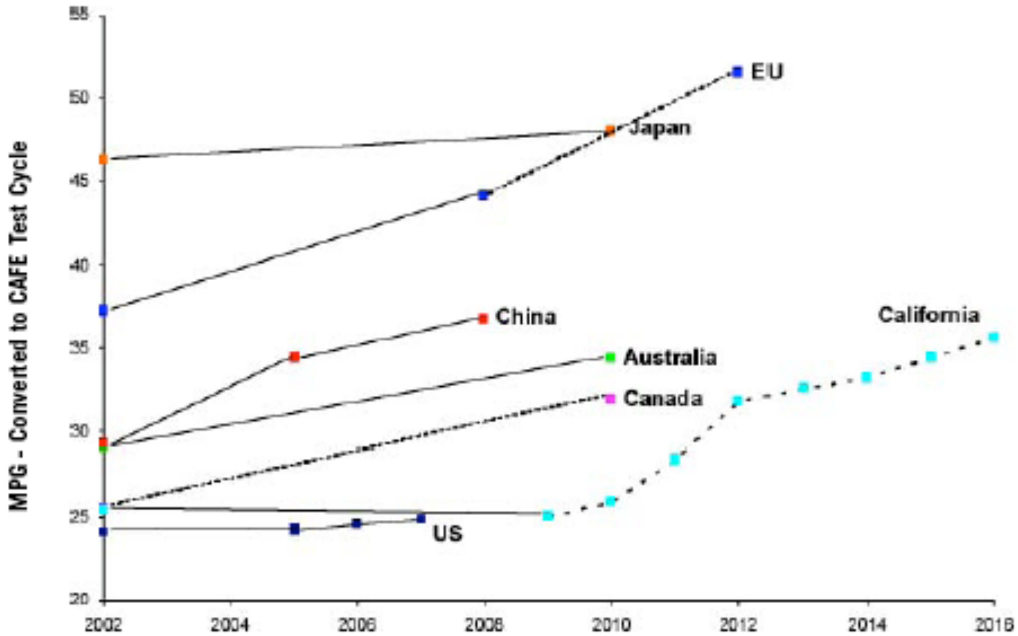
Similarly, the so-called German “Ecotax” included a tax differentiation aimed at favouring the early penetration of low-sulphur fuels: the first differentiation was introduced for low-sulphur fuels (50 ppm) in November 2001, quickly followed by a narrowing of the incentive to sulphur-free fuels (< 10 ppm) in January 2003. The EU requirements regarding the reduction in the sulphur content (50 ppm from 2005) were thus already met in 2001, and by 2003 sulphur content fell considerably below the EU's prescribed level. According to a report by the German Environment Ministry[22], thanks to the early announcement of the differentiated tax rates, the relevant fuels were available early on in the required amounts and the extra tax premium has not led to an additional burden but rather it has prompted a speedy market shift towards tax-privileged low-sulphur and sulphur-free fuels.

From a fiscal point of view there may be a potential revenue loss with using fiscal incentives, such as reduced tax rates, to promote less harmful fuels. If the incentive is successful it will lead to reduced tax revenues, especially if it has a stronger effect than planned. When the new fuels have become the standard product on the market, it could prove difficult to increase the rate of duty in order to compensate for lost revenue. At least one Member State has tried an alternative route. Instead of applying a reduced tax rate on better grade unleaded petrol to promote its use, Sweden increased the tax rate on lower grade unleaded fuel with the aim of bringing about a behavioural change whilst minimising revenue loss.

Fuel taxation and vehicle taxation…

Motor fuel taxation should also be seen in conjunction with vehicle taxation. Figure 4 presents a comparison between the fuel economy standards for passenger vehicles across the world, and figure 5 shows the tax rates applied to gasoline in various OECD countries.

22 “The ecological tax reform: introduction, continuation and development into an ecological fiscal reform”, Update February 2004, Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU)



Notes: (1) dotted lines denote proposed standards
(2) MPG = miles per gallon

Figure 4. Comparison of fuel economy (or greenhouse gases emissions) standards across the world, normalised by CAFE-converted mpg
Source Pew Center on Global Climate Change, December 2004

It is noteworthy to see that the countries with the highest fuel taxes are also the ones that aim for the highest standards in terms of fuel efficiency. While a cross sectional analysis between EU Member States does not show a clear inverse relationship between the level of fuel excise taxes and car use or the average fuel efficiency performance of cars sold in a given country, it is important to underline that fuel taxation should be seen in the wider context of demand management, and of the promotion of energy efficiency. For example, the United Kingdom had the highest excise taxes on unleaded petrol and diesel of all EU countries, but also the highest share of cars in land-based passenger transport. Nevertheless, evidence suggests that fuel consumption by the road-transport sector in the United Kingdom has fallen as a result of the "fuel duty escalator". For example the average fuel efficiency of articulated Lorries over 33 tonnes increased by 13% between 1993 (introduction of the fuel duty escalator) and 1998 (cf. UK DETR 1999).

Figure 5. Tax rates for unleaded petrol, € per litre, between 1.1.2000 and 1.1.2005.
Source: European Environment Agency and OECD

Another point to underline is the fact that most EU Member States have introduced a tax difference between diesel and petrol, partly because originally diesel was mainly used by road freight transport. This preferential treatment of diesel fuel, which is in some respects questionable from an environmental point of view due to the higher carbon and energy content of diesel, has provided an incentive to buy diesel passenger cars, compounded by the lower consumption per km (of course, these lower running costs have an impact if they overcompensate the usually higher purchase price of a diesel car minus its higher resale value). The high market penetration of diesel technology in new cars sold in the EU has been one of the main contributor to the 12% fuel efficiency progress (new cars) observed in EU 15 between 1995 and 2003.

Practical conclusions in terms of best practice in fuel taxation

Based on the experience of a number of countries in fuel taxation and associated initiatives to improve fuels' environmental qualities, the following recommendations can be drawn up:

- **A very efficient tool:** Fuel taxation is a very efficient instrument to phase-out lead and reduce the sulphur content of motor fuels
- **Getting the price right:** To be effective, both the level of the tax and the tax differentiation need to be finely assessed.
- **Getting the timing right:** The availability of cleaner fuels on the market also depends on the ability by refiners to provide them.

- **One element of a toolbox:** Motor fuel taxation must be seen in conjunction with other measures to reduce the environmental impacts of transport, and in particular fuel efficiency standards.

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Tax and Fiscal Policies for Energy Efficiency in Buildings

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I. Overview

China could advance its policies to promote energy efficiency in buildings and equipment—which account for almost 35% of China's energy consumption and a higher fraction of electric peak load—and, more broadly, use energy efficiency policy as a way of promoting prosperity and economic growth, by following a set of strategies that are being used by leading regions and countries in many places throughout the world.

The types of policies can be discussed at two levels: the overall energy policy level and the specific level of the design and implementation of financial incentives.

II. An Energy Policy Focused on Energy Efficiency

At the highest levels, the policies should be:

1. Continued updates to energy codes and equipment efficiency standards based on the incorporation of available and cost-effective technologies for efficiency coupled with

    - Expanded implementation and enforcement of the energy codes with the goal that 100% of new construction is planned, checked, and field inspected by financially-disinterested government or private sector officials, and

    - Energy compliance documents are made part of the legal property records of the building, so that they can be used to establish the value of energy efficiency in the marketplace.

2. Based on consistency with the energy code, the government should establish a rating system for buildings that measures their energy efficiency, focusing on higher levels of efficiency that go beyond the code.

3. The government should establish one or more "recommended levels of energy efficiency" that are substantially higher than code.

4. An agency or agencies should be given the budget authority and charge with responsibility of developing managed incentives to encourage efficiency technologies that could be available in the very short term and that do not require major changes in practice. This could be done through the utility system by decoupling profits from sales and establishing a public benefits fund to support DSM; or it could be provided through a government or non-profit agency that is

provided with a revenue source commensurate with the task. This same agency could offer incentives for producing energy efficiency.

5. The government should develop long-term incentives that complement the managed incentives by establishing much more ambitious targets and relatively long-term (4-7 year, for example) commitments to the qualification level and the funding level. These could be provided through the tax code, or could be provided by the entity that administers managed incentive programs, or by some other organization.

6. All of these polices should be coordinated so that they are mutually reinforcing and non-duplicative.

At a much greater level of specificity, it is possible to make recommendations about how these programs should be designed and administered. Section III looks at recommendations for energy efficiency.

III. How to Design and Implement Tax and Fiscal Policies for Energy Efficiency in Buildings and Equipment

China's markets for energy, much like those of the rest of the world, are afflicted by a variety of barriers and failures that cannot be overcome by pricing policies alone.

So while developing tax and fiscal policies that get energy prices right—that allow consumers to see the full price of energy to the economy—makes sense as an economic reform measure, the reformed prices will do little or nothing to promote energy efficiency and cleaner energy sources, even if these alternatives to polluting energy are more cost effective.

Fiscal and tax policies should concentrate on getting the most advanced technologies for efficiency into the market place in ever-increasing numbers, and on encouraging Chinese building designers and industries to achieve continual improvements in technology for clean energy.

Many countries and regions around the world have experimented with fiscal and tax incentives for clean energy, but only a few of these programs have been evaluated. Nevertheless, the results of the evaluation are consistent with each other, and support a clear set of policy recommendations:

1. The incentives should be based on performance. Incentives for energy efficiency should be based on meeting goals of energy savings or of low energy consumption. Incentives for clean energy production should be based on the level of production.

    - To the extent possible, the incentive should not be based on cost.

2. It is important to make the incentive the right size. Too large an incentive will cause budgetary problems, while too small an incentive will not motivate decisions.

- An incentive of 30% to 60% of expected incremental cost appears appropriate.

- The energy efficiency threshold for the incentive should be relatively high, particularly for multi-year programs.

3. Multi-year programs can achieve higher levels of energy efficiency than managed programs. But they require more careful program design.

   - *Managed incentive programs* with less ambitious goals can complement *long-term incentive programs* with more aggressive goals.

4. Programs should allow choice among the recipients of the incentives so that many technologies can compete or the incentive can be shared or utilized by many different players in the market.

5. The results of the incentive should be evaluated formally.

   - Incentives should be designed to be complementary to other public policies. These other policies could be developed in parallel with the incentives.

Managed Incentives

Managed incentives refer to programs that are operated by an agency that has active oversight of the design of the program and of its administration and implementation. Programs are managed in the sense that when they are unsuccessful in terms of marketing, different approaches can be taken, including alterations in the program design itself. Conversely, management sometimes may consist of shutting down programs that have become too successful in the sense that they have outrun their budgets.

Managed incentives can be operated by a government agency at the national, provincial, or municipal level, or by NGOs or utilities. In all cases, the agency will need a dedicated source of funding. The amount of funding that can be spent in a cost-effective manner is likely to be equal to at least 3% of the revenues of the utilities supplying the energy.

If a utility is chosen to operate the program, it is essential that their revenues be decoupled from their sales. If this is not done, the utility will profit from making the programs ineffective. But if utilities are regulated properly, their most profitable business plan will be to promote all cost-effective efficiency measures undertaken by their customers.

A key element of management for many of these programs is formal measurement and evaluation of the programs' results at the end of the program year. These measurement studies look at statistically significant subsets of program participants and non-participants and try to establish using conservative assumptions how much energy was saved by the program, compared to what would have happened in the absence of the program. These evaluations also look at the cost to the program administrator and to the end user that is making the energy efficiency investment to determine a basis for calculating cost effectiveness.

For designing and implementing managed incentives, the reports available at www.eebestpractices.com provide comprehensive guidance.

Long-Term Incentives

From experience with energy codes and managed incentives, we can develop a set of policy criteria for the development of long-term incentives. These would appear to be:

1. Set a whole building energy performance target that qualifies for a fixed incentive measured in monetary value per dwelling unit or per square meter.

2. Coordinate the methods for calculating energy consumption and energy savings and the methods for validating them--both on paper, through calculations, and in the field - in parallel with the procedures used for code compliance.

3. Try to develop infrastructures of people who can check plans and check buildings that can perform this service equally for incentive qualification and for code compliance.

4. Develop whole building targets based on a reference to the Energy Code, such as percent better than code, or adding specified prescriptive measures to those required in the code.

5. Set ambitious targets relative to the levels of efficiency achieved through managed incentives. Ideally, empirical results of the managed incentives program can provide a distribution function of efficiency levels found in the field that will guide in the selection of a sufficiently ambitious but still reachable goal for the long-term incentives.

6. The incentives should be designed to cover a significant fraction but much less than 100% of the expected incremental cost of energy efficiency. Particularly over the term of these incentives, it is reasonable to expect that the cost of efficiency will decline significantly through innovation and competition as well as through the learning curve effect of increased production of more efficient designs and products.

7. The incentives should be evaluated rigorously after about 3 years and again after they expire.

8. The incentives should be of moderate, limited duration, such as 3-7 years. After evaluations have been made, the program can be discontinued or changed (for example by increasing the energy efficiency of the target).

9. Do not assume that the mere promulgation of long-term incentives will cause their acceptance in the marketplace. Work with government agencies and others

interested in promoting efficiency to publicize the tax incentives and to provide marketing and design assistance for those who may wish to try to comply.

These principles have been incorporated into the U.S. proposed law S.680. It can be found at http://thomas.loc.gov/; after accessing this website type ‘S680’ in the box for “Bill Number”. Several of its provisions were adopted as law in August 2005 in the Energy Policy Act of 2005.

S. 680 includes tax incentives for commercial (“public”) buildings, both new and retrofit, for HVAC equipment, for new home construction and for retrofits in homes, as well as some other incentives taken from other bills. The buildings incentives are fully performance-based, and the target levels of efficiency and the financial amounts of the incentives were chosen based in the principles described here.

Several American organizations, both governmental and NGO, as well as manufacturing corporations and manufacturing trade associations are beginning to organize a dialogue that will allow coordination of government information and education programs with private marketing and advertising for efficiency and with utility-sponsored programs. One of these efforts will be organized through the Consortium for Energy Efficiency (http://cee1.org**).**

Enterprise Income Tax Preferential Policy for High-Efficiency Products

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1. General principles and measures for the design of the preferential policy enterprise income tax

1.1 General principles

1.1.1 The overall context. The energy conservation preferential policy for enterprise income tax is not just a makeshift measure. Rather, it is conceived as a long-term framework based on China's present energy conservation status and current financial and tax policies. It is an incentive mechanism with an intended long-term effect for the promotion of energy conservation.

1.1.2 The key aim. The energy conservation preferential policy for enterprise income tax must be able to reflect the key environmental aim and outline crucial steps, while being practical and in synch with financial policy. In addition, it must attempt to gain maximum energy conservation while expending relatively little money for implementation.

1.1.3 The combination of direct and indirect incentives. According to the development direction of China's reform on enterprise income tax, and with reference to current international common practice, more indirect incentive measures should be taken. These will be concurrent with necessary direct incentive measures.

1.1.4 Simple to follow, easy to operate. According to the present status of China's energy conservation products and the rules for the levy management of income tax, the design of the measures for the preferential policy of enterprise income tax should adhere to rules that are simple to follow. This is helpful in lowering the cost of policy making and implementation.

1.2 Categories of Energy conservation preferential policies for enterprise income tax

1.2.1 Enterprise income tax preferential policy measures to promote the production of energy conservation products

- Direct incentives: Lower tax rate; Tax credit within a fixed time period; Tax rebates for reinvestment.
- Indirect incentives: Investment deduction; Accelerated depreciation; Augmented deduction of R&D expenses.

1.2.2 Income tax preferential policy measures to stimulate purchase and use of energy conservation products

- For energy conservation products or equipment purchased by firms aiming towards innovation in the realization of the national energy consumption standards, the actual investments are to be proportionately deducted from taxable income.

- For the business trading firms that do not produce but trade energy efficient products, a certain percentage, rather than the full amount, of the sales revenues from energy efficient products are to be taxed.

1.2.3 Income tax preferential policy measures to promote the popularization and utilization of energy conservation technologies

- Company income deriving from the technical services for energy conservation production such as technological transfer, technical training, technical consultancy, technical contracting should be exempted from enterprise income taxes.
- Company expenses on the purchase of technical services for the production of energy conservation products can be deducted by an amount of more than 100 percent.

1.3 Enterprise income tax preferential policy measures to be carried out in the near future

The recent focus of enterprise income tax preferential policy measures should be launched and implemented; mainly by taking the form of "investment deduction" and "direct incentives":

1.3.1 Investment deduction. 15% of a firm's investment on the purchase of energy conservation products (equipment) should be deducted from the taxable income of the firm. If the taxable income for the current year is not sufficient for the deduction, the deduction may be carried over subsequent years, but not beyond 5 years.

1.3.2 Direct tax reduction. Direct income tax reduction should be offered to the firms producing energy conservation products. Income taxes for the firms specially engaged in the production of energy conservation products should be halved. The firms not specially engaged in the production of energy conservation products should separate the business accounting into income deriving from the manufacture and sales of energy conservation products on the one hand and other income on the other; and the income tax for the former part should be halved.

2. The Catalogue for Energy Conservation Products eligible for the enterprise income tax preferential policy and its evaluating indexes

2.1 The definition of "energy conservation products" eligible for enterprise income tax preferential policies

The energy conservation products (equipment) refer to those products (equipment) meeting the relevant standards on quality, safety and environmental protection compared with products of the same kind or functions that do not conform. The energy efficiency of these products meets Requirement 1 or the Evaluating Values of energy conservation in the Energy Efficiency

Standards, attaining an advanced international level, in addition to having reasonable users and a smaller payback period.

2.2 Principles encouraged by the government in deciding the content for the Catalogue of Energy Conservation Products/Equipment

- Meeting current or future market demand and the requirements of energy conservation work, while having broad development prospects.
- Being used in large volume, possessing obvious potential for energy economization and higher efficiency of energy utilization.
- Outlining tried and tested techniques and guidelines for popularization.
- Experiencing difficulties in marketing due to price factors.
- Accounting for a low market share, currently less than 10%.
- Possessing a high technological level that allows enterprises to conduct equipment updates and technological innovations, promote the optimization of industrial structure and realize economic benefit.
- Lowering the cost of implementing the incentives while achieving greater comprehensive economic benefits.

2.3 Potential energy saving and economic benefit analysis

This analysis aims to forecast the energy-saving, environmental and economic benefits of different products as a result of implementing the enterprise income tax preferential policy in the coming 10 years (2006-2015).

2.3.1 Analyzing steps

- Collect data on the product prices, annual production volumes and operating time, energy efficiency, and subsidizing rate.
- Conduct a preliminary analysis to obtain data on production cost increments, annual electricity savings, and fiscal expenditures.

By analyzing economic benefit, electricity cost saving and emission reduction, the total economic and environmental benefits for the implementation of these preferential policy measures may be figured out.

2.3.2 Input data for the analytical model

- Major input data
    - Annual volume of the product/equipment.
    - The market share of the product/equipment included in the Catalogue.
    - Forecast of the net annual volume increase for the product/ equipment.
    - Forecast of the volume of the highly efficient product as a share of total volume.
    - Average annual operating time for the product/equipment.
    - Average life time for the product/equipment.
    - Growth rate of electricity price and yearly electricity cost.

- Annual energy consumption per unit product.
- Cost increment per unit product.

- Determination of common data
  - Electricity price in 2006: RMB 0.6 / kWh.
  - Annual growth rate of electricity price in the following 10 years: 2%.
  - Ratio of investment deduction: 15%.
  - Direct income tax reduction ratio: 50%.
  - The emitting coefficients for CO_2 and SO_2 are 0.953kg/kWh and 0.053 kg/kWh respectively.

2.3.3 Basic descriptions of the products to be included in the first preferential "Catalogue"

Considering the features of the effects of the enterprise income tax preferential policy, and the specificities of the energy conservation products in China, 6 products/equipment in 3 categories are finally determined officially included in the Catalogue.

- Medium and small-sized three-phase asynchronous motors

The motor is the driving force of industrial society. In China, almost 70% of industrial electricity is consumed by motors. China's national standard GB18613 "*Limited values of energy efficiency and evaluating values of energy conservation for small and medium three-phase asynchronous motors"* was released in 2002. Statistics show that currently highly efficient motors only account for 1% of the total market share for motors. The focus of the present market competition is on lowering product prices.

- Transformers for electricity distribution

Electricity transformers are the electrical equipment widely used in various industries of the national economy of China. Given the vast number and type in use, as well as the long operating time of the equipment, there is a great potential for energy saving in the selection and usage of the transformers. Despite the gradual improvement of energy saving technologies for transformers in China, there are always a few highly efficient transformers whose market is constrained by price factors. It is additionally more difficult to promote the technologies for such energy efficient transformers. Compared with other products, the transformers for electricity distribution are expensive, and have a longer lifecycle. Thus, the net benefits from offering it tax incentives can only be observed several years later. The national standard for *"The limited values of energy efficiency and evaluating values of energy conservation of Transformers for Electricity Distribution"* has recently been formulated and will be released soon. Therefore, transformers for electricity distribution have already met the basic condition of inclusion in the Catalogue.

- Unitary Air Conditioner

Unitary air conditioners (so called cabinet type air conditioner) are a type of product widely used in many places in large volume. In China, the newly increased capacity for unitary air conditioners was approximately 3.75 million kW in 1999, and the volume is expected to reach 150,000 sets by

2005. Thus far, in China, the electricity consumed by cooling air conditioners and heat pump refrigerating equipment is about 20% of total electricity generated, and is growing at an annual rate of 10%-15%. The national standards of GB19576 "*The minimum allowable values of the energy efficiency and Energy efficiency grades for unitary air conditioners*" was promulgated in August, 2004, so the pre-conditions for including the unitary air conditioners into the Catalogue are well established.

- Water Cooling Systems

Water cooling systems (heat pumps) for centralized air-conditioning run by compressed steam/recycled water cooling systems (heat pumps) which are generated by electricity and an absorbing type bromized lithium, resulting in cooling (heating) generated by oil, gas and hot water. The refrigerating air conditioners and pump heating equipment in China consume more than 20% of total electricity generated, and the consumption is growing at an annual rate of 10-15%.

In August 2004, the national standards of GB19576, "*The minimum allowable values of the energy efficiency and Energy efficiency grades for water chillers,*" was promulgated by the Standardization Administration of China. The pre-conditions for including water-cooling systems into the Catalogue are thus mature.

- Room air conditioners

At present, room air conditioners consume more than 40 billion kWh of electricity annually. As air conditioners increase in popularity, this number will become even greater. Meanwhile, since the season for the use of air conditioners is relatively concentrated, huge electricity consumption peaks are created. In recent summers, the amount of electricity consumed by air conditioners accounts for 40-50% of the peak load, resulting in 2/3 of provinces and regions needing to take blackout measures to restrict the use of electricity, seriously affecting people's living and ability to be productive.

On March 1st, 2005, national standard GB 12021.3, "*The minimum allowable values of the energy efficiency and Energy efficiency grades for room air conditioners",* was promulgated. Therefore, room air conditioners are also an ideal product to be included in the income tax incentive policy covering energy efficient products.

- Electric washing machines

China produces a substantial number of washing machines, with the annual production volume reaching over 14 million. The ownership figure for the whole of society is over 50 million, making China number one in the world. In the residential sector, the amount of water consumed by washing machines accounts for 25% of total water consumption. It is obvious that besides the challenge of saving energy, water conservation is also an urgent issue to be solved. Along with the rising consumption level and the demand of social development, it is of important practical value to design and manufacture washing machines that can satisfy not only the requirement of making clothes clean, but also the need to save both energy and water.

In 2004, national standard GB 12021.4, "*The maximum allowable values of the energy consumption and Energy efficiency grade for household electric washing machines,"* was promulgated. Consequently the washing machine is naturally included in the catalogue.

Detailed analysis and calculation show that, if the 6 selected energy conservation products/equipment can enjoy the incentives of "investment deduction (30%)" and "direct tax reduction (tax rate halved)" in the coming 10 years, the tax losses for the government will be approximately RMB 28.734 billion, while the cumulative electricity saving would be 12.32 billion kWh, electricity cost saving would be RMB 86.86 billion. The cumulative emission reduction for CO_2 would be 117.2 million tons, and that of SO_2 6.5 million tons.

3. Accreditation and management scheme for the enterprise income tax preferential policy for energy conservation products

3.1 Conditions for application

The energy conservation products sold or used can be separately accounted; the energy conservation products are included in the "catalogue"; the energy efficient products sold or used meet the requirements of government industrial policy and relevant standard(s).

3.2 Contents for accreditation

The energy conservation product applied is included in the "Catalogue"; the energy conservation product meets the requirements of the "catalogue"; the manufactures or users of energy conservation products meet the conditions to be qualified to enjoy the preferential policy specified in the government's document on enterprise income tax preferential policy; the category and scope for the enterprise to enjoy income tax preferential policy.

3.3 Accreditation procedure

Applicants should submit written applications to the Development and Reform Commission of the local government (city level) and also submit a copy to the mandated tax authority. Manufactures or users of energy conservation products applying to take advantage of the income tax preferential policy should submit the following material as required:

- A copy of the business license or registration proof for the manufacture or use of energy conservation products.
- A test report regarding the energy efficiency of the energy conservation product for which the company is applying.
- Proof of the price and amount of the energy efficient material sold or purchased.
- Tax proving material manufactures or users of energy conservation products.

Manufactures or users of energy conservation products should entrust product quality supervision and a test center to provide the test reports of the energy conservation products for which they are applying. Each province, autonomous region or municipality directly under the central government should establish an energy conservation product accreditation committee. The Development and

Reform Commissions should head the accreditation committee at the provincial level, and the tax bureaus and financial bureaus of the same level and relevant industrial management departments should also be included in the committee.

Manufactures or users of energy conservation products who obtain the accreditation certificates must submit the tax-exempt or reduction application reports to the relevant tax administrative department.

3.4 Supervision/monitoring and management

Provincial level Development and Reform Commissions and Tax Bureaus should strengthen the supervision and management; each year, at least 30 percent of accredited units should be checked.

A reporting system for the basic status of the tax preferential policy for energy conservation products should be established.

Fiscal Policies and Supervision Systems For Energy-Efficient Buildings in China

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Building a society oriented toward saving energy is a primary goal if China aims to develop in a sustainable way. "Energy saving priority" has already become an important component of China's energy development strategy. However, "energy saving priority" has not yet been implemented. The main reasons are that energy saving is widely regarded as a public welfare cause, leading to lack of responsibility, and "market failure," where energy savings have not been realized in an uninhibited competitive market.

Policy intervention is necessary to overcome these market failures and secure public goods. Enacting energy conservation incentive policies can actually reduce costs. Currently, energy conservation incentives are not in place, and without them, it is hard to convince consumers and enterprises to save energy when they operate in a market economy driven by profits.
Energy conservation in the buildings sector has a public welfare nature. It is quite easy to develop fiscal mechanisms utilizing a leverage effect, "using less money, and obtaining better results."

At present, China is at a stage in development where the residential consumption structure is being upgraded and there is increasing consumption. Society is transitioning from "survival-oriented" to being "enjoyment-oriented". China currently has the most new housing developments, in addition to space heating, air conditioning, and household appliances in the world. Air conditioning and space heaters have become a major reason why during peak seasons, demand for energy skyrockets. Air conditioning systems, space heaters, lighting facilities, and existing buildings all waste a great deal of energy, hence a huge energy-savings potential. Energy conservation incentive policies in the building sector should be formulated and issued as soon as possible. This will set the foundation for the development of a society oriented towards energy saving and the promotion of sustainable social and economic development.

1. Analysis: Current barriers to the establishment of energy conservation fiscal policies in China

(1) Mechanism barriers

Because China uses district heating/cooling meters and bills according to floor area, consumers have little incentive to save energy. Also, because "heat supply reform" may also affect thermal power companies' profits, reform is difficult.

(2) Barriers to implementation of compulsory regulations and policies

China is now in a period of political and economic system reform. Rule of law is unsound, laws are not abided by, and laws regarding energy conservation are not rigorously enforced, all of which seriously affects the enforcement of compulsory regulations and policies.

(3) Technology barriers

Although "heat supply reform" policy has been promulgated, it still has technical issues and problems selecting thermal meters, reducing the cost of thermal meters, and solving technological difficulties. Most buildings (including new buildings) that have applied with a district for heating have not yet installed thermal meters, seriously hindering reform progress.

(4) Barriers to capacity building

China has few organizations authorized to conduct evaluations, tests, and certify high-efficiency energy-saving technology. There is still a great need to perfect the market energy-saving-technology assessment mechanism. This deficiency to evaluate and test energy conservation effects has become a very real barrier to the spread of energy conservation in the building sector.

(5) Barriers to energy pricing

Currently, no market-based thermal pricing mechanisms have been established in China. Furthermore, thermal price regulating policy has not yet been promulgated.

(6) Barriers to investment

The biggest barrier to developing an energy conservation incentive policy system is a lack of capital and a shortage of long-term incentive fiscal policies. China does not have a special energy conservation fund to support short-term energy saving renovation projects and new high-efficiency energy-saving technology.

2. Targets, principles, and basic framework for building energy conservation incentive policies

(1) Targets

- A specific implementation approach for building an energy-saving-oriented society through energy-efficient buildings.
- Exploration of practical and applicable financial and tax incentive policies suitable to China's current construction industry.
- Promotion of energy conservation evaluation and testing of buildings.
- Development of high-efficiency energy conservation management, and maintenance of buildings and facilities.
- Encouragement of energy saving performance requirements for newly-built and existing buildings (facilities), of increased production of high-efficiency buildings (facilities), and of adoption of energy-saving technology by the entire market.
- Achieve peak-load cut-back and improvement of the reliability of the energy supply thanks to guidance in the use of space heaters and air conditioners.

(2) Principles

- Be realistic. Development of incentive policies should be in accordance with the current situation of energy conservation in the building sector. Ensure that all policies are formulated on a sound basis for specified reasons; avoid blindly promulgating policies.
- Applicability. All incentive policies should be developed in line with laws and regulations and with the regional, and technological characteristics of energy use for buildings in China.
- Practicability. All policies should be feasible and easily carried out in a step-by-step fashion.

(3) Fundamental Concept

- Who is the key beneficiary of incentive fiscal policies?
- Who should be the targets of restrictive fiscal policies?
- Which field does the supervision system impact?

(4) Framework

A. Assist building developers to expand the market of energy efficient buildings. Consumers are key to successfully promoting energy efficiency in buildings; hence, fiscal policies should focus on how to encourage consumers to buy energy-efficient buildings. The main reason behind these fiscal policies should be to pave the way to reaching the set energy-efficiency standards.

B. Establish a "market-entry" mechanism for energy-efficient buildings. Greatly increase the matched, standard rate by establishing a practical supervision system and by enforcing mandatory standards on energy efficiency.

C. Avoid the condition of no energy savings of energy-efficient buildings. Emphasize the importance of improving the energy efficiency of the energy supply system. This should encourage equipment suppliers to improve the energy efficiency of their products.

D. Encourage building administrators to improve management and operation of energy supply systems. Enhance assessment of the energy saving of energy-efficient buildings, and especially strengthen the energy management of large public buildings.

E. Enhance energy-efficiency information services for buildings. Develop mandatory energy-efficiency-information labeling policies and establish an annual energy consumption reporting mechanism for governmental buildings.

F. Accelerate renovation of existing buildings to increase their energy efficiency. Develop fiscal policies to encourage such renovations.

G. Promote capacity building for energy efficiency in buildings. Develop incentive policies to encourage energy efficiency in building design, construction, supervision, management, assessment, promotion, training, and so forth and create a service industry for energy-efficient buildings.

(5) Sources of capital

- Energy-saving building should receive public financial support; a heading for energy saving should be included in the public budget. Also, broaden the scope of supportive incentive policies, including tax reductions and exemptions, subsidies, interest deductions, and the accelerating of depreciation.
- Establish a special, self-funding energy conservation fund. Internalize the Resource and environmental costs through collection of additional electricity fees and resource and environmental taxes (carbon tax, ecology tax). This fund should be used especially to support resource-saving and environmentally-related activities.
- Penalize violations of compulsory energy conservation policy.

3. Recommendations for implementation of energy conservation incentive policies over the next one to two years

To make the proposed incentive policies a reality, the following considerations should be taken into account:

- Over the next one to two years, it is not feasible to issue widespread fiscal policies for energy-saving building as the construction sector currently lacks the most basic energy-saving capabilities. Even if financial incentives were to be issued, it would be difficult to implement these policies.
- Policy must take into account the big barriers in setting up a building energy conservation fund, and should consider taking the amount used for building energy conservation from the social energy conservation funds.
- Ensure that key points are emphasized, and give priority to energy-saving measures that will result in significant energy saving and in an obvious reduction of peak-load energy demand.
- Combine the relevant implementation plans for the ten key energy-saving projects laid out in the "11th Five-year" plan period.

It is suggested that the following energy saving incentive policies be implemented in the near future:

(1) Extend dates for current, successful policies in place

It is necessary to extend the current expiration date for fee collection for the "new wall material special fund." According to the stipulations laid out in this plan, the fund will cease to collect fees by the end of 2005. Analysis of the results show that it is necessary to not only prolong the longevity of this fund, but also ensure that it integrate building energy saving into the fund.

(2) Reduce Title Deed Taxes on purchases in order to encourage consumers to select energy efficient buildings

Current fiscal policy reduces Title Deed Taxes, which are paid when consumers purchase property. To date, certain cities have issued reduction policies to encourage consumers to buy small sized apartments. It is also viable to expand the scope of the policy to encourage consumers to select apartments using advanced energy-efficient technology , which would also offer an added incentive for builders to construct energy efficient buildings by limiting the risk of such construction.

(3) Establish a supervision system to enforce implementation of mandatory design energy efficiency standards

Build a supervision system that can watch over design, construction, inspection, and operations while fostering third-party inspection institutions to assist with the implementation of mandatory energy efficiency standards.

(4) Pay more attention to improving energy efficiency in the energy supply system while facilitating market entry for energy-saving household appliances, office facilities and other types of construction.

There have not been significant results in terms of energy saving for appliances such as air conditioners, refrigerators, lamps, heat pump heaters, however improving their energy efficiency should be easy. Generally speaking, these types of appliances are individual products that have the advantage of being easily upgradeable. And, they are directly available to the consumer. Policy incentives mainly target suppliers and their implementation is consistent with the Income Tax reform of key industrial and residential end-use products.

(5) Enhance capacity building for energy efficiency in buildings through the Energy Conservation Fund and by perfecting the necessary institutions

Use the Energy Conservation Fund to improve the capability of energy efficiency in buildings as soon as possible, especially with respect to energy conservation assessment and institutional inspection. Regulate the market of building-related energy-efficient technologies and products.

(6) Implementation of volunteer agreements with large hotels and restaurants

Encourage large hotels and restaurants that are enthusiastic about saving energy to sign energy-saving volunteer agreement with the government. This should be combined with an energy performance contracting mechanism, and the signing of an energy-saving guarantee agreement with energy service companies. Discuss with local government about different incentive policies to encourage large hotels and restaurants to voluntarily commit to energy saving.

(7) Energy use performance information labeling system for buildings

Implement an urban residential household energy-use information labeling system in "hot summer and cool winter" regions. This would help remove barriers to incomplete information on energy saving and would mobilize consumer enthusiasm for purchasing energy-saving homes. The motivation of this incentive policy is to support capacity building in the field of energy-efficient design and evaluation of energy saving as well as to encourage developers to build energy-saving buildings.

Tax and Fiscal Policies To Promote Industrial Energy Efficiency

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I. The status quo of industrial energy consumption and factors obstructing industrial energy economization in China

In China, the industrial sector is the primary consumer of energy, representing about 70% of total energy consumption in China since 1970, a high figure compared with other countries. The eight industries with the most intensive energy consumption are the steel, non-ferrous metals, construction materials, chemicals, coal, electricity, petroleum, and petrochemicals industries. Together, these industries represent 78.8% of total industrial energy consumption, with basic material sectors such as steel, construction materials, non-ferrous metals, and chemicals representing 54.3% of total consumption. Energy consumption in basic material sectors is notable in that energy costs account for a very large share of total production costs. This means that creating a more energy-efficient industrial sector will also have the benefit of making it more cost-effective.

Factors obstructing industrial energy economization:

- An ineffective industrial structure due to profit-driven activities.
- Blind and overheated investments in high energy-consuming industries.
- Evidence of small firm size and low industrial concentration in major basic material industries.
- Externalities of energy-saving activities are not internalized through price or taxation adjustments, and energy-saving initiatives for firms are not fully in place.
- Inadequate government guidance and financial support policies to promote energy-saving technology improvements in energy-consuming firms.
- Lack of financial support in energy-saving monitoring, legislation, training, and education.

II. Overview and basic principles of fiscal policies that support industrial energy saving

When using fiscal policies to promote industrial energy saving, adjusting energy consumption should be stressed. Original over-dependence on administrative instruments should be abandoned and market-based energy-saving methods should be explored. Administrative compulsion should be replaced with economic guidance; direct administration should be replaced with indirect adjustments; and, effective market-based incentives and constraints should be put into place to promote energy saving among market agents. Formulating fiscal incentives to close the gap between individual economic benefits and social benefits should be the emphasis when utilizing fiscal policies.

The basic principles should be overall balanced planning, combining market orientation and moderate government intervention, long-term programming and readiness to resolve urgent issues, ensuring cost-effectiveness of policies, and coordination of fiscal policies and of other policy measures and instruments.

III. Taxation policy recommendations to foster industrial energy efficiency

1. Tax policy priorities to improve industrial energy efficiency

The industrial structure should be optimized to promote energy saving by increasing energy efficient investments, encouraging social capital to flow into energy-efficient areas, and fostering an energy-efficient consumption structure. Also, there should be greater resource protection in order to reduce the external cost of industrial development.

2. Policy recommendations to establish an industrial structure favoring higher energy efficiency

(1) Foster hi-tech industrial development:

- Accelerate full transformation of the production-based VAT to a consumption-based VAT in hi-tech enterprises, so as to ease enterprises' burden in purchasing machinery and other equipment.
- Remove regional blockades of tax incentives for hi-tech enterprises, and extend incentives currently targeting only hi-tech development zones to all hi-tech enterprises in and outside the selected zones to ensure that all hi-tech firms receive equal treatment.
- Abolish the current system where enterprises only enjoy reduced income taxes when technological development expenses increase 10% annually. The 10% growth requirement should be abolished so that all firms' expenses on new products and technologies that are not intangible assets can be deducted by 150% from the taxable income, and so that those expenses on intangible assets can be calculated into the value of intangible assets-at 150% value-and amortized according to regulation.
- Restructure tax incentives for technology enterprises engaged in venture investments in order to increase social capital during their initial development stage.

(2) Minimization of low-level repeated construction:

- Adjust the tax-revenue dividing mechanism across jurisdictions to break the linkage between imbalanced regional interests and subsequent low-level construction.
- Set up reasonable and principal tax instruments for localities in order to eliminate low-level construction caused by illegal fund-raising activities by local governments.
- Rationalize tax incentives in order to avoid low-level construction due to hazardous taxation competition.

(3) Optimization of the foreign investment structure:

The most urgent issues are the need for the consolidation of the enterprise income tax for both domestic and foreign firms, and the elimination of discriminatory tax measures so as to transform tax investments intended to attract foreign investment from quantity-based to quality-based.

3. Policy recommendations to foster energy-efficient industrial investments

Our recommendations are as follows: reduce rates of taxation; provide tax relief within a fixed timeframe; offer tax rebates for re-investment; and, increase deductions for associated expenses. Similarly, investment deduction from taxable income, accelerated depreciation, and import tax incentives should also be instituted in order to promote usage of energy-efficient equipment.

4. Tax policy suggestions for the promotion of R&D and popularization of energy-efficient products

- Direct reduction revenues deriving from technology transfer, training, and consultancy, technical services, and technical contracting that provide services for the production of energy efficient products, should be exempted from business tax and enterprise income tax.
- Augment current deductions. Expenses for production of energy-efficient products and related technical services and training should be deducted by 150% from taxable incomes, with reference to the expenses on R&D.

5. Tax policy suggestions to promote the consumption of energy-efficient products

- Adjust the consumption tax. Levy an excise tax on high energy-consuming and resource-consuming products that currently are not covered in the scope of such taxes. The excise tax rates for some products should also be adjusted, such as to increase excise taxes for vehicles with significant exhaust gas emission.
- Reform excise tax incentives. Cars, SUVs, and mini-buses that meet certain energy-consumption or pollution standards should also be given certain tax reduction incentives.
- Change vehicle purchase taxes and taxes for vessel usage. Lower excise tax rates for vehicles that operate on clean energy and that meet certain energy-efficiency standards; and, reform the standard for the taxable amount on the vessel usage tax so that vessels with different energy-consumption levels are subject to different rules.
- Introduce fuel levies in the near future. Tax fuel that has different rates of energy consumption according to how energy efficient the different rates are.

6. Tax policy suggestions to promote the protection of resources and the environment

- Further improve the current resource tax system by broadening the tax base for resource taxes to include water and forest resources, and adjust the resource tax burden. Resources that heavily exploit and consume energy should face higher levies. Also, improve the current method of taxation by replacing quantity-based calculation methods with a combined quantity- and quality-based calculation, and establish a flexible mechanism linking the resource tax rate with the price of the resource product.
- Improve the tax system for environmental protection. First, reform current tax measures in turnover tax and income tax frameworks designed for environmental protection. In particular, offer greater incentives within the income tax framework for science- and technology-related expenses and equipment investments that protect the environment. Within the turnover tax framework, increase incentives to stimulate further clean production and sustainable energy utilization, while increasing punitive measures for polluting products. Second, accelerate research on the adoption of environmental protection methods. We suggest that an environmental protection tax be levied immediately for the pollutants that either need to be limited urgently or are very obvious, examined and measured by taxation authorities.

IV. Fiscal policies to foster industrial energy efficiency

1. Fiscal investment policies

Policy directions fostering industrial energy efficiency and fiscal investments are fairly consistent in theme. Budgetary investments and investments from national debt revenues should be consolidated to increase energy-efficient investments in the industrial sector. The following are specific recommendations:

- Budgetary investments and national debt investments should be centrally managed by the National Development and Reform Commission, and should be in line with national economic and social development needs.
- Increase energy-efficient investments as a share of total investments, while making energy-efficient investments in the industrial sector the top priority.
- Increase the use of government discounted loans to ensure easier access to bank loans. This will support energy efficiency in the industrial sector.
- Use state-direct investments for some particularly important, large-sized energy-efficient projects in the industrial sector.
- Arrange earmarked transfers from the central government to local governments for the use of energy-saving activities in the industrial sector.

2. Public budget policies

Directions for, and priorities of, fostering industrial energy efficiency in government public budgets should include the following four areas:

- R&D on energy-efficient sciences and technologies.
- Demonstration and popularization of energy-efficient technologies.
- Education and training on energy efficiency.
- Establishment of a supervisory and regulatory system to promote energy efficiency.

3. Government procurement policies

The authentication of industrial energy-efficient products should be further reinforced, and government procurement of these products should be accelerated. Products that are more energy efficient and in greater demand should be quickly authenticated and added to the procurement list. We suggest that this practice be implemented in central, second-level budgetary units and in prefecture-level budgetary units in 2006. This practice should be extended then to cover the whole nation by 2007.

V. Several issues to be handled with care in fostering industrial energy efficiency in present-day China

1. Fiscal policy measures should encourage industrial enterprises to sign "voluntary agreements"

- Overall planning and extending the scope of pilot projects.

We suggest that the state formulate an overall plan to popularize the use of voluntary agreements on energy saving in the industrial sector. Specific policy measures should be taken to ensure that planned objectives are actually met. The current priority is to extend the scope of experimentation with voluntary agreements. First, energy saving voluntary agreements should be fully extended to the steel industry. Second, experiments should be carried out in intensive energy-consuming industries such as the non-ferrous metal, construction materials, and chemistry industries. The general objective in the Eleventh Five-Year Plan Period should be to popularize the use of energy-saving voluntary agreements by major energy-consuming enterprises in most industrial sectors.

- Fiscal incentives should be developed so as to promote effective implementation of energy-saving voluntary agreements in the industrial sector.

We suggest that all enterprises signing voluntary agreements should be offered incentives in the form of, for example, accelerated depreciation, increased deductions for R&D expenses, investment deductions, and a fifty percent reduction in income tax. In addition, import tax incentives should be offered to those firms importing technologies with higher energy efficiency and lower energy consumption. With regard to fiscal support, financial authorities should provide subsidies. Moreover, the government should consider offering discounted interest loans for energy-efficient projects.

- An effective balancing mechanism should be explored. The government should provide enterprises with incentives for entering into and adhering to voluntary agreements on energy saving. However, time lags in effective implementation incentives are inevitable. In order for there to be results, incentives must be developed first. Thus, an effective balancing mechanism should be established. When the enterprise cannot fulfill its commitments, certain punitive measures should be taken. The form of these punitive measures needs to be carefully considered.

2. Establish a Special Energy Saving Fund

The primary objective of such a fund would be to realize technology advancement for higher industrial energy efficiency and to minimize energy costs for the society as a whole, with the end goal being sustainable energy development. This is to support the realization of national energy-saving programs and to provide full support for the national economy's sustainable development.

The fund money should be invested in the following areas:

- Popularizing and expanding the use of major energy-saving technology.
- Popularizing electricity-saving technology.
- Popularizing R&D, demonstration, and use of energy-saving technology.
- Development of energy-saving industries.
- Establishment of energy-efficient products and services.

Available options for financing of the fund:

- Earmarked fiscal transfers.
- Price increases in electricity or electricity surcharges.

Suggestions for realizing the targeted objectives and ensuring efficient use of funds:

- Prioritize mega-projects (capital construction or technological innovation) that can set up large-scale energy economization.
- Support the development of numerous small-sized energy-saving projects.
- Support the development of energy-saving industries.

The first two suggestions should be used primarily. Discounted loans, partial- or full-amount financial sponsorship and other incentives should also be put into practice.

3. Corporate income tax incentives to improve energy efficiency

- Halve corporate income tax rates for enterprises producing energy-efficient products.
- Deduct a certain percentage (e.g. 30 percent) of a firm's investment in energy-efficient equipment from its taxable income.

The most crucial issue is the drafting of a *Catalogue for Energy Efficient Products (Equipment)*. Key products with great energy-saving potential should be included.

Environmental Levy Policies Promoting Clean Energy Development

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1. Environmental tax policy design

Environmental taxes are collected from entities/firms which are proven to cause environmental damage. The principle that "polluters pay" was first raised by the Environmental Committee of the Organization for Economic Cooperation and Development (OECD) in the early 1970s. Since then, an increasing number of countries have implemented an emissions-charges system to control pollution and to prevent environmental damage. Based on the "polluters pay" principle, the objective of this system is to charge entities/firms causing environmental damage a fee, the revenues of which are then collected in an environmental fund. Such a system promotes social justice and reduces the financial burden of environmental protection undertaken by the government and society.

Since the 1990s, "green taxation" reform has been the trend in environmental tax policy design in many developed countries. This type of reform promotes environmental protection and sustainable development through market mechanisms, i.e. by using economic measures such as price mechanisms and environmental taxes and charges. These environmental taxes and charges not only aim to generate funds for environmental preservation and restoration on the principle that "polluters pay," but also aim to promote resource conservation and changes in production and consumption patterns that will steer economies down a path of more sustainable development. At present, three approaches to environmental damage and pollution control have been implemented in developed countries: (1) command-and-control or direct regulation, such as enacting pollutant emission standards or environment quality guidelines that are enforced by legislation; (2) market-based economic instruments, such as taxes and charges on pollution, an energy tax or tradable permits; and, (3) voluntary agreements, such as voluntary energy-saving agreements between companies and governments, voluntary purchase of energy-saving products and of electricity produced with clean energy, and so on.

2. Review of China's environmental tax and charges policy

China has had pollution emission charges since 1978. Prior to 2003, China had already levied charges against entities/firms if wastewater, exhaust gas, waste residue, noise, or radioactivity produced from their activities exceeded certain standards. Up until 2003, 113 forms of contamination had been defined. Most of the revenue from these fees was returned to entities/firms for pollution control, and a small portion of the revenue was used for onerous loans. In 2003, this system was changed to charges being assessed for *all* pollutant discharges, whether they exceeded previous standards or not. The revenue from these charges then entered the newly-established Environmental Protection Fiscal Fund to support the significant environmental protection projects. This reform signifies a change in the guiding principle behind China's pollution control, i.e. a shift from "terminal control" to "process control."

Although the new environmental levy has a number of advantages over the previous one, the levy still can not fully cover the cost of emission mitigation. Taking SO_2 emission for example, the present charge standard is 630 RMB/t, which is equal to 0.0044RMB/kWh for a coal-fired power plant. Thus, for a desulphurization unit constructed in a new coal-fired power plant, the levy would represent less than 1/3-1/2 of this construction cost. In other words, the current levy is insufficient to stimulate enterprises to adopt SO_2 mitigation measures. Moreover, current power-generation costs in small hydropower, biomass, wind power, and other renewable energy stations are about 1.2 to 1.8 times those of coal-fired power plants that do not use desulphurization devices. Thus, present pollution charge levels do little to improve the market competitiveness of renewable electricity production. To remedy this, pollution charges should be gradually increased to equal at least emission mitigation costs; this will stimulate companies to reduce pollutant emission in the short-run. In the long-run, the levy should be raised to equal eventually the full social cost of emissions, which far exceeds emission mitigation costs; this will promote energy saving, the adoption of environmentally-sound technologies, like renewable energy, and should be compatible both with protection of the environment and economic development. On the other hand, the Environmental Protection Fund should not be limited to pollution treatment and emission mitigation (such as installing desulphurization sets in thermal power plants). Rather, it should also be used to support the deployment of technologies that reduce or avoid pollutant emissions upstream, such as energy-saving and renewable-energy technologies; this could reduce pollutant emissions radically.

3. Suggestions for the Reform of Environmental Levy Policies that Promote Energy Conservation and Renewable Energy Development in China.

(1) Formulate guiding principles for environmental levy policy in China so that the policy adopted can have an important impact on pollution reduction, environmental protection, energy-saving and support for renewable energy development.

(2) Formulate a complete environmental tax and charge policy framework by integrating different economic-based environmental policy instruments. Eventually, build an economic and environmentally-friendly society to promote compatible sustainable development of the economy, the energy industry and the environment.

(3) Integrate environmental tax and charge policies with direct regulatory policy tools, such as the law and code, to ensure that these market-based economic instruments have their desired effect.

(4) Integrate environmental tax and charge policies with voluntary actions, improve the participation of the public and of companies, and build a supportive ambience for environmental protection and energy saving.

(5) Build a well-coordinated policy system for environmental protection, energy conservation, and renewable energy development, improve existing laws and regulations, and create a consistent policy framework and market-based economic instruments.

(6) Make full use of the environmental taxes and charges policy to promote energy-saving and renewable energy technology innovation, and technological advancement in resource saving and environmental protection.

(7) Integrate environmental tax and charge policies with other energy pricing and market penetration policies to support the large-scale development of the energy-saving and renewable energy technology industry.

(8) Integrate long-term objections with short-term feasible measures of levy policy reform, and be proactive in their implementation to ensure the policy's continued success.

In short, as the reform of the environmental levy is a complex and systemic project, its success depends on how well it accounts for different factors, and efficiently integrates various policies.

Using Pollution Levies and Emissions Taxes to Promote Industrial Energy Efficiency

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Pollution levies on energy-intensive industries are a type of tax aimed at reducing emissions and wastes. Pollution levies are broadly defined as taxes or fees imposed on industrial facility owners with the goal of reducing pollution generated through the operation of a given manufacturing facility.

In industrialized countries, pollution levies were initially introduced in the 1970s as a means of penalizing polluters for emissions that exceeded a specific threshold. Such pollution levies are currently in use in Australia, Austria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Portugal, Slovakia, Spain, Netherlands, the UK, and the U.S. Mitigation options associated with this type of pollution levy generally focused on "end-of-pipe" technologies.

In the early 1990s, a different type of pollution levy in the form of taxes on polluting energy sources used by industry, was adopted in a number of northern European countries. Such taxes are now found in Austria, the Czech Republic, Denmark, Estonia, Finland, Germany, Italy, the Netherlands, Norway, Sweden, Switzerland, and the UK and are under consideration Japan and New Zealand.

Pollution Levies

Pollution levies are imposed on violators of pollution emissions standards in a number of countries. While these levies are not directly tied to a facility's energy consumption, they are typically imposed on large energy-consuming facilities and the regulated emissions are often associated with energy use.

In general, levels of penalties for environmental offences have been rising across countries, regardless of the type of regulatory system. Minimum penalties are typically small and maxima can be quite large, giving administrative and judicial authorities wide discretionary powers. In many countries, penalties for violations are based on daily rates that can add up to hundreds of thousands of dollars in a single case, or tens of millions of dollars in some recent settlements in the U.S. Some countries allow unlimited penalties, generally informed by the value of damages or the economic benefit the violator gains by the infraction. These higher penalties are credited with having increased the effectiveness of environmental enforcement and motivating regulatory compliance.

Most systems have become more sophisticated over time in balancing the social and economic benefits of violators' activities against the harm of their offences. Experience in the U.S. has borne this out. Other countries with systems of administrative penalties, notably Germany, have also found them effective. It is in part that record of success that is leading other countries to initiate or expand their systems of civil penalties.

Practices vary among countries, but in general one can usefully distinguish between *civil* and *criminal* penalties for violating emissions standards, and between *judicial* and *administrative* proceedings. Criminal penalties can be difficult to apply, because they require lengthy judicial proceedings to prove criminal intent or negligence on the part of individuals or corporations. Civil penalties tend to be easier to pursue, since it is necessary only to show that a violation of regulations has occurred. Civil penalties have thus come to be more widely used. They can be pursued through administrative actions, which are much less costly than court proceedings, though administrative judgments may still be subject to judicial review. Not all countries have provision for administrative procedures. Some have in place only criminal statutes governing environmental violations.

Typically rates for maximum penalties are set *per day* in which an emitter is in violation, often with a cap for the maximum fine per administrative action or per criminal case. Administrative and judicial authorities usually adjust fines based on considerations including the seriousness of the offence, the intent of the violator, ability of the violator to pay, and benefit to the community of the violator's activities. In many countries, the guidelines for fines can be exceeded based on the judgment of competent authorities, and negotiated or court-ordered settlements can be many times higher than maximum fines listed in schedules.

Penalties for emissions violations in the United States can range from warning notices or small fines issued in field actions, to administrative penalties in the hundreds of thousands of dollars, to legal settlements requiring payments of tens to hundreds of millions of dollars and requirements to install new equipment costing as much as or more than the fines themselves (USEPA/OECA, 2004).

There have been many large corporate fines in the U.S. in recent years. Boise Cascade, a major wood products company, paid $4.35 million in civil penalties and committed to installation of $18 million in pollution control technologies (USEPA/OECA, 2004). In 2005, a utility company in the U.S. was fined $9 million for violations at a power plant and committed to installing a $500 million package of emission controls as well as to invest $15 million in Supplemental Environmental Projects (SEPs). SEPs are actions that improve public health or the environment that are taken by an individual or company beyond those required to ensure compliance with environmental laws. SEPs can be undertaken in the areas of renewable energy or energy efficiency, such as projects to establish facility energy management systems or to perform comprehensive energy audits (USEPA, 2005).

Energy or Energy-Related Emissions Taxes

Energy or energy-related carbon dioxide (CO_2) taxes have been used in a number of countries to provide an incentive to industry to improve the energy management at their facilities through both behavioral changes and investments in energy-efficient equipment. Often these taxes are combined with tax rebates for companies that sign voluntary agreements and reach specified energy efficiency improvements levels.

Taxes imposed on energy use or energy-related CO_2 emissions are considered by economists as theoretically superior to other policy instruments because they provide a clear indication of the environmental costs associated with energy consumption. The advantages of such taxes are that they aim to reduce demand for the product taxed, they raise revenues, and they reduce pollution and related detrimental health and labor productivity impacts (Royal Society, 2002). Environmental taxes can also bring a "double dividend" through tax shifting where income or labor-related taxes are reduced, creating additional jobs while protecting the environment. The disadvantages are that taxes can have undesirable effects such as disproportional impact on certain sectors of society (e.g. poor households) or on the competitiveness of industrial sectors (Scrimgeour et al., 2005). Controlling and sanctioning related to taxes can be expensive for governments (Johannsen, 2002). Taxes can also result in strong opposition (Royal Society, 2002) and their enactment can become mired in political debate (Johannsen, 2002). Evaluations of the effectiveness of energy taxes, though, show that they generally achieve their objective of reducing emissions (Scrimgeour et al., 2005). A recent evaluation of energy and CO_2 emissions taxes provides the following guidance (OECD/IEA, 2003): "When setting individual tax rates, governments need to ensure that rates are high enough to be effective and provide sufficient incentive for action while ensuring that they are not so high that industries close down or relocate."

In 1992, Denmark was one of the world's first countries to introduce a CO_2 tax on industrial energy consumption with the aim of encouraging energy efficiency and switching towards fuels with less CO_2 content. The tax is based on the CO2 emissions associated with each fuel type. A portion of the revenues raised by the CO_2 tax was used to subsidize business energy conservation projects. In 1996, the total energy and CO_2 tax on industrial energy consumption was increased and a new system of voluntary energy efficiency agreements introduced in which reduced the tax for industries that signed agreements. The energy efficiency agreements are made between individual companies or associations of companies and the Danish Energy Agency for periods of three years. Between 1996 and 2001, approximately 300 companies entered into such agreements, representing 60% of total industrial energy consumption in Denmark (Hansen, 2001). Under the agreements, companies are required to implement all "profitable" energy savings projects, which are defined as projects with payback periods of up to four years, as identified in an energy audit or through internal investigations. The energy audits are conducted by authorized energy consultants or by company staff. In any case they must be verified by an independently certified organization. In addition, companies must introduce energy management and motivate staff to ensure that investments in new equipment are energy efficient. Subsidies are provided for up to 30-50% of the cost of energy efficient investments (Bjørner and Jensen 2000; Johannsen, 2002).

In the UK, the Climate Change Levy was introduced in 2001. This is a levy on the sales of electricity, coal, natural gas, and liquefied petroleum gas to the business and public sectors. The Climate Change Levy adds about 15% to typical energy bills for these consumers, but companies that meet negotiated energy efficiency improvement targets receive an 80% levy discount. All revenue raised is paid back through a 0.3% cut in employers' National Insurance Contributions and through additional government support for energy efficiency measures and energy-saving technologies. In terms of CO_2 the levy is 7 €/tonne CO_2 for coal, 13 €/tonne CO_2 for natural gas and 14 €/tonne CO_2 for electricity (Smith, 2004). During the first target period (2001-2002) total reductions of 4.3 MtC were realized, which was three times higher than the target for that period (Pender, 2004). Industry realized total reductions of 4 MtC during the second target period, more than double the target set by the government (DEFRA, 2005). Sectors did better than expected because industry underestimated what they could achieve via energy efficiency. When negotiating the targets, most companies believed that they were already energy-efficient. When they actually managed energy because of the CCA targets, companies saved more than they thought that they could, especially through improved energy management (Future Energy Solutions, 2004).

Conclusions

The most well-designed energy or CO_2 tax programs recycle the revenue to provide tax incentives for energy-efficiency investments or to provide information and auditing programs, and provide tax reductions for industries that meet negotiated energy efficiency targets. Overall, the best practices internationally are those that combine energy or CO_2 taxes with other fiscal policies into an integrated program that provides clear economic signals and incentives that raise management awareness so that industries are motivated to reduce the costs associated with consumption of polluting energy sources and to improve the energy efficiency of their facilities.

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Emissions Levy Implementation in China

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Pollution emissions charges are a basic environmental protection policy tool in China, and a key economic policy designed to reduce pollution. In the two decades since its inception, the pollution emission charge system has played an instrumental role in encouraging corporations and institutions to strengthen operation management, enhance resource saving and comprehensive utilization, boost pollution treatment, and limit environmental degradation. They have helped boost supervisory and inspection capabilities for environmental protection.

I. Policy Evolution of China's Pollution Emission Charging

The pollution emission charging system originated in developed economies, and evolved into a full-fledged regime in the early 1970s. To reduce pollution and ecological damage, many developed countries implemented a system in which polluters were assessed pollution charges according to the "polluters pay" principle. Along with its drive to develop the economy and protect the environment, China drew on the experience of developed countries in instituting such a pollution emission charge system. With this system used throughout the country, China has established a legal and regulatory regime for levying pollution charges nationwide.

Over the past two decades, China has established a basic system of laws, regulations, policies and enforcement measures for levying pollution emission charges. The pollution emission charges regime has played a very important role in promoting corporate pollution treatment, raising pollution treatment funds, boosting environmental protection capacity building, and strengthening the enforcement of environmental inspection laws. China's pollution emissions charges have done the following:

1. Encouraged enterprises to strengthen operational management and comprehensive utilization, reduce material and energy consumption, and minimize emissions.

2. Offered a reliable channel for raising environmental protection funds and promoted pollution treatment. As of July 2003, China levied and disbursed 63.8 billion RMB in pollution charges, including 39.1 billion RMB for pollution treatment, accounting for 62% of the total investment in pollution treatment nationwide.

3. Promoted environmental protection. As of July 2003, China had cumulatively given 24.7 billion RMB in subsidies for environmental protection, and employed 160,000 people in the environmental protection system.

4. Become an important means for environmental law enforcement. Levying pollution emission charges has played an increasingly important role in environmental law enforcement, and has become an important means and effective carrier for environmental administration.

II. The Reform of China's Pollution Emission Charge Policies

Given its rapid economic growth, China has not been able to fundamentally change its "brute force" economic growth pattern, resulting in an unsound economic structure. Numerous polluters are discharging pollutants way above the prescribed limits, and total pollution is skyrocketing. To address this situation, China proposed a policy to control the total quantity of pollutant emissions, and reformed the pollution emission charging system accordingly.

In January 2003, the State Council promulgated the *Administrative Ordinance for Using Pollution Charges* (State Council Decree No. 369) to go into effect July 1, 2003.

This *Administrative Ordinance for Using Pollution Charges* delineated a new pollution emission-charging framework that is based on the principle of total pollution control, using environmental standards as legal limits. The core contents of the framework are as follows:

1. It made four changes to pollution emission charging standards: it changed (i) from charging excess pollution to charging per quantity of pollution, (ii) from charging based solely on concentration to charging based on concentration and quantity, (iii) from single-factor charges to multi-factor charges, and (iv) from low charging standards to charging in excess of treatment costs. The new *Ordinance* clearly mandates changing from single-factor charges for statute-exceeding sewage and flue gas to multi-factor charges based on the quantity of pollutants measured in equivalent weight according to their types and volume.

2. It strictly separated collection and disbursement in regards to pollution emission charges. Under the principle of "bills from environmental watchdogs, collections by banks, uniform management by treasury authorities," all charges collected are transferred to the state coffer for inclusion in the fiscal budget. Pollution charges so collected are managed under an escrow account for environmental protection and all of the funds are used for pollution treatment, including important pollution sources prevention and treatment, regional pollution prevention and treatment, pollution prevention and treatment technology and process development, demonstration and utilization, etc. The state treasury provides funds for environmental law enforcement, superseding the erstwhile rules of earmarking pollution charges (20%) and 4 other levies to finance the construction of environmental protection departments. By so doing, China has completely patched the loophole of squeezing, tying up, and embezzling pollution charges.

3. It includes clear-cut provisions strengthening environmental protection law enforcement, regulating law enforcement behavior, building up a robust supervision and assurance system, and making the government more transparent.

As a result of charging per pollution quantity and raising unit charges, China found its pollution emission charges surging to 9.418 billion RMB in 2004, an increase of 32.85% (2.329 billion RMB) from 2003, and there were 733,600 payers of pollution charges, 63.69% more (285,400 more payers) than in 2003. This demonstrated the overall success of restructuring the pollution charge system.

There are, however, still problems. The most striking problem relates to growing motor vehicle flue gas pollution levels in medium and large cities. Currently, the lack of policies imposing pollution emission charges on mobile pollution sources wastes an opportunity to control motor vehicle pollution through effective economic means. We will actively urge concerned government departments to research and formulate policies assessing pollution charges (taxes) on mobile pollution sources.

III. Promoting energy conservation and reducing losses through pollution charges

Along with its sustained, rapid pace of economic development, China is facing the double-pronged pressure of energy shortage and environmental degradation. We are willing to promote energy conservation and cut losses through pollution emission charges. Perhaps the most viable approach is to utilize pollution emission charges, imposing charges per quantity of pollutants, thus encouraging enterprises to reduce emissions. Meanwhile, China can use the pollution funds generated to support energy conservation and minimize pollution. This necessitates the support of the related departments and organizations such as the Energy Foundation. Their support will be valuable, particularly in piloting such policies in traditional industries such as steel making.

Energy and Environmental Tax Models from Europe and Their Link to Other Instruments for Sustainability: Policy Evaluation and Dynamics of Regional Integration

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Executive Summary

Many countries supporting Agenda 21, including the European Union and its Member States, have recognized that action for improving the environment is necessary. The EU has committed itself to binding greenhouse gas (GHG) emission reduction targets under the Kyoto Protocol, encourages and obliges its Member States to implement effective policies, and monitors their progress.

Energy systems need to change for many reasons: the requirement of more energy services due to economic growth, limited access to modern forms of energy, concerns over the security of supply, and important environmental issues, including air pollution, acidification and climate change. These reasons are further related to issues of peace, poverty alleviation, and geopolitical stability. The main strategies are to improve energy efficiency, increase the use of renewables, the introduction of new technologies, and policies mitigating climate change.

Since the early 1970s, and as reflected at the 1992 Earth Summit, sustainability and respect for the environment in the context of development have become global political goals, marked by the following international agreements: Agenda 21, the Rio Declaration on Environment and Development, the Statement of Forest Principles, the United Nations Framework Convention on Climate Change, and the United Nations Convention on Biological Diversity. The Agenda 21 plan of action is especially seen as a "global consensus on the road map towards sustainable development".[23] The World Summit on Sustainable Development (WSSD) in 2002 underlined the importance of energy for development and the urgency for sustainable development worldwide.

China is committed to Agenda 21, and was the first nation to adopt a national Agenda 21. Cleaner, energy efficient production of goods and services is one of China's key strategies for sustainable development, recently documented by the entry in 2003 of the Cleaner Production Promotion Law[24]. Article 7 of this law stipulates the way towards introduction of ecological taxation:

[23] Global Environmental Outlook 1, United Nations Environment Programme, Global State of the Environment Report 1997, Introduction

[24] Approved by the Standing Committee of the National People's Congress (NPC) of the People's Republic of China in the 28th Session on June 29, 2002, entered into force on First of January 2003

"The State Council shall formulate fiscal and tax policies conducive to the implementation of cleaner production. The State Council and other relevant administrative departments having corresponding responsibility and the people's governments of provinces, autonomous regions and municipalities directly under the central government shall formulate and implement beneficial industrial development policies and technological development and popularization policies and undertake supervision and management measures conducive to the implementation of cleaner production."

The European Union, and especially many of its Member States, has gained experience in the use of tax and fiscal policy tools to pursue environmental goals. Some of the policies and experience gained in Europe may be relevant for China's own progression towards sustainable development. However, not all tools or their application have had sufficient results.

The introduction of tax instruments is integral for sustainable development. Ecological taxation normally means a shift in the tax philosophy of the respective country, applying a cost reflecting the environmental impact of a products entire life cycle through production, use, and waste. "Don't tax goods, tax bad-s" is the general slogan or motivation for such Ecological Tax Reforms (ETRs), or Ecological Fiscal Reforms (EFrs).

The increased use of green taxation has shown positive results in some countries through a shift from labour taxation towards pollution or resource-use taxation. Improved environmental indicators clearly underline the necessity to adopt this instrument in the future.

In the EU, energy and carbon taxation is seen as part of the sustainable management of a country and industry. This management requires a variety of different tools from strict legislation to voluntary agreements. Depending on the method and stage of development, each country's priority for certain tools may vary. Overall, one binding element is a master energy and emission reduction plan, setting clear and binding targets with enforceable deadlines. The thoughtful combination of tools and development of a balanced program can generate the most significant effect.

This paper reflects on the most important instruments used to date in Europe, especially energy taxation, and puts these efforts into perspective with other measures such as emission trading and voluntary agreements. It provides examples from selected Member States on energy taxation and their effectiveness, and outlines the strengths and weaknesses in combining different mechanisms.

Modern, flexible, and sustainability-driven policy works best with green taxation, and especially energy or carbon taxation. However, it is evident that tax models are just one important tool in a necessary range of policy instruments. Sound environmental policy requires state responsibility to enforce strict rules. These rules provide the basis for supportive measures and incentives such as eco-taxes and voluntary agreements.

Specifically, voluntary agreements and emission trading can be effectively coordinated with energy taxes. A combination of input taxes for fossil fuels and uranium, electricity taxes for end-users and careful tax rebates for industrial installations taking part in emissions trading has proven to be a productive solution.

It is important that the overall tax system is balanced in a way that shifts towards sustainable green taxation. Energy taxation is necessary to achieve climate mitigation and CO_2 reduction. As a consequence, the tax system needs to integrate effects on the overall electricity market, including the taxation of nuclear technologies despite the fact that they do not add substantially to CO_2 emission levels. In the United Kingdom, a specific supplementary "primary energy tax on nuclear fuels" was designed in conjunction with the Climate Change Levy in order to balance the market effects.

Green taxation can lead to technological modernization and a shift in consumer behaviour. Green taxation can be applied on different levels, from local to international. Energy taxation is mostly a nationwide instrument, sometimes supranational in Europe.

Harmonization of energy taxes became necessary at the European level in order to ease competition and to decrease levels of exemption for energy-intensive industry and other participants in the economic process.

In view of the respective targets, especially the CO_2 emission reduction target, the tax instruments must be designed carefully and their effect on the environment must be monitored.

In general, exemption from energy taxation for specific sectors such as energy-intensive industries represents state aid in the European Treaties' definition and must be notified to the European Commission by the Member State and evaluated by the Commission according to EC State Aid Rules. The European Commission works with a set of evaluation criteria for the acceptance of state aid in the context of energy and overall environmental taxation. These published guidelines are regularly reviewed and updated.

Subsidies and the eco-tax mechanisms require the implementation of controls and surveys by an independent authority. This is necessary to increase knowledge and experience with green taxation mechanisms, including economic knowledge of the costs of not internalizing externalities.

Energy consumption in the majority of EU Member States is still rising, requiring continued attention to policy matters. These include improving energy efficiency, increasing the use of renewables in electricity, the transport and heating/cooling sector, and the encouragement of energy services.

Overall, the following lessons can be drawn from the European experience:

- Ecological taxation needs clear programming with specific environmental targets, such as monitored GHG reduction targets over a specific time period.

- The first step towards the introduction of ecological taxation is a clear design of the overall tax scheme. Planning for eco-taxation needs to be integrated into the overall fiscal development plan of a government and into ecological measures and instruments. National Sustainable Development Strategies are important to help define on which level of administration each type of taxation is appropriate. Often, the local level is best suited to execute plans decreasing pollution and minimizing waste, and to issue regulations that generate income to pay for clean-up, insure polluters take responsibility for charges, and maintain a sustainable lifestyle for local communities. The role of the central governmental level is to monitor the beneficial execution and enforcement of the tax income and to control expenditure for this specific tax revenue.

- Emission limits have to be legally defined with clear consequences for compliance failures. Ecological state governance is to be introduced, meaning an administration which cares for sustainable governance capability in combining corporate and political governance under well defined sustainability priorities.

- All exemptions from taxation must be referred to an independent agency for approval. The exemption can only be given with a review clause and should be limited and decreasing over time.

- The structure and level of the tax scheme is important, and its compatibility with other environmental measures is crucial. Too generous exemptions undermine achievement of the objectives and become counterproductive to the very environmental aim the tax was designed for.

- The tax system must, as all tax systems in democratic structures, avoid undue burdens on the individual citizen. The law must be transparent and easy to understand, meaning that the basic principles of clear tax schemes such as generality, equivalence and ability must be met.

- Harmonization of energy taxation helps to avert competition issues regarding distortion in the market place. The introduction of a harmonized energy tax in Europe will increasingly phase out concerns over competition. More challenging reduction targets for GHG emissions attached to the EU tax level will certainly increase the effectiveness and efficiency of the tax scheme.

- The use of revenues can play an important role in reinforcing the incentive signals which the levy is intended to convey.

- A careful negotiation with main stakeholders before introduction of the tax scheme and a persistent information campaign to the public is crucial to success.

Recommendations for China's Fuel and Energy Taxes

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1. Background

Due to rapid economic growth between 1978 and 2004, total primary energy consumption in China increased at an annual average rate of 4.3 percent, from 400 Mtce to 1300 Mtce. Coal is the primary energy source consumed in China, accounting for 70.7 percent of total primary energy use in 1978, and 70 percent in 2003. The recent rapid increase in China's energy use has already caused environmental, transportation, energy security, and production safety problems. With both environmental and energy supply concerns rising, China must find a sustainable energy development path.

Recently, several important energy policies were promulgated, but there is a great need for further research that focuses on policies currently lacking sufficient support, such as on energy taxes and emission caps. This study addresses questions being asked by policymakers by developing a modeling framework for the quantified assessment of fiscal mechanisms for energy system development in China.

2. Research Objectives

The purpose of this study was to develop a modeling framework to assess several fiscal mechanisms—including energy taxes, gasoline taxes, and emission taxes—for energy system development in China. We extensively analyzed each fiscal mechanism, including its effects, the obstacles it faces, and its impact, in order to provide a systematic framework to guide the use of such taxes in China.

3. Modeling Framework

This study used the IPAC model, a model group that includes both bottom-up and top-down modeling. We targeted two models from IPAC: IPAC-AIM/technology model and IPAC-SGM model.

Both models used the same package of scenario parameters, such as population, GDP, technology efficiency, energy resource, energy price, and sector output, in order to keep the two models in line with the same analysis framework. Despite having different analysis mechanisms, and input and output parameters, the two models we designed share data effectively.

4. Research Review

Tax systems in China and other countries. We focused on energy-related taxes, such as energy taxes, carbon taxes, and transportation fuel taxes. This study explored the motivation of using such taxes, obstacles to their implementation, reasons for choosing a particular tax rate, and provided background information on how to determine the tax rate.

Subsidy systems in China and other countries. Subsidies used for energy conservation and renewable energy were reviewed. We analyzed reasons and sources for subsidies use, obstacles to implementation, and provided background information on how to determine subsidy rates.

Based on these research reviews, the study designed an energy tax, vehicle fuel tax, carbon tax, and SO_2 emission tax that were then assessed by models.

In order to report the effects of energy fiscal policies, indicators were designed, including energy saving (by energy type), emission reduction of gases or pollutants, GDP loss, change in employment, and change in output of various sectors.

5. Results/Recommendations

This analysis shows that the use of an energy tax has a significant impact on energy use. By 2010, with a tax rate of 50 RMB/tce, energy demand will decrease by 6.3 percent, or by around 123 million tce, as compared with the baseline scenario. By 2030, with a tax rate of 120 RMB/tce, energy demand will decrease by 16.2 percent, or by around 400 million tce. An energy tax would only have a slightly negative impact on GDP. In 2010, GDP loss would be 0.4% and 0.36% in 2030. The main reasons for this small reduction are (1) decreased output from the energy industry due to energy saving and (2) the impact on other sectors due to an increase in the price of energy. However, this calculation of the effect of an energy tax on GDP does not fully reflect the impact of reduced energy imports nor does it reflect new economic activity that would emerge from increased investment in new sectors. If these factors were also to be considered, then the negative impact on GDP development could be abated. From the perspective of the GDP growth rate, there will be no fundamental change. More importantly, the concept of "green GDP" could further limit the tax's minor negative impact on GDP.

Considering the social costs of rapid energy development in China –the cost of energy security, the cost of extending the international market, and the environmental cost - the benefits of an energy tax levy promises to be even more significant. Recent wide discussions of a vehicle fuel tax provide a good opportunity to introduce an energy tax, and now is the time to begin serious planning on adopting this important tax.

From a long-term perspective, use of a carbon tax, or combined energy and carbon tax, would be a good choice. A carbon tax has positive effects on carbon reduction and on the optimization of China's energy system, while limiting impact on GDP. Use of a carbon tax would stimulate new technology manufacturing in sectors such as clean-coal technology, new and renewable energy, and energy services, and would also upgrade technology, promoting economic development.

Reforming China's Energy Management System and Establishing a Modern Regulatory System

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Sustainable development of energy in China can be achieved through reforms in the government energy management system, as well as through the establishment of a modern regulatory system. China needs to draw on the successful experiences of foreign countries and apply them to the actual current domestic conditions. A primary goal is also to establish a modern management mechanism and system that aims to improve the efficiency and regulation of governmental energy management, and achieve sustainable energy development through continuous innovation.

I. Major Problems in China's Energy Administrative Mechanism and Regulatory System

In general, the existing energy management mechanism and energy regulatory system in China fails to meet the requirements of sustainable energy development. There are six reasons for this:

1. Lack of coordination capability. The "3 discrepancies" problem, i.e. discrepancy between objectives and pace, discrepancy between national interest and local interest, and discrepancy between short-term benefits and long-term benefits, are common throughout all levels of governments and functional departments responsible for finance, taxation, investment, pricing, economy, urban construction, communications, state assets management, etc.

2. The implementation of policies is unsatisfactory. The government management system is putting more emphasis on the examination and approval of policies, rather than their regulation and management.

3. Inadequate social regulation. Existing government energy management focuses more on the economic side, such as investment, pricing, production scale, etc., than on the regulation of external issues such as environment, security, quality, and resource conservation. This imbalance has resulted in more emphasis on production than on consumption, and more emphasis on supply than on conservation.

4. Discrepancies between central and local government policies. Energy plays an important role in economic growth, finance, employment, and distribution of income, as well as the social stability of the country. The long-term objectives of the central government conflict with the short-term objectives of local government. This conflict in objectives creates disagreements between the central government and local governments regarding

the target, actions, and level of energy management. A typical example is the difference in opinions regarding the regulation of economical automobiles.

5. Regulation is inadequate. In foreign countries, one can see that centralization of the regulatory power facilitates enforcement of regulatory policies. However, the power to regulate the energy sector in China is decentralized and regulatory organizations lack clear functions. In some cases, even the most fundamental regulatory power is lacking. For example, the National Electricity Regulatory Commission lacks essential regulatory powers regarding pricing and accession of administration.

6. Severe understaffing of energy management agencies. The population of China is 1.3 billion and there are 12 million workers in the energy sector, with over 5 million in the coal industry alone. However, only a few dozen people now work in the energy management department in the Chinese central government, in comparison to 150,000 federal employees engaged in full-time energy management in the U.S. Department of Energy.

The figure below lists the key components and foci of the existing energy management and regulation system in China. Three time periods are included: prior to, during, and after projects.

	Economic Returns	**Energy Conservation**	**Environmental Protection**	**Security**
Before	high	below average	moderate	low
During	low	low	below average	low
After	low	low	high	moderate

Note : high moderate below average low

II. Objectives & Focus of Reform

To solve the previously stated six problems, China needs to reform its energy management system and allow market forces to act freely.

General Objectives of Reform:

1. Establish a modern regulatory system by absorbing successful international methods. This system should be independently operated, administration and regulation should be

separated, and adequate authority should be ensured. Checks and balances of power should be effective.

2. Ensure independence of the regulatory body. Whether the regulatory authority is under direct government administration or not, keeping the regulatory authority independent is the foundation of building the modern regulatory system.

3. Separate the administrative body from the regulatory body. Administration should be separated form regulation and the formulation of a policy should be separated from its implementation. This is essential to ensure the independence of the regulatory body and consistency of regulatory policies.

4. Improve regulatory function. In conjunction with loosening economic regulations (e.g. regulations on investment, pricing, market access, etc.), we should strengthen social regulations, especially those on monopolized sectors. The focus of the regulation should be shifted accordingly to changing needs.

5. Strengthen regulations through the law. We should improve the connection between law and regulation in the energy field. Strengthen regulatory law, carry out regulations effectively, and establish an effective checks-and-balances system.

Under the guidance of these general objectives, China's reform of its energy administration mechanism and regulatory system can be carried out step-by-step. The different requirements of short, mid, and long-term targets will work as a reference to specify the reform focus and steps to be taken.

Short-Term Target (1-2 years): The focus in this period shall be improving regulatory function, shifting management focus, strengthening coordination capability of energy management departments, and improving the regulatory function of the regulatory body (e.g. regulatory function of State Electricity Commission on electricity pricing). The focus of the regulation will shift from energy production and supply, to demand, while economic regulation will shift to social regulation.

Mid-Term Target (2-5 years): The focus in this period will be restructuring the government bodies by clarifying the responsibilities of central and local governments. The energy administrative bodies shall be reformed with a focus on strengthening the administrative ability of the government. The targets of the central and local governments regarding organization and system security will be integrated.

Long-Term Target (5-10 years): The new management system and long-term mechanism for sustainable development will be developed according to current laws. While carrying out energy management regulations, the focus will be on saving energy, improving energy efficiency, ensuring energy safety, and developing renewable resources.

III. Initial Concepts in China's New Energy Administrative System

The "separation of administration from regulation" shall be adopted to restructure the energy administrative bodies when establishing the new energy administration system in China. The "separation of administration from regulation" will be realized by establishing a "two-tier structure" in energy management: comprehensive energy management bodies (e.g. Ministry of Energy) will be separated from specialized energy regulatory agencies. The division of labor will be clear since the power and responsibility shall be well defined. The comprehensive energy management bodies will mainly be responsible for the formulation of national energy strategies, proposals and policies, and coordination between energy departments. The specialized energy regulatory agencies will be responsible for market regulation, so as to ensure the healthy development of, and orderly competition in the energy industry.

Tables 1 and 2 below show the functions of the energy administration and regulation at the government level. These functions are distributed according to the specific trades, their functions, and their aim to meet long-term objectives.

Table 1. Energy Administrative and Regulatory Departments and Agencies by Industry

	Coal	Gasoline	Natural Gas	Electric Power	Nuclear Energy	Renewable Resources
Formulating Energy Policies	Ministry of Energy (MOE), National Development and Reform Commission (NDRC)					
Investment	MOE, NDRC, Ministry of	MOE, NDRC	Energy Regulatory Commission (ERC)	ERC	MOE	MOE
Pricing	OE，Price Analysis and Evaluation without Direct Control		ERC	ERC	Nuclear Power and Energy Regulatory	Electric Power and Energy Regulatory
Finance & Taxation	Ministry of Finance (MOF), State Administration of Taxation (SAT)					
Technology	NDRC, Ministry of Technology (MOT)					
Information Collection & Analysis	MOE, ERC (Electric Power and Natural Gas Information Analysis)					

Table 2. Energy Administrative and Regulatory Departments and Agencies by Function

	Supply Side	Demand Side		
		Industry	Construction	Communications
Energy Efficiency	MOE	MOE	Ministry of Constructio	Ministry of Communications (Future Transportation Department)
Environmental Protection	State Environmental Protection Administration (SEPA)			
Security	Mainly production safety on supply side, including gasoline (MOE), natural gas and electric power (ERC), nuclear energy (Nuclear Safety Center) and coal (State Administration of Work Safety)			
Quality	Mainly on supply side, including electric power and natural gas (ERC), without special requirements for the others.			

Based on China's geographic economic zones (e.g. northeast, north, southwest), it is feasible to establish specialized regional energy administrative and regulatory departments (e.g. East China Energy Bureau and East China Regulatory Agency). These departments shall work as representative agencies of the central comprehensive energy administrations and specialized regulatory departments. The provinces, autonomous regions, and municipalities could also establish their own comprehensive energy administrations and specialized regulatory departments, working as representatives of the corresponding departments in their economic zones. This practice will enhance integrity and congruity in energy administration, effectively carrying out specialized regulation and enforcing the national policies.

Features of the new energy administration system:

1. Shifting the administrative functions. The focus of the administration will be shifted from supply side to demand side. Conventional supply-side management focuses on exploitation, processing, and production of energy resources, while demand-side management focuses on energy resource development, conservation, efficiency, technology, etc.

   (a) **Examination and approval periods:** The focus of management will be on market access and accession of standards in terms of the environment, efficiency, etc. More emphasis will be placed on the direction, openness, and transparency of policies.

(b) **Mid-project periods:** Managerial focus will be on regulation, administration, and examination. In addition, the energy efficiency auditing system, organizational structure, and manpower security should be improved.

(c) **Post-project period:** The focus of the management will be shifted to the punishment of regulation violators and loss compensation.

2. Transforming the regulation mode. The conventional regulation mode, in which social regulation takes a back seat to economic regulation, will be transformed into a new one focusing more on economic regulation.

The new regulatory mode includes:

(a) Improve market access regulation by publicizing market access regulations, abolishing discriminatory opinions on ownership, ensuring the transparency of policies, and formulating a proper complaint system.

(b) Improve pricing regulation by reforming the pricing mechanism and regulating naturally monopolized sectors effectively. It is also necessary to integrate protective regulation with incentive regulation and improve the financial, cost, price hearing, and information notification systems.

(c) Strengthen social regulations by focusing on improving resource utilization efficiency, safeguarding the energy supply, and protecting the environment.

(d) Reinforce market order regulations by focusing on countering monopolies, encouraging efficient competition, and examining merger and acquisition cases that would influence market structure.