

**Energy and Power in China:
Domestic Regulation and Foreign
Policy**

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Preface by Gong Li and Mark Spelman

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The FPC's China project aims to engage a broader group of actors with emerging new thinking on the social and economic consequences for China of globalisation and the impact of the rising Chinese economy on the future of globalisation. The China project will take Chinese perspectives as its departure point, focusing on three principal areas:

- ❑ how China's government, interest groups and diverse communities see their values and how they project these values to the world;
- ❑ outside attempts to understand and engage with the values of the Chinese government, leading interest groups and diverse communities; and
- ❑ the role of these diverse, often competing, Chinese actors in globalisation and global trends.

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Preface

This Foreign Policy Centre report draws together key findings from other major studies on the power and energy situation in China today and forecasts for the future. The report poses a key question not often asked outside the country – how important is the domestic regulatory environment in China to those forecasts?

Accenture's experience in Europe suggests that this question is of vital importance both to China and the wider world. Effective regulation is one of the most important tools for harmonising energy consumption and building stable economic development. Regulation helps countries arrive at the optimum structure for the energy sector, addresses fuel mix issues, provides incentives for capital investment and establishes realistic pricing.

The growth engine

The energy sector in China is growing rapidly to match the country's economic transformation. With the exception of oil, China has now taken the lead position (surpassing the United States) in the consumption of virtually all major commodity categories.

The rapid rise in production and consumption of energy has taken place largely as a consequence of the economic reforms introduced in the late 1970s and 1980s which ushered in the rapid industrialisation and urbanisation of the country.

This process has triggered a high demand for energy both to feed growing industry and business, and to meet growing consumer demand, having far-reaching consequences for China, the Far East and the global energy market. It is shaping Chinese foreign policy and presents both challenges and opportunities for governments and energy players the world over.

This was borne out by a recent research study by Accenture in Asia that revealed that China is considered by far to be the most attractive country for investors in the region, with 94 per cent of respondents citing it as having the biggest growth opportunities in Asia. Yet at the same time, the survey revealed that businesses see a large amount of risk in China, the biggest of which is the continuing increase in the price of oil and other raw materials.

Matching supply and demand

The national demand for electrical power during the first years of the new century, which had been forecast to grow at about 6 per cent per year, has in fact grown from 2001 onwards at a rate exceeding 10 per cent per year, reaching 15 per cent in 2003.

This in turn has led to a mismatch between supply and demand. In 2005 a power supply deficit exists, resulting in the emergence of power shortages across the country. Households and industries continue to experience planned power outages on a regular basis. This appears to be a direct result of the drive for economic growth being pursued without sufficient regard for the energy requirements involved or enough lead-time to build the necessary generation, transmission and distribution infrastructure.

The government has responded. By working with Chinese power companies it is pushing ahead with plans to raise the country's installed generating capacity from 385 gigawatts at the end of 2003 to 480 gigawatts by the end of this year (2005). Transmission and distribution capacity will also have to be enhanced dramatically.

One must also not forget the huge issues of geography that China faces. Most of China's coal, the backbone of its electricity generation, and so many of its power stations, are in the north of the country. While the bulk of its economic growth and urbanisation is in the coastal regions of the east and south.

The fuel mix quandary

In addition to solving the issues around supply and demand, China is faced with a separate challenge of reducing its reliance on coal. China's government has just passed a law which seeks to increase the usage of solar and wind power to 10 per cent of China's total energy consumption within five years, a target most see as overly optimistic. The country still relies on coal for two thirds of its power, mining 1.8 billion tonnes in 2004, the equivalent of 700 million tonnes of oil.

The price for this dependence on coal is high, and not just in environmental and emissions terms. Digging the coal costs the lives of 15 miners a day, or nearly 6,000 fatalities a year. The biggest culprits are small private mines, despite the Beijing government's attempt to consolidate the mining industry.

Though use of hydro and nuclear (using 'pebble bed' technology) is growing, coal will still be providing the majority of China's energy needs in 2030. Whatever the fuel mix, if economic growth in China stays on course, China is likely to account for 25 per cent of the world's increase in energy generation in the next 30 years.

The importance of pricing

At the same time, prices for electricity have not been allowed to rise sufficiently. Price rises would provide signals both to the power industry to invest in additional generation and transmission capacity and to consumers to enhance their energy efficiency and conserve energy.

Regulatory institutions do exist. The State Energy Commission was established in 2002 to regulate the power sector serving under the National Development and Reform Commission, but with a staff of only twenty, it is hardly surprising that the government is under pressure to set up a more powerful Energy Ministry.

The regulation imperative

Indeed, this FPC paper suggests that the domestic regulatory framework for China's power sector may be a more urgent and important subject for foreign policy specialists than China's growing oil imports from the Middle East. Regulation must be a tool to quickly bring China's energy process in line with the market value of energy.

Regulation must also be an engine for energy efficiency. Energy consumption per unit of GDP in China is five times greater than in the United States and 12 times greater than Japan. This lack of efficiency may cause shortages which could slow down China's economy.

Conclusion

Beyond China itself, untrammelled energy growth without effective controls could have wider geopolitical implications. How China resolves its energy challenges will be felt not just within the country but will reverberate around the world. China's growing presence on the international stage could ultimately create issues with the world's largest energy consumer, the United States, with both economies potentially in competition for energy resources in Russia, the Caspian region, the Middle East, the Americas, and Africa.

So for economic, social, environmental and geopolitical reasons, effective energy regulation is needed. This means arriving at an optimum industry structure, addressing imbalances in the fuel mix through regulatory incentives, providing regulatory mechanisms which incentivise capital investment in transmission and distribution, and realistic pricing within a market framework. This will lead to a positive effect on customer behaviour and facilitate foreign investment.

Accenture believes that effective regulation informs effective energy policy and can do so in China as it has done elsewhere. In the case of China this can have a thoroughly positive role in sustaining China's economic growth and so enhance the lives of its 1.3 billion

people. It can also facilitate the inward and outward investment in China's energy sector that is urgently required.

Through managing growth, and so promoting energy efficiency and mediating environmental impact, the effective regulation of China's energy industry can have a positive effect on Asia as a whole – and beyond. Better regulation of energy is a win-win situation for everyone.

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Executive Summary

China's rising demand for energy goods and services is putting pressure on global energy markets. According to the International Energy Agency, China will account for 20 percent of world incremental energy demand and for half of the increase in coal use over the next three decades.

Some prominent international commentary has painted this emerging situation in classic 'resource security' terms. The main suggestion has been that China's gargantuan energy consumption in coming decades will position it as a rival to other major energy importers and that the consequent rivalry will have a destabilising effect on international security, either globally or at least in key oil producing regions, like the Middle East.

This paper starts from a different vantage point. It suggests that the most important international impact of China's growing energy use may not be strategic in classic 'hard security' terms that emphasise great power rivalry. The paper suggests that the most important international impacts of China's energy use in the coming decade will lie in the changing patterns of domestic energy use, and the efficiency of China's power sector – especially the generation, pricing and transmission of electric power. The paper contends that it is difficult to understand China's external energy demand (or its global impact) without understanding the Chinese domestic power market.

The domestic regulatory framework for China's power sector may be a more urgent and important subject for foreign policy specialists than China's growing oil imports from the Middle East. The efficiency of China's industrial sector is also an issue, as industrial processes in China continue to require large amounts of fuel relative to output. For example, energy consumption per unit of GDP of China is five times greater than in the US and twelve times greater than in Japan.

For 25 years China's government has been promoting new approaches to energy efficiency and more recently to environmental protection. International actors can help China in this field in various

ways, but most directly through investment in energy-efficient technologies, including development of Chinese specialist expertise. The goal of promoting energy efficiency in China is about reducing future demand.

The paper draws on a variety of specialist studies, on industry structure, the benefits of competition-enhancing regulatory change, energy demand and supply forecasts, and the link between macro-economic conditions and energy consumption. The paper condenses the main findings from such studies to make them more accessible to foreign policy analysts who may be less familiar with the micro-economics issues they address.

The key policy finding is that further regulatory change in China's domestic energy market is necessary as the current arrangements create inefficient outcomes, which will have very real consequences for energy market operation. In particular, the current energy regulatory system is characterised by:

- ❑ Price signals that have negligible effect on consumer behaviour and investment;
- ❑ Weak institutional capacity; and
- ❑ Limited transmission capacity.

Further reform of pricing practices and regulation is needed to establish a link between price, consumption, and investment. The integration of electricity markets and increased competition in other sectors of the Energy sector could promote greater efficiency and provide greater reliability and cost effective supply.

The USA, EU and Britain have – following the lead of China itself – all recognised that domestic regulation of China's energy use and power industries constitute a 'global good'. They have all instituted bilateral programs for promoting more efficient energy use by China. But the EU and Britain have only recently introduced such a program with China, nearly a full decade after the United States. The policy question is whether the EU and Britain can and should prioritise and devote more resources to this program. This paper contends that the answer is self evident as the need is urgent.

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Introduction

Over the last two decades, expansion of China's industrial base has put pressure on China's energy sector to meet increasing demand.¹ Industrial demand currently accounts for approximately two thirds of energy end use.² At the start of his annual report to the National People's Congress on 5 March 2005, Prime Minister Wen Jiabao identified energy shortages as one of five sets of problems, which if left unchecked, could threaten China's continued economic growth.³

It was only weeks earlier that Wen Jiabao formally promulgated the Regulations on Electricity Regulation (15 February 2005)⁴ and Regulations on Electricity Supervision and Control (25 February 2005).⁵ Together, the two sets of regulations are China's most comprehensive effort so far to establish a competitive market in energy inside the country. The regulations on Electricity Regulation set out the organizational framework for electricity regulatory institutions, the duties of regulators, regulatory measures, the code of conduct for regulatory institutions and their staff as well as their due legal responsibilities. The regulations on supervision and control provide for the State Electricity Regulatory Commission (SERC), the

¹ Investment in industrial infrastructure has been a key driver of the continued high rates of economic growth in China. In 2003, total investment in fixed assets (excluding collective and private firms) grew at 32 per cent for the first 8 months. Investment growth rates in coal, electricity, and oil for the first 8 months of 2003 were 59 per cent, 27 per cent and 11 per cent, respectively. These interim figures tend to overestimate trends as the annual figures released by the official sources are sometimes adjusted downwards. These growth figures are in nominal terms and are not adjusted for inflation.

² According to the US government study, *International Energy Outlook 2004*, China's energy consumption to 2025 will increase on average each year by 3.5 per cent. (The report estimated annual average GDP growth of 6.1 per cent in the same period.)

³ See <http://www.chinability.com/2005%20government%20work%20report.htm>. The problems were identified as 'tight grain supply, overheated investment in fixed assets, excessive money and credit, and shortages of coal, electricity, petroleum and transportation'.

⁴ See Shao Bingren, Vice Chairman of the State Electricity Regulatory Commission, Speech of 25 February 2005, <http://www.china.org.cn/e-news/news050225.htm>.

⁵ Xinhua Economic News, 27 February 2005.

relevant departments of the State Council, or the central government to supervise and regulate electricity price; and for the SERC to issue and manage electric power business permits. The regulations come into effect on 1 May.

Chinese leaders have reasons to be concerned. Energy consumption per unit of GDP of China is five times greater than the US and twelve times greater than Japan. Industrial processes still require large amounts of fuel relative to output. China's electricity consumption has more than doubled in the last decade and will probably increase four-fold by 2020.

Electricity use and regulation, not oil imports, may be the most important subject in China's energy sector for international affairs specialists. The energy sector in China has not been liberalised to anywhere near the same extent as the manufacturing sector, either in terms of private ownership versus state ownership, openness to foreign ownership,⁶ or pricing. A study by China's Energy Research Institute indicates substantial gains in energy efficiency are achievable.

This paper provides a summary of recent changes to energy market regulation (electricity, natural gas and oil) in China. The analysis includes an overview of trends on the demand side (changes in energy intensity of industry and consumption patterns) and the supply-side (changes in the relative cost of fuel sources used for electricity generation and investment in infrastructure). It highlights a need for further changes in energy regulation to ensure reliable cost-effective supply in the face of increasing demand and environmental regulation. The paper identifies key risk factors associated with China's energy security and energy consumption.

Within China's energy sector, the electricity sub-sector is more regulated than the oil sector. (The two are not completely independent of each other however because some power stations are fired by oil.) The main impacts of regulation on competition,

⁶ At present, FDI is allowed only in power generation but loan financing has been obtained for some transmission projects.

pricing and consumption are highly technical and highly variable depending on the policy mix, the regulatory regimes and enforcement mechanisms. A brief note is included at Appendix 1.

The key features of China's current energy regulatory system are:

- ❑ Separation of government administration and commercial operation
- ❑ Centralisation of government regulation of energy sub-sectors
- ❑ Integration of upstream and downstream activities in the oil sector.

Rapid Change

The main parameter in determining energy demand projections is *income elasticity of energy demand* (the growth rate of energy consumption divided by that of GDP). Until recently, official statistics indicate that in China the income elasticity of energy demand has been approximately 0.5 (a one percent rise in GDP brings about a half percent rise in energy demand). By contrast, the average value for most developing countries is 1.0 or greater. The significant variation in China's case has been caused by a decoupling of electricity consumption and economic growth, due not only to the capital constraint but also to other factors such as energy efficiency measures and technological change.

According to a recent study, 'preliminary Chinese data for 2004 indicates that the energy elasticity of demand surpassed 1.5 in 2004'.⁷ This would mean that for every one per cent increase in GDP, energy demand is now growing by over 1.5 per cent. Reports such as this, showing a dramatic surge in the income elasticity of energy demand (from 0.5 to 1.5), have helped propel the issue of

⁷ U.S. Senate, Committee on Energy and Natural Resources, Hearing on EIA's Annual Energy Outlook for 2005, 3 February 2005, Testimony of Jeffrey Logan, Senior Energy Analyst and China Program Manager, International Energy Agency, 'Energy Outlook for China: Focus on Oil and Gas'. See http://www.iea.org/textbase/speech/2005/jl_china.pdf.

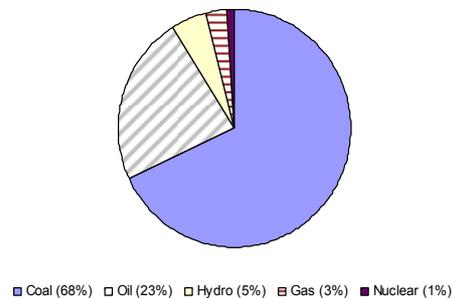
rapid change in China's energy consumption to the top of the international agenda.

Energy Use Snapshot

Industrial processes in China still require large amounts of fuel relative to output. This section provides a brief overview of China's energy sector by providing growth projections, a brief description of the industry structure and a summary of energy use by sub-sector.

China has a number of unique features in the structure of its energy use, particularly its heavy reliance on coal. The industrial sector accounts for 70 per cent of overall energy consumption. Per capita consumption of energy in China is much lower than in the US and Japan. Figure 1 below shows energy consumption by fuel in 2003.

Figure 1: Energy consumption by fuel 2003⁸



According to the International Energy Agency (IEA), China's demand for energy goods and services will increase pressure on global energy markets as:

⁸ Based on million tonnes of oil equivalent. Percentages are rounded to the nearest whole number. Source: BP, *2004 Statistical Review of World Energy*, http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/publications/energy_reviews/STAGING/local_assets/downloads/pdf/statistical_review_of_world_energy_full_report_2004.pdf, p.38.

- ❑ China will account for 20 percent of world incremental energy demand and for half of the increase in coal use over the next three decades;
- ❑ China's oil imports will soar from less than 2 mb/d now to almost 10 mb/d in 2030 – equal to over 80 per cent of domestic demand for oil;
- ❑ Although China's gas production will rise rapidly, demand will be increasingly met by imports over the next three decades;
- ❑ China will need to invest more than \$4 billion per year in coal production to raise productivity, improve safety and meet demand growth; and
- ❑ China's electricity investment needs will increase sharply in the coming decades – especially for transmission & distribution.

On one estimate, average growth in electricity consumption in China is projected to be 4.3 per cent per year through to 2025. The largest future growth in terms of fuel share in the future is expected to be natural gas in part due to environmental concerns regarding the current reliance on coal. But oil will also increase its share, to as much as 50 per cent according to one estimate made public in February 2005.⁹

Changes in the regulatory regime of the energy sector can have a marked effect on consumption because of the volatility and irrational settings in the Chinese domestic market. For example, through 2004, notwithstanding a continuing high GDP growth rate to early 2005, there was considerable fluctuation over the year in oil consumption with preliminary data from the IEA suggesting that consumption slowed in August to 6 per cent, down from 12 per cent in July and from 25 per cent in the second quarter. According to the IEA, this slow-down reflected price effects, conservation measures and new non-oil power generation capacity.

⁹ See Stephen Voss, 'China Says Oil to Exceed 50 Percent of Its Energy by 2010', Bloomberg, 14 February 2005, <http://www.energybulletin.net/4336.html>. Voss cited a senior Chinese official, the director of Energy Economics and Development Strategy in China's National Development and Reform Commission, Gao Shixian.

Coal and Electricity: Price Controls and the Market

The primary source of energy in China (about 68 per cent of consumption by fuel) is coal-based generation. For comparison's sake, using a slightly different but still related measure – coal and coke for energy use, the share in the USA and OECD as a whole accounts for 12.1 per cent and 5 per cent respectively, compared with the share in China of 52 per cent. Such heavy reliance on coal carries high costs, since its use in electricity production is one of the main sources of air pollutants and of greenhouse gases, such as carbon dioxide.

Most of the coal consumed in China is domestically produced, with imports accounting for only 10 per cent of total supply. Prices tend to reflect domestic conditions and are not heavily influenced by the imported price of coal. In the early 1990's, prices for coal declined as demand decreased but in 2003 prices started to rebound. The current outlook is uncertain as there are signs of overproduction as stockpiles of coal at ports and at end user facilities are increasing.

China's use of coal as an energy source has been characterised by significant shortfalls from best practice. Coal cleaning technologies can increase efficiency and decrease pollution in the course of the mining, processing, transforming and use of coal. For example, 'combined cycle' is an electricity technology in which electricity is produced from otherwise-lost waste heat exiting from gas (combustion) turbines. The benefits of combined cycle generation are greater efficiency (an increased energy use per unit of input) and relatively lower emissions than traditional coal-based generation. The use in China of combined cycle technology in electricity generation is become more widespread.

China's leaders have long recognised the shortfalls in its power generation from coal and have worked consistently, if not always as effectively as might be hoped, to improve the performance of this sub-sector. Examples from a long list of measures to promote cleaner coal use or use of renewable sources of energy as a substitute for coal have included:

- ❑ direct subsidies from the national government to encourage the development and uptake of renewable technology
- ❑ new funding for renewable energy technology under the State Science and Technology Commission
- ❑ local government support for renewable technologies
- ❑ tax reduction incentives.

China's government also has a long history of looking to its traditional price control tools to bring about some of the desired efficiencies in coal generation. For example, in July of 2004 the average price of electricity was increased by 0.022 yuan kilowatt/hour in order to dampen surging demand and prevent power shortages. Prices were increased during peak demand periods in Shanghai, Beijing, Tianjin, Hebei, Jiangxi, and Chongqing. Compensation measures were also introduced in Shanghai to encourage off-peak power usage.

The State Council decided on 4 June 2004 to take the following measures to maintain reliability of supply in periods of peak demand for electricity:

- ❑ demand side management policies to control demand for electricity and ensuring supply. This includes restricting power consumption by power intensive industries;
- ❑ differentiated pricing for off-peak and peak consumption;
- ❑ improving the reliability of power distribution and transmission networks;
- ❑ maintain coal supply and improve coal distribution channels with an emphasis on decreasing transportation costs;
- ❑ accelerating construction of energy and transport projects to ensure supply; and
- ❑ increased emphasis on energy efficient consumption.

In Jiangsu, Hunan and Henan province and some places with abundant hydropower resources, the government varies electricity prices between wet and dry seasons. China has also started to adopt variable pricing for peak and off-peak periods of demand. It has also adopted differential pricing for six high energy consuming industries (aluminium, ferroalloy, calcium carbide, caustic soda, steel, and cement production), and has abolished the price discount on power supply to 14 state owned alumina factories.

Household expenditures in urban China may allow for increase in energy prices as fees for water and fuels accounted for only 4 per cent of household expenditure in 2001 (State Statistical Bureau, 2001). Prices for residential consumers have remained unchanged as the increase in demand that leads to power shortages is largely driven by energy intensive industrial production. China has also allowed differential pricing for rural consumers, especially rice farmers, who in the late 1990s were paying as little as one fourth the price for power that industrial consumers were paying.

In July 2003, China announced some experiments with 'marketised' pricing for electricity in the East and Northeast of the country. As summarised by the annual report of Huaneng Power International, one of the few Chinese-owned independent operators, the State Council set a number of short term objectives:

- ❑ to establish an appropriate on-grid price-setting mechanism to accommodate a reasonable level of competition in power generation;
- ❑ to establish a preliminary pricing mechanism for transmission and distribution to facilitate the healthy development of the power grids;
- ❑ to link the retail prices with the on-grid prices;
- ❑ to optimize the structure of the retail price; and
- ❑ to pilot-run the practice for high voltage users to directly make purchases from the power generation companies based on a reasonable price for transmission and distribution.¹⁰

In the longer term, as Huaneng saw it, China's government is hoping to 'establish a standardised and transparent price setting mechanism, classifying the electricity prices into the on-grid price, the transmission price, the distribution price and the end-user retail price, and to allow the on-grid prices and retail prices to be determined through market competition'. The central government

¹⁰ Cited in Huaneng Power International Inc, 'Announcement of Results for 2004', 15 March 2005, <http://202.66.146.82/listco/hk/huanengpower/annual/2004/res.pdf>.

would retain the right to regulate transmission and distribution prices.

As of 31 December 2004, these reforms had registered little impact. Although the power market formally commenced in Northeast China in January 2004, with several rounds of simulated operations, the market was only established in practice on 13 December 2004. Huaneng assessed the results of the simulated operations and trial runs and concluded that the regulations for the Northeast China power market were 'not mature'. By early 2005, its monthly bidding practice had been suspended while opinions were being gathered from participants to improve the regulations. In Eastern China, the power market started simulated operations on 18 May 2004, and Huaneng assessed after eight monthly simulated bidding rounds that 'there is room for improvement'. Huaneng expected in March 2005 that 'simulated operations using price setting at a day before spot market should be ready by the second half of 2005'. Tariffs continued to vary widely according to region. Table 1 on the following page lists the prices charged by Huaneng at its various power stations throughout the country in 2003 and 2004.

Oil Imports and Pricing of Petrol and Electricity

In spite of the sustained growth in China's economy in the past two decades, the recent surges in China's oil demand were unexpected. Estimates of annual demand for 2004 were progressively revised upwards throughout the year as actual demand exceeded initial expectations. Over the past two years, China has accounted for one third of the global increase in demand. On-going pressure on oil demand is likely to continue as per capita oil consumption is expected to rise significantly from current low levels as incomes rise. The increase in the demand for oil in China in the last two years has been driven by sharp increases in use of motor vehicles¹¹ and by

¹¹ The Chinese passenger car market grew tenfold between 1990 and 2000. In addition, demand for cars exploded in 2002, when a price war was launched by local automakers in expectation of increased import competition after tariffs were lowered by the government following China's entry into the World Trade Organization in December 2001. However, the road system still is failing to keep up with the growth in car use, and major cities are already facing gridlock. Chinese vehicle emission

power shortages. China's oil imports are mainly made up of crude oil and fuel oil for power. Even with the high degree of domestic refining, China has a deficit in fuel oil, with imports accounting for half of domestic consumption. The fuel oil is used in power plants along the southern coast where coal becomes less price-competitive when electricity demand peaks. As the information in Table 1 on Huaneng's operations indicates, the retail price of electricity from an oil-fired power station can be more than double that from a coal-fired station.

**Table1: Retail Electricity Prices by Power Station for Huaneng International
Average rate (inclusive of VAT) (Rmb/MWh)**

	2004	2003	Variation
Dalian	283.62	272.69	4.01
Fuzhou	365.00	331.82	10.00
Nantong	325.18	312.52	4.05
Shang'an	303.25	307.94	-1.52
Shantou Oil-Fired	604.08	672.14	-10.13
Shantou	446.86	435.17	2.69
Dandong	289.05	276.95	4.37
Shidongkou II	342.56	332.85	2.92
Nanjing	321.67	307.31	4.67
Dezhou	332.58	333.34	-0.23
Weihai	394.06	386.50	1.96
Jining	299.89	274.66	9.19
Shidongkou I	285.43	256.64	11.22
Taicang	341.10	312.80	9.05
Changxing	351.94	320.57	9.79
Huaiyin	330.88	317.21	4.31
Xindian1	320.83	342.41	-6.30
Yushe1	282.10	200.63	40.61
Yingkou2	315.48	n/a	n/a
Jinggangshan2	325.67	n/a	n/a
Luohuang2	286.74	n/a	n/a
Yueyang2	316.52	n/a	n/a
Qinbei3	273.11	n/a	n/a
Average	327.88	318.68	2.89

standards allow cars to emit almost twice as much carbon monoxide and three times as much hydrocarbons and nitrogen oxides as do the U.S. emission standards. Air pollution has been estimated to cost China roughly 5 percent of GDP annually.

Domestic oil prices are set by the government based on monthly average international prices. Imbalances in regional supply and demand tend not to be reflected in domestic prices. Pump prices for petrol rarely reflect market shortages as PetroChina and SinoPec tend to maintain profit margins at retail by squeezing wholesale margins. According to Chinese sources, fuel consumption per kilometre for cars in China is 10 to 20 per cent higher than in developed countries.

The short term outlook for oil demand is heavily dependent on macro economic conditions and oil pricing policy. According to the International Energy Agency reporting in late 2004, administered oil prices were well below international markets and the price controls in China are shielding end users while cutting into refining margins.

The distortion of the refining and import markets creates retail conditions that do not fully reflect movements in international oil prices. The central government has attempted to increase imports in an attempt to decrease the pressure on retail price ceilings. It has been reported that petroleum products are being sold above the administered retail price ceilings. Another symptom of the ineffectual price control mechanism is that refiners have complained of consumer stockpiling.

Natural Gas

According to the International Energy Agency the average annual growth rate in primary demand for natural gas in China is expected to increase by 5.4 percent per year between 2002 and 2030, from 36 bcm in 2002 to a projected 157 bcm in 2030.¹² China will become more reliant on gas imports, projected to account for 27 percent of primary gas supply by 2030. According to the WETO report for the European Commission, the share of electricity generated from Natural Gas is expected to increase from the 1990 level of 5 percent

¹² Global consumption of natural gas is expected to increase more in absolute terms than that of any other primary energy source almost doubling over the projection period 2002 to 2030.

to 17 percent by 2030 in Asia. Table 2 below shows the percentage share of electricity generated from natural gas globally by region.

Table 2: Share of electricity generated from natural gas¹³

	1990	2000	2010	2020	2030
European Union	12	22	27	29	27
CIS, CEEC	35	30	36	44	49
North America	15	14	22	24	20
Japan, Pacific	24	31	40	37	35
Africa	25	34	39	47	49
Latin America	10	15	29	38	40
Asia	5	12	13	16	17
World	18	19	25	28	28

China's installed LNG processing capacity will account for approximately one-fifth of installed capacity in the Asia Pacific by 2011. Owners¹⁴ of Australia's Northwest Shelf project agreed to sell LNG to China at an approximate 20 percent discount to existing contracts. It has also been reported that contracts renegotiated by buyers located in Malaysia have also been discounted by approximately 5 percent relative to existing contracts. Importing countries are seeking increased flexibility and better contract terms. Typically LNG contracts are long term often 20-25 years to guarantee supply and have destination clauses that prevent buyers from reselling the cargos to third parties. Short term contracts (under one year) approximately account for 8 per cent of the market. In Asia, prices are linked to the imported crude oil price. The pricing formula typically includes a base price indexed to crude oil prices, a constant, and perhaps a mechanism for the review/adjustment of the formula. LNG import prices in Asia are typically higher than Europe and the United States. Costs related to the processing and transporting of LNG have fallen significantly over the past twenty years.

¹³ European Commission, *World energy, technology and climate policy outlook 2030*, 2003, p.87.

¹⁴ Woodside operate the LNG project on behalf of the joint venture partners BHP Billiton, BP, Chevron Texaco, Japan Australia LNG (consortium of Mitsui and Mitsubishi), Shell, and CNOOC Limited which will become a partner from 2005/06.

While LNG projects are currently one of the most expensive energy projects, LNG industry costs are declining.¹⁵ Costs vary widely depending on the location and whether the project is Greenfield, i.e. built in a new location, or an expansion of an existing plant. Generally the trend in the production and the shipping of LNG is declining. There is increasing demand for natural gas as it is considered to be a cleaner alternative to coal. This has led to increasing investment in LNG processing capacity. It is considered as one of the higher growth areas of the energy sector in China.

Electricity regulation in China

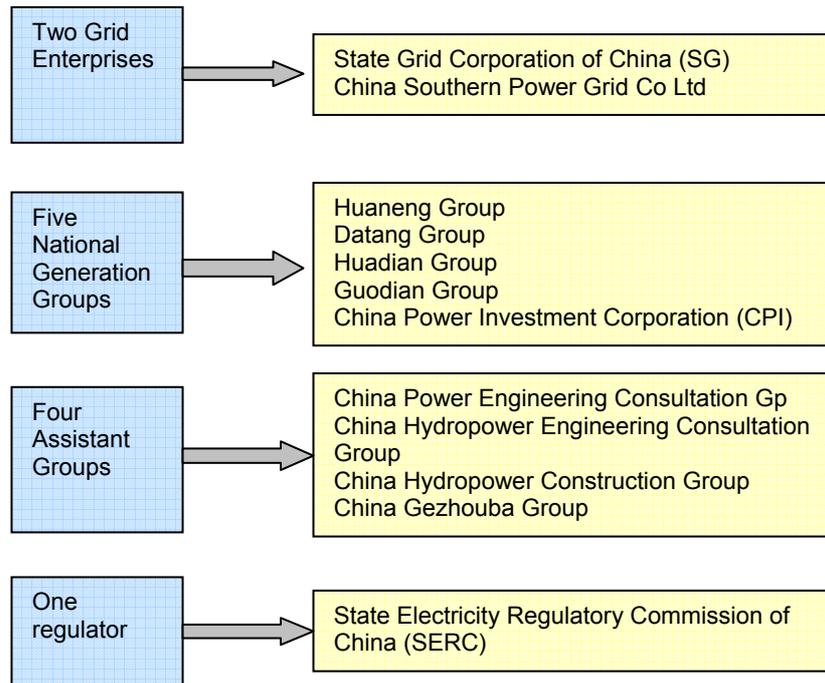
The main law governing the sector is the Electricity Law, passed in 1995, which was the first time the electricity industry was subjected to legislative control, as opposed to administrative fiat. In March 1998, China's government announced a reorganisation of regulatory agencies and the restructuring of state owned companies. This move, part of government-wide restructuring, was intended to streamline, simplify and further centralise the apparatus of control in parts of the energy industry. Further structural reforms followed in 2002, with the creation of the State Electricity Regulatory Commission (SERC), and additional legislative reforms were trialled through 2003 and 2004, leading to the promulgation in February 2005 of key regulations mentioned in the Introduction.

Figure 2 below shows the electricity industry structure in China.¹⁶ In 2002, the vertically integrated utilities organised under the State Power Commission were divided into separate service providers – two grid companies, five national generation companies, four assistant companies (that provide engineering and other business services), and one regulator.

¹⁵ There are four main cost components of LNG (gas production at 15 to 20 per cent; LNG plant at 30 to 45 per cent; LNG shipping at 10 to 30 per cent; and receiving terminal at 15 to 25 per cent).

¹⁶ See Appendix 1 for background on regulatory principles in the electricity sector.

Figure 2: Electricity sector structure



The adoption of one industry regulator is an important aspect of the regulatory change that has taken place. Increased transparency of the regulatory process may provide firms with greater certainty in regard to investment choices.¹⁷ Uncertainty contributes to broader economic instability as long term investment choices are likely to be

¹⁷ See Hallward-Driemeier and Stewart (2004) on business perceptions of investment conditions in different countries commented on the role that regulatory risk impacts on investment decisions. They note (p.5) that: 'The role of risk in investment decisions is not a new insight per-se, but much of the recent emphasis has been on costs, particularly the costs associated with a poor regulatory environment. The survey results reinforce that policy makers need to address ways of lowering policy-related risks to generate a desired investment response.'

affected more than short-term investment decisions. The costs associated with regulatory uncertainty are cumulative over time. A firm may have a range of investment choices both short-term and long-term strategic investment decisions. A firm may be of the view that if regulatory uncertainty exists then its investment decisions may incorporate a regulatory risk premium. The regulatory risk premium for a project would be higher in the case of longer term strategic projects.

Investment is growing at a rapid rate in China. This indicates that even though regulatory risk impacts on investment decisions it is not deterring firms from making large investments in capital projects.¹⁸ The World Development Report 2005 notes that while China's 'investment climate is still not perfect', the 'persistence of its reform process has yielded enormous benefits'.

The regulatory changes in the electricity sector in China have competition. There is one industry regulator and the industry has been split into separate organisations that control various aspects of the supply chain. The transmission and generation activities of the industry have been split. There has also been a greater emphasis placed on the interconnection of the regional transmission and distribution networks. The Government has also made a commitment to developing renewable technology. The Government is attempting to ensure supply at least cost and cleaner forms of production to a growing economy. The reform process is likely to continue and mimic the changes in other countries. Increased competition at the retail level will also provide the mechanism that will ensure that benefits of reform in the industry are passed onto the wider community.¹⁹

¹⁸ In the first three quarters of 2004, the contracted volume of foreign direct investment reached US\$107.4 billion, an increase of 35.6 per cent over the same period last year; the actually utilized foreign investment was US\$48.7 billion, an increase of 21.0 per cent for the same period last year. The supply of coal, electricity and oil could not meet the demand.

¹⁹ Retail competition however remains limited in many countries and retail contestability has only been introduced in the last few years in the United States and Australia. The benefits of retail contestability have not fully been realised in these markets.

Residential electricity consumption tends to rise when incomes rise and is highly dependent on the income elasticity of demand. Electricity is generally considered a homogenous good by consumers. The move to off peak pricing and green electricity options for consumers in the US, Europe and Australia is slowly changing the perception by consumers that electricity is homogenous product. The introduction of retail contestability in China may be possible however it will need to be supported by appropriate regulation and legislation to protect retailers and consumers.

The increased interconnection of electricity markets though interconnection and regional trading could provide the impetus for increased competition. This could alleviate the current situation where prices tend not to reflect the costs of production in different regions. The advantages of increased interconnection are:

- ❑ shared reserves
- ❑ load diversity
- ❑ delayed new capacity construction as demand shortfalls in one region can met by imports from another region in the market
- ❑ larger generating units which provide greater economies of scale
- ❑ cost reduction due to the competitive pressures of pool pricing.

The increased interconnection of electricity networks provides the opportunity for least-cost production outcomes and potential new entrants may enhance the technological development of the market in order to compete with larger scale generators. However, evidence suggests that market power can exist in a more interconnected market. Bidding behaviour by firms in interconnected markets can be used as form of projecting market power and encouraging collusive behaviour, particularly if the interconnected network is based on regional/provincial trading areas. The interconnection of electricity markets does not necessarily provide least cost production outcomes.

Appropriate institutional arrangements need to be in place to enforce the 'rules of the game' to prevent the misuse of market power. With-holding capacity in attempt to bid up the price is an example of bidding behaviour that could be construed as a misuse of market power.

Encouraging greater competition in the generation sector is not an end to itself. A package of reforms should be considered to provide competition enhancing regulatory change within the electricity sector at all levels through the supply chain. The key to effective regulation of the Electricity sector is determining the appropriate regulatory mechanisms for each part of the supply chain.

A recent assessment by the China Daily of the 2005 regulatory changes was not hopeful in the absence of further radical change.²⁰ The article argued that the regulations failed to give the SERC 'substantial power to nod approval to pricing and industrial investment', two powers essential for it to carry out independent regulation. The article also noted that the supervisory role of the SERC had not been brought fully into play, saying that two years after it came into being, 'people have heard stronger voices from the National Development and Reform Commission (NDRC)' than from the SERC. The article described the role of the SERC as 'embarrassing' and attributed it the fault in the 2002 reform plan, which provided for the SERC and NDRC share the power of pricing supervision.

The article observed that until the SERC was fully independent in pricing regulation, its ability to imposing supervision on the power sector would 'sour the SERC's authority'. The author criticised the 2005 regulations because the 'NDRC also has the exclusive power of making decisions on investment in the sector'. The 'SERC does not have a say in the process, further undermining its authority'. The article also criticised the 1995 Electricity Law because it 'was drafted at a time when the idea of independent regulation had not arrived in

²⁰ 'Electricity Agency Lacks Power, *China Daily*, 6 March 2005, <http://www.chinaembassy.org.in/eng/szyss/t185949.htm>.

China'. If the SERC needs a revision of the 1995 electricity law, the author argued, it is to have stronger supervisory power.

Even more importantly, China lacks a central energy ministry. As a recent study noted, China has not had a single central-government entity in charge of energy policy and regulatory matters in all areas since 1992 when it abolished its Ministry of Energy.²¹ There is a newly formed Energy Bureau within the National Development and Reform Commission but according to the study, it 'does not have enough staff or resources to perform all the necessary functions'. It notes that 'there are roughly 30 employees at the Energy Bureau in China, while most OECD countries would have hundreds, if not thousands, of employees to create the policy framework and oversight needed to steer a modern energy industry'.

Environmental Regulation

As noted above, China is heavily reliant on coal based electricity generation. The environmental impact of coal based generation is evident with increased pollution in major cities. As mentioned above, the passenger car market has also expanded over the last decade which has also contributed to the decreasing air quality.

Externalities associated with energy production have increased the pressure on the Government to implement more rigorous environmental regulation. One option the Government has to deal with these externalities is to provide regulatory incentives to increase renewable generation. A mechanism that could facilitate an increase in renewable generation is the introduction of a renewable portfolio standard. This policy measure has been introduced in a number of other countries and provides a target for a renewable generation as a proportion total energy production by a specific date. A renewable portfolio standard only provides an incentive to invest in renewable generation if the target is binding. The target must be enforced by a regulatory authority and must also be higher than a current 'business as usual' approach.

²¹ U.S. Senate, Committee on Energy and Natural Resources, Hearing on EIA's Annual Energy Outlook for 2005, 3 February 2005, Testimony of Jeffrey Logan.

China passed its first law on renewable energy in late February 2005. The aim of the legislation is to promote renewable energy production (hydro, wind, biomass and solar), and to bring its share of energy production from the current level of one per cent to ten per cent by 2020. The law will also lead to increased capacity at small hydro-power stations²² – from the current 31,000 megawatts to 70,000 to 80,000 megawatts by 2020. The wind power capacity is expected to increase to 20,000 megawatts from 560 megawatts, while biomass will increase to 20,000 megawatts from the current 2,000 megawatts.

A comparison of the price of grid connected wind electricity between China and other countries is shown in Table 3 below.

Table 3: A comparison of price of grid connected wind electricity: Selected Chinese Provinces and other countries²³

	China (yuan/kWh)			Other (yuan/kWh)	
	Grid connected wind	Coal-fired		Grid connected wind	Coal-fired
Xinjiang	0.70	0.32	US	0.25 to 0.41	0.25
Inner Mongolia	0.71	0.35	Germany	0.74	0.45
Liaoning	0.95	0.45	UK	0.37-0.51	0.41
Guangdong	0.77	0.60			

There are number of other policy options which could implemented in the near future to curb air pollution these could include taxes to internalise the costs of pollution in the market and changes in industry standards. Innovation and the international transfer of technology may create greater efficiencies in production by lowering costs and promote the use of cleaner (less polluting) technologies.

²² Small hydro-power stations are those with a capacity lower than 50 megawatts.

²³ J. Fan, W. Sun, D. Ren, 'Renewable portfolio standard and regional energy structure Optimisation in China', *Energy Policy Journal*, 33.

The optimisation of the energy system will need to take into account environmental externalities to maintain economic growth.

Oil and petroleum regulation

The level of regulatory change in the electricity sector has not been matched in the other leading sector of oil and petroleum where an oligopolist structure has emerged. There are four oil and state owned enterprises grouped under the regulatory body – the State Administration of Petroleum and Chemical Industries.

Two of the four companies are involved with off-shore exploration, the other two China National Petroleum Corporation and China National PetroChemical Company (SinoPec) has the domestic market divided between the two of them. The four companies have licenses to operate in particular regions. CNPC (with the most domestic crude oil reserves) operates in the North and the West; and Sinopec (with the most developed markets and access to foreign oil) operates in the South and the East. The IEA noted in a report published in 2000 that ‘this arrangement could easily turn into a cartel, with state controlled trading between territories to relieve local imbalances in production and consumption’. The only way to avoid this, the report said, was ensure that ‘real competition occurs’, and it noted that ‘no signs of that presently exist’ (p.37).

On 6 July 2004 China’s Ministry of Land and Resources issued a licence to PetroChina Company Ltd for offshore exploration. Prior to this, PetroChina’s exploration activities were confined but not legally bound. CNOOC was primarily responsible for off-shore exploration. Sinopec is also submitting an application for off-shore oil exploration and production in the South China Sea. There are also plans to restructure the parent company of PetroChina, the China National Petroleum Group. The Government aims to create a company that could compete with the major multinational oil companies.

A number of multinational oil companies have entered into joint ventures with China’s two major domestic oil companies. Sinopec operates 30,000 service stations in China. The Chinese government,

which owns 77 percent of Sinopec, has been allowing foreign oil companies to enter the booming domestic market following their investment in the stocks of Chinese oil firms. BP has recently entered into a joint venture with Sinopec to operate 500 retail outlets in China within three years of establishment.

According to the contract, Sinopec and BP will make a joint investment in Zhejiang Province to establish BP Sinopec Zhejiang Petroleum Company Limited. The joint venture will acquire, build, operate and manage 500 service stations within 3 years of its establishment. The term of the project is 30 years, with a total investment of US\$250 million. Sinopec will hold 60 percent of the equity during the initial period. Shell has signed a deal with Sinopec to open 500 service stations. Total has also set up a joint venture in northern China with Sinochem.

The key issue is whether further regulatory change will result in more efficient markets and increased competition. Increased competition may provide the incentive to reduce costs and greater incentives for investment.

Further energy market regulatory change is needed as the current arrangements have real consequences for energy market operation and create inefficient outcomes. The current energy regulatory system produces the following outcomes:

- ❑ Price signals that have negligible effects on consumer behaviour and investment
- ❑ Weak institutional capacity; and
- ❑ Limited transmission capacity.

Further reform of pricing practices and regulation is needed to establish a link between price, consumption, and investment. The integration of electricity markets and increased competition in other sectors of the Energy sector could promote greater efficiency in the sector and provide greater reliability and cost effective supply.

Appropriate institutional arrangements are necessary to form a comprehensive approach to Energy Policy in China.

Key risks to competition-enhancing regulatory change

In framing appropriate responses to the regulatory needs of China (and thereby contributing to a reduction in growth of energy demand by China), it is important to identify key risk factors for effective competition-enhancing change. These, in point form are:

- ❑ Lack of co-ordination between government agencies;
- ❑ Maintaining current pricing mechanisms that provide inappropriate signals for investment and consumption behaviour;
- ❑ A disjuncture between environmental policy aims and maintaining reliable cost effective supply of energy; and
- ❑ Lack of business confidence resulting from increased regulatory risk which may impact multinational firms pursuing joint ventures with large state owned Energy sector enterprises.

Policy Recommendations

The policy choices for China have been identified by a number of international studies. For example, Chandler and colleagues concluded that technology transfer for energy efficiency in China would not proceed without fundamental policy reform. They argued that any rational energy policy must be based on market mechanisms, with limited intervention to regulate monopolies and overcome market failures. They suggested that basic mechanisms of a market-based strategy should include:

- ❑ market pricing of energy supplies;
- ❑ energy supply sector restructuring;
- ❑ privatization and re-regulation of transmission and distribution networks for electricity, gas, and heat supply enterprises;

- ❑ privatization of energy suppliers.²⁴

Another study recommended other measures:

- ❑ Support the development of province-based collaboratives to identify renewable energy opportunities and to document barriers;
- ❑ Establish a national renewable energy institute with provincial affiliates (including university centers);
- ❑ Promote government-industry partnerships to commercialize renewable energy technologies.²⁵

These two representative studies highlight just a number of areas of possible policy development that remain relevant in 2005.

This paper has posed a question about the priority for one area of policy: regulation. The levels of new investment needed in the electricity distribution and transmission networks will be substantial, especially to provide interconnection of the network. Regulatory mechanisms that provide investment incentives will play a role in the level and type of investment in the network. Reliability standards also need to be maintained capital expenditure on non-augmentation projects is an important part of the capital expenditure plans of network providers.

Increased investment in China's energy sector will only occur if:

- ❑ A rigorous sector reform process is pursued – notably more cost-reflective pricing;
- ❑ Stable and predictable investment regimes are setup;
- ❑ The implementation of transparent corporate governance;
- ❑ The development of domestic financial markets; and
- ❑ Stronger incentives for private and foreign investors.

²⁴ William U. Chandler and Marc R. Ledbetter with Igor Bashmakov and Jessica Hamburger, 'Energy efficiency: New approaches to technology transfer',

²⁵ John Byrne and Bo Shen, *Toward a Sustainable Energy Policy Framework: U.S. Experience and China's Opportunities*, Center for Energy and Environmental Policy, University of Delaware, http://www.nrel.gov/international/china/pdfs/toward_a_sustainable_energy_policy_framework.pdf.

Electricity regulation has a big part to play in this.

China is open to significant support from its international partners in this endeavour. In September 2003, addressing the International Conference on Electricity Regulation in China, Vice Premier Huang Ju called for international support in this field, saying that China should learn from successful overseas experiences in electricity regulation.²⁶ He said that electricity regulation in China has become increasingly essential.

The international response to the Chinese interest in energy efficiency, especially through support to enhanced regulatory regimes, has been effective and relatively well-paced given the constraints, but it may now be opportune to significantly increase the pace and scale of international support to China's regulatory aspirations.

As noted in a paper in 2000, the most important step in the successful restructuring of China's power sector is having a very clear understanding of the goals China seeks to achieve through restructuring as well as a realistic assessment of the political and practical constraints imposed on restructuring. (Regulatory Assistance Project, 2000).

That study had eleven primary recommendations, the most striking of which were:

- Create a strong and central regulatory body with a broad scope charged with implementing reforms to meet China's goals and constraints, and having direct involvement in the restructuring process.

²⁶ *China Daily*, 18 September 2003. http://english.people.com.cn/200309/18/eng20030918_124468.shtml.

- ❑ The regulatory structure should be designed to minimize the possibility of future conflicts between central, regional, and provincial levels of government.²⁷
- ❑ The scope of the regulatory agency should be broad. It should include oversight of competitive generation markets; anti-monopoly authority; distribution and transmission prices; access; service quality, reliability, and resource planning for captive customers; and environmental performance.
- ❑ There are substantial opportunities to reduce the cost of existing generation with or without more extensive restructuring. Dispatch rules and the approach to contracting and privatization provide the main opportunities to reduce costs and prices in the near term.
- ❑ Demand response by consumers, distribution companies, and energy service companies should be built directly into the structure of wholesale markets.
- ❑ Include some sort of capacity feature in the electricity markets. This is needed to send early price signals for investors to reduce price volatility.
- ❑ Regulate transmission and distribution utilities in a fashion to encourage end-use energy efficiency as well as improvement and expansion of the transmission and distribution system. There are two basic options: price caps and revenue caps. Price caps promote increased electricity sales and discourage utility investment in end-use energy efficiency. Revenue caps encourage cost reductions without giving the incentive to increase sales.
- ❑ Incorporate environmental and economic goals in the restructured markets.

²⁷ The study noted: 'Initially, electricity markets in China will be regional in nature and some of these markets may be relatively small. Over time, as the system grows and as transmission expands, markets will combine to form fewer and fewer markets with the distinct possibility that a single national market may ultimately develop. Structuring the regulatory institutions as well as the transmission institutions in ways that minimize the possibility of provincial conflicts between different regions will make the transition to larger and larger markets easier to accomplish.'

- Coordinate with the other closely related laws in China, including the energy conservation law and clean production law.

In 2002, the World Bank issued a paper on an indicative 'roadmap' for establishment of an effective and functioning State Electricity Regulatory Commission (SERC) for China by the end of 2003. The roadmap had been prepared based on preliminary discussions with the concerned Government agencies in China. In March 2003, China officially launched the operations of the SERC after it broke up the State Power Corporation, the former monopoly entity.

In December 2003, SERC issued a tender for a study on Capacity building of China Electricity Regulatory Agency to be funded under a credit from the International Bank of Reconstruction and Development (IBRD). The study was intended to assist in the transfer of regulatory experience from outside China with a view to implementing new policy directions.²⁸

Among major development donors, the EU and Britain have not been as active in providing support in this area as the US.

The EU has had contacts with China on energy issues for many years. Five EU-China Energy Conferences have been held, the last in Brussels in May 2004, but the regulatory regimes for the power sector may not have had as high a priority as they need to. The agenda at the fifth conference included the security of energy supply, environmental/climate change considerations, energy efficiency, nuclear energy and renewable energy, as well as market access for European firms in the Chinese energy sector and energy market reforms. The two sides agreed that future cooperation would include discussions on the use of clean coal technologies and of renewable energies, on gas and oil, and on energy forecasts in general. They agreed to aim to try to finalise discussions on an agreement on the peaceful uses of nuclear energy before the end of the year.

²⁸ See http://www.serc.gov.cn/djh/details.jsp?content_id=91.

An EU–China cooperation programme on energy and environment is underway in China's Liaoning province, focussing on clean coal technologies, natural gas, energy efficiency and renewable energies. In April 2004, China and the European Commission launched a five-year, €42.9 million energy and environment program to improve China's energy efficiency. The programme will involve projects on energy saving, development of renewable energy and natural gas. The partner organisation in China is the State Development and Reform Commission.

The EU also has a formal dialogue with China on regulatory and industrial policy to facilitate bilateral trade of industrial products by enhancing compatibility of the regulatory systems of the parties in areas like the circulation of counterfeit or unsafe industrial products. A new dialogue on industrial policy and competitiveness was launched in September 2003 but has focussed initially on the automobile industry.

As far as the UK is concerned, the joint statement issued by Prime Ministers Tony Blair and Wen Jiabao in May 2004 committed the two sides 'to accelerate and develop the global market for climate friendly technologies, including through the Renewable Energy and Energy Efficiency Partnership' (REEEP).²⁹ But as of late 2004, the global initiative launched by Britain was only getting off the round for China. The REEEP East Asia Regional Secretariat was officially established at The Chinese Renewable Energy Industries Association (CREIA) in August 2004 with support from BP, the Norwegian Embassy in Beijing and REEEP funds.

²⁹ The Renewable Energy and Energy Efficiency Partnership (REEEP) is a coalition of progressive governments, businesses and organisations committed to accelerating the development of renewable and energy efficiency systems (REES). It was initiated at the Johannesburg World Summit on Sustainable Development (WSSD) in August 2002 by the UK Government. It is intended to provide an open and flexible framework within which governments work together to meet their own sustainable energy objectives according to their own timetables. In November 2003, with assistance from the Austrian Government, REEEP opened its International Secretariat in the Vienna International Centre.

In contrast with the EU and Britain, the US began its cooperation with China almost a decade ago. In 1995, former Secretary of Energy Hazel O'Leary led a Presidential Mission to China to 'promote U.S.-China cooperation in energy, sustainable development, and free trade and to pursue cooperative ventures that would produce economic and environmental benefits to both countries'.³⁰ In the energy efficiency area, the US and China participants agreed to each form teams (comprising representatives from industry, state agencies, energy associations, the DOE national laboratories, and other interested parties) to address opportunities and barriers in ten energy efficiency areas: energy policy, information exchange and business outreach, district heating, cogeneration, energy-efficient buildings, energy-efficient motors systems, industrial process controls, lighting, amorphous core transformers, and finance.

In 1997, the first US-China Energy Efficiency Steering Committee met in Beijing. The steering committee coordinates activities under a Protocol for Cooperation in the Fields of Energy Efficiency and Renewable Energy Technology Development and Utilization, which was signed in February 1995 between DOE and China's State Science and Technology Commission. Annex III of the Protocol pertains to energy efficiency.

In December 2004, the US Energy Secretary, Spencer Abraham, told an audience at Qinghua University that he felt it unlikely that the US and China would become competitors over energy. ('Some outside observers might predict that we must necessarily become competitors for supply—a move which could lead to shortages, strained supplies, higher prices, and dampened economic growth for both nations. But I reject that scenario, because I believe there is no possible long-term winner in this sort of competition.')

Abraham noted that in January 2004, he and the Chairman of China's Development and Reform Commission, Ma Kai, agreed to form the US-China Energy Policy Dialogue. The Dialogue is intended to enhance collaboration in high energy and nuclear

³⁰ See <http://www.oit.doe.gov/international/china.shtml>.

³¹ See <http://www.usembassy-china.org.cn/press/release/2004/121704add.html>.

physics, fossil energy, energy efficiency and renewable energy and energy information exchanges. He also noted that in May 2004, at the International Energy Forum in Amsterdam, he and China's Minister Zhang Guobao signed a Memorandum of Understanding establishing the agenda for the Energy Dialogue, and that preparations are now under way to further coordinate cooperative measures.

A leading US NGO in the field of regulation policy, the Regulatory Assistance Project (RAP) is working on a Sustainable Energy Programme in Beijing. It works closely with Chinese officials on the establishment of a new electricity regulator. In September 2004, it conducted a workshop for the State Electric Regulatory Commission (SERC) in Beijing.³²

There is still a very rich agenda for international support to reform of regulatory affairs in China's electricity sector, as much by governments as by corporations and specialised NGOs. An official from the Chinese Electricity Council in the second half of 2004 (Mi 2004), identified the following priorities:

- Reform of electricity price mechanism;
- Reform of project approving mechanism;
- Deepening the reform of regional grid company and provincial company.
- To establish regional electricity market and regional regulatory organization.
- To revise Law of Electricity and other regulations.

The EU and Britain should now look closely at their cooperation programmes with China and review the priority given to support of China's regulatory regimes and agencies in the electricity sub-sector, the dominant sector in China's energy picture. It may be through this avenue that much more strategic impacts can be achieved in key policy areas such as poverty alleviation, climate change and energy security, than by traditional approaches which

³² See <http://www.raonline.org/Home.asp#top>.

see domestic regulatory affairs as largely irrelevant to China's global impact in the energy sector.

Appendix 1: Note on Competition and Electricity Regulation

In most countries, the energy industry is highly regulated in order to protect important national objectives such as health and safety, environmental protection, universal service and consumer protection. In those countries where vertically integrated public utilities maintain a monopoly on the supply of energy, there is no scope for international competition. Market access barriers, however, also remain in partially liberalised markets, where only a segment of the energy supply chain is opened to competition. Foreign equity commitments may be used to further cooperation between domestic and foreign suppliers and increase competitive pressures.

If the energy sector is opened to competition, domestic regulation and competition rules become more important. Those countries that have divided up vertically integrated utilities, have also introduced new regulation to ensure more competitive outcomes. The separation of the supply chain allows for the introduction of competition in generation and retail areas of the supply chain. Generally, the transmission and distribution networks are more heavily regulated. To ensure that prices reasonably reflect the costs of operating electricity networks.

In most developed countries the energy sector is subject to some form of environmental regulation. These regulations tend to affect the production of energy goods more than services aspects such as transport, transmission and distribution. Environmental regulations attempt to balance the growing demand (especially in developing countries) for energy products with the need to minimise the negative impact on the environment.

The electricity industry can be divided into five functions; generation, dispatch, transmission, distribution, and retailing activities. There are a number of different electricity market models in operation.

However, there are some major guiding principles that tend to be followed in the restructuring of electricity markets. These are:

- ❑ The facilitation of transparent legal and regulatory arrangements;
- ❑ The restructure of the sector to limit the potential for the misuse of market power in vertical and horizontal integration. This can be achieved by facilitating the separation of generation, transmission, and retailing activities of the industry and encouraging competition in generation;
- ❑ Incentive regulation can provide incentives for monopoly service providers (such as transmission service providers) to reduce costs; and
- ❑ Non-discrimination of network access and an increase in network interconnection.

The increased interconnection of electricity networks can provide greater price transparency as it relates to the costs of production in different locations.³³

Using data provided by the International Energy Agency (IEA) and other sources for 19 OECD countries over the period 1986-96, Steiner (2001) considered the effects of the regulatory reform on efficiency and prices in this industry. The results suggest that:

- ❑ The unbundling of generation and transmission, expansion of access to multiple service providers and creation of spot markets of electricity reduced both industrial end-user electricity prices and the ratio industrial to residential prices.
- ❑ Private ownership contributed to improving capacity utilisation in the electricity generation.

³³ Jimin Zhao, 'Reform of China's Energy Institutions and Policies: Historical Evaluation and Current Challenges', Energy Technology Innovation Project, Belfer Centre for Science and International Affairs, John F Kennedy School of Government, Harvard University, November 2001.

- ❑ However, a high degree of private ownership and imminence of both privatisation and liberalisation tended to increase industrial end-user prices.
- ❑ The unbundling of generation and transmission brought reserve margins (the ability of capacity to handle peak load) closer to their optimal level.

Results of comparative case studies of selected industries in the United States, Japan and Europe by Baily (1993) and by Baily and Gersbach (1995) suggest that competition (especially global competition with best-practice producers) enhances productivity. The link between competition, innovation, and economic growth is not straightforward.

Over the past decade many countries have implemented competition-enhancing regulatory change in electricity generation. Joskow has emphasised that the problems with the Californian electricity market were not inherent with deregulation. In his view the problems were associated with ineffective government responses to extreme contingency events in the market.

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