# Reform of China's Energy Institutions and Policies: Historical Evolution and Current Challenges

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**Abstract**

China's institutional settings and policies have played a crucial role in shaping China's energy system. Drawing upon interviews and secondary source materials, this paper reviews the development of China's energy institutions and policies over the past five decades and identifies factors that have influenced this development. This review shows a changing role of government in the energy sector—from complete control to decentralized control—with the government focusing increasingly on improving the effectiveness of regulatory oversight and less on the operational aspects of energy production. The commitment of the government to promote energy efficiency and the subsequent policies and programs have been and will continue to be important for improving the efficiency of energy use and restructuring the energy system. The key remaining issues are the optimal extent of government involvement and the most appropriate and effective means of intervention.

This paper finds that Chinese institutions and policies have been very responsive to short-term energy needs but do not necessarily support effective long-term strategies. Some institutional changes and policies displayed conflicting and perverse effects from a long-term perspective. Incremental adjustments in policy implementation during the transition from a planned economy to a market economy reduced the risk of serious mistakes in policy making and implementation, but distorted market signals in energy production, distribution, and utilization activities. The coordination issues among government agencies and between local and central governments in China have always been complicated and challenging, limiting the efficiency of policy implementation in China's energy sector.

Development, environment, and security concerns in the 1990s encouraged policies to promote cleaner and more efficient use of energy, with particular attention to the use of coal and the development of oil, natural gas, and electric power. This shift has led to a number of strategic changes and policies. However, a lack of detailed implementation rules and targets, an ineffective monitoring system, and a lack of proper regulatory or market-based policies to create a favorable condition for the commercialization of clean and efficient energy technologies have reduced the effectiveness of these policies.

## 1. Introduction

While energy has consistently received a great deal of attention from the central government of China, the institutional basis for setting and implementing policies has frequently shifted, especially during the transition from a planned to a market economy. These changes have played a crucial role in shaping China's energy system (World Bank, 1997). In this paper, drawing upon interviews conducted during 2001 with numerous Chinese energy experts and government officials and secondary source materials, I review the development of China's energy institutions and policies over the past five decades and identify factors that have influenced this development. Understanding this evolution is essential for developing policy strategies and institutional reforms that can deal effectively with the development, environment, and security issues related to energy production and use in China.

The paper first reviews institutional development since 1950, identifying four periods with different levels of government control—central planning, 1950 to 1979, transition from a central planning to a market economy, 1980 to 1992, reassertion of central government control, 1993 to 1998, and more market-oriented management, 1999 to the present. Reforms during the past 50 years have been incremental, at times progressive while at other times regressive, and occasionally contradictory, but overall these reforms have freed a large portion of the energy industry from strict planning control. The paper then analyzes in greater detail the development of energy-related policies during the 1980s and 1990s. China's energy-related policies have shifted their focus from strategies to increase energy supply and energy efficiency to diversifying energy sources and environmental protection. This paper ends with a historical summary, highlights of current policy goals, and a discussion of the issues that may shape future policies and institutions.

## 2. Energy Institutional Development

Chinese energy institutions are part of a complex, hierarchical Chinese political-economic system. Similar to China's other institutions, energy institutions have experienced continuous changes since the 1950s, especially since the economic reforms began in the late 1970s. In this section, I describe China's energy institutions during four different periods and explain the motivation for the changes that occurred.

### 2.1 Central Planning, 1950 to 1979

Between 1950 and 1979, China's bureaucratic structures and economic systems were modeled after the Soviet Union's centrally planned economic system. The institutional structure for the energy sector had the following features: 1) central planning system with complete government control and little competition; 2) management shifts between central and local governments; 3) constantly changing bureaucratic administration due to merging and separation of ministries; and 4) lack of long-term energy production strategic plans. The development of energy institutions during this period is outlined in Table 1.

**Table 1. Energy Institution Development, 1950 to 1979**

| Year | Institutions | Rationale for Change |
|---|---|---|
| Early 1950s | ▪ One ministry: Ministry of Fuels and Power (MFP) | ▪ Manage production of all types of energy |
| 1955 | ▪ Divide MFP into several ministries:<br>--Ministry of Coal Industry<br>--Ministry of Petroleum Industry<br>--Ministry of Electric Power | ▪ Response to increased demand for energy services and diversification of supply |
| 1970 | ▪ Institutional mergers<br>--Ministry of Fuel and Chemical Industry<br>--Ministry of Water Resource and Electric Power<br>▪ Shift of management of state-run energy enterprises to local governments | ▪ Institutional simplification and decentralization favored by Cultural Revolution ideology |
| 1975 | ▪ Separate ministries for coal and petroleum<br>▪ Central government resumes control of larger energy enterprises | ▪ Poor performance of the energy sector |

The energy sector was completely dominated by the central government during this period. The State Planning Commission (SPC, currently the State Development Planning Commission, SDPC), established in 1952, was the key agency responsible for managing China's centrally planned economy. The SPC included energy production, distribution, and investment allocations in its five-year plans. The State Economic Commission coordinated and monitored the implementation of annual and short-term plans. Within the central government, a web of constantly changing bureaucratic agencies controlled planning, production, and distribution in the energy sector. Even day-to-day energy policies and energy production were directed at the ministerial level.

The centrally controlled system functioned well when China began to recover from civil war during the early 1950s. At that time, the tight controls on the energy sector and rigid institutional structures could pool limited resources to meet the immediate demands of economic development (Lieberthal and Oksenberg 1988). This system, however, showed weaknesses when the economy grew and became more diversified. The centrally controlled system provided little opportunity for an independent examination of potentially damaging policies. Subjective judgement during the process of formulating national five-year plans significantly affected the course of economic development. Furthermore, lack of competition left enterprises with few incentives to improve product quality, develop new processes and products, and reduce costs.

During this period, the central ministries concentrated on short-term planning for energy production; the well-known five-year plans established by the SPC provided only rough guidelines for long-term direction (Yang et al 1995). Implementation of plans relied on administrative authority over allocation and production, and each year's directions were based on incremental changes from the previous year. In fact, aside from the *15-Year Electrification Program* formulated in the early 1950s, no long-term strategic plan was established for the development of the energy sector before 1979.

During the early 1950s, meeting economic development goals was the focus of institutional change. Energy production at the beginning of the 1950s was limited. One single ministry, the Ministry of Fuels and Power, managed the production of all types of energy. When China recovered from its civil war in the early 1950s, economic growth and rapid industrialization were major priorities. National policies were directed at securing adequate supplies of primary energy to meet these goals. Increasing diversification of supply and the rapid growth of the economy soon overwhelmed this ministry (Lieberthal and Oksenberg 1988). In 1955, in response to the increasing demand for energy services, the State Council disbanded the Ministry of Fuels and Power and replaced it with several ministries: the Ministry of Coal Industry, the Ministry of Petroleum Industry, and the Ministry of Electric Power (MEP).

The Cultural Revolution during the 1960s and the early 1970s reshaped China's institutional structures (Yang et al 1995). Ideology, rather than economic development, dictated the institutional structure. Since the prevailing ideology favored institutional simplification (and thus consolidation), the central government merged the Ministry of Coal Industry, the Ministry of Petroleum Industry, and the Ministry of Chemical Industry to form the Ministry of Fuels and Chemical Industries in 1970. The Ministry of Electric Power and the Ministry of Water Resources Utilization were combined to form the Ministry of Water Resources and Electric Power. According to the principle of decentralization proposed by the Cultural Revolution, the central government transferred the management of all state-run enterprises in the energy sector to local governments.

After this institutional restructuring, China's energy sector experienced a drop in the growth of coal production during the 1960s (Wang 1997). Even though this was largely due to the political turmoil of the Cultural Revolution, restructuring and decentralization also contributed to the downfall. The poor performance of the energy sector eventually led to a scaling back of the initial restructuring and by 1975 the central government had reassumed control of the larger energy enterprises and re-established separate ministries for the coal and petroleum industries (Yang et al 1995).

### 2.2 Transition from Central Planning to a Market Economy, 1980 to 1992

During the 1980s, China began to open its door to the outside world and reform its economic system. China experienced rapid economic development and a shortage in energy supply. The Chinese government tried to restructure its institutions to increase energy production while limiting the growth of energy demand by lowering energy intensity. During this period, two major government reorganizations occurred, the first from 1981 to 1983 and the second from 1985 to 1989. These changes began the process of separating energy production and distribution from governmental administration in order to grant more freedom to enterprises, introduce energy corporations into the energy institution system, and establish energy conservation institutions to promote energy saving (see Table 2).

**Table 2. Energy Institution Development, 1980 to 1992**

| Year | Institution | Rationale for Change |
|---|---|---|
| 1981 | ▪ Establishment of State Energy Commission | ▪ Coordinate energy development |
| 1982-1983 | ▪ Split Ministry of Petroleum into three organizations:<br>--CNOOC, for offshore oil (international)<br>--Sinopec, for petroleum chemical industry<br>--CNPC, for onshore oil and gas (domestic) | ▪ Stimulate oil production and eliminate direct government interference |
| 1983 | ▪ Disbanding of the State Energy Commission<br>▪ Merging of the Ministry of Electric Power Industry and Ministry of Water Resources Utilization into the Ministry of Water Resources and Electric Power | ▪ Simplify Institutional structure |
| 1985 | ▪ Establishment of the Huaneng Electricity Generation Corporation (renamed the Huaneng Group, Inc. in 1988) | ▪ Promote electricity development |
| 1988 | ▪ Establishment of the Ministry of Energy<br>▪ Abolishment of the Ministries of Coal Industry, Petroleum Industry, Water Resources and Electric Power, and Nuclear Industry; all replaced by special state-owned corporations<br>▪ Formation of the National Energy Investment Corporation | ▪ Encompass all energy sub-sectors<br>▪ End direct government control of production management of each sub-sector<br>▪ Increase competition and efficiency in energy production<br>▪ Promote national investment in the energy sector<br>▪ Facilitate foreign investment in joint ventures |
| Early 1980s-1992 | ▪ Establishment of offices (divisions) of energy conservation in commissions, line ministries, and local bureaus<br>▪ Setting up of more than 200 energy conservation technology centers | ▪ Manage and participate in energy conservation activities<br>▪ Address shortage of energy supply<br>▪ Promote energy efficiency |

The first reorganization, from 1981 to 1983, focused on the oil sector. Since the discovery of large oil fields in the late 1960s (e.g., in Daqing), a major concern of the central government was to create proper institutional structures to stimulate oil production. The Ministry of Petroleum Industry was split into three organizations: the China National Offshore Oil Corporation (CNOOC), the China National Petrochemical Corporation (Sinopec), and the China National Petroleum Corporation (CNPC). CNOOC held the rights to exploration, development, production, and sale in predetermined offshore zones and directed international cooperation in offshore petroleum development. Sinopec, run by the State Council, was established to utilize petroleum and natural gas for production of oil products, synthetic materials, and organic raw materials. CNPC focused on domestic exploration and production and managed onshore petroleum development as well as other energy activities. This was the first time that the central government tried to remove government control of production in any of the energy sub-sectors (Yang et al 1995).

The second wave of reorganization, from 1985 to 1988, encompassed all energy sub-sectors and removed the central government from control of production. More energy corporations were introduced into China's energy institutional framework in place of central government ministries. These special state-owned companies were responsible for energy production in the coal, oil, and electricity sectors. For example, the former Ministry of Coal Industry was divided into the China National Coal Corporation, the Northeast Inner Mongolia United Coal Industry Corporation, and the China National Local Coal Mine Development Corporation. In 1985, the Huaneng Corporation was created to increase electricity investment and generation. The Ministry of the Nuclear Industry turned its administrative role over to the market-oriented China National Nuclear Industry Corporation.

Consistent with enterprise reforms in other sectors, the energy corporations were given the right to make decisions on production management, personnel changes, and salary and bonus shares for employees. They became production “contractors” of the central government. The establishment of the corporations was intended to increase competition and efficiency in energy production, especially in the utility sector. At the same time, enterprises received less assistance from the government. Like other state-owned enterprises, however, the energy corporations were by no means fully independent during this period. Much of the capital allocation for the corporations was controlled directly by the central government. For example, the Huaneng Corporation, which was responsible for developing much of China's new thermal energy generation, was initially financed from a special government coal-for-oil substitution (*mei dai you*) fund. During the 1980s, the fund totaled 1.0 to 1.5 billion yuan annually and was financed by artificially maintaining a price differential between the prices at which the government bought oil internally and exported it on the world market (Wang 1992). Investment, pricing, and marketing decisions of these energy corporations were often influenced by the central government, which was reluctant to relinquish control over the critical energy sector until years after other industrial sub-sectors had been given relatively more freedom.

The China Energy Investment Corporation (CEIC), under the leadership of the State Planning Commission, was formed in 1988 with responsibility for investment in national projects in the energy sector.[1] CEIC also had access to foreign capital for joint ventures. For the domestic projects, CEIC shared responsibility for capital investment with local governments and enterprises. It oversaw the bidding and issuance of contracts jointly with the boards of directors of individual enterprises. CEIC possessed the authority to entrust banks to issue bonds and stocks both domestically and abroad and to fund both enterprises abroad and joint-ventures with foreign companies.

Due to the abolishment of energy sector ministries, the Ministry of Energy was formed as a coordinating body of the newly created corporations, but its functions were limited to developing an energy strategy, planning long-term production, and overseeing major energy-development projects. Even given this mandate, energy corporations, which had been created from former ministries, still maintained some administrative powers. In fact, the Ministry of Energy was active only in the electricity sub-sector (Yang et al 1995). As a result, no single institution was actively coordinating the various sub-sectors of the energy industry during the period between 1980 and 1992.

Another important institutional innovation during this period was the establishment of energy conservation institutions and programs, which have successfully contributed to China's decline in energy intensity since the 1980s (e.g., Chen 2001, Levine and Liu 1990, Sinton et al 1998). These institutions and programs were set up in response to China's energy shortage. They aimed to reduce energy demand by increasing energy efficiency. The Office of Energy Conservation was established within the State Council. An energy-conservation apparatus (divisions, centers, offices) was developed in parallel at both the central and provincial levels as well as in the planning and production bureaucracies (commissions and line ministries) in order to improve the effectiveness of policy implementation. More than 200 energy conservation technology centers, with nearly 5000 employees, were set up in ministries and across the country (Liu, Yang, et al 1994). These centers provided technology consultation, monitoring, and training in energy conservation mainly related to energy use in industrial sectors. Enterprises consuming 10 thousand tons of coal equivalent (tce) or more annually were required to designate an energy manager and report to the energy conservation offices of local governments. China's energy conservation programs are credited with saving 280 million tce between 1981 and 1990.[2]

Due to the transition from a planned economy to a market economy, the relationship between central and local governments changed significantly during this period, and has been characterized by a lack of cooperation and divergent development objectives. Under the central planning system, local administrations had little room to take initiative

[1] Like other government investment funds, the funds at the CEIC's disposal are divided into two categories: capital construction and technological renovation. The former refers to large projects aimed primarily at creating new production capacity, and the latter to smaller projects intended to improve existing production capacity, but which may also increase production capacity somewhat.

[2] Energy conservation capacity in the end of 1990 reached 55.8 million tce/year. For further documentation, please refer to Liu, Yang et.al (1994) and Levine and Liu (1990).

for development projects, and projects often did not fit well with local needs and conditions. One goal of the economic reform was to improve central-local government relationships by sharing power and benefits.

Before the reforms, local governments were required to transfer a major part of their revenues to the central government (Wang 1993). In 1980, a new treasury policy required local governments to establish quota contracts with the central government. Under these contracts, local governments were only obligated to pass on to the central government a fixed amount of the revenue they collected and could allocate the rest themselves. This trend continued, and in 1985 tax laws allotted local governments additional powers over their funds. Because of these policies, local administrations had more financial power and were able to invest more in local projects.

By 1987, local governments had gained more power over financial decisions and project selection and could ratify energy sector projects costing up to 50 million yuan ($5.5 million). (The previous level had been 10 million yuan.) Local governments also were allowed to examine and approve fuel-fired power plants with capacities of up to 800 MW and hydropower stations with capacities of up to 100 MW. The contribution by local governments to total investment in power plants increased from 1% in 1983 to 17% in 1990, or from about 57 million yuan to 4.6 billion yuan (Gao 1991). The revenue from a special tax on power development imposed in 1988 was earmarked for local power construction. The central government encouraged local governments to cooperate in the development of energy projects in other ways as well, such as by providing rights-of-way for long-distance power transmission lines.

The increased revenues made local governments and enterprises more able to invest, but often they did not spend much of the money on energy projects (Yang et al 1995). Instead, a major portion of the new revenues were invested in light industry, processing industries, real estate, and small power plants (10 MW was a popular size), all of which yielded higher profits in the short term because they tended to be less capital-intensive. With the exception of small plants, energy projects tend to be long-term ventures, require long construction periods and high up-front costs, and offer lower rates of return than other investments. Local administrations and enterprises invested only small amounts of capital in the energy sector and relied on the central government to provide financial credit and assistance to help meet energy supply shortfalls.

Local administrations tended to prevent imports of commodities from other regions and to duplicate production capacity already found in other regions. They also tended to assert control over their territory, which was encouraged by self-sufficiency policies. This unnecessary duplication of investment resulted in the development of small energy-intensive manufacturing plants that consumed more energy than larger plants for the same processes. Local administrations also imposed many energy taxes and fees on industrial customers and forced centrally-owned enterprises to pay higher rents for land, pollution fees, and other service fees. Therefore, although reliance on central government planning may have dampened economic activity, local administrations often respond to local concerns in ways that are at odds with national energy investment needs.

Due to increased tax revenues controlled by local levels and overall revenue scarcity, the central government's financial deficit increased, weakening its ability to control the development and distribution of resources. In sum, finding a workable balance between central government and local administrations is always complicated and challenging.

### 2.3 Reassertion of Central Government Control, 1993 to 1998

While China's energy institutions between 1980 and 1992 featured less control by the central government and more freedom for energy corporations, between 1993 and 1998 the central government took back some control rights (see Table 3). This is consistent with the pattern of China's institutional system development between control (*shou)* and noninterference (*fang).* When the central government found that it controlled too much, it would give more power to local governments or industries; when it found that it had lost control, it would take back some authority.

**Table 3. Energy Institution Development, 1993 to 1998**

| Year | Institution | Rationale for Change |
|---|---|---|
| 1993<br><br><br><br><br>1994 | ▪ Dissolve the Ministry of Energy<br>▪ Reestablish the Ministry of Coal Industry and the Ministry of Electricity Industry<br>▪ Establish the State Economic and Trade Commission (SETC)<br>▪ Expand government ministries and energy corporations | ▪ Inefficiency in coordination<br><br>▪ Streamline, simplify, and centralize the apparatus of control in the energy industry<br>▪ Strengthen government control in each energy sub-sector |

From 1993 on, the SPC and the State Economic and Trade Commission (SETC) coordinated policies across energy sub-sectors. During the period 1980 to 1992, the central government could not effectively control energy production and consumption due to the lack of institutional capacity of the Ministry of Energy to coordinate production in the energy sector. The government therefore disbanded the Ministry of Energy and used the agency established in 1993, the SETC, as a coordination agency to manage short-term production planning and to supervise the production of energy in different energy sub-sectors. The SPC was responsible for long-term planning and macroeconomic policy and project selection.

Furthermore, the government also strengthened its control over investment. In 1994 the central government restructured its investment corporations, unifying all of them, including the State Energy Investment Corporation, into a national development bank under the authority of the SPC. The exception was the Energy Conservation Investment Company (ECIC), which remained independent, also under the supervision of the SPC.

The central government expanded government ministries and corporations. Authority in the oil and natural gas sectors was divided among a number of competing actors, including those responsible for surveying (Ministry of Geology and Natural Resources),

production (CNPC), refining and marketing (Sinopec), offshore production (CNOOC), and oil imports and exports (e.g., the China National Chemicals Import and Export Corporation, Sinochem). Central government-owned coal mines were administered by the Ministry of Coal, while production was carried out by several large-scale independent coal corporations. Medium- and small-scale coal mines were largely owned and operated by provinces, local governments, private individuals, and collectives. Thermal and hydroelectric power production and transmission were managed by the MEP. Five regional power corporations and seven provincial grids produced and transmitted power. The China National Electric Power Development Corporation, also under the MEP, developed and administered power and transmission projects. Nuclear power fell under the authority of the China National Nuclear Industry Corporation.

The expansion of government agencies strengthened government control in the energy sector but increased the difficulty of effectively coordinating among agencies. Many energy experts in China criticized the changes, saying that the government's role in energy planning and decision-making was confused. To summarize, during this period, the energy sub-sectors were under close government supervision, and authority in each sub-sector was scattered among a number of ministries and ministry-level corporations. The distribution of authority among an increased number of government agencies reduced effective coordination among sectors and resulted in duplication of policy implementation.

### 2.4 More Market-Oriented Management, 1998 to the present

The mixing of government and business activities, the overlapping responsibilities of different government departments, over-staffing, inefficiency, and conflicts of interests among government agencies were perceived as obstacles that hindered economic productivity in China (Lee 2000). To reduce these barriers, in March 1998, the government announced a radical reorganization and streamlining of government agencies, and restructuring of certain state companies. The number of ministries and commissions under the State Council was reduced from 40 to 29, and the number of government staff was also reduced (IEA 2000).

In the energy sector, the reorganization sought to streamline, simplify, and further centralize the apparatus of control. One objective was to separate the commercial operators from policy makers and regulators. Currently two types of organizations govern China's energy sector, comprehensive commissions or ministries as policy makers and regulators, and national corporations as commercial operators. Energy institutions since 1998 have less government control and more market-oriented management. The current functions of major agencies in the energy sector are described as follows.

#### 2.4.1 Government Commissions and Ministries—Policy Makers and Regulators

Many government agencies are currently involved in the policymaking and regulation of the energy sector (see Table 4). The major central government agencies in charge of

coordination and management are the SDPC, the SETC, and the Ministry of Science and Technology (MOST). The SDPC (formerly the SPC) is responsible for national social and economic planning. It formulates medium and long-term plans and allocates resources for sectoral development. SDPC now consists of 19 departments. The Department of Basic Industry within SDPC formulates strategy, policy, and plans for energy and transportation development, including the railway, aviation, transportation, electric power, coal, and energy conservation sectors. The restructuring has greatly decreased the number of government officials in order to increase efficiency. For example, the Division of Energy Conservation and Renewable Energy has two staff members. This is significantly smaller than in the early 1990s, when it was a Department with 30 staff. Staff from research institutes and other support units help fulfill the duties previously performed by SDPC staff.

**Table 4. Government Agencies and Their Current Functions in the Energy Sector**

| Ministry | Department | Function |
|---|---|---|
| SDPC | ▪ Department of Basic Industry<br>--Division of Transportation<br>--Division of Coal Industry<br>--Division of Electricity<br>--Division of Energy Conservation and Renewable Energy | ▪ Strategy, policies, and plans for energy and transportation development and energy efficiency |
| | ▪ Department of Investment | |
| | ▪ Department of Foreign Financing Utilization | ▪ National energy investment projects |
| | ▪ Department of Regional Economic Development<br>--Office of the National Coordination Group for Combating Climate Change | ▪ Policies for foreign investment<br>▪ Coordination of nation-wide efforts to deal with climate change issue<br>▪ Treaty negotiation with international partners |
| SETC | ▪ Department of Electric Power | ▪ Policy, planning, and regulation of electricity |
| | ▪ Department of Resource Conservation and Comprehensive Utilization<br>**--Division of Energy Conservation and New Energy** | ▪ Policies and regulation for energy saving and renewable energy<br>▪ Promotion of technology innovation for energy saving |
| | ▪ Department of Industrial Policy | ▪ Sector policies including oil, gas, and coal |
| | ▪ Department of Sectoral Planning | ▪ Sectoral planning including petrochemicals and coal |
| | ▪ Sectoral Associations | ▪ Sectoral management |
| MOST | ▪ Department of New Technology and Industrialization<br>--Division of Energy and Transportation | ▪ Management of energy R&D programs<br>▪ Formulation of policy and plans for energy R&D |

| | | |
|---|---|---|
| | ▪ Department of Rural and Social Development | ▪ Research, development, demonstration, and deployment of renewable energy |
| MLR | ▪ Department of Mineral Resources<br>▪ Department of Mining Management<br>▪ Department of Geological Exploration | ▪ Planning, management, protection, and sustainable use of all natural resources |
| SQBTS | ▪ Department of Standardization | ▪ Setting energy efficiency standards for products and process |
| SEPA | ▪ Department of Pollution Control<br>▪ Nuclear Safety and Radiation Management | ▪ Pollution control policies in the energy sector<br>▪ Nuclear safety management |
| MOA | | ▪ Biomass, wind, solar |
| MWR | | ▪ Hydropower |
| COSTIND | | ▪ Nuclear power |

The Department of Investment and the Department of Foreign Financing Utilization are two other important departments. The former is responsible for formulating the list of national key investment projects, including energy development and environmental protection projects. The latter takes responsibility for formulating policy governing the use of multilateral and bilateral soft loans and commercial loans, deciding when candidate projects should receive the above-mentioned loans, and developing the policy guiding foreign direct investment.

In order to reinforce the coordination of nation-wide efforts to deal with the climate change issue, the Office of the National Coordinating Group for Combating Climate Change was relocated from the State Meteorological Administration to the SDPC and is now at the Department of Regional Economic Development. The relocation occurred because the focus of the climate change issue changed from the study of climate change impacts to the negotiation of climate change agreements. The relocation takes advantage of the coordination capability of the SDPC among concerned ministries. The Ministry of Foreign Affairs is responsible for international negotiation.

As previously described, the SETC was created in 1993 to coordinate the implementation of production plans set by the SDPC and to deal with the allocation of resources for sectoral technology development. The SETC's authority was widened in 1998 to include control over most line industrial sectors. Such reorganization strengthens its role as a counter-balance to the influence of SDPC in economic policy-making. For instance, the coal industry and the petroleum industry are under the supervision of SETC through the China Coal Industry Association and the China Petroleum and Chemical Industry Association. These associations are bridges between SETC and enterprises, assisting enterprises in implementing government policies. The Ministry of Electric Power became the Department of Electric Power within the SETC. The Department of Industrial Policy and the Department of Sectoral Planning now take charge of sectoral planning and policies including oil, gas, and coal. SETC's activities in energy efficiency and new energy are coordinated by the Division of Energy Conservation and New

Energy, the Department of Resources Conservation and Comprehensive Utilization. The purpose of SETC's control over line industrial sectors is both to reduce the direct government control over these sectors and to strengthen the coordination of these energy sub-sectors.

The State Science and Technology Commission was demoted to the ministry level, and it has been renamed the Ministry of Science and Technology. It retains its authority over R&D for energy conservation technologies and formulates energy-related science and technology policies through the Energy and Transportation Division, Department of New Technology Development and Industrialization. Research, development, and deployment of renewable energy technologies such as wind, solar, and biomass are managed by the Department of Rural and Social Development. MOST also manages research on technology assessment, forecasting, and selection of priority areas for implementation.

Several other ministries have influence in the energy sector. The Ministry of Land and Resources (MLR) was established in 1998 and is the product of merging four former ministries: the Ministry of Geology and Mineral Resources, the State Land Administration, the State Oceanic Administration, and the State Bureau of Surveying and Mapping. The latter two remain as bureaus supervised by the MLR. The MLR oversees planning, management, protection, and sustainable use of all natural resources including land, mineral (coal, oil and gas), and oceanic resources. The Ministry of Water Resources under the State Council regulates China's hydropower production. The State Commission of Science, Technology, and Industry for National Defense (COSTIND), which reports directly to the State Council, supervises the development of nuclear power. The Ministry of Agriculture and the Ministry of Water Resources both have units working on renewable energy.

The State Bureau of Technical Standards was given authority over quality; to reflect this change it was renamed the State Bureau of Quality and Technical Standards (SBQTS). It has responsibility for setting energy efficiency standards for a variety of products and for industrial processes. Standard setting for industrial processes was previously the responsibility of technical units within the former line ministries.

The National Environmental Protection Agency (NEPA) was upgraded to be a half step below the ministry level, and was renamed the State Environmental Protection Administration (SEPA). SEPA is not directly involved in the energy sector, but affects the energy sector through its pollution control policies.

The Ministry of Foreign Trade and Economic Cooperation (MOFTEC) continues to take responsibility for coordinating international economic and technological cooperation and utilizing foreign capital. Energy projects and international cooperation on energy issues are its major responsibilities.

2.4.2 National Corporations—Commercial Operators

The previous section provides a comprehensive discussion of the commissions and ministries that formulate policies and regulations that affect development of China's energy sector. This section describes the national corporations that are responsible for investment in and operation of the energy sector (see Table 5). The government reorganization that occurred in 1998 attempted to separate government policymaking from the production process. In the energy sector, this resulted in energy corporations having more decision-making authority for production planning and management, even though major investment and marketing decisions are still influenced by the central government. Nonetheless, some energy corporations that were transformed from government ministries maintain a small policymaking function.[3]

**Table 5. National Corporations Involved in Energy Production**

| Sector | Energy Corporations |
|---|---|
| Oil and Gas | CNPC (north and west oil exploration and production)<br>Sinopec (east and south oil exploration and production)<br>CNOOC (offshore oil and gas)<br>Sinochem (imports and exports)<br>UNIPECK<br>ChinaOil |
| Coal | CNLCMDC (exploration and production)<br>NIMUCIC<br>CNCIEC (imports and exports) |
| Electricity | State Power Corporation<br>Huaneng Group, Inc.<br>China National Power Industry Corp.<br>Regional electric power corporations |
| Hydropower | China International Water and Electric Corp. |
| Nuclear | CNNC |
| Renewable Energy | CREIA |
| Investment | State Energy Investment Corporation |

The State Energy Investment Corporation oversees major investment loans for the energy sector. It is the primary channel of government funding for energy projects. It functions like a bank and assesses the economic and financial viability of new projects. China International Engineering Consulting Corporation (CIECC) is the development arm of SDPC and acts as a consultant and sometimes equity participant in building and operating energy projects. These and the corporations described below are under the supervision of the Large Enterprise Industry Commission within the State Council.

The China Coal Industry Association currently functions as the bridge between SETC and coal producers. A number of changes have occurred in the last few years. In 1998, the Ministry of Coal Industry was changed to the State Bureau of Coal Industry (SBCI),

[3] Interviews with government officials, Beijing, September 2001.

which is supervised by the SETC. SBCI was responsible for administering the coal industry, but in March 1999, the SBCI was replaced by the China Coal Industry Association (CCIA) in an attempt to move to a more market-oriented structure. The China National Coal Corporation, the China National Local Coal Mine Development Corporation (CNLCMDC), and the Northeast Inner Mongolia United Coal Industry Corporation (NIMUCIC) engage in coal production and distribution. The China National Coal Industry Import Export Corporation (CNCIEC) is a state run foreign economic trade and cooperation enterprise founded in 1982.

The oil and gas sector has experienced great changes in management during the late 1990s. In March 1998, the National People's Congress approved reform measures that allowed, for the first time, integration of upstream and downstream activities in independent national oil corporations (Yuan and Chen 2000). This was the largest restructuring in the oil and gas industry's history, and an oligopolistic structure has emerged since 1998. The four oil and gas state-owned enterprises each have its own "territory" but may compete freely. The CNPC, originally involved mainly in upstream production and exploration activities, is assigned responsibility for 12 provinces in north and west China. It has a crude production capacity of 106 million tons per year and refining capacity of 100.3 million tons per year with assets of $58.2 billion. Sinopec**,** originally specializing in downstream refining and distribution, is responsible for petroleum processing and product distribution in 19 provinces in east and south China. It has a crude production capacity of 36 million tons per year and refining capacity of 117.9 million tons per year with assets of $45.9 billion (Yuan and Chen 2000). China National Star Petroleum Corporation (Star) was established in January 1997 with guidance from MLR. It was merged with Sinopec in December 1999 to enhance Sinopec's upstream capabilities (Yuan and Chen 2000). These two corporations can trade freely and independently in both the domestic and international markets. Such reorganization was intended to make these state firms more like vertically integrated corporate entities elsewhere, to prepare the firms for limited competition when China enters the World Trade Organization (WTO), and to promote more effective development of China's oil and petrochemical industries (EIA 2001).

The CNOOC was established in 1982 to handle offshore exploration and production and accounts for roughly 10% of China's domestic crude production. CNOOC has four regional subsidiaries, Bohai, East China Sea, Nanhai East, and Nanhai West, and several specialized subsidiaries. The China National Chemicals Import and Export Corporation (Sinochem), which was established under the Ministry of Foreign Trade and Economic Cooperation, is primarily involved in imports and exports of crude oil, petroleum products, and natural gas. It has also invested in refineries and petrochemical plants. Sinochem is a partner with CNPC in China United Oil Corp. (CHINAOIL) and with Sinopec in United International Petroleum and Chemical Corp. (UNIPEC). These two joint ventures are both authorized to trade crude oil, petroleum products, and chemicals in international markets.

Three companies, CNPC, CNOOC, and Sinopec, all have successfully carried out initial public offerings (IPOs) of stock within the last two years, bringing in billions of dollars

of foreign capital. The stock companies CNPC Group Ltd., Sinopec Group Ltd., and CNOOC Group Ltd. were established to serve as operating entities. Parent companies CNPC, Sinopec, and CNPOOC became holding companies with no less than 51 percent of the shares of the operating companies. The remaining shares were offered on the Shanghai, Shenzhen, Hong Kong, and New York stock exchanges. All CNPC, Sinopec, and CNOOC social-service organizations remain under the holding companies so as not to increase the financial burden of the operating companies. CNPC completed the first step of corporate restructuring by establishing a shareholding company named PetroChina in early November 1999, for which shares were flatted on stock exchanges in New York and Hong Kong. It is hoped that this restructuring will improve productivity, increase competition, and ultimately reenergize China's oil and gas sector to meet future demand. This new structure facilitates China's growing energy interface with the rest of the world.

The management and operation of China's electricity is now also in the hands of corporations. In January 1997, the State Power Corporation was established to manage the nation-wide power network and inter-regional power transmission, and to produce electric power more effectively according to market economic rules. In March 1998, the 9$^{th}$ NPC abolished the Ministry of Electric Power and replaced it with the State Power Corporation. The MEP was reorganized into the Department of Electric Power within the SETC. This reorganization separated production, including both generation and distribution, and regulatory functions. The Huaneng Group, Inc., the China National Power Industry Corp., and regional electric power corporations are all involved in power generation and transmission. The State Power Corporation has proposed plans to separate grid operation from power production, promote competition in power generation, and break down inter-provincial barriers to trade in electric power (China Economic Times, May 30, 2001).

The China National Nuclear Corporation (CNNC), which manages the country's nuclear power sector, was split into two separate companies in 1999. One handles uranium extraction, nuclear processing for civilian and military use, waste treatment, and safety; the other is responsible for building nuclear power plants.

The Chinese Renewable Energy Industries Association (CREIA), established through the UNDP and Global Environmental Facility (GEF) project, is a business-led, independent, and self-financed association, working for the interests of its industry members. CREIA serves as a liason between regulatory authorities, research institutes and industry professionals. It provides a forum to discuss renewable energy development at the national level and subsequently to advise the central government on strategic policy formulation. CREIA is intended to be a window bringing together national and international project developers and investors. It plans to promote technology transfer and raise awareness of renewable energy investment opportunities through the development of an online Investment Opportunity Facility, and through regional networking meetings and training activities.

In sum, the energy institution system in this period exhibits the following features:

- Separation of government administration and commercial operation
- Centralization of the control of energy sub-sectors in the SETC and SDPC
- Integration of upstream and downstream activities in the oil sector

## 2.5 Conclusions

The historical development of China's energy institutions demonstrates the changing roles of the government in the energy sector. The institutional change exhibited conflicting tendencies and occasional reversals, but overall generally relaxed centralized control and introduced market mechanisms. In moving from a planned economy to a market economy, the government adopted a process of "crossing the river by groping the stones." Between 1980 and 1992, the government granted more power to energy corporations, between 1993 and 1997, the government took back some control, and since 1998, the government has returned some of that control back to energy corporations. With further development of the market economy, government control focused increasingly on improving the effectiveness of regulatory administration and less on administering and funding energy development. This in turn brought about staff reductions in government entities that oversee energy institutions.

The power balance among agencies has changed over time. Since the 1950s, responsibility for overall planning and management has remained in the domain of the State Council, the SDPC (formerly SPC), and later the SETC, but the importance of the SDPC has been reduced. Under the planned economy, between 1950 and 1979, overall planning was controlled completely by the SPC. Under the transition from a planned to a market economy, the SPC's role in China's economy narrowed to long-term planning and macroeconomic policy. Meanwhile, SETC has increased its role in short-term production planning and overall management of energy sub-sectors since 1993, in particular since 1998.

Even though the overall planning authorities remained relatively stable, specific ministries have been repeatedly reshuffled since the 1950s. At some points, all energy ministries were brought together in one ministry (e.g., the early 1950s, 1988 to 1992), but this arrangement was always followed by decentralization (e.g., late 1950s, 1993). Along the way, ministerial authority for energy sector activities has increasingly been spun off to large state-owned corporations that are still closely associated with the government and that retain many of the same personnel, but which have more freedom to allocate investments and manage production.

The relationship between the central government and enterprises has changed. At the beginning of the 1980s the state sector was considered the mainstay of the economy and the role of the central government was correspondingly large. As enterprises gained more autonomy and the private and joint-venture enterprises occupied a greater share of China's energy sector, the state no longer has the resources to direct the entire economy through its line ministries. The central government now seeks to influence development through institutions that use different methods of control, e.g., tax policies and other economic instruments. Local institutions have become much larger players in the energy

arena and are now capable of undertaking large development projects that were previously under the control of the central government.

The relationship between local and central governments is always complicated and challenging. The economic reform has granted more power over financial decisions and project selection to local governments, and thus energy development projects fit better with local conditions and needs. However, even though local governments have increased revenue due to economic reform, they tend to invest in projects that have higher profit in the short-term instead of energy projects that are long-term and carry higher risk (e.g., small-scale power plants with low energy efficiency).

## 3. Energy Policies

Next, I review the development of energy-related policies during three periods: the 1980s, the 1990s, and the present. Economic reform policy, price policy, energy efficiency policies, and environmental policies are examined. Institution change and policy change in the energy sector are connected but not linked directly. These three periods are thus not consistent with the periods used in the above discussion of changes in energy institutions, but are coherent with respect to the changes in policy focus.

### *3.1 Energy-Related Policies in the 1980s*

Energy development policies in the early 1980s concentrated on responses to the failure of oil output to match earlier predictions and the inadequacy of energy supply to support ambitious economic development goals. On the supply side, small collective and private mines were allowed to develop and the contracting responsibility system was used to stimulate energy output. By the middle of the 1980s, electric power generation had become the focus of most of the government's development efforts. Price reforms and new funding mechanisms were introduced to attract non-governmental investment. The principle of self-reliance directed China's energy supply and development strategies. Coal continued to dominate the power supply and natural gas was relatively neglected. Governmental efforts centered on maintaining output from existing coal power plants. The government also began to conduct R&D for nuclear power even though no policies were set up to prepare for nuclear fuel and waste transportation and processing. On the demand side the responses to energy shortages were in two areas: an emphasis on energy conservation, funded on a scale unprecedented in any other country; and an effort to switch from oil-using facilities to coal.

#### 3.1.1 Contract Responsibility System

The contract responsibility system was established to facilitate the transition from a centrally planned economy to a market economy. The government assigned production quotas to enterprises, and enterprises were allowed to sell their products above the quota in the free market. Because the energy price in the free market was higher than the government controlled price, this system was designed to encourage enterprises to increase production to meet the increasing energy demand. The contract responsibility

system was set up for most petroleum industry enterprises in 1981, for state-owned coal mines in 1984, and for natural gas production in 1987 (Yang et al 1995).

The system, however, was not a feasible long-term mechanism compatible with a market-based framework (Yang et al 1995). The system was still subject to the weaknesses of central planning methods because of the importance of planned quotas. In addition, the contract responsibility system focused on the amount of production but did not provide incentives for enterprises to reduce their costs in order to increase competitiveness.

### 3.1.2 Pricing Reform

In a free market, energy shortages result in a rise of energy prices, creating an economic incentive to increase supply and improve demand-side efficiency, thus bringing supply and demand into balance. In China before the 1980s, however, the central government set all energy prices, usually at very low levels. In order to maintain low energy prices, the government had to heavily subsidize energy producers. China's low energy prices worked as a powerful disincentive to greater energy efficiency, despite the challenge of energy shortages. Market prices were needed to improve profitability in the energy sector and to expedite the development of energy resources. However, the political sensitivity of introducing market prices in China slowed the pace of energy price reform. The central government tended to characterize price changes as "adjustments" rather than "reforms." A two-tiered (or multiple) price structure was introduced for coal and petroleum prices, allowing for quantities beyond production quotas to be sold at higher prices. These higher prices were first restricted to certain ranges within plan prices and were known as indicative prices, but later were allowed to float. Similar reforms were enacted in the electricity sector. Although many policymakers were long ago convinced of the need to eliminate multiple pricing systems, energy price adjustments turned into protracted negotiations among central government agencies and between central and local governments.

***Coal***. Until the late 1970s markets and prices for coal were tightly controlled. In 1982, state-owned mines, which then produced just over half of China's coal, were allowed to sell coal beyond their production quotas at a higher, though still regulated, indicative price. In 1984, price controls on the output of smaller rural mines were lifted and their prices rose, further reinforcing this "two-tiered" pricing structure. In the latter half of the 1980s the central government again raised coal prices based on the thermal value and quality of the coal so that the average price at the minemouth rose from 22.7 yuan/t to 30.7 yuan/t (Yang et al 1995).

Even with all of the price increases, the average coal price at the minemouth only covered about 60% of actual costs (Yang et al 1995). In addition, the artificial difference in price between the output of state-owned and rural mines led to unfair competition among coal mines of different ownership types. Struggling under the price ceilings, state-owned mines did not have the capital to invest in increasing output. Relatively high prices for the low-quality products of rural mines, which typically have very low capital requirements, encouraged proliferation of such mines. The collective and private coal

mines increased their output from 18% of total production in China in 1980 to 36% in 1990.[4] However, proliferation of such mines led to irrational utilization of natural resources and environmental pollution.

***Oil.*** A two-tiered pricing system was introduced to the oil industry in 1981. Any output by the national oil corporations beyond the 100 Mt joint "contractual" output was sold at prices approaching world market levels. Although the two-tier system encouraged increased production—crude oil output rose to 137 Mt in 1988—the increase was much less than production potential during the same period (Yang et al 1995). In 1988 the government raised plan prices by an additional 10 yuan, a minuscule rise compared to market levels.

This lower-than-production-cost wellhead price led to declining profitability in the oil industry. In addition, distortions in the pricing of upstream and downstream products allowed refineries to profit at the expense of oil fields. This helps explain the over-development of refining facilities, many of which were small plants built by local governments that hoped to capture the rents created by the irrational pricing system. Meanwhile, oil exploration and extraction became much less attractive and slowed down because low prices could not cover production costs. Price distortions existed for diesel and heavy oil as well. The low price of diesel discouraged production, limiting the supply (especially in rural areas) for large trucks that instead had to use less efficient gasoline engines (Hou 1991).

***Natural Gas***. A two-track system of pricing was established for natural gas in 1987. Historically, gas prices were set low as a method of subsidizing fertilizer and industrial production. Low prices offered little incentive for exploration and development of new gas fields. This is one of the reasons that gas still accounts for a very small portion of China's energy system.

***Electricity.*** Pricing reform in the electricity sector was motivated by attempts to ease the serious electricity supply shortages. The central government established a multi-tiered and diversified price system for the sector in 1985 (SPC 1992). Prices for enterprise-owned power plants (China's version of independent power producers) and small hydropower stations were set higher than the plan price for state-run utilities. Even for state-owned utilities, the multi-tier system was intended to have an effect; enterprises that were able to generate even one percent above the contractual level were allowed to raise prices on the extra amount by 50% of the plan price.

Other steps to rationalize electricity pricing were taken as well. In 1987, peak load pricing began to be introduced in some areas. Hydropower prices were varied between dry and rainy seasons to reflect added resource costs. In 1988, state-owned enterprises were levied an added electricity consumption tax of 0.02 yuan/kWh for national electric power development, although lighting use and highly electricity-intensive enterprises (e.g., aluminum smelters) were exempted (Yang et al 1995).

[4] "Transportation Situation in China," *World Daily*, March 23, 1993.

Not all of the developments in electricity pricing were positive. Electricity price classifications, as well as rules and regulations for price-setting, were confusing and not well established. No one could fully understand how many electricity prices there were and how the prices were determined. Rates were subject to negotiation, and enterprises faced with being cut off from the grid for nonpayment of bills could ask local authorities to intercede with the utility on their behalf. For state-owned utilities, the choice of prices was sometimes subjective and prices were generally too low to cover loan interest payments.[5] On top of this, local authorities added arbitrary fees onto the electricity cost, which further distorted prices.

In spite of the multiple-tier pricing system, unlike oil and gas, the electricity sector has been historically profitable. This can be partly explained by the frequency of price adjustments, but the real cause has been the difference between the low cost of energy inputs for generation (mainly coal) and the market-based tariffs set by many power plants in the sector.

In summary, energy price reform during the 1980s was slow and partial in nature. Social and political considerations delayed rapid reforms, weakening the sector in the long term by reinforcing sub-optimal energy use and consumption patterns. Incremental adjustments distorted market signals in energy production, distribution, and utilization. The price system also discriminated against certain energy customers and limited energy enterprises' ability to survive and develop.

### 3.1.3 Energy Efficiency Policy

China's energy intensity fell by one-third in the 1980s. Improvement in energy efficiency, largely due to government-led investment programs and regulatory activities, was believed to have accounted for one-third to one half of the drop in energy intensity (Sinton et al. 1998). China's energy conservation efforts began in the early 1980s, and focused on administrative and regulatory structures and direct support for energy efficiency projects. Institutional structures were established to manage energy use, develop standards for processing and equipment efficiency, formulate energy codes, and create financial incentives. A nationwide network of technical service centers was set up for consulting, training, and public education (Sinton et al 1998).

The SPC and related ministries under the supervision and coordination of the Office of Energy Conservation within the State Council established energy conservation policies. A remarkable investment program during the Sixth Five-Year Plan (1981-1985) poured funds equal to about 10 percent of energy supply investment into energy conservation projects (Yang et al 1995). Commitment to this course continued through the Seventh Five-Year Plan (1986-1990) and the early 1990s, when efficiency investments declined to about 8 percent of supply investments. Nonetheless, efficiency investments continued to grow in absolute terms.

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[5] The profit rate for capital investment was 3.7% in 1989, down from 12% in 1980, while the average loan interest for the electricity sector was in the range of 8-10% (Ding 1992).

The major energy conservation policies included: adjusting the sectoral structure and product mix for energy-intensive industries; reducing the direct burning of oil; using technology to renovate inefficient equipment and processes; eliminating the most grossly inefficient equipment and production processes; issuing energy-consumption standards for energy-intensive products; using a system of rewards and penalties to encourage energy-conservation activities; providing low-interest loans for some energy-conservation projects; and supporting research and development in energy-conservation technologies.

The central government's energy-conservation programs targeted the reduction of energy use in China's most energy-intensive industrial sub-sectors—steel and iron, chemicals, building materials, and power generation. These four sub-sectors accounted for 10.7%, 11.1%, 9.8%, and 3.9%, respectively, of total 1990 energy consumption (Yang et al 1995). Targeted investment in technological innovation to improve manufacturing processes and equipment considerably reduced energy consumption per unit produced. Table 6 depicts the decrease in energy consumption of 10 major energy-intensive products during the 1980s. The most dramatic reductions took place in the steel, aluminum, and ammonia industries. Nonetheless, physical energy intensities were still high compared to international levels.

**Table 6 Energy Consumption for Ten Energy-Intensive Products**

| Product | Unit | 1980 | 1985 | 1990 | Percent Change (1980-1990) |
|---|---|---|---|---|---|
| 1. Fossil-fuel electricity (> 6,000 kW) | MJ/kWh | 13.1 | 12.6 | 12.5 | -4.7% |
| 2. Steel (total energy) | GJ/ton | 59.8 | 51.0 | 47.2 | -21.0% |
| 3. Aluminum (large plants) | GJ/ton | 596.0 | 624.5 | 475.3 | -20.2% |
| 4. Ammonia (large plants) | GJ/ton | 41.9 | 40.1 | 39.3 | -6.1% |
| 5. Ammonia (medium plants) | GJ/ton | 71.5 | 65.5 | 63.8 | -1.1% |
| 6. Ammonia (small plants) | GJ/ton | 88.5 | 69.1 | 66.0 | -25.3% |
| 7. Cement (large plants) | GJ/ton | 6.1 | 6.0 | 5.9 | -3.4% |
| 8. Caustic soda | GJ/ton | 54.8 | 51.3 | 48.6 | -11.2% |
| 9. Calcium carbide (large plants) | GJ/ton | 75.3 | 73.3 | 64.8 | -13.9% |
| 10. Plate glass | MJ/box† | 951.7 | 954.9 | 923.8 | -2.9% |

† A box contains 50 kg of plate glass.
Adapted from Yang et al 1995.

In addition to the conservation efforts in energy-intensive industries, other successful programs included cogeneration, promotion of district heating systems, manufacture of honeycombed coal briquettes, coal washing, use of heat waste in power generation, boiler and furnace retrofitting, renovating industrial boilers and furnaces, and the manufacture of more efficiency equipment.

Many of the energy-conservation programs led to remarkable energy savings and

required less investment than the equivalent development of new supplies. A total of 28 billion yuan was invested, which resulted in the conservation of 66 million tce of capacity by 1990 based on 1980 levels, and led to annual average savings of 21 million tce (Yang et al 1995). In many cases the investment costs for conserving energy were found to be only one-half to one-third of the investment cost for similar capacities from new energy supply (Liu et al 1994; Levine and Liu 1990). The success of energy conservation policies contributed to a growth rate of energy consumption below the GNP growth rate. Some experts suggest that the existence of centralized institutional structures were partly responsible for the success of the conservation programs (Zhu 1991).

#### 3.1.5 Conclusions

In summary, during the 1980s, many of the policies and approaches that were attempted—the sectoral contract system, the partial freeing of prices in the multi-tier system, and the energy conservation program—contributed to improving the productivity and efficiency of the energy sector. The continued presence of the central planning system, however, led to structural inefficiencies. Market reforms in China's energy sector were slow and did not proceed in a coherent fashion. Social and political consideration delayed price reform and incremental adjustments distorted market signals in energy production, distribution, and utilization activities. Well-intended policies suffered from a lack of supervision and implementation during the transition period. Reforms, strategies, and specific programs were developed independently for each sub-sector, and there was little effort to integrate these reforms into a unified framework and strategy. The result was that guidelines for enterprise managers were often confusing and sometimes conflicting.

### *3.2 Policy Development in the 1990s*

The overall level of economic activity and economic policy strongly influenced energy consumption. Deng Xiaoping's tour of southern China in 1992 spurred a second wave of economic reform. In the Eighth Five-Year Plan period (1991-1995), China achieved its fastest economic development since 1950; the GDP growth rate was 12.0 percent (Annual Energy Review 1997). The strong growth in the early 1990s reinforced the need to provide more commercial energy supplies. To meet the higher energy demand, reform in the energy sector accelerated. The planned price of coal was allowed to float at market levels in some regions and more oil was put on the free market in 1993. At the same time, the central government issued a set of laws and regulations to push state-owned enterprises into the market and make them responsible for their own economic performance. However, the slowing economic growth and reform in the state-owned sector in the mid- and late-1990s led to a drop in energy demand, due to closure of some enterprises and reduction in output of others.

Energy conservation continued to be a major energy priority even though government support for energy conservation centers decreased. This was replaced in part by international grants or loans for energy conservation projects. Environmental policies increasingly addressed the pollution resulting from energy activities. In the late

1990s,China began diversifying its energy sources, moving away from dependence on coal by strengthening the development of renewables, natural gas, and nuclear power. China developed policies to encourage the development of renewables, such as geothermal and wind resources, in remote and economically undeveloped provinces where coal and oil resources, or infrastructure to deliver them, was lacking. Nuclear power plants were also built during this period in the southeast coastal areas, where the economy was developing rapidly but lacked adequate supply of coal due to the distance from coal sources.

China's energy strategy also changed from self-reliance to one of aggressively seeking oil and gas supplies abroad. This shift has led to a number of strategic changes in the country's oil and gas industry in terms of raising funds for capital investment, cutting costs, and focusing on development of cleaner fuels (*Oil and Gas Journal*, January 10, 2000).

Many factors were behind the improvements in energy efficiency in the 1990s. An essential element was the commitment of the government to promote energy efficiency, and the subsequent development of policies and programs to meet this goal. Slowing economic growth, campaigns to close thousands of small coal mines, increases in the quality of coal, and the switch from coal to gas fuels and electricity in households are all believed to have contributed to the rapid decrease in coal consumption and energy efficiency improvement between 1997 and 1999 (Sinton and Fridley 2001; Logan 2000).

### 3.2.1 Pricing Reform

Continued energy price reforms are viewed by economists as the key to attracting investment from domestic as well as foreign sources. Nonetheless, such reforms were implemented very slowly in the early 1990s. A rapid reform occurred in the late 1990s when the price of coal was liberalized and the price of oil was pegged to the international market.

***Coal.*** In 1993, all coal prices in northeastern and eastern China and in Hunan Province were allowed to float freely and restrictions on the price of washed coal (except for town gas plants) and utility boiler coal were lifted in all areas. However, the immediate impact on market prices was not great. Price increases of only 5 to 30 yuan/t were reported in the Northeast (Yang et al 1995). In many areas where controls were still in effect, market and planned prices converged. Until January 1994, China continued to operate a dual pricing system. Planned prices were fixed for state mine production, while market coal produced by small township mines was priced by the free market. The dual system led to inefficient allocation of coal and to the expansion of small coal mines. In the early 1990s, township and village enterprises and private enterprises produced more coal than state-owned enterprises (Yan 1997).

The dual system was abolished in January 1994 for most of the coal market. In 1996, more than two thirds of all coal was sold at the market price (IEA 1999). However, the prices of coal used for electricity generation were still regulated by the government due to

the need to accelerate electricity output. The government coordinated the sales of coal in annual meetings. This liberalization provided an incentive for the less cost-intensive small mines to rapidly expand production, which became one of the principal causes of the oversupply that emerged during the latter part of 1997 (IEA 1999:51). While coal prices continued to rise until 1997, they fell in 1998 and 1999, implying a large drop in demand compared to supply.

***Oil.*** After announcing several measures to open the oil market, in 1992 China's oil prices began to follow the world market price and gradually increased. In the middle of 1993, Sinopec began to pay the world market crude oil price to all suppliers except the Daqing, Shengli, and Liaohe oil fields. In mid-1994, the average price for domestic crude was about 750 yuan/ton, or about two-thirds of the international market price (Yang et al 1995). Prices for oil products, especially gasoline, increased steadily, in some areas to levels far higher than international price levels. In response, the government re-centralized the pricing and distribution system in the summer of 1994 (Kahn 1994; Yan 1997:79). The government controlled the prices of all onshore oil, increased the crude oil price and formulated prices for different categories of crude oil. The increased oil prices raised enterprises' capability to collect funds, although prices remained lower than the international price. A new oil price regime was instituted in June 1998, with the domestic price pegged to Singapore prices, with a one-month lag built in. Since then, domestic oil prices have been set with reference to changes in Singapore export prices, but remain significantly higher than import parity prices. The low-price international environment of 1998 and early 1999 reinforced domestic pressure to import and dealt a severe blow to hopes for exploiting the relatively high-cost Tarim basin as an alternative to growing net imports (IEA 2000:7). The low world price also created rampant smuggling in 1998.

***Natural Gas***. Natural gas prices rose in 1997, but not by a large margin. Natural gas from fields in Sichuan was selling for between 220 and 240 yuan/tcm, and between 130 and 330 yuan/tcm in other parts of the country (Sinton et al 2000). Gas prices remain highly regulated and are set differently depending on the type of customers, with fertilizer plants typically receiving the lowest prices.

***Electricity***. In 1993, power plants that began operation after 1992 were allowed to set their prices based on a formula for return on investment. This measure was intended in part to improve the attractiveness of investment in the power sector. Pricing policies aimed at regulating demand continued to suffer from uneven application. Peak load pricing, for instance, was advocated, but implementation was slow, even in coastal areas where the economic system and other reforms were most advanced. The equipment needed to monitor loads at various times of the day has not been installed in most industrial enterprises. Load management consists of agreements between utilities and customers, e.g., for large industrial users to shift electricity-intensive operations to night hours during the summer months when cooling loads are high, or to shut down during periods when agricultural use is high. Electricity prices increased through 1998, but dropped significantly in 1999, with the abolition of hundreds of illegal fees, particularly in rural areas.

### 3.2.2. Energy Efficiency Policy

Government-supported R&D, technical assistance, training, and information exchange continued to play an important role in China's energy efficiency improvement. However, with deepening reforms in ownership, management, finance, and investment decision-making, the energy conservation program did not receive the same support from the government in the 1990s as in the 1980s. Rather the government shifted from direct involvement in technology diffusion to regulatory control.

In the early 1990s, a number of the financial incentives that encouraged investment in energy efficiency in the 1980s were wiped away. In the 1980s, enterprises were allowed to repay loans for energy-efficiency investments with pre-tax income; taxes were reduced or waived on sales of energy conservation products and materials needed for technology development; and import duties were reduced or waived on equipment imported for efficiency projects. At the beginning of 1994, a simplified tax code was instituted and the tax reductions on efficient technology development and investment projects were abolished. Banks became less willing to lend for energy-efficiency projects because the economic reforms required them to focus more on repayment ability and economic benefits, rather than their previous focus on social and environmental benefits.

In addition, reforms also weakened China's bureaucratic energy management apparatus. The energy conservation service centers gradually lost their government funding (Sinton et al 1998). Many of them became dependent almost entirely on funds generated from sales of their services. Some energy conservation technology service centers closed. By the late 1990s, there were only about 180 centers, employing 3,200 staff (Sinton and Fridley 2000). The energy conservation centers established in the 1980s created channels for increasing the flow of information about energy-efficient technologies. However, during the 1990s, the old system had lost most of its effectiveness, while the rules that were expected to govern the market economy, and which were expected to promote energy efficiency through market signals, were not yet functioning as intended.

Although government funding fell, the government has continued to promote energy efficiency with the assistance of international organizations and through voluntary actions of enterprises. Numerous international assistance projects have aimed at helping China to raise energy efficiency, from early direct assistance in demonstration projects and technology transfer, to more recent efforts to support comprehensive transformation of markets (Sinton and Fridley 2001). For example, since its launch in 1996 the China Green Lights Program (CGLP) has been very successful in raising awareness of available energy-efficient lighting technologies, and has contributed significantly to the substantial increase in the production and use of efficient lighting technologies (Sinton et al 1999). The American Council for an Energy Efficient Economy, Lawrence Berkeley National Laboratory (LBNL), and other organizations have provided technical assistance to the Green Lights Program, with backing from UNDP and the China Sustainable Energy Program. In August 1999, China formally launched the China Energy Conservation Label and established the Center for Energy Conservation Product Certification (CECP) to implement and manage the program. USEPA approved a one-year program to train

CECP staff in the methodology and modeling used in the U.S. Energy Star program (Sinton and Fridley 2000).

The Beijing Energy Management Center, established through the World Bank/GEF Energy Efficiency Program, in conjunction with the UNDP-funded China Green Lights program, assisted the Beijing subway system to carry out a purchasing program to install compact fluorescent lighting in all Beijing subway stations. The China Energy Conservation Association (CECA), with assistance from LBNL, is being supported by the China Sustainable Energy Program[6] (CSEP) to carry out a project for the SETC to update energy-conservation regulations to be more appropriate for current technological conditions and the transforming economic system.

The most important energy conservation policy in the 1990s was the *Energy Conservation Law* (ECL) that was approved on November 1, 1997 and came into force on January 1, 1998. The law seeks to promote energy conservation activities throughout society, increase the economic benefits from energy efficiency measures, protect the environment, ensure economic and social development, and meet the needs of households. The law codifies China's approach to promoting energy efficiency under a more market-oriented economic system. The law states that the government should:

- encourage energy efficiency, as well as the development and use of new and renewable energy,
- formulate energy conservation policy, compile energy conservation plans, and incorporate them into the economic and social development plans of the nation,
- develop policies and plans that ensure rational energy utilization, and coordinate those plans with environmental protection and economic growth,
- stimulate and support technology R&D and scientific research in energy conservation as well as application and dissemination, and
- strengthen educational activities and propaganda in energy conservation to disseminate scientific knowledge and increase public awareness of energy conservation.

As for the implementation of the ECL, the SDPC was given overall policy authority for energy efficiency, while the SETC was given authority for implementation. The SDPC issued several regulations to support the ECL (Sinton and Fridley 2000). For example, the Policy Outline for Energy Conserving Technologies, issued in 1997, laid out a set of specific technical goals, e.g., abolition of certain types of equipment and adoption of particular technologies for specific sectors and for products, such as boilers and electric motors. The SETC also issued regulations, but consistent with its orientation, focused mainly on implementation. For example, in the spring of 1998, the SETC published a list of energy-intensive equipment that was to be taken out of service, including small fossil-fuel fired power plants, obsolete transportation equipment, and vehicles in urban areas over 15 years old. The SETC also issued guidance on the investment of central government funds and on the level of energy efficiency to be achieved by plants of specific size.

[6] The China Sustainable Energy Program is a joint program of the Packard Foundation and the Energy Foundation.

The ECL requires provincial-level administrations to formulate and implement regulations, taking into account local economic and environmental conditions. Shandong, Zhejiang, Shanghai, and Beijing are the only provincial administrations that have so far prepared such regulations. Shanghai, often in the vanguard of energy efficiency activities in China, reportedly has established an energy-conservation inspectorate, which has powers to inspect facilities, to levy fines on offenders, and even to close down offenders (Sinton and Fridley 2000).

In sum, the ECL is broad in its provisions and gives little guidance for implementation. Responsibilities among government organizations are broadly defined, leaving areas of uncertainty and a potential for overlap (Wang 1999). Formulation of specific rules and methods is left to planning and implementing organizations of the central and local governments. Implementation and enforcement of the ECL is thus dependent on decentralized action by numerous governmental agencies.

### 3.2.3 Environmental Protection Policy

Environmental problems were serious in China in the 1990s. The energy sector is a major source of air and water pollution. Dirty, inefficient fuel use is widely recognized as one of China's most pressing environmental problems. About 85 percent of China's $CO_2$ emissions are from coal burning, as are 90 percent of $SO_2$, 60 percent of NOx, and 70 percent of total suspended particulates (Zhou 1998). Environmental policies in the 1990s focused much attention on the energy sector. *China's Agenda 21* was developed following the United Nations Conference on Environment and Development in 1992. The agenda emphasized use of energy efficiency, renewable energy, clean coal technology, combined cycle power plants, and nuclear power. In March 1994, China's State Council approved the *Sustainable Energy Programs* under Agenda 21. In 1995, there was increasing concern about the environment. In the *Ninth Five-Year Plan* (1996-2000), China initiated several national programs including the Brightness Program, Integrated and Comprehensive Rural Electrification, Energy Efficient Lighting, and the Riding Wind Program. Recognizing problems with its rapidly growing transportation sector, China passed the Law of the Highway, effective January 1998, a fuel-based taxation system intended to save energy, reduce pollution, and promote automobile technology development (NRC 2000: 19).

Energy efficiency was also directly addressed in the latest revision of the *Air Pollution Control Law*, passed by the National People's Congress on April 29, 2000, and effective from September 1, 2000. Article 19 states that enterprises should use energy-efficient, low-polluting clean production technologies, and tasks the economic management authorities (SDPC and SETC) with promulgating lists of equipment to be retired permanently from service. Other articles have significant implications for energy efficiency. In particular, Chapter 7 (Articles 24 to 31) deals exclusively with pollution from coal burning. Article 24 requires sorting and washing of high-sulfur and high-ash coal, which would lead to marketing of coal that could be used more efficiently in end-use equipment. It also contains provisions to improve the structure of household fuels and to provide heat through district heating schemes. The provision requiring

desulfurization equipment on some new and re-powered power plants (Article 30), could decrease energy efficiency as a fraction of electricity would be diverted to power this equipment (Zhang, Li and Wan 1998).

More forceful implementation of environmental regulations led to plant closures, even though the major factor affecting plant closures was economic policies. Among the most important activities have been campaigns, begun in 1998 and 1999 and continuing in 2000, to shut down small mines, refineries, and manufacturing facilities. According to Sinton and Fridley (2000), many thousands of facilities across the country were shut down in 1999, including

- 31,000 small coal mines and several hundred medium to large mines,
- 70 small oil refineries,
- numerous small power plants,
- small cement plants with a combined production capacity of 40 million tons/year (out of a national total in excess of 600 million tons/year),
- small glass plants with a combined production capacity of 15 million cases/year (out of a national total of over 170 million cases/year), and
- textile manufacturing capacity of over 9 million spindles.

The plants that were shut down were typically small, highly polluting, and financially marginal. While the impact cannot be easily quantified, it is likely that these closures have resulted in widespread improvements in sectoral efficiency by raising the average energy-efficiency of production processes (Sinton et al 1999). At the same time that small plants have been closed, new production capacity, generally with better energy performance, has come on line. The closure of small mines has also improved the quality of fuels available on the market, probably leading to significant improvements in combustion efficiency in most applications. While the closure of small mines is expected to improve financial performance in the coal sector, the persistence of a buyer's market and generally flat prices for coal resulted in further losses for the coal industry, amounting to over 4.5 billion yuan in 1999 (Sinton et al 1999).

Forceful application of environmental regulation has the potential to change industrial energy demand significantly (Sinton and Fridley 2001). The regulation of sulfur dioxide emissions in China's "acid rain control zones" may result in greater use of washed coal and installation of flue-gas desulfurization (FGD) equipment at power plants. New regulations introduced by the State Environmental Protection Agency in September 2000 increase the fee on sulfur dioxide emissions from roughly U.S.$ 25 to U.S.$100 per ton (Lew and Logan 2001). Including this cost in the price of power could make renewable energy more competitive. Coal washing would provide a higher heat-content product that would burn more efficiently, reducing demand for coal. Requiring urban factories to move or to replace equipment often results in the use of newer, larger, cleaner, and more efficient equipment, which tends to increase energy efficiency. Closing down heavily polluting factories contributed to concentration of production in larger and more modern enterprises with greater energy efficiency.

### 3.2.4 Renewable Energy Policies

The government's interest in diversifying energy sources and protecting the environment resulted in the promotion of renewable energy during the 1990s. Renewable energy is also consistent with China's poverty alleviation plans, as it is often the most available energy resources in remote rural areas. In the 1990s, the government began to actively encourage the development of renewable energy through government planning, incentive policies, and R&D activities.[7]

#### *Government Policy and Regulation*

The Electric Power Law, the Ninth Five-Year Plan, and the Energy Conservation Law all include measures to promote renewable energy. In 1995, the Chinese Government promulgated the Electric Power Law. It emphasizes government support of small hydropower systems, solar energy, wind, geothermal, biomass, and other renewable energy resources for rural electrification. In 1996, the then Ministry of Electric Power issued the "Parallel Operation Regulations for Wind Power Generation," which requires that power grids must allow interconnection and parallel operations of wind farms, and that the power grids must buy all the electricity generated by wind farms at a price that covers production costs.

The Ninth Five-Year Plan, 2010 Long-Term Objectives on Economic and Social Development in China, and the 1998 Energy Conservation Law all stress the importance of renewable energy and propose strategies for using renewable energy to reduce emissions and to protect the environment. In accordance with the new provisions, ECL, SDPC and MOST issued renewable energy policies and initiatives to promote renewable energy projects through project management and bank loans. The Chinese laws enacted to support renewable energy policies usually lacked detailed implementation rules and regulations, and specific implementation targets. Although they grant government agencies maximum flexibility in executing policies, lack of specific policy goals often has hindered actual implementation.

#### *Economic Incentive Policies*

***Import Duty Reduction***. Import duty reduction is one of the most direct economic incentives that the Chinese government has provided to stimulate the development of renewable energy. China has reduced the import duty several times in the past few years to make it similar to that of most other countries. The average import duty now stands at 23%, but renewable energy technologies enjoy special low rates: 3% for components of wind power plants, 6% for wind turbines, and 12% for photovoltaics (PV) systems.

***Tax Incentives***. These include reductions in the Value Added Tax (VAT) and in income taxes. The Chinese central government has reduced the VAT for two renewable energy

[7] This section is based on the paper of "Comparison of Renewable Energy Policies of China and the United States" (Zhang, Li and Wa 1998) and the report of *Renewable Energy Development in China: the Potential and Challenges* (Zhang, et al 2000).

technologies. The standard VAT is 17%. However, VAT for biogas is only 3%, and VAT for small hydro-projects is only 6%. Income taxes are collected by local government. Currently, the corporate income tax rate is 33%. Several provincial and autonomous regional governments (e.g., Inner Mongolia and Xinjing) have initiated special low income tax rates to encourage the development of renewable energy technologies.

***Pricing Policy***. The former Ministry of Electric Power issued a pricing principle in 1994 requiring power grids to include production costs, debt service, taxes, and reasonable profits in determining the purchasing price for wind energy. The cost of this pricing policy is borne by the customers of the entire power grid. The overall impact of pricing policies on the cost of electricity is relatively minor because the installed capacity of renewable energy technologies in the power system is small. Several local governments have decided to establish special favorable purchasing prices for electricity from renewable energy sources. For example, the municipal government of Shanghai has set a special price for biogas for household cooking.

***Low Interest Loans***. Low interest loans and interest subsidies can reduce the cost of renewable energy technologies. Since 1987, the Chinese government has provided low interest loans for rural energy development. The primary targets for these loans are large and medium biogas projects, solar energy applications, and wind turbines. The interest rate on such loans is only half that of comparable commercial loans. The amount of low interest financing was increased to 120 million RMB yuan in 1996. In addition, China has also established low interest loan programs for small hydro projects.

***Subsidies***. The Chinese government provides subsidies to support renewable energy technologies. For example, the Chinese government subsidizes small hydropower development in rural areas. Another form of economic incentive for renewable energy is direct subsidies to customers. China has subsidized customers of solar energy, small wind turbines, rural biogas applications, high-efficiency stoves, and biomass applications. Subsidies provided by the central government usually support research, development and demonstration projects. Local governments also subsidize renewable energy development through price reductions on raw materials. For example, Sichuan and Guangdong Provinces offer special low prices for cement that is used to construct biogas facilities.

Direct government subsidies for renewables are effective in accelerating the development of the market for renewable energy. However, government subsidies raise several issues. One is the source and availability of the funds; funds for subsidies are limited and their long-term availability is uncertain. The government would have to make large capital investments in order to significantly stimulate the development of renewable energy markets. In China, these funds would come from the central government's general revenues. The recipient of subsidies, the level of subsidies, and the developmental goal of subsidies are important issues that need to be further addressed.

***Government Supported R&D***

The central government supports renewable energy through its R&D strategy for the renewable energy industry and by funding many R&D projects directly. From 1980 to 1999, the government, through its national science and technology key projects, invested 200 million RMB yuan in research and development of renewable energy. The national Torch Program and Spark Program loaned 2 billion yuan to promote the development and utilization of renewable energy (Shi 2000). R&D initiatives include the following three major areas:

- Supporting various renewable energy research institutes and research projects
- Targeting specific technologies for improvement and providing necessary training
- Subsidizing renewable energy demonstration projects; for example, the central government invested 7 million RMB in four PV generation stations (total capacity 85 kW) during the Eighth Five-Year Plan

### 3.3 Conclusions

Pricing of energy has been significantly liberalized since the late 1990s; nearly all coal is now priced by the market, and electricity prices have risen dramatically, in some cases to levels higher than those paid in the U.S. Oil prices have been pegged to international levels. Development, environment, and security concerns in the 1990s encouraged cleaner and more efficient uses of coal, and energy overall, as well as the development of oil, natural gas, and electric power. These developments have proceeded through increased integration with international markets and greater international involvement. Renewable energy was promoted in rural areas through government programs and international assistance projects. Energy efficiency continued to be focused upon by the Chinese government, but government financial support decreased due to the shift to a market-oriented economy.

## 4. Outlook for Future Energy Institutions and Policy

### *4.1 Conclusions and Implications*

This review of the development of energy institutions in China shows a changing role of government in the energy sector. Institutional change has exhibited conflicting tendencies and occasional reversals, but overall has resulted in decentralized control and the introduction of market mechanisms. Governmental efforts have focused increasingly on improving the effectiveness of regulatory oversight and less on the operational aspects of energy production. Ministerial authority for energy sector activities has increasingly been spun off to large state-owned corporations that remain closely associated with the government and that retain many of the same personnel. The central government now seeks to influence development through indirect methods of control, e.g., tax policies and other economic instruments. This in turn has brought about staff reductions in the government entities that oversee energy institutions.

The trend toward separating policymaking and production operations will continue. However, because most energy corporations were originally government agencies, they still retain some administrative power in practice. Investment and marketing decisions of

these corporations will continue to be influenced by the central government. The extent of this influence will depend on the national and international economic situation and corporate performance.

The commitment of the government to promote energy efficiency and the subsequent development of policies and programs to meet this goal are important factors behind the reduction of energy intensity in the 1990s. There continues to be an important role for the government to play in improving the efficiency of energy use and restructuring the energy system. The key remaining issues are the optimal extent of government involvement and the most appropriate and effective means of intervention.

A historical review demonstrates that Chinese institutions and policies have been very responsive to short-term energy needs. The merging and splitting of energy ministries were undertaken to resolve management problems in energy demand and improve the performance of the energy sector. Energy development policies in the early 1980s concentrated on responding to the shortage in energy supply. Many of the policies and approaches—the sectoral contract system, the partial freeing of prices in the multi-tier system, and the energy conservation program—were designed to stimulate energy output and decrease energy demand by improving the productivity and efficiency of the energy sector. The accelerated liberalization of energy prices in the 1990s was in response to market demand created by rapid economic growth.

However, these institutions and policies do not necessarily support effective long-term strategies. Some institutional changes and policies displayed conflicting and perverse effects from a long-term perspective. The two-tiered pricing system, for example, lifted price controls for small mines but maintained them for coal produced by state-owned mines, which led to an uneven playing field for among coal mines of different ownership types. This led to the proliferation of small mines in the 1980s, which helped resolve the energy shortage problem but led to irrational utilization of natural resources and serious environmental pollution. Recognizing the substantial costs to this policy later, the central government had to make great efforts to close small mines in the late 1990s.

In moving from a planned economy to a market economy, the government adopted a process of "crossing the river by groping the stones." This process reduced the risk of serious mistakes in policy making and implementation. However, there are also negative aspects of gradual and incremental progress. Market reforms in China's energy sector were slow and did not proceed in a coherent fashion. Incremental adjustments distorted market signals in energy production, distribution, and utilization activities. The continued presence of the central planning system, along with other social and political considerations, will continue to limit the efficiency of policy implementation in China's energy sector.

In the energy sector, the Chinese government has tried hard to resolve coordination issues in management by merging ministries. At times, all energy ministries were brought together under one ministry (e.g., the early 1950s, 1988 to 1992), but this arrangement was always followed by decentralization (e.g., late 1950s, 1993) with more ministries

involved. Reforms, strategies, and specific programs were developed independently for each sub-sector, and there was little effort to integrate reforms into a unified framework and strategy. The result was that guidelines for enterprise managers were often confusing and sometimes conflicting. This problem has not been fully resolved. Stable energy institutions would contribute to improvements in policymaking, policy implementation, and investment in energy development.

Even though the organization of planning authority remained relatively stable, the power balance among agencies has changed over time. Since the 1950s, responsibility for overall planning and management has remained in the domain of the State Council, the SDPC (formerly SPC), and later the SETC. The importance of the SDPC has been reduced, while SETC has increased its role in short-term production planning and the overall management of energy sub-sectors since 1993, in particular since 1998.

The relationship between local and central governments in China has always been complicated and challenging. The economic reform has granted more power over financial decisions and project selection to local governments, and thus energy development projects fit better with local conditions and needs. Local institutions have become much larger players in the energy arena and are now capable of undertaking large development projects that had previously been under the control of the central government. However, even though local governments have increased revenue through economic reform, they tend to invest in projects that have quicker short-term profits (e.g., small-scale power plants with low energy efficiency) instead of energy projects that are long-term and carry higher risk.

Development, environment, and security concerns in the 1990s encouraged both cleaner and more efficient use of energy, with particular attention to the use of coal and the development of oil, natural gas, and electric power. These developments emerged through increased integration with international markets and greater international involvement. Renewable energy was promoted in rural areas through government programs and international assistance projects. Energy efficiency not only continued to be a priority for the Chinese government but also for international agencies and foreign countries. China's energy strategy saw a shift from complete self-reliance to seeking some supplies abroad. This shift led to a number of strategic changes in the country's oil and gas industry in terms of raising funds for capital investment, cutting costs, and focusing on the development of cleaner fuels.

China now has general policies to support the development and deployment of clean, efficient renewable resources and clean coal technology. These policies usually contain a general framework but lack detailed implementation rules and targets. Although they grant government agencies maximum flexibility in executing policies, the lack of specific policy goals often hinder the actual implementation of the laws. An ineffective monitoring system further reduces the effectiveness of these policies. Moreover, even though China is shifting to a market economy, it lacks proper regulatory or market-based policies to create a favorable condition for the commercialization of clean and efficient energy technologies.

### *4.2 Future Challenges and Energy Policy Outlook*

Environmental problems, high energy intensity, dependence on oil imports, existing economic barriers to clean technology development, and electricity development will continue to be challenges to China's development. The Tenth Five-Year Plan (2001-2005) responds to some of these challenges by focusing on energy efficiency improvements, optimization of energy systems, and environmental protection. Some challenges, however, are not addressed well in the Tenth Five-Year Plan and would need to be included in other energy policies.

Adverse local, regional, and global economic, health, and environmental impacts due to energy-related emissions, particularly from coal use, are of great concern to the Chinese government. In the Tenth Five-Year Plan, China plans to continue to diversify its energy infrastructure, although coal will continue to dominate China's energy resources for several decades. Development of natural gas and renewable energy resources has been given priority in the plan. The Chinese government plans to support increased use of natural gas through the construction of gas pipelines and other facilities for natural gas imports. It also plans to strengthen support for clean coal R&D and the deployment of clean coal technologies. Renewable energy development is also valued because it creates new employment opportunities and is a potential area for economic growth in western China.

There exist economic barriers for developing and deploying clean and efficient energy technologies in China. The commercialized market for clean coal and renewable energy technology is very small. In order to support the development of renewable energy and clean coal technology, the government would also need to increase R&D funding and investments in commercial infrastructure, as well as provide economic incentives, including tax exemptions or reductions, price subsidies, and low interest loans. The Tenth Five-Year Plan does not provide a good foundation for the design and implementation of such economic-incentive policies.

China will continue to strengthen the development and reform of electricity production. While making full use of existing power-generating capacity, the Tenth Five-Year Plan argues that China needs to develop hydroelectric power, build large-scale thermal power plants near coal mines, reduce small thermal power stations, and develop nuclear power on a moderate scale. The main task of nuclear power development in the early 21$^{st}$ century will be to promote standardization, localization, and the development of a nuclear fuel industry.

During the Tenth Five-Year Plan period, China plans to further reform the power management system, gradually allowing power plants and grids to operate separately, providing a forum for institutions to bid for power supply projects, and establishing an improved electricity price system. China also plans to strengthen rural electricity grid development and build north, middle, and south channels for electricity from the west to the east.

Even though China has made great achievements in reducing energy intensity, its physical energy intensity is still very high. In the Tenth Five-Year Plan, China's energy-efficiency policy was adjusted in accordance with the changing role of the government in the economy, (from a player to a regulator) as China moves rapidly to a market economy. The focus of the government's energy conservation work continues to be in the area of end-use efficiency, with priority given to completing the legal and regulatory system for energy efficiency, and developing in a timely fashion a system of inspections for implementation of energy conservation work. Energy efficiency standards are to be applied to new capacity in the industrial, residential, commercial, and power sectors. Targets for expanding natural gas supply and improving coal quality represent a step toward integrating energy supply development strategies with an effective energy-efficiency policy. China plans to increase coal efficiency and coal quality through merging companies, upgrading existing technologies, and using cleaner coal.

Growing oil dependence, and in particular, increasing dependence on petroleum imports poses a great challenge to the Chinese government. The Tenth Five-Year Plan places energy and oil in positions of strategic importance. The plan indicates that China will institute a system to conserve oil, accelerate exploration and exploitation of oil and natural gas resources, and make effective use of overseas resources. As for domestic development, government priorities focus on stabilizing production in the eastern regions of the country at current levels, increasing production in new fields in the west, and developing the infrastructure required to deliver western oil and gas to consumers in the east. Since accession to the WTO will leave China with fewer mechanisms to restrict oil imports, policies that affect oil demand will be critical. Transportation policies that affect mode choices (e.g., road vs. rail, private vehicle vs. public transportation, traditional vehicle vs. clean vehicle), fuel efficiency standards for vehicles, and policies affecting demand for petrochemicals will influence the amount of oil imports.

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**Acronyms and Abbreviations**

| | |
|---|---|
| CCIA | China Coal Industry Association |
| CECIC | China Energy Conservation Investment Corporation |
| CGLP | China Green Lights Program |
| Chinaoil | China United Oil Corporation |
| CIECC | China International Engineering Consulting Corporation |
| CNCIEC | China National Coal Industry Import and Export Corporation |
| CNLCMD | China National Local Coal Mine Development Corporation |
| CNNC | China National Nuclear Corporation |
| CNOOC | China National Offshore Oil Corporation |
| CNPC | China National Petroleum Corporation |
| COSTIND | State Commission of Science, Technology, and Industry for National Defense |
| CREIA | China Renewable Energy Industries Association |
| ECL | Energy Conservation Law |
| FGD | flue gas desulfurization |
| GEF | Global Environment Facility |
| IEA | International Energy Agency |
| MEP | Ministry of Electric Power (China) |
| MLR | Ministry of Land Resources (China) |
| MOA | Ministry of Agriculture |
| MOFTEC | Ministry of Foreign Trade and Economic Cooperation (China) |
| MOST | Ministry of Science and Technology (China) |
| MWR | Ministry of Water Resource |
| NEPA | National Environmental Protection Agency (China) |
| NIMUCIC | Northwest Inner Mongolia United Coal Industry Corporation |
| NRC | National Research Council (U.S.) |
| OECD | Organization for Economic Cooperation and Development |
| PCAST | U.S. President's Council of Advisors on Science and Technology |
| SBQTS | State Bureau of Quality and Technical Standards (China) |
| SDPC | State Development and Planning Commission (China) |
| SEIC | State Energy Investment Corporation (China) |
| SEPA | State Environmental Protection Administration (China) |
| SETC | State Economic and Trade Commission (China) |
| SinoChem | China National Chemical Import and Export Corporation (China) |
| Sinopec | China National Petrochemical Corporation (China) |
| SPC | State Planning Commission (China) |
| UNIPEC | United International Petroleum and Chemical Corp. |
| VAT | value added tax |