

Overview of Current Energy Efficiency Policies in China

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Abstract

From 1970-2001, China was able to significantly limit energy demand growth through aggressive energy efficiency programs. Energy use per unit of gross domestic product (GDP) declined by approximately 5% per year during this period. However, the period 2002-2005 saw energy use per unit of GDP increase an average of 3.8% per year. To stem this out-of-control growth in energy demand, in November 2005 the Chinese government enunciated a mandatory goal of 20% reduction of energy intensity between 2006 and 2010. The National People's Congress passed legislation identifying the National Reform and Development Commission as the lead agency to design and carry out programs in support of this goal. These policies and programs, created after almost a decade of decline of the energy efficiency policy apparatus, have had considerable impact. Although initial efforts have not been sufficient to meet the annual declines required to reach the ambitious 20% energy intensity target, the latest reports indicate that China may now be on track to meet this goal. The paper provides an assessment of these policies and programs to begin to understand issues that will play a critical role in China's energy and economic future. Activities undertaken in China will have a significant influence on the global effort to reduce the growth, and later the absolute quantity, of greenhouse gas emissions.

Keywords: China, energy efficiency, policy, energy intensity, target, assessment

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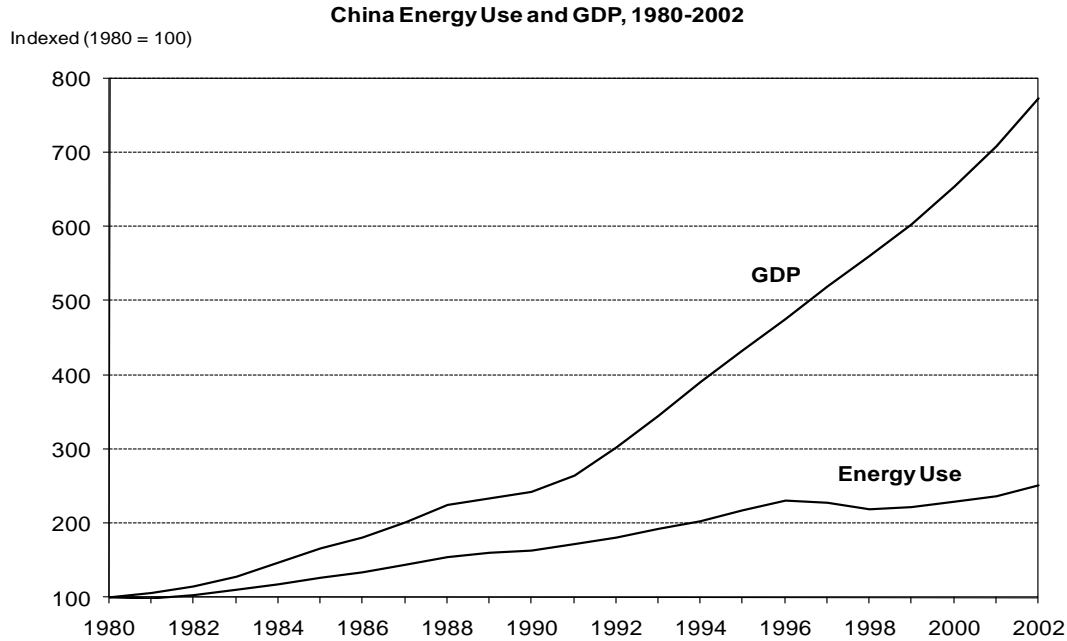
Introduction

From 1980-2001, China was able to limit energy demand growth to less than half of GDP growth. This was achieved through very aggressive energy-efficiency programs organized by the central government working closely with provincial and municipal authorities. The main features of the governmental policy and implementation approaches during this period included: (1) tight oversight of industrial energy use, including monitoring requirements for large industrial energy users in support of energy quotas as well as closing of inefficient facilities and promotion of efficient technologies; (2) financial incentives, initially grants and later low interest loans for energy efficiency investments and cogeneration; (3) information services at the national, provincial, and local levels, including the creation of over two hundred energy conservation service centers; (4) education, training, and propaganda, including an annual energy conservation week in November and training promoted by the government and the Party; and (5) research and development (at modest funding levels) and demonstration projects (at more significant levels) (Sinton et al., 1998; Sinton et al., 1999; Sinton and Fridley, 2000; Wang et al., 1995). The energy conservation service centers and the energy efficiency loans were innovative and effective policy tools. By the early 1980s, investment in energy efficiency and cogeneration reached more than 10% of total energy investment in China (Lin, 2005). No other country has ever created an investment fund for energy efficiency – either through the private or government sector – that resulted in energy efficiency constituting such a large portion of total energy investment.

The effect of these policies and programs was profound. Energy demand grew less than half as fast as GDP. This greatly reduced the need for investment in energy supply and allowed capital to be used for other investments that supported important social goals. It is difficult to imagine the environmental impacts of a Chinese energy system in which energy demand in 2000 was more than two and one-half times its actual value. This exceptional emphasis on energy efficiency for two decades provided many benefits to China and, in terms of energy-related carbon dioxide (CO₂) emissions and reduced stress on global energy resources, to the world.

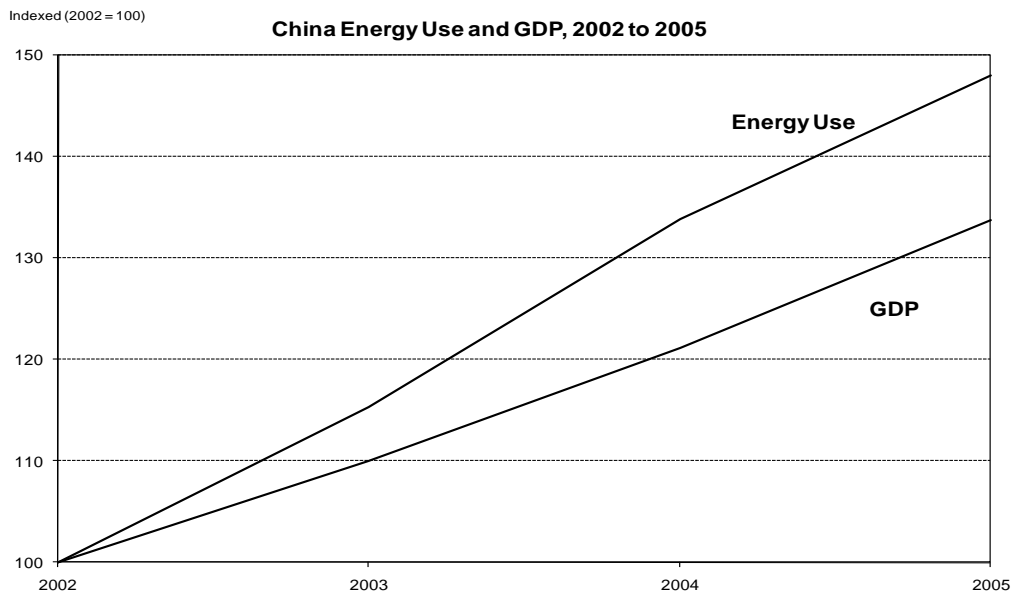
The period 2002-2005 saw a dramatic reversal of the historic relationship between energy use and GDP growth. While there was an average annual decline in this measure of energy intensity of about 5% between 1980 and 2002, the situation turned around completely in 2002; energy use per unit of GDP increased an average of 3.8% per year between 2002 and 2005 (NBS, various years). The contrast between the 1980-2002 and 2002-2005 periods is shown in Figures 1 and 2. One measure of energy demand growth during the latter period is the increase in annual construction of power plants from less than 20 GW in the 1990s to an average of 66 GW per year in the years 2003-2005 (Wang, 2008), the most rapid expansion of electric power in such a short period of time the world has ever seen. The global impact of this dramatic increase in energy demand is significant. By 2006, nearly 50% of global energy demand growth was due to growth

in China. Figure 3 shows the dramatic increase in energy-related CO₂ emissions in China between 2001 and 2005. By 2006, China caught up with and surpassed the United States in five years rather than the 15-20 years projected by most forecasts published as late as 2004 (Levine and Aden, 2008). Figure 4 shows the global significance of this growth in emissions.



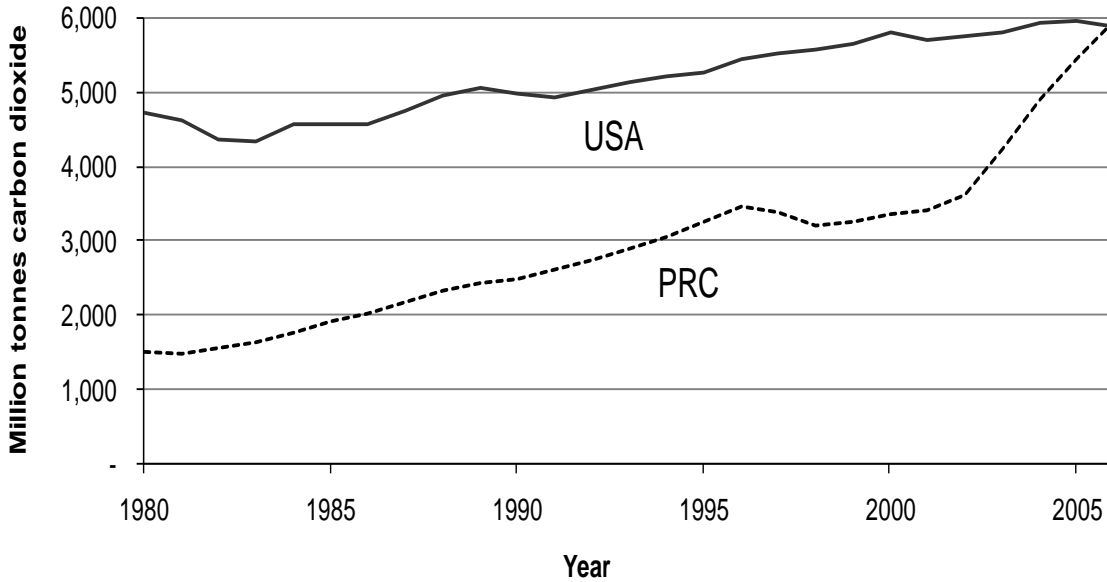
Source: NBS, various years

Figure 1. China Energy Use and GDP, 1980-2000



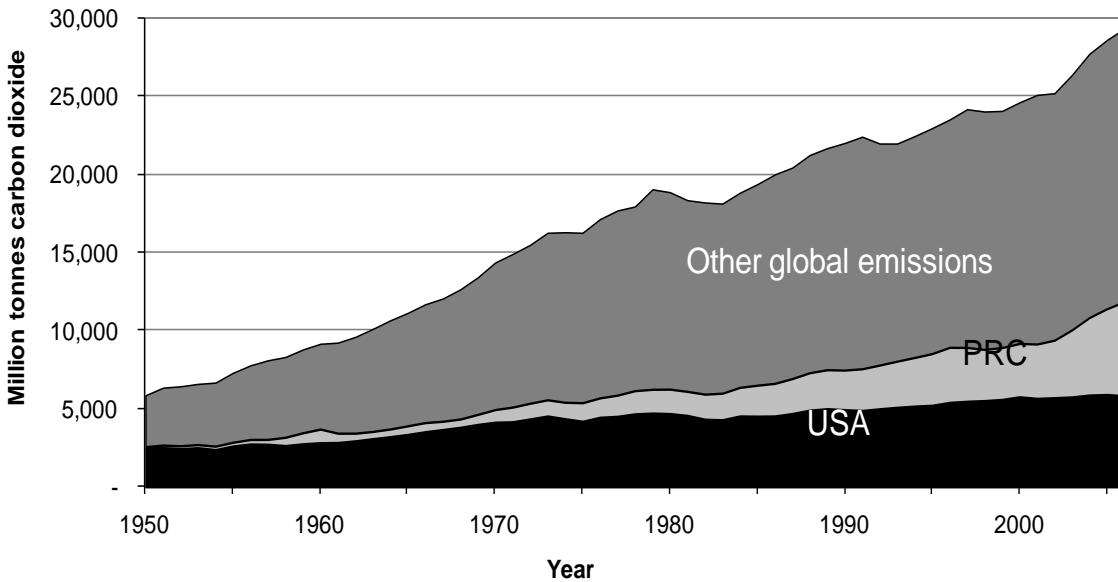
Source: NBS, various years

Figure 2. China Energy Use and GDP, 2002-2005



Source: Levine, M.D. and Aden N.T., 2008. *Global carbon emissions in the coming decades: the case of China,* Annual Review of Environment and Resources. Vol. 33.

Figure 3. Annual energy-related carbon dioxide emissions, 1980-2006



Source: Levine, M.D. and Aden, N.T., 2008. *Global carbon emissions in the coming decades: the case of China,* Annual Review of Environment and Resources. Vol. 33.

Figure 4. Annual energy-related carbon dioxide emissions, 1950-2006

In 2005, senior leaders in the Communist Party and government agreed that energy demand had to be brought under control. In recognition of the unsustainable pace of energy demand growth and its associated adverse consequences, the Politburo of the Communist Party issued a

communiqué on November 2005 in which it called on the nation to reduce energy intensity by 20% in five years. The intent of this exhortation was to bring China back to the relationship between energy and GDP growth experienced during the 1980s and 1990s.

The pronouncement of the Politburo was reinforced by the government in three ways: clear support for the goal of reducing energy intensity by 20% in five years by Premier Wen Jiabao, confirmation of the goal by the National People’s Congress, and revitalization of the energy efficiency policy apparatus in the National Development and Reform Commission (NDRC). The message has been repeated in Party meetings, at all levels of government, and in the media; awareness of the national goal of achieving 20% energy intensity reduction in a five year period is widespread in China.

This paper provides a review and initial assessment of the policies and programs that China has instituted in its quest to fulfill the national goal of a 20% reduction in energy intensity by 2010. Table 1 summarizes the key policies and programs announced and implemented since 2004 that are examined in this paper.

Table 1. Key Policies and Initiatives Implemented Since 2004

Type of Policies	Energy Policies	Date Effective	Responsible agency
Laws	Revision of the Energy Conservation Law	Oct. 2007	National People's Congress and National Development and Reform Commission (NDRC)
Comprehensive policies	Medium And Long-Term Plan For Energy Conservation	2005	NDRC
	11 th Five-Year Plan	Mar. 2006	NDRC
	The State Council Decision on Strengthening Energy Conservation	Aug. 2006	State Council
	Implementation Measures of 10 Key Projects in 11th FYP	Oct. 2006	NDRC
Fiscal Policies	Reduced Export Tax Rebates For Many Low-Value-Added But High Energy-Consuming Products	Sep. 2006	NDRC and Ministry of Finance (MOF)
	Interim Management Measures for Incentives to EC Technology Reforms and Phase out program	2007-Dec. 2010	MOF
	Regulations on Implementation of Corporate Income Law (a:Tax Reduction and Exemption for Energy Conservation Projects, b: Tax Credit for Capital Expenditure on Energy Conservation Equipment)	Jan. 2008	State Administration of Taxation

Sectoral Policies			
Industry	Top-1000 Energy-Consuming Enterprise Program	Apr. 2006	NDRC
Buildings	National Energy Efficient Design Standard For Public Buildings	2005	Ministry of Housing and Urban-Rural Development (MHURD)
	Interim administrative method for incentive funds for heating metering and EERERB(Energy efficiency retrofit for existing residential buildings) in China's northern heating area	2007	MOF
Appliances	Appliance Standards and Labeling	Various years	General Administration of Quality Supervision, Inspection and Quarantine(AQSIQ)
	Government Procurement Program	2005 2007	NDRC and MOF
Transportation	Fuel Consumption Limits For Passenger Cars	2004	AQSIQ
	Revised Consumption Tax For Larger, Energy-Inefficient Vehicles	Apr. 2006	MOF State Administration of Taxation
	National Phase III Vehicle Emission Standards	Jul. 2007	Ministry of Environmental Protection (MEP)

The research was conducted through literature review and interviews. Interviews were conducted with leading energy-efficiency policy makers, researchers, analysts, and industry association members including staff of NDRC, the Ministry of Construction (MOC),¹ the Ministry of Finance (MOF), the Ministry of Industry and Information Technology (MIIT), the National Bureau of Statistics (NBS), the Energy Research Institute (ERI), Tsinghua University, the China Energy Conservation Association (CECA), the China Iron and Steel Association (CISA), the China Cement Association (CCA), the China Building Materials Academy(CBMA), the China National Institute of Standardization (CNIS), and the China Standards Certification Center (CSC). The analysis is based on assessment of the information gathered in the context of China's historical efforts to improve energy efficiency, developments during the 10th and 11th Five Year Plans, and China's current situation, both domestically and in the international context. The paper aims to describe and analyze issues that will play a critical role in China's energy, environmental, and economic future since activities undertaken in China will have a significant influence on the global effort to reduce the energy growth, and later the absolute quantity, of greenhouse gas emissions.

Energy Efficiency Policies

¹ Recently renamed to the Ministry of Housing and Urban-Rural Development (MOHURD).

By 2005, it became clear that the rapid growth of China's energy demand presented serious problems and thus would not be sustainable. Following the announcement of 20% reduction in energy intensity target stated in 11th Five Year Plan, a series of policies, notices, measures, and government reorganizations were put in place to support the realization of the goal, This section summarizes the comprehensive policies and measures announced or implemented in the period 2004 to 2008.

Medium and Long-Term Plan for Energy Conservation

In a prelude to the massive attention to energy efficiency policy beginning with the November 2005 announcement by the Politburo, the NDRC released the *Medium and Long-Term Plan for Energy Conservation* in 2004 (NDRC, 2004). The plan sets out specific targets for the industrial, transportation, and buildings sectors. The plan is still considered to be operational. Its focus is on "top ten priorities" and "ten key projects." The "top ten priorities" are:

- 1) Establish a system for monitoring, evaluating, and public reporting of energy intensity
- 2) Eliminate and/or reduce production from inefficient industrial processes, technologies and facilities, reduce production from inefficient industrial facilities, encourage high technology industry, and shift production away from energy-intensive industries
- 3) Implement "Ten Key Projects"
- 4) Implement "Top 1000 enterprises energy conservation action"
- 5) Strengthen existing and create new financial incentives for energy efficiency, including preferential tax policies on energy conservation
- 6) Strengthen energy conservation laws, regulations and standards (e.g., mandatory appliance labels; more aggressive enforcement of building energy codes)
- 7) Strengthen government programs to gather energy data
- 8) Establish a national energy conservation center
- 9) Promote energy efficiency and conservation in government agencies
- 10) Expand media programs; strengthen training of energy conservation professionals

Some of these stated priorities, such as the implementation of the Top-1000 enterprises conservation action, increased financial incentives for energy efficiency, and strengthening energy conservation laws, have been realized since the issuance of this plan, while others, such as the establishment of a national energy conservation center, have floundered.

Ten Key Projects

In 2005, the "ten key projects" first described in the *Medium and Long-Term Plan for Energy Conservation* were incorporated into the 11th Five Year Plan as important engineering technological measures to achieve the 20% intensity reduction target. The ten key projects are focused on reducing energy use in industry and buildings and include: (1) renovation of coal-fired industrial boilers using 70 million tons of coal (50 million tons of coal equivalent, Mtce)²

² To convert Mtce to exajoules (EJ), multiply by 0.0293

annually; (2) district level combined heat and power projects (saving 35 Mtce annually); (3) waste heat and pressure utilization (1.35 Mtce/year); (4) oil conservation and substitution saving 38 million tons of oil (54.3 Mtce/year); (5) motor system energy efficiency saving 20 terawatt-hours (TWh) (2.46 Mtce/year); (6) energy systems optimization; (7) energy efficiency and conservation in buildings saving 100 Mtce/year; (8) energy-efficient lighting saving 29 TWh (3.56 Mtce/year); (9) government procurement of energy efficiency products; and (10) monitoring and evaluation systems. The expected impact of these ten projects is >250 Mtce/year or about 40% of the 2010 target (NDRC, 2004).

To assist the implementation of the ten key projects, 20 provincial energy conservation centers (ECCs) were given financial support from the central government. In 2006, the level of support varied from 2.4 million RMB¥ (\$299,843) to 4 million RMB¥ (\$499,738)³. In addition, eight ECCs will receive between \$110,000 and \$120,000 through the United Nations Development Program/Global Environmental Facility End-Use Energy Efficiency Program (Jiang, Y., 2006).

11th Five-Year Plan

Shortly after the Politburo announced the national goal of reducing energy intensity by 20%, China's 11th Five Year Plan provided an initial view of the means to achieve this target.⁴

The 11th Five Year Plan was approved by the 5th Plenary Session of the 16th Communist Party of China (CPC). It is a binding energy conservation target for local governments and key central government departments, requiring all government divisions at different levels to ensure the achievement of the target. The Plan also establishes specific efficiency targets for electricity generation, selected industrial processes, appliances, and transport (see Table 2). In late 2006, the State Council approved and distributed a scheme disaggregating the 11th Five Year Plan's national energy-saving target into energy-saving targets for each province. While 20 provinces proposed and were given a 20% energy-saving target, seven provinces were given targets ranging from 12% (for Hainan and Tibet) to 17% and four provinces were given targets above 20% (World Bank, 2008). The State Council further required local governments to disaggregate provincial targets to cities and counties (Zhou, 2006).

Table 2. Selected 11th Five Year Plan Energy Efficiency Targets

	Unit	2000	2005	2010
Electricity Generation				
Coal-fired	gce/kWh	392	370	355
Small & medium generators	% (rated)	87		90-92
Wind turbine	% (rated)	70-80		80-85
Industry				
Raw steel	tce/t	0.906	0.760	0.730

³ Based on a currency conversion of \$1 = 8.00419 RMB¥ (average rate of June 2006); following conversions in this paper are based on historical currency rates according to the relevant year.

⁴ The plan also set the target of reducing pollution by 10% in absolute quantities.

Avg 10 non-ferrous metals	tce/t	4.809	4.665	4.595
Aluminum	tce/t	9.923	9.595	9.471
Copper	tce/t	4.707	4.388	4.256
Synthetic ammonia	tce/t	1.372	1.210	1.140
Soda	tce/t	1.553	1.503	1.400
Cement	tce/t	0.181	0.159	0.148
Construction ceramics	kgce/m ²	10.04	9.9	9.2
Oil refining	kgce/t factor	14	13	12
Ethylene	kg standard oil/t	848	700	650
Coal-fired boilers	% (operational)	65		70-80
Pump	% (rated)	75-80		83-87
Air compressor	% (rated)	75		80-84
Appliances				
Room air conditioner	energy efficiency rate (EER)	2.4		3.2-4.0
Refrigerator	% (energy efficiency indicator)	80		62-50
Household cookstoves	% (heat efficiency)	55		60-65
Household gas water heater	% (heat efficiency)	80		90-95
Transportation				
Railways	ton/mt km	10.41	9.65	9.4
Average automobile fuel economy	liter/100 km	9.5		8.2-6.7

Source: NDRC, 2004.

In November 2007, the State Council called for the creation of new statistical indicator, monitoring, and evaluation systems for energy intensity and pollution reduction (NDRC, 2007a). It also established a personnel evaluation system that stipulates that officials from regions, organizations and companies that do not meet their energy conservation reduction targets will not be allowed to participate in annual rewards programs or to be conferred honorary titles, and leaders in state-owned or state-controlled enterprises will not enjoy the benefits of annual evaluation award programs. In addition, officials will not be promoted if their jurisdiction fails to meet energy conservation targets. Small and medium-sized enterprises in the coal and electricity sectors were required to establish databases starting in 2008; local government bodies are required to annually evaluate the largest energy-consuming enterprises in their jurisdiction. Provincial governments and enterprises are subject to the evaluation process and scores are given to them and to cognizant officials and leaders based on the results. The results are submitted to an assessment team comprised of officials from the NDRC, the Ministry of Supervision, the Ministry of Personnel, and a number of other departments. Failure to pass the evaluation will result in the suspension of the jurisdiction's high energy consumption projects followed by an investigation by administrative bodies. Deception in the reporting of results can lead to criminal charges.

The State Council Decision on Strengthening Energy Conservation

In August, 2006, China's State Council stated that the fundamental approach for reducing energy intensity involves changing China's industrial structure in its *Decision on Strengthening Energy Conservation* (State Council, 2006). China's economic growth since 2000 has been mainly driven by industry and construction, referred to in Chinese statistics as secondary industry.⁵ The service, or commercial, sector share in China has remained at a constant share of 40% after 25 years of rapid industrialization, which is not only much lower than the proportion of services in the economies of developed countries, but also lower than that in other developing countries (World Bank, 2006). The Decision restricts new high energy-consuming projects and sets mandatory thresholds of energy consumption for new project approval. China has not, however, crafted macroeconomic policy to slow the rate of investment in general and in energy-intensive industry in particular.

The Decision stresses the importance of energy efficiency policies for all sectors as put forth in the Medium and Long-Term Plan and the 11th Five Year Plan. It clearly identifies NDRC and its provincial counterparts as accountable for assigning targets as well as assuring achievement of the targets.

The Decision prioritizes clean energy in the power generation sector, promotes energy efficiency power plants (EPPs) and demand side management (DSM) (see Box "Jiangsu Demand Side Management and Efficiency Power Plants"), and revises building codes to set the air conditioning in public buildings to a more moderate temperature to reduce building power loads.

The Decision also promotes tax and fiscal policies to support energy conservation, as well as reform of energy pricing. It directs the central government to set aside funds for the support of major energy-saving projects, demonstration projects, and the promotion of efficient and energy-saving products. It calls for the strengthening of capacity in energy conservation and the establishment of a national energy conservation center.

State Council Work Plan for Energy Conservation

In June 2007, the State Council further issued a *Comprehensive Work Plan for Energy Conservation* (NDRC, 2007b). The Work Plan has two broad purposes: to strengthen the administration of the policies already adopted and to initiate a series of specific measures to reduce energy intensity. These measures include:

- Taxation and fiscal policies, including differentiated pricing policies for high energy-consuming industry;

⁵ Chinese statistics divide GDP into primary (agriculture), secondary (industry and construction), and tertiary (transportation, residential, and commercial).

- 745 separate projects to improve energy efficiency in industry, including waste heat and pressure recovery, efficient motor systems, oil conservation, energy system optimization, and boiler and kiln renovation;
- Accelerated approval for installation and renovation of 16.3 gigawatts (GW) of combined heat and power (CHP) projects;
- 30 green building demonstration projects;
- Heat metering and energy-saving renovation in 150 million m² of existing residential building floor area;
- Energy-saving demonstrations in large public buildings
- Dissemination of 50 million highly efficient lighting products.

A number of these measures were originally promoted in the 2004 Medium and Long-Term Plan and then repeated as part of the Ten Key Projects outlined in the 11th Five Year Plan. Their reiteration and more detailed description in this Work Plan signaled China's continued commitment to these energy-saving activities.

Restructuring Energy Agencies in the Central Government

The policies and programs for promoting energy intensity reduction outlined above were announced and undertaken during an intense period of restructuring of the energy bureaucracy in China's central government. For the past two decades, China's Energy Bureau has been under the jurisdiction of the NDRC and its predecessor agencies. The Energy Bureau has been responsible for energy supply while the divisions responsible for energy efficiency have been in different parts of NDRC.

In June 2007, the State Council established a leadership group on energy conservation and the reduction of pollutant emissions, with Premier Wen Jiabao serving as the named head of the group. The formation of such a group moves the topic to a level above even the NDRC, involving all relevant ministries. In March 2008 an overall reorganization of energy functions within the central government was announced. It is not as yet clear what changes the restructuring will produce, as the functions of the newly formed Energy Bureau (operating outside NDRC) and State Energy Commission (SEC) are not yet well defined. Many observers doubt that this new arrangement will in itself result in significant changes in energy policy formulation. In particular, the role of energy efficiency is not changed in the government restructuring, as energy efficiency remains in the Department of Resource Conservation and Environmental Protection of NDRC, separate from the new Energy Bureau. Some provinces have also reorganized their governments to strengthen institutional capacity in energy efficiency. For example, Shandong province has established an Energy Conservation Office within the government that includes three divisions.

In 2008, The Ministry of Industry and Information Technology (MIIT) was launched to replace the old Ministry of Information Industry, responsible for regulation and development of industry

and informational industry. Its Department of Energy Conservation and Resource utilization was expected to have 18 staff member, and shoulder some load of the energy conservation work in industry within NDRC, specifically on energy conservation, clean production, industrial environmental protection. It was said that NDRC will be in charge of policy making and MIIT on implementation. However, the division of the jurisdiction still largely remains unclear. So far, Department of Environment and Resource Conservation of NDRC is still in charge of the Top-1000 Enterprise Program and Ten-Key Projects, whereas the industrial structure adjustment falls under MIIT's responsibility. MIIT has also been involved in drafting and publishing guidelines for key energy consuming industries⁶.

Establishment of National Energy Conservation Center

A unique feature of China's energy conservation success in the 1980s and early 1990s was the establishment of a network of energy conservation bureaucrats, engineers, experts and policymakers. Of particular importance were the 140 "energy conservation technology service centers" that China created to provide technical assistance to large energy users and to promote energy efficiency (CECS, 2007). These centers received government mandates and funding to conduct energy audits, to implement demonstration projects, and to provide training to energy managers for end-users from all sectors (Sinton et al., 1998). Such an infrastructure of energy service centers was instrumental in implementing government policies and enforcing regulations regarding energy intensity standards and energy quotas. Since the mid-1990s, however, budget cuts have weakened the capacity of many of these centers (Lin, 2005).

In the 11th Five Year Plan, and again in the State Council Decision on Strengthening Energy Conservation, the government has called for the establishment of a National Energy Conservation Center. The Center will be responsible for conducting policy studies, energy conservation assessments, technology dissemination as well as providing training, information dissemination, and international cooperation and exchange. The plan calls for capacity building for energy statistical work and for governmental departments to assure the security and accuracy of data collection and auditing. The National Energy Conservation Center will host workshops and conferences to bring experts together to share information on energy efficiency.

The Revision of Energy Conservation Law

The National People's Congress (NPC) Standing Committee approved China's Energy Conservation Law in November 1997 and enacted it on 1 January 1998. It governs the administration of energy policies, the proper use of energy resources, and the promotion of energy-saving technologies and energy-related environmental protection (CPG, 2008). The breakneck pace of energy demand growth from 2002-2005 revealed the inadequacy of the Law in its unclear assignment of responsibility to government agencies, failure to address outdated

⁶ Based on interview with Jingbo Wang at NDRC, May 2009, and interview with Tiesheng Yang at MIIT in Nov 2008.

energy standards for industrial equipment, lack of provision for energy efficiency in transportation or buildings, and inadequate incentives for advanced energy-saving technologies.

The Financial and Economic Committee (FEC) of the NPC, the country's top legislative body, and NDRC jointly revised the Energy Conservation Law. On October 28, 2007, the revised Energy Conservation Law was adopted at the 30th Meeting of the Standing Committee of the Tenth National People's Congress. The newly revised law clarifies the legal basis for the measures identified in the 11th Five Year Plan, identifies the organizations of government responsible for implementing the plan, prohibits many high energy-consuming products, authorizes provinces to penalize companies deemed to be using energy wastefully, and provides the basis for the creation of special fund and incentive policies for energy efficiency.

In addition, the Law clarifies government authority for energy efficiency in buildings, transportation and public organizations. It provides a legal basis for holding private and public entities liable when producing or selling products not meeting energy efficiency standards, investing in fixed assets that do not meet energy requirements, and engaging in a host of activities that contravene energy efficiency regulations.

Energy Pricing, Tax, and Fiscal Policies

A set of financial instruments and fiscal policies, including energy price adjustments, has also been undertaken to intensify the effort and support the achievement of the national 20% energy-saving target.

Energy Pricing

By 2006, subsidies for energy had been dramatically reduced and energy prices in China increasingly reflected actual costs (IEA, 2007). For example, electricity prices were increased from 0.43 RMB¥/kWh (\$0.052/kWh) in May, 2004 to 0.51 RMB¥/kWh (\$0.064/kWh) in July 2006 (Moskovitz et al., 2007).⁷ Coal prices are largely unregulated. They rose through 2006 and continued their rise thereafter; coal prices are currently at levels higher than those in the United States.

Between 2006 and 2008, energy prices on the international market—led by oil prices—have increased substantially. Because China purchases large quantities of crude oil through international markets, the price for crude oil in China is at international levels. However, the Chinese government has set oil product prices low compared with the price of crude oil, creating a situation that causes the government to pay large subsidies to the upstream oil industry. More recently, international oil prices have declined, thus alleviating the problems caused by lower oil product prices. Similarly, the regulated electricity prices do not necessarily reflect the

⁷ Based on a currency conversion of \$1 = 8.27707 RMB¥ (average rate of May 2004) and \$1 = 7.9897 RMB¥ (average rate of July 2006), respectively.

unregulated price of coal, leaving many utilities in economic distress as coal prices increase. As a result of these developments, since 2006 China has provided very large subsidies to energy suppliers in order to address the mismatches between regulated electricity and oil product prices and the cost of the raw inputs for producing these energy sources. There is a general expectation in China that the subsidies will decline over time as domestic energy prices reach international levels. The pace of such price increases will be influenced strongly by inflation rates for the overall Chinese economy.

In June 2004, NDRC established a policy permitting differential electricity pricing for high energy-consuming industries, including electrolytic aluminum, ferroalloy, calcium carbide, caustic soda, cement, and steel, in which electricity prices can be set based on the energy intensity level of each enterprise. Under this policy, enterprises are grouped into one of four categories based on their level of energy efficiency: encouraged, permitted, restricted, and eliminated. The electricity price varies by the different categories and was designed to phase out inefficient enterprises and encourage efficient ones (Moskovitz et al., 2007). Enterprises in the “encouraged” and “permitted” categories pay the normal price for electricity in their areas. Enterprises in the “restricted” and “eliminated” categories pay surcharges of 0.05 RMB¥ and 0.20 RMB¥ per kWh (\$0.0060/kWh and \$0.0242/kWh), respectively. In 2007, the policy was adjusted to allow local provincial authorities to retain revenue collected through the differential electricity pricing system, providing stronger incentives for provincial authorities to apply the policy (Moskovitz, 2008).

The differentiated electricity pricing policy, however, has not yet been fully implemented. In some areas, preferential (reduced) electricity prices were provided to some high-energy-consuming industries without authorization. This contributed to the very rapid and unplanned development of these industries. In September 2006, the State Council gave NDRC the authority to prohibit or halt preferential electricity pricing and expanded the coverage of the industries subject to differential pricing to include phosphorus and zinc smelting industry. Importantly, it further increased the electricity price for “eliminated” enterprises to 50% higher than the price for high-energy-consuming industries to be phased over three years and immediately increased the price differential for “eliminated” enterprises by a factor of four to 0.20 RMB¥ per kWh (\$0.0252/kWh) and for “restricted” enterprises by a factor of 2.5 to 0.05 RMB¥ (\$0.0063/kWh) per kWh (NDRC, 2006a). On April 16, 2007, NDRC further required 14 provinces to immediately halt their preferential electricity pricing policy for local high energy-consuming enterprises in an attempt to curb the development of such energy-intensive industries (NDRC, 2007c).

Tax and Fiscal Policies

Tax and fiscal policies such as imposition of taxes on energy consumption, tax rebates for energy efficiency, tax credits for investment in energy efficiency measures, and bank lending criteria for energy efficiency loans, have been found effective in developed countries for the promotion of energy efficiency and energy conservation. China's tax revenue in 2007 reached more than 5 trillion RMB¥ (\$655 billion), or 20% of the overall GDP (Wen, 2008). Three tax-related measures--corporate income tax deductions, vehicle and fuel taxes, and export taxes—have been used to promote energy efficiency in China in recent years.

China's new law on corporate income tax, which took effect in January 2008, grants preferential tax treatment for investment in energy-saving and environmentally-friendly projects and equipment (NDRC, 2008a). Qualified investments receive a tax exemption for three years and a 60% reduction in corporate taxes in the fourth to sixth year, starting from the year in which the project first generates operating income (KPMG, 2008). Additionally, 10% of the investment can be credited against income tax obligations.

China has adopted 24 types of vehicle taxes, which include value added tax, sale tax, vehicle acquisition tax, vehicle usage tax, and certain fees such as registration fee and road maintenance tolls. On April 1, 2006, the Ministry of Finance and the State Administration of Taxation jointly enacted a revised consumption tax. The newly revised tax policy puts a higher tax burden on larger, energy-inefficient vehicles.

In 1994, the Chinese government announced that it was considering a fuel tax to replace road tolls. In 1997, it enacted the Highway Law, which permitted this change in taxation. In 2001, plans were finalized for launching the fuel tax; however, implementation was suspended due to the skyrocketing price of oil on the global market. More recent efforts led by the State Council to institute a fuel tax in order to finance the National Trunk Highway System (the Expressway Network) have run into strong opposition from the National People's Congress, largely out of concern for its impact on farmers. In March 2007, the Finance Ministry's budget report (MOF, 2007a) stated that the fuel tax reform scheme was to be drafted in 2007, and the tax launched at the appropriate time (2008 at the earliest). At that time, the various administrative fees levied on the transport sector such as road maintenance fees would likely to be annulled and replaced by the new fuel tax. However, the release of the fuel tax continues to be delayed due to fluctuations in the world oil price.

Tax rebates for exporters introduced in 1985 have made Chinese products extremely competitive in the international market. The rate of the rebate was raised in 1998 during the Asian financial crisis, which resulted in much growth in exports. However, such rebates have become a burden on central finances and are inconsistent with China's energy conservation and environment

protection goals. In September 2006, China reduced export tax rebates for many low-value-added but high energy-consuming products (MOF, 2006). The export tax rebate was reduced from 11% to 8% for steel, from 13% to 8% for cement and from 13% or 11% for glass and from 13% to 5%, 8% or 11% for some nonferrous metal products. In April 2007, the government canceled or cut to 5% tax rebates on exports of most steel products (MOF, 2007b). From August 2008 to June 2009, the tax rebate for export has been raised 7 times to maintain the economic growth in the global financial crisis, however, high energy consuming products will not enjoy the raise⁸.

In 2007, the Chinese government allocated 23.5B RMB¥ (\$3.08B)⁹ to improve energy efficiency and abate pollution (MOF, 2008a). This funding supported the launching of the Ten Key Projects, elimination of inefficient facilities, and installation of environmental protection measures. The Ministry of Finance and NDRC is using a portion of this funding to award enterprises 200 to 250 RMB¥ (\$26 to \$33) for every tonne of coal equivalent (tce) saved (Lv, 2007; Jiang, 2007) related to the implementation of five of the Ten Key Projects. In 2008, the total allocation for energy conservation, emissions reduction, and ecological improvement was increased by 3.5B RMB¥ (\$507M), for a total budget of 27B (\$3.913B) RMB¥ (MOF, 2008a). This funding includes 7.5B RMB¥ (\$1.087B) for awards for the Ten Key Projects, and 4B RMB¥ (\$580M) for phasing out inefficient plants. An additional 14.8B RMB¥ (\$2.145B) provided through Central Construction Investment brings the total funding provided by the central government for energy savings and emissions reduction to 41.8B RMB¥ (\$6.059B) (MOF, 2008a).

Jiangsu Demand-Side Management and Efficiency Power Plants

Jiangsu Province has taken the lead in developing, advancing, and implementing a strategic plan for procuring as much cost-effective energy and peak demand reductions as possible with efficiency power plants (EPPs) – large-scale demand-side management programs using financial and technical strategies to remove barriers to market adoption of energy-efficiency technologies. Through cooperative efforts among the Natural Resources Defense Council, the Jiangsu Economic and Trade Commissions, State Power Corporation DSM Instruction Center, Energy Foundation, the China-U.S. Energy Efficiency Alliance and The Regulatory Assistance Project, a comprehensive inventory of energy efficiency resources and a variety of options to enable these resources to be delivered, beginning in 2006 and into the future, is being developed. Jiangsu Province is preparing first-stage implementation plans for launching two EPP initiatives investing 100 million RMB¥ (US \$12.5 million) in funds earmarked by the Economic and Trade Commission. The Asian Development Bank (ADB) is funding a prefeasibility study of China’s “building” an initial EPP financed by an ADB loan, with the loan to be repaid from reduced energy and construction costs made possible by energy efficiency gains.

⁸ Source: <http://english.people.com.cn/90001/90778/6674963.html>

⁹ Based on a currency conversion factor of \$1 = 7.63329 RMB¥ (average rate of June 2007)

Sector-Specific Energy Efficiency Policies

NDRC and the Ministry of Science and Technology issued the *China Energy Technology Policy Outline 2006* in January 2007. The Outline updates the previous version, released in 1996. It describes energy-saving technologies that became available in the last 10 years; and emphasizes research, development, demonstration, and promotion of major energy-saving technologies. It also proposes the elimination of and restrictions on high energy-consuming technology, processes and equipment. The Outline can be seen as providing a technical basis for the energy target in the 11th Five Year Plan and the programs and technologies in each of the energy-using sectors.

Industry

Industry is the largest energy-consuming end-use sector in China, officially using about 70% of China's total primary energy (NBS, various years). This value, however, overstates the amount of energy used for manufacturing and also includes energy used for non-industrial activities in non-industrial facilities, such as hospitals, schools, and living quarters for workers in industrial units. When these activities are removed from the industrial sector, the share of China's total energy use that is consumed for industry declines to 61% (Zhou et al., 2007). The Chinese government has placed much emphasis on improving the energy efficiency of its industrial sector. Efforts related to energy pricing and fiscal policies, closure of small industrial facilities, and the introduction of a program focused on the largest industrial energy consumers are discussed below.

Energy Pricing and Fiscal Policies

Prices for electricity and coal for the industrial sector in China vary by region and by type of coal. Industrial power tariffs plus the demand charges range from 0.4 (Jilin) to 1.0 (Guangdong) RMB¥/kWh, and average around 0.6 RMB¥/kWh (\$0.09/kWh) in China (NDRC, 2008b) which is comparable to electricity prices for industry in other countries such as the US (\$0.06/kWh) and the countries of the OECD (average \$0.08/kWh) (IEA, 2006). In 2005, the price of coking coal in China was about \$62/ton and about \$92/ton in the U.S. (IEA, 2006), but it has recently exceeded \$200/ton in China (MOFCOM, 2008) while the most expensive coal in the U.S. reached \$150/ton (U.S. EIA, 2008).

During the 1980s and 1990s, financial incentives were heavily used to promote energy-efficiency investments in China's industrial sector, especially when a shortage of capital was a major issue preventing such investments. The most widely used fiscal policies were low-interest loan programs, interest subsidies, tax credits, and tax reductions and exemptions (Lin, 2005). One

program, managed by the China Energy Conservation Investment Corporation (CECIC), provided loans with interest rates typically 30% below comparable commercial loans (ERI, 2004). In 1998, this program was phased out and a new one run directly by banks was established. This program provided loans to enterprises for technical renovations with interest subsidies of 50% provided through national Treasury bonds and local government budgets (ERI, 2004). A fixed asset investment credit of up to 40% for investments in energy conservation projects was used by fewer enterprises, as tax reforms in the late 1990s eliminated many tax benefits for energy conservation projects (Lin, 2005).

As discussed above, in June 2004 China implemented a “Differentiated Electricity Pricing” policy for a number of large electricity-consuming industries including electrolytic aluminum, ferroalloy, calcium carbide, caustic soda, cement, and steel. This policy, in which electricity prices for industrial enterprises are established based on their energy intensity level, has been implemented in 30 provinces (Moskovitz et al., 2007).

Industrial Structural Adjustment

The 11th Five Year Plan calls for the closure of small plants and phase-out of inefficient, outdated capacity in high energy-consumption industries, including electricity, iron steel, electrolytic aluminum, ferroalloys, calcium carbide, coking, cement, coal, plate glass, pulp and paper, alcohol, monosodium glutamate, and citric acid. Specific targets for each of these industries are outlined in the 11th Five Year Plan. For example, the Plan calls for closing 50 gigawatts (GW) of small thermal power generating capacity and production facilities responsible for 100 million tons of iron, 55 million tons of steel capacity, and 250 million tons of cement (State Council, 2007). NDRC reported that in 2007 small thermal power plants representing 14 GW had been closed, along with 47 and 38 million tons inefficient production capacity of iron foundries and steel mills, respectively (NDRC, 2008c). In addition, the China Cement Association reports that 140 million tons of inefficient cement plants were also closed that year (China Cement Association, 2009).

Top-1000 Energy-Consuming Enterprise Program

In April 2006, China’s Central government launched the Top-1000 Energy-Consuming Enterprises Energy-Efficiency Program (Top-1000 program), the goal of which is to improve industrial energy efficiency by targeting China’s 1000 highest energy-consuming enterprises. These enterprises account for approximately 50% of total industrial sector energy consumption and 30% of total energy consumption in China.

The Top-1000 enterprises are from nine sectors: iron and steel, petroleum and petrochemicals, chemicals, electric power, non-ferrous metals, coal mining, construction materials, textiles, and paper. Estimated 2004 final energy use for the Top-1000 enterprises was 673 Mtce (19.7 EJ).

The energy reduction goal for these enterprises after five years is 100 Mtce (2.9 EJ) (NDRC, 2006b). The target of the Top-1000 program is designed as one of the tools to realize the 11th Five Year Plan goal of reducing energy consumption by 20% per unit of GDP.

The Top-1000 program involves a number of key players, including NDRC (as lead agency), the Office of the National Energy Leading (while it existed), the National Bureau of Statistics (NBS), the State Owned Assets Supervision and Administration Commission, the General Administration of Quality Supervision, Inspection and Quarantine, Provincial DRCs (or Economic and Trade Commissions) and industrial associations.

The Top-1000 program target has been established down to the provincial level. During the summer of 2006, all participating enterprises signed energy conservation agreements with local governments and have promised to reach the energy savings target by 2010. For example, NDRC signed an agreement with the Beijing Municipal Government covering ten enterprises within Beijing's jurisdiction. The Beijing Municipal Government, in turn, signed an energy efficiency target contract with each of the ten enterprises that includes energy-saving guidelines (Wang, 2006). Achievement of the energy-saving targets has been added to the provincial government cadre evaluation system wherein the individuals responsible for implementation will be evaluated each year on whether or not the targets under their jurisdiction have been achieved (NDRC, 2007a). Use of the evaluation system in this manner provides strong incentives to government officials to assist the enterprises in achieving the energy-saving targets.

The enterprises are required to report their energy consumption by fuel quarterly to the NBS (NDRC, 2006a). The Top-1000 reporting is directly to NBS via a website, not through regional statistical bureaus. The data collection is done in this manner to improve accuracy and reliability, to make it easier for the enterprises, and to reduce work for regional statistical bureau staff members. NBS will only release information on average or total energy use or energy use by industry, but not by specific enterprise (Zhu, 2006).

Some provinces have extended the Top-1000 program to include key energy-consuming enterprises beyond the national Top-1000 enterprises in their provinces. Shandong Province, for example, has implemented a provincial additional Top-1000 enterprise program (Xu et al., 2006). Beijing is planning to implement a top 100 enterprise and 10 key project program; Guangdong Province has asked 1000 provincial enterprises to reduce their energy consumption (PGGP, 2006).

In September 2007, NDRC held the *National Top-1000 Enterprise Energy Conservation Workshop*. At the same time, NDRC and the NBS jointly released the *Report on the State of the Energy Use of the Top-1000 Enterprises* (NDRC and NBS, 2007). The report provides information on energy consumption, energy mix, the level of energy consumption of major

products, the status of energy management, and the status of energy technology and equipment of the 1000 enterprises. In 2006, the Top-1,000 enterprises saved 20 Mtce (0.59 EJ). The Report indicates that the unit energy consumption (energy intensity) of major producing industries such as steel, cement, flat glass, crude oil processing industries are close to the international advanced level. Energy intensities in thermal power, electrolytic aluminum, ammonia, calcium carbide, caustic soda, and soda ash industries still trail international advanced levels. NDRC recently reported that the enterprises in the Top-1000 program invested over 50 B RMB¥ (\$7.25 billion) for over 8,000 technology renovation projects, saving 38 Mtce (1.1 EJ) in 2007 (Zhao, 2008).

Buildings

Building energy consumption in China accounts for 25% of the total energy (Zhou et al., 2007). Total floor area is more than 40 billion square meters in 2006. Two billion square meters of building space have been added each year during the past several years (TUBERC, 2008), which are thought to represent half of the construction in the entire world (Xinhua, 2007).

China has a centralized Ministry of Construction (MOC), which is responsible for regulating its massive building industry. Under the MOC, a network of Construction Commissions in the major cities and provinces oversees building construction, including the granting of building permits and the enforcement of building codes. MOC also has a parallel network of building research institutes to provide technical expertise and support for its own activities and for the building industry.

China adopted building energy standards in stages, starting with an energy design standard for residential buildings in the Heating Zone of north China in 1986.¹⁰ This was followed by a standard for tourist hotels in 1993, for residential buildings in the Hot-Summer Cold-Winter Region of central China in 2001, and for Hot-Summer Warm-Winter Region of south China in 2003. A national energy efficient design standard for public buildings (the term used in China to refer to commercial buildings) was adopted and implemented in 2005. Lastly, a revised national energy design standard for residential buildings that combines the three previous regional standards has been under development since 2005 and was expected to be completed in early 2007, but has been delayed without announcement of expected date of implementation.

Earlier standards for residential buildings set targets to reduce building energy consumption compared to pre-existing construction by 30% in 1986 and by 50% in 1995. The 2005 standard for public buildings set the target at 50% energy reduction compared to pre-existing buildings.¹¹

¹⁰ This standard was revised in 1995.

¹¹ These high savings occur because the base building to which the new building is compared was constructed before there were any energy standards in China. During this period, buildings in all climates were constructed without insulation, with inefficient heating systems, and with leaky walls. Thus, 50% design savings are not tight standards.

In addition to national or regional standards, there have been local standards in major cities, such as Beijing, Shanghai, Wuhan, and Chongqing.

In 2006, the State Council required MOC to draft a bill to strengthen energy efficiency in buildings. This Building Energy Conservation Regulation Ordinance Bill was expected to come into effect in the beginning of 2007, but was delayed. The bill includes regulations in six areas: building energy management systems, energy efficiency rating systems, energy consumption statistics, energy-saving retrofits, construction practices, and licensing of new buildings (Wu, 2006).

For new buildings, the law requires full implementation of the standard and tightens it in some regions to 65% reduction compared to uninsulated buildings. For existing buildings, it requires government buildings (and large public buildings) to take the lead in energy retrofits. It also promotes the use of renewable energy by encouraging local jurisdictions to support such applications.

Although the building standards cover all new construction in China, their implementation is incomplete. According to a survey conducted by MOC in large urban areas in 2006, only 60% of new buildings met the energy-saving standard during the design stage and just 38% at the construction stage. In southern China, the percentages are just 10% and 8%, respectively (Wu, 2006). More recent survey results, also only for large urban areas, show much higher implementation rates (Wu, 2008). These results should be viewed with some skepticism for at least two reasons: first, they are only for sample of a small number of large urban areas. More importantly, they show only that the building was checked. It is not possible from the surveys to know whether the checks are thorough, whether the construction quality is high, or what fraction of buildings passes the test without meeting the standard.

In addition to the standards and encouragement of energy retrofits, the bill requires MOC to propose a method for energy-efficiency labeling of buildings (to be mandatory for residential and most commercial buildings)¹²; the establishment of a uniform system for collecting and analyzing energy consumption data; establishment of three of products and practices in buildings categories – desired, restricted, or prohibited – based on energy consumption; encouragement of local governments in providing incentives for energy efficiency measures in new and existing buildings. These efforts remain exploratory, but are expected to have increasing impacts over the coming years.

¹² In 2005, the Beijing city government adopted a standard for rating the energy efficiency of public buildings that requires detailed computer modeling of the building (DBJ/T01-100-205).

Appliance Standards and Labeling

The rapid uptake of appliances and electronics into Chinese households has driven a sustained increase in residential electricity use at an average growth of 14% per year between 1980 and 2005. The impact of this growth spurred the government to establish China's first equipment standards in 1990, which covered refrigerators, air conditioners, clothes washers, electric irons, electric rice cookers, televisions, radios, and electric fans. These first standards were modest efforts that eliminated very inefficient models. Enforcement was inconsistent throughout China.

China currently has three major programs:

1. Mandatory minimum efficiency standards. Twenty-three mandatory energy-efficiency standards now cover most residential and commercial appliances, lighting and heating and cooling equipment. Beginning in 1999, the China National Institute of Standardization (CNIS) developed a series of new single-period standards based upon international best practices, and in 2003 began the development of "reach" standards, or two-period, two-tiered standards. Though the standards are mandatory, compliance varies widely. Strengthening enforcement is now a major policy focus. Box "The National Reach Standard for Air Conditioners in Jiangsu Province" shows an example of Jiangsu's experience in adopting the national reach standard for room air conditioners ahead of the national implementation schedule.

2. Voluntary energy efficiency labeling. The China Standards Certification Center (CSC) has administered the voluntary energy-efficiency endorsement labeling program, analogous to the US Energy Star program with which it cooperates closely, since 1998. Currently, the program labels 50 products from over 300 participating manufacturers including home appliances, consumer electronics, office equipment, lighting, and selected industrial equipment. The program requires manufacturers to submit to an on-site audit of production facilities and undertake third-party testing in certified laboratories.

3. Mandatory energy information labeling. In 2005, China launched a mandatory energy information label (showing five categories of energy efficiency), adapted from the European Union categorical energy label. The five categories range from products just meeting energy-efficiency standards to those that are almost twice as efficient. Initially, the label applied only to refrigerators and room air conditioners, clothes washers and central air conditioners were added in 2007. On 1 June 2008, the program expanded to include CFLs, high pressure sodium lamps, small and medium tri-phase motors, chillers, and gas water heaters. Unlike both the mandatory standard and the voluntary energy-efficiency label, manufacturers are able to self-report the energy consumption of each model.

Many products are covered both by minimum energy-efficiency standards and voluntary labeling. Until recently, most consumer electronics products were generally not subject to minimum efficiency standards and were covered only by the voluntary labeling program. In the

last few years, however, an increasing number of electronic products, such as printers and computers, are being brought into the mandatory standards system.

The National Reach Standard for Air Conditioners in Jiangsu Province

Jiangsu Province has been the goal of adopting the national reach standard for room air conditioners ahead of the national implementation scheduled for 2009. Jiangsu was expecting the new reach standard (that is, a COP requirement of 3.2 instead of current 2.6) to go into effect on September 1, 2007, two years sooner than the current schedule. However the 2007 deadline faced strong resistance from the manufacturers. As a compromise solution, Jiangsu Economic and Trade Commission (ETC) decided to enforce the standard in government buildings first, thus requiring all government departments to purchase products which meet the reach standard.

Transportation

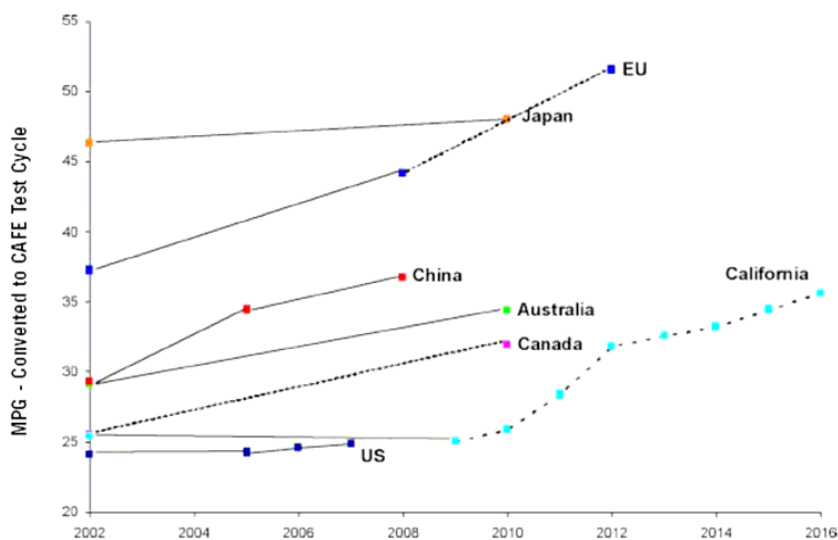
Fuel Economy Standards

China adopted *Fuel Consumption Limits for Passenger Cars* in 2004. The limits are divided into 16 categories based on vehicle weight, and are subjected to two phases of enforcement implementation.¹³ The 16 weight classes cover passenger cars, sport utility vehicles (SUVs) and multi-purpose vans (MPVs). SUVs and MPVs share the same standards as passenger cars with automatic transmissions. Commercial vehicles and pickup trucks are not regulated under the standards.¹⁴ The Chinese standards are based on maximum allowable fuel consumption limits by weight category (An and Sauer, 2004). Every vehicle model sold in China is required to meet the standard for its weight class. The standards were designed to be "bottom heavy," meaning that they become relatively more stringent in the heavier vehicle classes.

In 2003, 66% of new cars sold in China met Phase I standards (with 35% meeting Phase II standard) while only 4% of SUV's and minivans met the Phase I standards (with no light trucks today meeting the Phase II standard) (He, 2005). Figure 5 shows that China's fuel economy standards, normalized around metrics and vehicle test cycles, are much more stringent than those in U.S.

¹³ For newly certified vehicle models, Phase 1 started on July 1, 2005, and Phase 2 took effect on January 1, 2008. For previously certified models, Phase 1 started on July 1, 2006, and Phase 2 will take effect on January 1, 2009 (He, 2005).

¹⁴ These vehicles will be covered in two proposed standards: Fuel Consumption Limits for Light-Duty Commercial Vehicles and Fuel Economy Labels for Light-Duty Commercial Vehicles.



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

Source: An, 2004

Figure 5. Comparison of fuel economy and emission standards

Emission Standards

China follows the European standards for emission requirements. China implemented the National Phase III (equivalent to Euro III standards) vehicle emission standards in July 2007. This took place later than originally planned because of delays in producing sufficient quantities of high quality, low sulfur gasoline. Rollout of the Euro IV emission requirements is scheduled for July 2010. Meeting this schedule is uncertain; it will depend on the availability of sufficient quantities of gasoline that meet the required lower sulfur standards.

Government Procurement

NDRC and MOF implemented a new program of government energy-efficiency procurement in 2005. The program established a list of nine products: air conditioners, refrigerators, fluorescent lamps (linear and CFLs), TVs, computers, printers, faucets, and toilets. Initially, the program required that China's centralized procurement system should "preferentially procure" only models on the list (i.e., certified under the energy-efficiency labeling program by the China Standards Certification Center, CSC). The program was first launched by the central government agencies in Beijing and in provincial capitals. In 2006 it was extended to other provincial cities and in 2007 it was applied nationwide. In August 2007, the program became mandatory and the list of products was expanded to nineteen.

In December 2006, MOF and the State Environmental Protection Administration (SEPA)¹⁵ initiated a “green purchasing” program. They released a “green purchasing list” that identifies products carrying the China Environmental Label. The current “green purchasing list” includes 859 products in 14 categories, ranging from vehicles, copiers, printer, and TVs to interior furnishing and construction materials.¹⁶ Governments at all levels are required to purchase from this list starting January 2008. In July 2008, MOF and the Ministry of Environmental Protection (MEP, successor to SEPA) made the use of the purchasing list mandatory (CCGP, 2008).

In 2006, the total budget for government procurement was estimated to exceed 300 billion RMB¥ (\$37.5 billion). Currently the program is voluntary except for government agencies. Efforts are underway to prioritize the list; however, this prioritization has been difficult because of uncertainties in added costs, lifetimes, and reliability and performance of products.

Analysis and Commentary

11th Five Year Plan

The 10th Five Year Plan set a target of 15-17% reduction in energy use per unit GDP between 2000 and 2005. It completely failed in achieving the desired goal; in fact, energy intensity *increased* during this period, for the first time since 1980. Between 2000 and 2005, the annual average growth rate of GDP was 9.5%. By 2005, energy consumption per unit GDP had increased 11.1% over 2000 levels.

As a result, senior leaders in China recognized that success in pursuit of energy intensity improvements would require deep involvement of the Chinese Communist Party and the government. As discussed, the November 2005 communiqué of the Politburo placed the 20% target as a major national priority. This was followed by legislation by the National Peoples Congress, which made NDRC responsible for carrying out this mandate. NDRC quickly went to work designing programs and engaging provincial authorities to formulate and initiate implementation plans to achieve the target. The Communist Party continued to stress the importance to the nation of this target.

The 11th Five Year Plan’s 20% reduction goal assumed annual economic growth of 7.5%. Under this economic growth rate assumption, the Plan was expected to save 640 Mtce (18.8 exajoules, EJ) over its five years.¹⁷ In actuality, annual economic growth ranged from 10.7% to 11.4% between 2005 and 2007. This higher economic growth rate means both a higher required savings

¹⁵ SEPA is now the Ministry of Environment.

¹⁶ This information is made widely available through the Chinese government procurement website (<http://www.ccgpn.gov.cn/>), the SEPA website (<http://www.sepa.gov.cn/>), and China green purchasing website (<http://www.cgp.cn/>). The China Environmental Label requires certification by SEPA’s Environmental Certification Center.

¹⁷ Calculated based on energy consumption in 2005 reported in China Energy Statistical Yearbook 2007.

(670 or 700 Mtce for 8.5% and 9.5% growth rates, respectively) to meet the target and higher absolute demand for energy than the lower economic growth case assumed in the Five Year Plan (Feng, 2007). Despite official declarations and a variety of efforts, China fell short of its 20% reduction target in 2006, reducing energy use per unit of GDP by 1.79% instead of the 4% average per year required to meet the target.¹⁸ This savings does, however, represent a reversal of the trends where energy use was growing faster than GDP from 2002 to 2005. The failure of all provinces¹⁹ to reach the target was considered to be the result of slow progress in industrial restructuring, difficulties in establishing a strong enforcement mechanism for energy-efficiency regulations, and the lack of tax and financial incentives (EF, 2006).

In 2007, energy consumption per unit of GDP dropped 4.04%.²⁰ This was achieved as a result of the rapid maturing of the energy-efficiency policy apparatus and in spite of the continued high growth of the high energy-intensive industries. Electricity, steel, nonferrous metals, building materials, petroleum and chemicals – China's six largest energy-consuming sectors – grew 14.5% during the first half of 2007, slower than the 20.1% growth experienced in the first half of the previous year. Energy consumption per unit of output dropped 6.74% in the coal sector, 4.05% in the steel sector, 3.7% in the non-ferrous metal sector, and 9.98% in the building material industry compared to the same period in 2006 (Fu, 2008).

Energy-savings in 2008 were recently report to be 4.79% and officials are now optimistic that China will be able to reach the 20% energy/GDP reduction goal by the end of the 11th Five Year plan (Lv, 2009; Energy Weekly, 2009). Savings of 150 Mtce, or about 60% of the stated goal of is >250 Mtce/year, have been realized from the Ten Key Projects (Lv, 2009). Savings of 58 Mtce from the Top-1000 program, or nearly 60% of the state goal of 100 Mtce, were achieved in 2006 and 2007 alone (savings from 2008 have not yet been reported).

Overall, achieving the very ambitious goal has been challenging for the government. In the 1980s, the government had direct control over state-owned enterprises (SOEs) and SOEs were the predominant form of industry in China. In those days, production quotas proved an extremely effective way to cut energy use. Today, such a quota system cannot be enforced as it was in the past. China has needed to be much more creative in its policy formulation and implementation, often drawing lessons from policies and programs that have been successful in other countries while molding them to fit Chinese conditions.

¹⁸ This energy-saving value was originally reported as 1.23%, then revised to 1.69% in 2007, and finally revised to 1.79% in 2009.

¹⁹ Except for Beijing, which surpassed the target by moving heavy industry outside the province in anticipation of the 2008 Olympics.

²⁰ This energy-saving value was originally reported as 3.66% (NBS, 2008a) and then revised to 4.04% in 2009.

Institutions for Energy Regulations

It is widely recognized that energy regulation in China is confusing, suffering in many instances from a lack of clarity in the assignment of responsibility for their interpretation and implementation (Andrews-Speed, 2004; Andrews-Speed, 2009). Prior to the government reorganization announced in March 2008, there was much speculation about the formation of a Ministry of Energy. Many people argued that such a Ministry was needed to unify laws and regulations affecting energy production, conversion, distribution, consumption, and pricing (Andrews-Speed, 2006; Sinton et al., 2005; World Bank, 2008). However, the reorganization did not create such a ministry. Instead a high-ranking Energy Bureau – with a Minister as leader – was established along with an Energy Commission. The effect of these changes is not yet clear, although it seems unlikely that they will adequately clarify the level of authority. One crucial example of the diffusion of authority over energy is the responsibility over energy prices. For electricity, the two energy agencies that could have control over prices are the Energy Bureau or State Electricity Regulatory Commission (SERC). However, the authority over electricity prices continues to reside in the pricing bureau of NDRC because of the significance of these prices to the overall economy. Authority over oil and natural gas prices also resides in the energy pricing bureau of NDRC rather than an agency responsible for energy policy.

Some of the areas lacking clarity could be resolved through the adoption of a new energy law. Such a law was drafted and widely circulated in December 2007. However, its adoption has been delayed as the government attempts to sort out the authority of the new Energy Bureau, the Energy Commission, NDRC, SERC, the large and powerful energy companies, and other entities.

Industry

The continued high growth in production of energy-intensive commodities such as chemicals, steel, and cement dwarfs improvements in energy efficiency. Administrative measures to restrain the growth of heavy industries still have only limited effect as market demand for commodities – both for domestic use and for export – continues to grow. Retiring inefficient processes is difficult in an environment of expanding demand for their output.²¹

Even with these challenges, the Top-1000 Energy-Consuming Enterprises Program has raised awareness and priorities of provincial authorities and top-level management of the largest enterprises to focus on improving energy efficiency. While the program goal of 100 Mtce

²¹ While the economic downturn of 2008-2009 has recently dampened demand for industrial products – especially exports – China's economic stimulus plan has created off-setting demand for construction materials such as steel and cement. In addition, as mass urban migration is expected to continue for many decades, industrial demand will likely continue to grow in response to the need for building materials and manufactured goods to construct housing, commercial and public buildings, and related urban infrastructure.

savings in 2010 is not extremely ambitious for these enterprises, the enterprises have already saved more than half of the goal at the end of 2007 and are on track to surpass the goal by 2010. It is possible that these 1000 enterprises will contribute 25% of the savings required to support China's efforts to meet a 20% reduction in energy use per unit of GDP by 2010 (Price et al., 2008; Price et al., 2009). The Top-1000 program is being expanded to include additional enterprises in a number of Provinces and further savings from the industrial sector will be realized through plant closures as part of the industrial structural adjustment efforts, through improvements spurred by the differential electricity pricing and the enterprise award system for energy intensity reductions, and a through implementation of a number of the Ten Key Projects focused on the industrial sector.

While China has taken steps to close small, inefficient industrial facilities, the effort to make larger adjustments to the industrial structure away from heavy industry to higher value-added manufacturing as well as to service industries has not been successful to date (World Bank, 2008). Energy auditing capabilities in China are generally weak and need improvement (EF, 2008a; Yang, 2008) and energy-efficiency outreach to "key enterprises" (those that consume 10,000 tce/year or higher) that are not included in the Top-1000 program should be strengthened (EF, 2008b; Yang, 2008).

Buildings

Even though there have been improvements in the enforcement of building energy codes in the past few years, buildings—as distinct from energy-using equipment in buildings—lag industry and vehicle transport in effective gains in energy efficiency. There are at least five major areas in which China could strengthen building energy efficiency policy: (1) refinement and improvement of existing standards, (2) better enforcement of existing standards, (3) limiting use of energy-intensive building materials, (4) developing and enforcing more aggressive energy retrofit requirements, and (5) offering of incentives to promote advanced energy efficiency measures in buildings (including so-called "green buildings").

Appliances

Within China's suite of energy-efficiency standards and labels, there are clear opportunities for further savings for clothes washers, refrigerators, and televisions. The market average efficiency for vertical axis clothes washers is higher than the minimum standard. The absolute level of the refrigerator standard is far lower than more stringent international standards in effect in the US, Australia, or Japan. Sixty-five percent of refrigerators meet the CSC voluntary label criteria, which specifies energy use that is 25% lower than the minimum standard. In 2009, China will impose a stricter refrigerator standard, but the gap between Chinese and best international practice will remain considerable. Additional savings for televisions can be obtained from a minimum standard for active mode power to the flat screen televisions (LCD and plasma), a

technology that promises to rapidly supplant CRT televisions over the next decade. Indeed, China is already working on such a standard.

For products subject only to voluntary labeling, the current labels are lagging in the market because of the global homogenization of design and styles. The energy use of printers, computers, monitors and other office equipment varies little between China and other countries. CSC's general principle has been to restrict their certified products to the top 25% of the market, but this has been exceeded in many cases, indicating a need for further strengthening.

CNIS receives, on average, about 100,000 RMB¥ (\$14,600) of direct budget allocation for each product for which it develops standards. In the last 7 years, however, a number of international funders have supplemented this amount, both through direct grants to CNIS and by supporting international experts working with CNIS. This has resulted in an additional 150,000 RMB¥ (\$22,000) for each product under the international cooperation program. Compared to these expenditures, consumers in 2005 alone enjoyed over 10 billion RMB¥ in savings (\$1.21 billion) from conserved electricity through the use of more efficient appliances.

Transportation

Although Chinese fuel economy standards are more stringent than those of the U.S., they still lag the EU and Japan. Enforcement of vehicle standards by the Chinese government will be critical to the success of fuel economy regulations. China has not yet announced specific details on how it will monitor and enforce the Phase II (2008) standards (Sauer, 2004).

Added incentives may be needed for the production and purchase of light vehicles. Although the policies are designed to be relatively more stringent for heavy vehicles, the sales of SUVs in China are increasing at a high rate: sales of SUVs are up 50% in 2007, and another 42.01% in the first half of 2008 over the same period last year (ChinaStakes, 2008).

In August 2008, the Ministry of Finance and the State Administration of Taxation announced adjustment of car sales tax for engines with large displacement and cutting those with smaller engines. The sales tax for cars with 4 liter or larger engines will increase from 20% to 40%; with 3 liters to 4 liters, from 15% to 25%; and with less than 1 liter, from 3% to 1%. The adjustment was put effect on September 1, 2008 (MOF, 2008b) The is the second car sales tax adjustment since April 2006 aimed to promote the sale of smaller cars. However, whether it will make a significant influence to curb the growth of SUVs remains to be seen.

Public transportation has seen much less support than improving fuel economy. As a result, urban highway networks continue to be built at a rapid pace—large cities today have multiple ring roads expanding in circles from the city center—and the use of private cars continues to receive substantial subsidies in the form of infrastructure investment to support such use.

Cross-Sectoral Policies

There are several major policies that cut across end-use sectors. The first is the transition from an industrial to a service-based economy through policies that favor development of a service economy. Related to this is the favoring of industries that produce higher value-added products over energy-intensive industries. There is a need for macroeconomic policy adjustments – such as higher costs of borrowing and appreciation of the RMB¥ – that could support these objectives but which have other impacts that many in China see as undesirable. The second is raising energy prices. At present, there is a need to raise the price of oil products and electricity. Raising these energy prices will cause inflationary impacts; as such, the government has in the last two years lagged in its efforts to attain market rates for these energy forms. The third is the likelihood that higher levels of incentives – and at times more focused ones – may be needed to achieve the energy intensity goals that China has set. Finally, there is the issue of whether the energy intensity goal of the 11th Five Year Plan will be repeated in the 12th Five Year Plan and in the longer term, and with the same vigor in its pursuit. It is also possible in the longer run that the Chinese government might consider a CO₂ intensity target to promote gains in energy intensity and changes in fuel mix, especially toward nuclear power and renewable energy sources.

Conclusion

In less than three years, beginning in 2006, China has created or recreated a policy apparatus to design and implement energy efficiency throughout the economy. While still a work in progress, it is clear that China is making a significant new beginning in its pursuit of greater levels of energy efficiency. Reforms have taken place at all levels of government, and their impact is being felt throughout the entire economy. Laws have been passed, regulations promulgated, new programs created and implemented in all provinces and many municipalities. Some of the most significant of these efforts include the creation of the Top-1000 enterprise program, the re-creation of a sizeable fund for energy-efficiency investments, the institution of personnel policies that provide strong incentives for achieving demonstrable energy intensity reductions, strong advocacy at all levels of the Communist party and the government for energy efficiency, and increasing attention on enforcement of energy-efficiency policies in all sectors.

It is still uncertain whether China will fully achieve its goal of 20% energy intensity reduction in five years. It is, however, certain that it will achieve a substantial portion of this goal. Of greatest importance in coming years will be the degree to which the policy reforms initiated in 2006 will become institutionalized in China and will lead to continuing energy intensity reductions. Long-term progress is needed in continued support for energy efficiency and for the reduction of the growth of energy-intensive industry in the Chinese economy.

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References

Andrews-Speed, P., 2004. *Energy Policy and Regulation in the People's Republic of China*. Kluwer Law, London.

Andrews-Speed, P., 2006. China's energy and environmental policies and their implications for OPEC. CEPML online Journal. www.dundee.ac.uk/cepmlp/journal/html/Vol17/Vol17_6.pdf

Andrews-Speed, P., 2009. China's on-going energy efficiency drive: origins, progress and prospects. *Energy Policy* 37 (2009): 1331-1344.

An, F. and Sauer A., 2004. Comparison of passenger vehicle fuel economy and greenhouse gas emission standards around the world. Washington, DC, Pew Center on Global Climate Change.

China Cement Association, 2009. *China Cement Almanac 2008*. Beijing, CCA.

China Energy Conservation & Supervision Information Net (CECS), 2007. Energy conservation technology service center. http://hunan.cecs.gov.cn/index.php?option=com_content&task=view&id=381&Itemid=100

China Government Procurement Website (CCGP), 2008. Notice on adjustment of environment product list for government procurement, 2008 NO.50. http://www.ccgp.gov.cn/zt/environment_conservation_2008/

ChinaStakes, 2008. China's small car tax incentives to have limited effect. <http://www.chinastakes.com/story.aspx?id=594>

Central People's Government of China (CPG), 2008. Solicitation of comments on draft Energy Law. http://www.gov.cn/gzdt/2007-12/04/content_824569.htm

Energy Foundation, 2006. Forum on implementing China's 2010 20 percent energy efficiency targets. November. Hainan, China

Energy Foundation, 2008a. 2008 Industry Energy Efficiency Workshop. July 10-11, 2008, Yantai, Shandong Province.

Energy Foundation, 2008b. Strategy and policy for reaching the 20 percent energy efficiency target and addressing climate change. China Sustainable Energy Program. Eleventh Senior Policy Advisory Council Meeting. November. Beijing.

Energy Weekly, 2009. National Development and Reform Committee: China is likely to reach energy conservation and emission reduction targets of the Eleventh Five-Year Plan. *Energy Weekly*. CHINA5E E-Magazine. May 26, 2009. Vol. 204

Feng Fei, 2007. Policy recommendations for achieving the 20-percent energy efficiency target. Presentation at the China Sustainable Energy Program's Tenth Senior Policy Advisory Council Meeting. 16 November. Tianjin.

Fu Jing, 2008. "Energy intensity falls, call to do more." China Daily, 08-09-2008.
http://chinadaily.cn/bizchina/2008-08/09/content_6919404.htm

He, K, 2005. Linking China's fuel excise tax to fuel quality. Presentation at the Energy Foundation Forum on International Forum on Tax and Fiscal Policies to Promote Sustainable Energy Development. 16-17 November. Beijing.

International Energy Agency (IEA), 2006. Energy Prices and Taxes. IEA: Paris.

International Energy Agency (IEA), 2007. Energy Prices and Taxes. IEA: Paris.

Jiang Yun, 2006. Personal communication with Jiang Yun, China Energy Conservation Association. November 6, 2006.

Jiang Yun, 2007. Personal communication with Jiang Yun, China Energy Conservation Association. November 13, 2007.

KPMG, 2008. PRC Corporate Income Tax Law.
http://www.kpmg.com/hk/en/virtual_library/Tax/PRCtaxLawBook.pdf

Levine, M.D. and Aden N.T., 2008. Global carbon emissions in the coming decades: the case of China," Annual Review of Environment and Resources. Vol. 33.

Lin Jiang, 2005. Trends in energy efficiency investments in China and the US. LBNL Report, Lawrence Berkeley National Laboratory, Berkeley, CA. LBNL-57691.

Lu Xinming., 2006. Personal communication with Lu Xinming, Director, Department of Environment & Resources Conservation, National Development and Reform Commission. 9 September.

Lv Wenbin, 2007. Personal communication with Lv Wenbin, Division Chief, Department of Resources Conservation and Environment Protection, National Development and Reform Commission. 11 September.

Lv Wenbin, 2009. Personal communication with Lv Wenbin, Division Director, National Development and Reform Commission, 31 March.

Ministry of Finance (MOF), 2006. Notice of the Ministry of Finance, National Development and Reform Commission, Ministry of Commerce, General Administration of Customs, State Administration of Taxation on adjusting the tax refund rates of certain commodities and supplementing the catalogue of prohibited commodities in processing trade, No.139 [2006], September 2006.

Ministry of Finance (MOF). 2007a. The Report of Central and Local Government Budget 2007. http://www.mof.gov.cn/caizhengbuzhuzhan/zhuantihuiyu/2007ysbg/ysbg/200805/t20080519_25823.html

Ministry of Finance (MOF), 2007b. Notice of the Ministry of Finance, and State Administration of Taxation on adjusting the tax refund rates of iron& steel products for export, No.64 [2007], April 2007.

Ministry of Finance (MOF), 2008a. Ministry of Finance sets aside 27 Billion RMB¥ for supporting energy saving and emission reduction, http://www.mof.gov.cn/caizhengbuzhuzhan/zhengwuxinxi/caizhengxinwen/200805/t20080519_29017.html

Ministry of Finance (MOF), 2008b. Notice of adjustment of sales tax on high emission passenger cars, http://www.mof.gov.cn/caizhengbuzhuzhan/zhengwuxinxi/zhengcefabu/200808/t20080812_62108.htm

Ministry of Commerce (MOFCOM), 2008. Downstream industries reduced production in response to the decline of price of coking coal. <http://acs.mofcom.gov.cn/cms/www/news/2444064470356.cgp>

Moskovitz, D., 2008. Climate change policy options for China's power sector. Regulatory Assistance Project.

Moskovitz, D., Lin, J., Weston, F., Zhou, F, Liu, S., Hu, Z., Bai, Jianhua., and Yu, C., 2007. Part A Final Report TA 4706-PRC: Energy Conservation and Resource Management Project. Asian Development Bank, Manila.

National Bureau of Statistics (NBS), 2008a. Report of energy consumption per unit of GDP in 2007. NBS. Beijing. http://www.stats.gov.cn/tjgb/qttjgb/qgqttjgb/t20080714_402491870.htm.

National Bureau of Statistics (NBS), various years. China Statistical Yearbooks. NBS. Beijing.

National Development and Reform Commission (NDRC), 2004. Medium and Long-Term Energy Conservation Plan. November. NDRC. Beijing

National Development and Reform Commission (NDRC), 2006a. NDRC officials press conference on "Improve differential electricity pricing and accelerate the industry structural adjustment", http://www.ndrc.gov.cn/xwfb/t20060930_87356.htm

National Development and Reform Commission, 2006b. Notice of issuance of the thousand enterprise energy saving action implementation plan, NDRC Environmental and Resource Planning Office #571.

National Development and Reform Commission (NDRC), 2007a. Notice of implementation scheme and methods of statistic, monitoring and evaluation of energy intensity reduction work and pollution reduction work. November.

National Development and Reform Commission (NDRC), 2007b. State Council Comprehensive Work Plan for Energy Conservation. June

National Development and Reform Commission (NDRC), 2007c. Policy No. [2007]773. NDRC notice on implementing differential pricing policy and prohibit preferential electricity pricing. http://www.ndrc.gov.cn/zcfb/zcfbtz/2007tongzhi/t20070416_129711.htm

National Development and Reform Commission (NDRC), 2008a. NDRC and MOF notice on income tax incentives on energy and water saving equipment investment. http://www.ndrc.gov.cn/zcfb/zcfbqt/2008qita/t20080919_236731.htm

National Development and Reform Commission (NDRC), 2008b. NDRC notice on increase of the price of coal generated electricity, various regions, No.259, 1682,1678,1677,1679,1680,1681

National Development and Reform Commission (NDRC), 2008c. Report on the implementation of the 2007 plan for national economic and social development and on the 2008 draft plan for national economic and social development. Presented at the First Session of the 11th National People's Congress. March 5.

National Development and Reform Commission and National Bureau of Statistics, 2007. Report on the state of the energy use of the Top-1000 Enterprises (Year 2007).

People's Government of Guangdong Province (PGGP), 2006. Guangdong achieved 10 Mtce of energy saving through "Double Thousand Energy Saving" program, http://www.guangdong.gov.cn/govpub/gdyw/200612/t20061215_11417.htm

Price, L., Wang, X., Jiang, Y., 2008. China's Top-1000 Energy-Consuming Enterprise Program: reducing energy consumption of the 1000 largest industrial enterprises in China. LBNL Report, Lawrence Berkeley National Laboratory, Berkeley, CA. LBNL-519E.

Price, L., Wang, X., Jiang, Y., 2009. The challenge of reducing energy consumption of the Top-1000 largest industrial enterprises in China. *Energy Policy*.

Sauer, A, 2004. Taking the high (fuel economy) road. Washington, DC. World Resources Institute.

Sinton J, Levine M, and Wang Q, 1998, "Energy efficiency in China: accomplishments and challenges," *Energy Policy* 26(11):813-829

Sinton, J., Levine, M., Fridley, D., Yang, F., and Lin, J., 1999. Status report on energy efficiency policy and programs in China. LBNL Report, Lawrence Berkeley National Laboratory, Berkeley, CA. LBNL-44605.

Sinton, J. and Fridley, D., 2000. Status report on energy efficiency policy and programs in China: recent and related developments. LBNL Report, Lawrence Berkeley National Laboratory, Berkeley, CA.

Sinton, Jonathan E.; Stern, Rachel E.; Aden, Nathaniel T.; Lin, Jiang; McKane, Aimee T.; Price, Lynn K.; Wisner, Ryan H.; Zhou, Nan; Ku, Jean Y., 2005. Evaluation of China's energy strategy options. LBNL Report, Lawrence Berkeley National Laboratory, Berkeley, CA. LBNL-56609.

State Council, 2006. The State Council Decision on Strengthening the Energy Conservation Work. State Council. August.

State Council, 2007. State Council Document [2007] 15, May 23, 2007.

Tsinghua University Building Energy Saving Research Center (TUBERC), 2008. 2008 Annual Report on China Building Energy Efficiency, China Building Construction Publishing Company. Beijing.

U.S. Energy Information Administration, 2008. Coal news and market: data for October 3, 2008. <http://www.eia.doe.gov/cneaf/coal/page/coalnews/coalmar.html>

Wang Qingyi, 2008. Sustainable energy development and economic policy research, 2007 Data. Report for the Energy Foundation.

Wang Qingyi, Jonathan E. Sinton, and Mark D. Levine, 1995. China's energy conservation policies and their implementation, 1980 to the present, and beyond. LBNL Report, Lawrence Berkeley National Laboratory, Berkeley, CA.

Wang Xuejun, 2006. "Top-1000 Enterprises Energy Efficiency Program: policy design and implementation" supporting documentation for the Energy Foundation's Forum on Implementing China's 2010 20-Percent Energy Efficiency Target, November 9-10.

Wen Jiabao, 2008. Report on the work of the government. Delivered at the first session of the 11th National People's Congress on March 5, 2008.

World Bank, 2006. The World Development Indicators 2006 (WDI) Database. Washington DC, The World Bank.

World Bank Beijing, 2007. Quarterly Report May 2007. Beijing.

World Bank, 2008. Mid-term Evaluation of China's 11th Five Year Plan. Washington DC, The World Bank.

Wu Yong, 2006. "Strengthening the Building Energy Efficiency (BEE) regulatory system in China" presentation at the Energy Foundation Forum on Implementing China's 2010 20-Percent Energy Efficiency Target, 9 November 2006

Wu Yong, 2008. Personal communication with Wu Yong, Vice Minister, Ministry of Construction. June.

Xinhua News, 2007. "Half of the new global construction were built in China," http://news.xinhuanet.com/newscenter/2007-08/23/content_6593780.htm

Xu H., Wei C., and Wang Y., 2006. Enterprises on Top 1000 Enterprise list should take the lead and meet the target, <http://www.china5e.com/news/newpower/200611/200611080217.html>

Yang Tiesheng, 2008. Personal communication with Yang Tiesheng, Department of Energy Conservation and Resources Utilization, Ministry of Industry and Information Technology. 18 November.

Zhao Tingting, 2008. "High-energy-consuming firms save 38.17m tons of coal," *China Daily*.

Zhou, D., 2006. "Allocation of the national energy intensity target to the provinces and sectors: policy recommendations" presentation at the Energy Foundation Forum on Implementing China's 2010 20-Percent Energy Efficiency Target, 9 November

Zhou, N., McNeil, M., Fridley, D., Lin, J., Price, L., Rue du Can, S., Sathaye, J., 2007. Energy use in China: sectoral trends and future outlook. LBNL Report, Lawrence Berkeley National Laboratory, Berkeley, CA. LBNL- 61904.

Zhu Hong, 2006. Personal communication with Zhu Hong, National Bureau of Statistics. 14 November.