



## **The Bank's Assistance to China's Energy Sector**

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## **.ACRONYMS**

CNPC	China National Petroleum Corporation
GDP	Gross Domestic Product
GEF	Global Environment Facility
IFC	International Finance Corporation
MIGA	Multilateral Investment Guarantee Agency
LNG	Liquefied Natural Gas
NCPGC	North China Power Group Corporation
PHRD	Policy and Human Resources Development Fund
SPA	Sichuan Petroleum Administration



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## **Preface**

Part I of this report is the Summary of *The Bank's Assistance to China's Energy Sector: An OED Country Sector Evaluation* (Report No. 21891, February 28, 2001). The Sector Evaluation was produced by OEDSP, Alain Barbu, Task Manager. Part II of this report is an update and extension of the 2001 Sector Evaluation. The updated report was written by Anthony Churchill and Cordula Thum



## **1. Summary of Report no. 21891 (February 28, 2001)**

1.1 China is now the second largest energy consumer in the world and the largest producer and consumer of coal. Owing to its large coal resources, it is and will remain in the foreseeable future largely energy self-sufficient, although crude oil imports have steadily increased since 1993. While the country's energy intensity, at 60,000 BTU per dollar of GDP, is three times the world average and twice that of all developing countries, it has been falling as a result of concerted energy conservation efforts over the past two decades. Industry accounts for as much as 75 percent of total energy consumption, but household use, now only 10 percent, is growing fast with recent improvements in the standard of living. Although service is of uneven quality, rural access to electricity is high: about 96 percent of the nation's villages and about 80 percent of rural families now have access to electricity.

1.2 In just 17 years, China has become the Bank's largest borrower in the energy sector having received about \$7 billion in loans to date. Energy accounted for 20 percent of the Bank's total lending to China between 1983 and 1999. Electric power received the most (86 percent), followed by oil and gas (10 percent), energy efficiency and renewables (2 percent), and coal (2 percent). The sector also received \$90 million in Global Environment Facility grants through the Bank. The Bank has also carried out a substantial amount of analytical and advisory services. Despite the amount of lending to the energy sector, the sheer size of the sector in China has made the World Bank, at least in financial terms, a relatively marginal player. Indeed, the Bank has had only limited involvement in the subsectors most critical to China's energy strategy, coal and petroleum.

1.3 The Bank's activities have been through four distinct periods. In the Early Years (1983–88), the Bank's assistance aimed at helping China's integration into the global economy. It focussed on removing bottlenecks to the country's accelerating economic growth and on institutional development (emphasizing technology transfer and capacity building). In the Years of Transition (1991–93), which followed a two-year hiatus in Bank lending the focus was on consolidating earlier assistance to the power sector, with an added emphasis on addressing the resettlement issues associated with hydroelectric projects. In the Power Reform Years (1994–97), the Bank's focus shifted to policy change and broad reform, primarily, although not exclusively, in the electric power sector. This coincided with economic reforms initiated by China in the early 1990s and the greater urgency attached to that subsector by the government in light of persistent power shortages in fast-growing Eastern China. In the Years of Diversification (since 1998), Bank assistance continued and strengthened a move beyond the power sector that had started in 1997. Lending operations were added in energy conservation, district heating, and renewable energy and AAA activities in the oil and gas sector were renewed. Only two power loans have been made since 1998, resulting in a significant decrease in overall energy lending.

1.4 With none of 20 completed projects rated unsatisfactory and only one of the 19 ongoing projects rated a problem project, the performance of the China energy portfolio is without equal. But an assessment of the Bank's impact in a country like China needs to go beyond the immediate achievements of Bank projects, which ultimately account for only a minute portion of overall sector investments. In this respect, the Bank's strategy in the earlier part of its involvement in the sector, from 1985 to 1993, was highly relevant to the sector's needs and fully consistent with the Bank's support of China's gradualist approach to economic reform. Most projects had minimal policy content, but they all shared a strong emphasis on technology transfer and capacity building. Projects were targeted to a few selected sector institutions and geared to maximize their demonstration effect to the rest of the

sector, particularly in terms of the benefits to be derived from modern technology and management methods, international procurement, and resettlement approaches.

1.5 This approach had extremely successful outcomes, the sector made remarkable progress in assimilating new technologies and technical skills, and increasing efficiency of project management and operation. The latter was critical to China's ability to rapidly expand energy supply in order to sustain a booming economy. Despite its limited policy content, the institutional development impact of the Bank's program for this initial period is thus rated substantial. These early physical and institutional achievements were fully sustainable and, indeed, paved the way for the more ambitious policy reforms of the mid- and late 1990s. The performance of the Bank is rated fully satisfactory, particularly for the solid technical advice and support it provided in the context of project preparation and implementation. Borrower performance is rated highly satisfactory because of the remarkable degree of commitment and ownership shown by central as well as provincial authorities throughout the initial period.

1.6 The ambitious power sector reform strategy the Bank has pursued since 1994 was, and continues to be, highly relevant in light of the importance of the sector and of the government's stated commitment to reform. However, the implementation of that strategy could have been strengthened by a more proactive, and earlier, stance on tariff structure distortions, accounting and auditing issues and a better articulation of its position on private sector development. More important, the concentration of efforts on the power sector may have distracted the Bank from making serious attempts at renewing a dialogue on the critical coal and petroleum sectors, where reform has been lagging, and at promoting an integrated approach to energy planning. The generally successful outcomes of the Bank's ambitious agenda in the power sector, then, are mitigated by its minimal impact in these two other sectors.

1.7 The outcome of the Bank's energy assistance program since 1994 is rated satisfactory, its institutional development impact substantial, and its achievements sustainable, considering the government's continued commitment. Bank performance during the period is rated highly satisfactory, while borrower performance is rated satisfactory, with excellence in such aspects as resettlement, sustained commitment to energy efficiency, and renewed promotion of renewables offset by weaknesses such as lack of effective sectoral coordination at the central level, slow pace of power tariff reform, insufficient enforcement of environmental regulations, and lack of progress in reforming the coal sector.

## Lessons

- *An incremental approach to institutional development, initially emphasizing technology transfer and capacity-building can be extremely effective.* However, it requires the Bank and the borrower to see it from the outset as a prelude to a second phase of policy reform; a minimum level of absorptive capacity in the country; high borrower ownership; and Bank assistance designed with a specific demonstration effect in mind.
- *Internal Bank factors are critical to building up and sustaining an effective long-term sector dialogue.* The Bank's successes in power, energy efficiency, and renewables in China have much to do with staff continuity, the high caliber of individual task managers, the existence of a dedicated pool of expertise on specialized aspects, and management's willingness to invest resources in quality, highly participatory sector work.
- *In focusing on the ultimate introduction of market forces in the energy sector as part of its policy dialogue, Bank staff should not lose sight of the importance of fundamentals.* Good

financial reporting, use of economic criteria in investment decisions and tariff setting, and integrated approach to energy planning are all fully pertinent during a prolonged period of transition to market.

- *A two-pronged approach that combines high-level policy dialogue with central authorities and a direct operational involvement with a representative set of provincial utilities is essential to success.* The second level of involvement was critical in China, where issues and constraints vary significantly from one province to the next and where the level of detailed information available at the central level is increasingly scarce.
- *The Bank should be particularly sensitive to possible misinterpretation by outsiders of its stance on private sector development issues.* This requires a determined and coordinated effort on the part of Bank, IFC, and MIGA staff to clearly articulate and explain the Bank Group's strategy to all relevant stakeholders, and especially to potential foreign investors.
- *The Bank's emphasis on ensuring compliance with environmental guidelines in the design of the projects it finances and on the design and enactment of appropriate environmental regulations at the national level, needs to be complemented by similar efforts at the monitoring and enforcement levels.* In China's power sector, the financing of monitoring equipment under Bank loans has proved an effective way to achieve this.

## Recommendations

1.8 The Bank is at a crossroads in its energy sector dialogue with China. After the major policy breakthroughs of the mid-1990s in the power sector, progress on sector reform has slowed and major policy issues in such critical subsectors as coal, oil and gas have largely gone unattended. To address this the Bank could choose to focus increasingly on "peripheral" subsectors such as renewables and energy efficiency where policy issues are less sensitive and government buy-in more likely. This approach would likely lead to a marginalization of the Bank's role in a sector of central importance to the country's future development, and at a time when IFC is not positioned to expand its involvement – precisely because major institutional and policy issues remain to be addressed. A more difficult path would be for the Bank to continue its sizeable financial support to the energy sector but frame it within a truly comprehensive dialogue on national energy policy issues. This evaluation clearly suggests that this is where the Bank's comparative advantage lies. In particular:

- ***Help promote comprehensive energy planning in China.*** The Bank should offer to help at two levels: regionally, preferably in Sichuan province, which has a varied resource endowment and where the Bank has ongoing operations and institutional relationships; and nationally, possibly building on the working dialogue recently initiated with the State Council, the just-completed PHRD-financed study of LNG demand, and the (older) major study of China's coal and electricity delivery services.
- ***Continue to balance assistance in terms of subsectoral priorities, mix of instruments, and central versus local dialogue.*** An appropriate mix of lending and non-lending instruments will continue to be needed for maximum impact. And sector interventions will need to continue following a parallel track, at both the central and provincial levels.

1.9 While future energy policy dialogue will need to be comprehensive, calling for broad-ranging economic and sector work, the scope of individual project interventions need not be. Instead, they may be geared to areas neglected in past Bank lending, and where potential IFC involvement is less likely, at least initially. Specifically:

- ***In the power sector, the Bank should increase its attention to inefficiencies at the distribution level*** and broaden the efforts initiated in Zhejiang province under the recently approved Tongbai project. This increased emphasis on local issues, together with the photovoltaic pilot financed by the Bank under the recent Renewable Energy project could pave the way for a more proactive, and better-integrated, Bank strategy on rural energy.
- ***Direct assistance toward municipal-level natural gas distribution and demand*** – for example, by replacing coal-fired furnaces with gas-fired furnaces, co-generation, and district heating. Loans to municipalities could help expand municipal gas-distribution infrastructure and utilization of natural gas in urban district heating systems.
- ***Make a renewed and determined attempt to engage Chinese authorities in a full-fledged dialogue on the coal sector.*** The coal sector is too important to China's future social, environmental, and economic development, and the issues the sector are facing too daunting, for the Bank to continue ignoring it in its assistance strategy.

1.10 In its future lending to the power sector – and possibly the petroleum sector – the Bank should give a higher priority to the early resolution of pending asset ownership issues, which continue to cloud the reliability of many sector agencies' financial statements. In this context, the Bank should consider revisiting its current auditing requirements (which only provide for certification by government audit bureaus) and at a minimum ask to be provided with audit reports from international auditors whenever these have been prepared (e.g. for those power companies which have obtained, or are seeking, partial listing on foreign stock exchanges).

## **2. Update Objective, Scope, and Limitations**

2.1 The purpose of this update of Report No.21891 (*The Bank's Assistance to China's Energy Sector. An OED Country Sector Evaluation*) is to assess the relevance, efficacy, and efficiency of World Bank assistance (comprising both lending and non-lending services) to China's energy sector over the last two Fiscal Years (2001-2002). The study findings are based primarily on recently available project documents and evaluation findings; selected analytical and advisory outputs; and interviews with Bank staff.

2.2 Despite the size of its assistance to the sector (US\$ 6 billion worth of loans to date), the Bank has been (as outlined in the aforementioned Report) in financial terms at least, a relatively marginal player in the Chinese energy sector, given the sector's sheer size.

### **COUNTRY AND SECTOR CONTEXT: RECENT DEVELOPMENTS**

2.3 *Electric Power.* The size and rate of growth of China's power sector have been very impressive. It has had similar problems to those in the transport sector, particularly the complexity and inefficiency of the institutional structure, and lack of long-term commitment to tariff adjustments, but has arguably made more progress in addressing these problems. China's power generation capacity exceeds 300 gigawatts, making it the world's second largest network. Over the last two decades electricity demand grew by nearly 9 percent a year (except in 1997 and 1998, when annual growth slipped below 5 percent due to the East Asian financial crisis).

2.4 The power sector in China has been undergoing institutional and organizational reforms for several years. The abolition of the Ministry of Electric Power in April 1998 and the transfer of its government/supervision functions to central government agencies, such as

the State Economic and Trade Commission and the National Electricity Council have paved the way for a clearer separation of government and enterprises functions. The Government remains committed to power sector reform during the 10<sup>th</sup> Five-Year-Plan (2001-2005). The new policy was established in the Electric Industry Master Reform Plan (Document No. 5, State Council, April 2002) which sets out a number of major tasks to be achieved during this FYP, aiming to (a) complete separation of network from generation and restructuring of both generation and network businesses, (b) establishing competitive and open regional markets through dispatching of generators according to bidding procedures, development of electricity markets code(s), (c) setting up of a new pricing mechanism including environmental protection mechanisms, (d) developing an efficient mechanism for all parts of the electricity chain (including generation, transmission, distribution and retail tariffs).

2.5 *Renewable Energy.* China has long had one of the world's largest renewable energy programs, leading to the establishment of 20 GW of small hydropower and large-scale installation of improved woodstoves and biogas plants. The government's energy strategy in the 10<sup>th</sup> FYP emphasizes renewable energy more strongly than in the past, as one measure to reduce the power sector's use of coal in the medium to long term, and to provide energy services to remote rural households.

### **Overview of the Strategy**

2.6 Over the last two FYs, the diversification (originally starting in 1997) of the Bank's assistance beyond the power sector took on full meaning with lending operations in energy conservation, district heating and renewable energy as well as renewed AAA activities in the oil and gas sector (see Report No.21891). Moreover, technical assistance in the power sector continued with the Hubei Hydroelectric Project (2002) to provide lessons on the following reform targets: (a) complete separation of the generation from transmission and distribution functions. Restructuring of existing generation assets into independent generation companies; (b) defining commercial contractual arrangements between the generators and the transmission and distribution company to gradually introduce competition at the generation level; (c) developing a mechanism to ensure power exchange and trade between the different provincial systems in the north China region; and (d) strengthening the commercial focus of the North China Power Group Corporation (NCPGC) by transferring all policy and regulation functions to government/independent agencies.

2.7 In contrast to the time period before 1998, only 4 power loans have been made since then, resulting in a significant decrease in overall energy lending (down to US\$100 million in FY1999, US\$320 million in FY2000, and US\$105 million in FY2002). In total, the Bank has approved only 1 energy and energy-related loan totalling to US\$ 105 billion over the last two FYs (list in Annex A). However, energy has still accounted for a major share of the Bank's total lending to China between 1983 and 2002. Overall, electric power has taken the lion's share of lending (86 percent), followed by oil and gas (10 percent), energy efficiency and renewable (2 percent), and coal (2 percent). In addition, the sector received US\$90 million in Global Environment Facility (GEF) grants through the Bank. Furthermore, the Bank has carried out a fair amount of analytical and advisory (AAA) services during the past twenty years (see further OED, China - Evaluation of the Energy Sector, 2001). In the past two years, the establishment of a power market in Zhejiang Province is one example of AAA.

### **Electric Power**

2.8 Between 1984 and 2002, the Bank made 24 power loans to China for a total of US\$6.0 billion (about US\$260 million on average per year), making it the Bank's largest borrower in

this sector. Twenty of these loans were primarily targeted to power generation facilities (11 to coal-fired thermal plants and 10 to hydroelectric plants) while 3 were primarily targeted to transmission facilities. None were specifically targeted to sub-transmission and distribution. Most loans included substantial funds for institutional components (training, studies, consulting services), ranging from 2 to 9 percent of the loan amount (see Annex).

2.9 During the early and late 1990s, assistance in the electric power sector was limited to the most-developed utilities and was aimed at introducing new technology (supercritical coal-fired units in Shanghai) and pioneering sector reform (generation market development in Zhejiang). In addition, all recent power projects have incorporated environmental protection as a core objective.

### **Petroleum (Gas only) Sector**

2.10 The loan (US\$255 million) for the Sichuan Gas Development and Conservation Project was made in 1994 and closed in FY 2001. Its stated objectives were ambitious, namely: to support the restructuring of the upstream oil and gas sector; to promote the development and conservation of gas resources in an economic, efficient, and environmentally sound manner; and to strengthen the institutional capabilities of the China National Petroleum Corporation (CNPC) and its subsidiary; the Sichuan Petroleum Administration (SPA). In many respects, however, these objectives have been surpassed following restructuring of the sector in 1998 and more recent developments.

### **Energy Efficiency and Renewable Energy**

2.11 As part of its portfolio diversification strategy (para.2.4), the Bank continued its financial support for energy efficiency and renewable energy projects, via a stand-alone GEF project, as well as the Renewable Energy scale-up Program. The World Bank and GEF helped, in collaboration with other multi- and bi-lateral agencies, SDPC in building consensus around the need to introduce a mandated market policy to scale up and sustain development of renewable energy during the current FYP. SDPC and other agencies acknowledge World Bank and GEF value added in: (a) bringing up to date knowledge about and lessons learned from international experience on a timely basis; (b) identifying and mobilizing high calibre experts; and (c) defining and assisting in carrying out analyses and studies required for informed decisions.

## **3. Project and Sector Outcomes**

### **EFFICACY OF BANK PROJECTS: PERFORMANCE AND OUTCOMES (UPDATE)**

#### **Completion and Supervision Ratings**

3.1 The record of completed energy and energy-related projects (Annex) is comparable to the one in the transport sector: none of the 20 projects had an unsatisfactory outcome (6 were rated highly satisfactory while 4 were rated marginally satisfactory; one project was not rated).<sup>1</sup> Sustainability was rated likely for all but one project (the Daguangba multipurpose hydroelectric project, which was rated uncertain). And institutional development impact was

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1. The Henan (Qinbei) Power project (Loan 3980, approved in fiscal 1996) was cancelled at China's request before being declared effective.

rated substantial or high for all but 3 projects (the Daguangba, Changcun Mining, and Fertilizer Rationalization projects, which all had a modest rating).

### **Resettlement aspects**

3.2 One of the most controversial aspects of hydro projects in China is the resettlement issue. With a large rural population and only 10 percent of its land suitable for agriculture, the available land in the river valleys is fully utilized. Any change in the river level due to dam building will result in resettlement. Since all the arable land is already under cultivation, the resettlement areas are usually less attractive. The government took advantage of the present economic growth in the urban areas and resettled part of the displaced people in the growth regions and the rest in irrigated areas. So far, according to the World Bank, China has one of the better resettlement programs in the world. As stated in “The Bank’s Assistance to China’s Energy Sector”: “Bank-financed hydroelectric projects have involved the involuntary resettlement of a significant number of people (up to 84,000 for Shuikou). Thermal generation and transmission projects have also required some resettlement, but to a more limited extent (typically 500–1,000 people for thermal plants and 5,000–10,000 people for high-voltage transmission projects). All projects have provided for the preparation and implementation of satisfactory resettlement plans consistent with OD 4.30“. “China’s resettlement record in Bank-financed energy projects appears to have been generally good”.

### **Institutional Development Impact and Sustainability**

3.3 The fundamental restructuring of the power sector has been the most ambitious institutional objective pursued by the Bank in the energy sector since 1994. A joint report between the State Power Corporation and the Bank was published in late 2000, which identified a three staged approach to introduce competitive power markets into the Chinese power sector. The report also concluded that competitive power markets in China should be initially established in areas made up of a province or several provinces. Due to technical and organization factors, the creation of larger market area at the outset is impractical.

3.4 *Competitive power market.* The Government’s master power sector reform strategy paper developed by SDPC with the assistance of the Bank, and approved by the State Council in 2002, also articulated that the development of integrated regional competitive power market is the long-term reform objective. The electricity industry in China is shifting to a competitively based electricity market framework, particularly Shanghai and Zhejiang in the East China power grid. Zhejiang is piloting the implementation of competitive power markets with assistance of the World Bank. The Bank is in a unique position to bring international experience to bear in power market design.

3.5 *Zhejiang’s case.* Zhejiang’s electricity market, for instance, is moving to the first phase of reform (the introduction of a competitive power market). Although its trial operations only began in January 2000, a recent World Bank review (2001) found that impressive achievements have already been made: sound trading mechanisms, operating rules, and risk management have been established; information systems to operate a competitive energy pool have been well conceived, developed and put in operation; the reform has been widely accepted and supported by government authorities; improvements have been widely accepted and supported by government authorities; improvements have been made by generators in cost control, internal performance management, and contract trading analysis and risk management; and most important, average generation availability (92 percent in 2000) continued to improve as a result of competition.

3.6 There are however, problems that have prevented the market from advancing further. The pilot project has also revealed the constraints and problems that arise if the Government persist in adopting a fragmented, piece-meal approach to power sector reform. Despite the attempt to implement a market-mechanism the Government has continued using certain administrative controls on energy output, energy prices, and the average bulk power price (see also Report No.21891).

### **Relevance of Bank Assistance**

3.7 Any assessment of the relevance of Bank involvement in China's energy sector needs to start with the recognition that in financial terms alone, Bank support has represented but a minute portion of the sector's total investment needs: even in the power sector where the Bank has been most active, total lending between 1984 and 1995 (US\$3.4 billion) accounted for a mere 3.4 percent of sector investments. Under these circumstances, and notwithstanding any actual or potential direct benefits of Bank projects, the relevance of Bank assistance has to be seen primarily in terms of whether it was geared (in terms of targeting, type of instruments, partnerships) to achieve maximum catalytic or demonstration effect and policy impact in areas emphasized by the Bank's corporate, sector, and country assistance strategies (see further Report No.21891).

3.8 The Bank's investments in the electric power sector reflected the Bank's comparative advantage and were driven by the high priority in China given to increasing power production. Financing big hydro projects, and later large thermal plants, has historically been the Bank's comparative advantage. Lack of electric power to support economic growth, combined with an inefficient and obsolete supply system made power plant construction an obvious high return activity for the Bank. Strong Chinese ownership of the projects (at least to the extent these projects increased supply) was an indication of the overwhelming priority of this activity. The difficulties associated with pricing and financial matters that accompanied these projects, reflected a lower level of ownership of these ideas.

3.9 In the last few years the Bank has encouraged China to seek private sources of financing for increasing electric power supplies. In spite of Bank encouragement, China has only been able to attract relatively minor amounts of private financing, usually with substantial government support. Without an appropriate market structure, private capital is reluctant to enter this market. Getting the market structure 'right' is the challenge for the future. In any case, given the size of the sector, most of the resources will have to come from domestic savings and external capital can only play a limited role.

3.10 Given the large size (for the Bank) of the electric power supply program, it was difficult for the Bank to find the resources and the will to move into other areas of energy investments. The supply problems associated with primary fuels, oil, gas, and coal were obvious but taking action was beyond the capacity of the Bank particularly in the face of Chinese unwillingness to deal with the associated institutional issues. The few attempts to do so were not notably successful and discouraged further action. The fuel sector is the major unfinished business for the future.

### **New Directions**

3.11 *Distribution.* The lessons of experience in undertaking the reform of the power sector around the world have suggested:

- Most of the inefficiencies are in the distribution system. Underinvestment in capacity, poor management, political interference in pricing decisions, and a host of other reasons have resulted in large and often growing losses that have dwarfed the modest gains in improving the efficiency of the generation process. In many countries all of the gains in lowering the costs of generation have been absorbed by further inefficiencies and rent collection activities at the distribution level.
- The development of wholesale or bulk power markets is limited by the lack of efficient retail or lower level distribution markets. The ultimate consumer is the one who generates the cash and unless the chain of market transactions reaches this consumer, the wholesale and intermediate market reforms are doomed to fail. India is usually cited as the classic example of failure of the retail markets limiting the success of the whole system
- Generation, with its large units and limited number of players is easier to deal with and appeared to be a more logical starting point. It is now increasingly recognized that unless an effort was made to deal with the distribution side of the market, the whole reform movement was at risk.

3.12 In China, some distribution systems are in bad shape. The difficulties in getting compliance on pricing covenants on the large generation projects can be directly attributed to the inefficiencies of the lower level distribution systems. A two-tiered pricing system for old and new plants makes little sense to the consumer who buys kilowatt hours and cannot distinguish between old and new kilowatts.

3.13 Most of the distribution systems in China are local or municipal and often include substantial generation assets as part of the system. Most of the small, inefficient, and highly polluting power plants are in the municipal sector. These systems are characterized by; unclear ownership, control and management, primitive financial systems, capacity utilization limited by poor investment decisions, ancient technology, uneconomic pricing and rationing systems, excess employment, and a whole host of other ills. They present large and growing problems that require immediate interventions if the gains already made in the bulk generations systems are to be maintained.

### *Coal*

3.14 Coal is the primary energy source for China. After an initial unsuccessful attempt to develop project lending in the coal sector, the Bank has maintained its distance. Coal production, its transport, and its use as the basic fuel for power generation are of overwhelming importance in underpinning China's rapid rate of growth. Coal mining, rail transport, and electric power production are all part of an interrelated investment nexus that cannot be ignored. In 1995, the Bank with the support of several Chinese institutions developed a model to examine these interactions. The application of the model showed that most of the current investment decisions with respect to coal, rail, and power investments fit within the efficiency parameters of the model. The overwhelming scarcity situations in all three sectors made identification of solutions obvious. The one exception was coal washing; it was identified as a potential high return investment in which, to date, only modest progress has been made.

3.15 The clear message that came out of this work was that the coordination of investments in these three sectors would be of increasing importance in the immediate future. Power plant location, transmission lines, and railway capacity are all substitutes in the investment decision making process. Coal accounts for forty-two percent of the freight traffic carried by the railways and capacity used for carrying coal is not available for other uses. In the absence of

clear market signals, for example, freight tariffs that reflect real costs, including congestion costs and retail tariffs that reflect real costs to the consumer, investment decisions in both transport and electric power will require coordination at the central level. It is ironic that in moving away from its highly centralized planning system, the one area requiring strong guidance from the center is being gradually weakened. As long as market signals remain weak, coal, power, and transport will require a continued emphasis on central planning.

3.16 Providing assistance in this transition process will be a challenge for the Bank. It will require a high degree of coordination within the Bank at the project and country level to offset the obvious weaknesses of coordination within China. It will also require the Bank to engage in the type of sector work represented by the power, transport model discussed above. (There appear to be no references to this model in any of the later project decisions). Without a better understanding of the economic forces driving these investment decisions, it will be difficult for the Bank to act as an effective advisor on the major policy issues in energy and transport.

### *Gas*

3.17 As noted in a number of studies, China's gas potential is relatively unexploited. Can the Bank do more to get this moving? This is obviously a sector where large international investors can play a major role but in order to jump start the process it may make sense for the Bank to underwrite major investments in pipelines and distribution systems. This again is an area where the discipline of the Bank's project process would provide substantial value added.

3.18 There is also an important link between gas and power generation. China has been reluctant to use gas in power generation because of its alleged scarcity and presumed alternative uses. Developments in technology, however, have modified this view in most of the world. The technology of gas fired power generation has developed to the point where economies of scale are irrelevant and capital costs dramatically reduced. A more diversified power system with smaller and more widely disbursed gas fired plants may present a more attractive alternative to the present strategy of large, integrated power systems with their substantial transmission costs. This is an area that could be usefully explored by the Bank in both its projects and AAA. Smaller size plants lend themselves to greater private financing and the Bank's support in this area could combine finance with strong value added services.

## China Energy Projects

### Power Projects

<i>Loan</i>	<i>Year</i>	<i>Project Name</i>	<i>Borrower</i>	<i>Amount (US\$ million)</i>
4666	2002	Hubei Hydroelectric Project	Hubei Provincial Finance Bureau	105
4529	2000	Tongbai Pumped Storage	Zhejiang Provincial Electric Power Co	320
4350	1998	Hunan Power Development	Hunan Electric Power Co.	300
4303	1998	Power Transmission.	East China Electric Power Group Co.	250
4197	1997	Waigaoqiao Thermal	Shanghai Municipal Power Bureau	400
4172	1997	Tuoketuo Power	Tuoketuo Electric Power Generation Co and North China Power Group	330 70
3980	1996	Henan (Qinbei) Power	Electric Power of Henan	440
3933	1995	Ertan II Hydro	Ertan Hydroelectric Development Co.	400
3848	1995	Sichuan Power Transmission	Sichuan Electric Power Co	270
3846	1995	Zhejian Power Development	Zhejiang Provincial Electric Power Co.	400
3718	1994	Yangzhou Thermal Power	Jiangsu Provincial Electric Power Co	350
3606	1993	Tianhuangping Hydro	E. China Electric Power Group Co.	300
3515	1992	Shuikou II Hydro	Fujian Electric Power Bureau	100
3462	1992	Zouxian Thermal	Shandong Provincial Electric Power Bureau	310
3433	1991	Yanshi Thermal	Henan Provincial Electric Power Bureau	180
3412	1991	Daguangba Multipurpose	Hainan Provincial Electric Power Co	65
3387	1991	Ertan I Hydro	Ertan Hydroelectric Development Corp.	380
2955	1988	Beilungang II	Zhejiang Electric Power Bureau	165
2852	1987	Wujing Thermal	Shanghai Municipal Power Bureau	190
2775	1986	Shuikou I Hydro	Fujian Electric Power Bureau	140
2707	1986	Yantan Hydro	Guangxi Electric Power Bureau	52
2706	1986	Beilungang I	Zhejiang Electric Power Bureau	225
2493	1985	Power II	Jiangsu Provincial Electric Power Bureau	117
2382	1984	Lubuge Hydro	Yunan Provincial Electric Power Bureau	145

**Total number of loans: 24 - Total amount of loans: US\$6,004 million**

### Petroleum Projects

<i>Loan</i>	<i>Year</i>	<i>Project Name</i>	<i>Borrower</i>	<i>Amount (US\$ million)</i>
	1995	Sichuan Gas Dev. & Conserv.	Sichuan Petrol. Authority	255
2708	1986	Liadong Bay Petroleum		30
2580	1985	Weiyuan Gasfield TA		25
2426	1984	Karamay Petroleum		100
2252	1983	Zhonggyuan Wenlia Petrol.		101
2231	1983	Daqing Oilfield-Gaotazi Reservoir		162

**Total number of loans: 6**

**Total amount of loans: US\$673 million**

### Coal Project

<i>Loan</i>	<i>Year</i>	<i>Project Name</i>	<i>Borrower</i>	<i>Amount (US\$ million)</i>
2501	1985	Changcun Coal Mining		126

**Total number of loans: 1**

**Total amount of loans: US\$126 million**

### Other Energy Related Projects

<i>Loan</i>	<i>Year</i>	<i>Project Name</i>	<i>Borrower</i>	<i>Amount (US\$ million)</i>
	1999	Renewable energy Development		100
	1998	Energy Conservation		63
	1998	Shandong Environment		95
	1997	Xiaolangi Multipurpose		430
	1997	Efficient Industrial Boilers (GEF)		n.a.
	1995	Liaoning Environment		110
	1992	Beijing Environment		n.a.
	1987	Fertilizer Rationalization		n.a.

**Total number of loans: 8**

### Major Institutional Development Components of Bank-Financed Power Projects

Loan	Project Name	Borrower	Components	US\$ m.(%) <sup>1</sup>	Outcome
4666	Hubei Hydroelectric	Hubei Provincial Finance Bureau	- Institutional strengthening of power companies - developing and implementing appropriate organizational arrangements and staffing and information systems as well as staff training in project management and hydropower station operation		Project currently under implementation
4529	Tongbai Pumped Storage	Zhejiang Provincial Electric Power Co.	- The development of the Tongbai pumped storage power plant - A competitive program for power market development, and sector restructuring will be implemented - Consulting services, for engineering, design, procurement, and construction management assistance		Project currently under implementation
4350	Hunan Power Development	Hunan Electric Power Co.	- Technical assistance for construction management, advisory services to help implement the electric power company's restructuring plan, and consulting services for organization restructuring and improvement of its financial management system. - Management development and training program designed to enhance managerial, legal, technical, and financial capabilities		Project currently under implementation
4303	East China Transmission	E. China Electric Power Group Corp.	- Power Exchange Policies, Transmission Planning, engineering & construction	9.0 (4%)	Project currently under implementation
4197	Waigaoqiao Thermal	Shanghai Municipal Power Bureau	- Large power plant construction, advanced operation, and preventive maintenance - on-job training engineering and construction management under consultants - engineering under contract for equipment - operation and maintenance of power plants	7.6 (2%)	Project currently under implementation

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4172	Tuoketuo Power	Tuoketuo Electric Power Generation Company and N. China Power Group	<ul style="list-style-type: none"> <li>- Simulator and computer systems for plant operation</li> <li>- Engineering &amp; construction</li> </ul>	9.5 (2%)	Project currently under implementation
3980	Henan Thermal Power	Electric Power of Henan	<ul style="list-style-type: none"> <li>- Electricity conservation</li> <li>- System operation and management</li> <li>- Engineering &amp; construction</li> </ul>	17.4 (4%)	Project currently under implementation
3933	Ertan II Hydro	Ertan Hydroelectric Development Corp.	<ul style="list-style-type: none"> <li>- Studies on: (i) reservoir operations; and (ii) preparation of future power projects</li> <li>- Investigations/tests on: (i) safety of structures; (ii) monitoring of energy dissipation facilities; and (iii) powerhouse ventilation</li> <li>- Training in planning, feasibility studies, design, hydrology, monitoring</li> <li>- Engineering &amp; construction</li> </ul>	37.2 (9%)	Project currently under implementation

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<b>Loan</b>	<b>Project Name</b>	<b>Borrower</b>	<b>Components</b>	<b>US\$ m.(%)<sup>1</sup></b>	<b>Outcome</b>
3848	Sichuan Transmission	Sichuan Electric Power Company	<ul style="list-style-type: none"> <li>- Technical training</li> <li>- On-job training, engineering and construction management under consultants</li> <li>- Engineering under contract for major plant equipment</li> <li>- Training in operation &amp; maintenance</li> </ul>	6.8 (3%)	Project currently under implementation
3846	Zhejian Power Development	Zhejiang Provincial Electric Power Co.	<ul style="list-style-type: none"> <li>- Improvement of T&amp;D planning</li> <li>- Training</li> <li>- T.A. for cogeneration plant</li> </ul>	12.5 (3%)	Project currently under implementation
3718	Yangzhou Thermal Power	Jiangsu Provincial Electric Power Co	<ul style="list-style-type: none"> <li>- Training: (a) utility management; (b) project related (consultants, contractors, suppliers); and (c) training facilities</li> </ul>	11.1 (3%)	Project currently under implementation
3606	Tianhuangping Hydro	E. China Electric Power United Co	<ul style="list-style-type: none"> <li>- Optimization of Operations Study</li> <li>- Training: (a) utility management; (b) project related (consultants, contractors, suppliers); and (c) training facilities</li> </ul>	11.3 (4%)	Project currently under implementation
3515	Shuikou II Hydro	Fujian Electric Power Bureau	<ul style="list-style-type: none"> <li>- SCADA system for new load dispatch center</li> <li>- Studies on: (a) system planning and operation; and (b) hydro inventory</li> <li>- Training: Planning and project related technology and management Engineering &amp; construction</li> </ul>	5.9 (6%)	Project completed. Studies and training completed.
3462	Zouxian Thermal	Shandong Provincial Electric Power Bureau	<ul style="list-style-type: none"> <li>- Large power plants, HV transmission, grid management w/ SCADA</li> <li>- On-job training engineering and construction management under consultants</li> <li>- engineering under contract for major plant equipment. Air pollution study</li> <li>- operation and maintenance of power plants in China and abroad</li> </ul>	5.7 (2%)	Project completed. Training and studies completed.

<b>Loan</b>	<b>Project Name</b>	<b>Borrower</b>	<b>Components</b>	<b>US\$ m.(%)<sup>1</sup></b>	<b>Outcome</b>
3433	Yanshi Thermal	Henan Provincial Electric Power Bureau	- Training on: (a) large power plants and automated networks;(b) HV transmission; (c) project related (consultants, construction, suppliers, O&M)	2.0 (1%)	Training components successfully completed.
3412	Daguangba Multipurpose	Hainan Govt. and Hainan Provincial Electric Power Co	- Studies for: (a) network telecontrol; and (b) power dispatch system - Training on project construction management	2.6 (9%)	Project currently under implementation.
3387	Ertan I Hydro	Ertan Hydroelectric Development Corp	- Studies on: (i) reservoir operations; and (ii) preparation of future power projects - Investigations/tests on: (i) safety of structures; (ii) monitoring of energy dissipation facilities; and (iii) powerhouse ventilation - Training in planning, feasibility studies, design, hydrology, monitoring	13.0 (3%)	- Studies successfully completed. - Technology for dam/plant construction and operation successfully introduced. - Transfer of know-how and technology well achieved. .
2955	Beilungang II	Zhejiang Electric Power Bureau	- Study for enhancement of distribution grids and tech. assist. on: (a) procurement; and (b) planning - Training for O&M of power plants	2.7 (2%)	- Completed. Improved operations - Enhanced procurement and planning procedures - Successfully completed
2852	Wujing Thermal	Shanghai Municipal Power Bureau	- SCADA system for new load dispatch center - Master Plan for Shanghai's distribution system - Staff Training for design, construction, operation and maintenance	4.4 (2%)	- System is operational: increase load regulation & economic dispatch capabilities - Improvement in system planning & reliability. Standard system voltages - Transfer of technology & practices for large power plants and distribution
2775	Shuikou I Hydro	Fujian Electric Power Bureau	- Studies for: (a) operation of hydro plants; and (b) power system control and load dispatch - Training on utility management	9.1 (7%)	- Enable to increased use of hydro generation. Dispatch center software allows annual planning

<b>Loan</b>	<b>Project Name</b>	<b>Borrower</b>	<b>Components</b>	<b>US\$ m.(%)<sup>1</sup></b>	<b>Outcome</b>
2707	Yantan Hydro	Guangxi Electric Power Bureau	- Training: (a) on-job training, engineering and construction management under consultants; (b) planning; and (c) purchase of equipment	0.6 (1%)	- High contribution on dam safety, computerized scheduling, quality control
2706	Beilungang I	Zhejiang Electric Power Bureau	- Training: (a) on-job training, engineering and construction management under consultants; (b) supplies; (c) O& M of power plants; and (d) utility management	6.1 (3%)	- Successfully introduced know-how and technology of large coal-fired power plants and enhanced O & M practices
2493	II Power Project	Jiangsu Provincial Electric Power Bureau	- Training: (a) new center; (b) transmission system studies and design;; and (c) O&M in transmission and substations	0.4 (0.3%)	- The impact of the T.A. component appear to be very limited , except for transfer of know-how on EHV lines
2382	Lubuge Hydro	Yunan Provincial Electric Power Bureau	- Training: (a) on-job training, engineering and construction management under consultants; (b) supplies; (c) O& M of power plants; and (d) utility management	11.5 (8%)	- The training program provided enhanced design, construction, and O & M practices

<sup>1</sup>. Amount includes all the T.A. components financed by the Bank loan. percent relates to the total amount of the loan.

## China Energy Projects – Completion Ratings

<i>Loan</i>	<i>Year</i>	<i>Project Name</i>	<i>Outcome</i>	<i>Sustainability</i>	<i>ID Impact</i>	<i>Bank Performance</i>	<i>Borrower Performance</i>
<b>Power Projects</b>							
3980	1996	Henan (Qinbei) Thermal Power	NR <sup>1</sup>	NR <sup>1</sup>	NR <sup>1</sup>	S	U
3515	1992	Shuikou II Hydro	HS	L	S	HS	HS
3433	1991	Yanshi Thermal	S	L	S	S	D
3412	1991	Daguangba Multipurpose	MS	U	M	S	U
3387	1991	Ertan I Hydro	HS	L	S	S	HS
2955	1988	Beilungang II	S	L	S	HS	HS
2852	1987	Wujing Thermal	S	L	S	S	S
2775	1986	Shuikou I Hydro	HS	L	S	HS	HS
2707	1986	Yantan Hydro	S	L	S	S	S
2706	1986	Beilungang I	S	L	S	S	S
2493	1985	Power II	S	L	S	S	S
2382	1984	Lubuge Hydro	S	L	S	S	S
<b>Petroleum Projects</b>							
2708	1986	Liadong Bay Petroleum	MS	L	S	U	S
2580	1985	Weiyuan Gasfield TA	HS	L	S	S	S
2426	1984	Karamay Petroleum	HS	L	S	S	S
2252	1983	Zhonggyuan Wenhia Petrol.	HS	L	S	S	S
2231	1983	Daqing Oilfield-Gaotazi Reservoir	HS	L	S	S	S
<b>Other Energy related Projects</b>							
	1992	Beijing Environment					
	1987	Fertilizer Rationalization	MS	L	M	S	S
2501	1985	Changcun Coal Mining	MS	L	M	S	U

1. Not Rated: loan was fully cancelled before being declared effective.

Ratings:

Outcome/Bank & Borrower Performance: HS=Highly Satisfactory; S=Satisfactory; U=Unsatisfactory

Sustainability: L=Likely; U=Uncertain

ID Impact: S=Substantial; M=Modest