

11th Five-Year Plan on Energy Development
National Development and Reform Commission
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The 11th Five-Year Plan on Energy Development mainly describes China's energy strategy, defines the energy development goals, developmental layout, reform direction as well as focuses on energy saving and environmental protection. It is the overall blueprint and action plan for China's energy development in the next five years. Relevant authorities should actively conduct various tasks in the light of the requirements of the Plan and strive to complete every task as defined in the Plan in consideration of the real situation.

Chapter I Energy Situation

1.1 New Starting Point of Energy Development

During the 10th Five-Year Plan, great achievements have been made in China on energy development. Basically they met the demand of national economy and social development, and paved the way for the development of the 11th Five-Year Plan and even longer periods. Hence, looking to the future, China's energy industry is now on a new historical starting point.

1.1.1 Energy Production Grows Rapidly; Supply and Demand Conflict Tends to Become Mild

In 2005 China's total primary energy production was 2.06 billion tce, 13.7% of the global primary energy production; total primary energy consumption was 2.25 billion tce, 14.8% of the global consumption. China is the 2nd energy production and consumption country in the world. The coal production exceeded 2.2 billion tons, which is the dominating part to the total energy output. The production of oil and natural gas increased steadily. The West-East Gas Transmission Project was completed smoothly. Western China's oil and gas field construction in Tarim, Jungar, Erdos, etc. also achieved important progress. Installed generation capacity achieved leaping development by exceeding 500GW, and the tension on power supply was mitigated obviously.

Column 1: Key indicators on energy development during the 10th Five-Year Plan Period

Indicator	Unit	YR 2000	YR 2005	Annual average increase rate (%) during the 10th Five-Year Plan Period (%)
Total production of primary energy	100 million tce	12.90	20.59	9.82
Of which: raw	100 million tons	12.99	22.05	11.16

coal				
Oil	100 million tons	1.63	1.81	2.12
Natural gas	100 million cubic meters	272	493	12.63
hydropower and renewable energy	100 million tce	0.86	1.41	10.39
Total consumption of primary energy	100 million tce	13.86	22.47	10.15
Of which: raw coal	100 million tons	13.20	21.67	10.42
Oil	100 million tons	2.24	3.25	7.73
Natural gas	100 million cubic meters	245	479	14.35
hydropower and renewable energy	100 million tce	0.86	1.41	10.39

Note: data source: National Statistics Bureau and Industrial Association; the renewable energy only includes commercial part (the same below)

1.1.2 Structural Readjustment Strengthened; Achievement Made in “Construction of Large Units and Retirement of Small Units”

The construction of large-scale coal bases, united reconstruction of medium and small-scale coal mines, closing and elimination of low efficient small coal mines are on progress steadily. The construction of large power plants is undergoing rapidly and the construction of large generation units and retirement of small units” for thermal power is pushed forward continuously. Some key power transmission projects are on smooth progress, such as West-East Power Transmission Project. The rural power network reform project is basically completed. The interconnection of the Six Power Grids is strengthened. New energy resources and renewable energy resources developed rapidly. Total installed capacity of wind power reached 126MW. PV installed capacity of solar energy is approximately at 70MW. The collection area of solar water heater is over 80 million square meters, which ranks 1st in the world. The annual production capacity of biofuel ethanol is 1.02 million tons. Coal liquefaction and coal-based co-production demonstration projects such as methanol & 2-methylether, wikipedia made by coal, etc. are on progress steadily.

1.1.3 Technical Innovation Achieved Improvement; Equipment Installed at an Increasingly Higher Level

Coal industry has gained capacity of being equipped with 10 million tons-level open mine and workface with output 10,000 ton/day, with construction of a number of large-scale coal mine at world advanced level. Technologies on oil and gas exploitation and development in complex blocks, oil recovery enhancement, etc. have

reached world advanced level. The smooth commission and operation of the Three-Gorge Project indicates that China's water electricity technology has reached the world advanced level. A batch of large thermal power generation units are put into operation. A relevant mature backbone grid of 500kv and 330kv is formed. The demonstration project of 750kv is constructed and in service. A trial demonstration project of ± 800 kv DC and 1000kv AC is being launched.

1.1.4 System Reform Accelerated; Market Mechanism Improved Step by Step

Strategic reorganization of coal enterprises got accelerated, industrial concentration is boosted. It shows visible trend on the amalgamation of upstream and downstream coal industries. A series of comprehensive energy enterprises with diversified ownership, integrated production of coal power, coal steel and coal carbonization are being developed and strengthened. The coal market pricing mechanism is being improved step by step. The regional trading market of coal is being developed positively. Several large-scale corporation groups with integration of upstream and downstream industries, domestic and foreign trade in oil and gas field are shaped. There is remarkable progress on the construction of the national strategic oil reserves. The power sector reform is under going smoothly. Separation of generation and transmission is basically completed. Construction of power market got started.

1.1.5 Energy Efficiency Improved to Some Extent; Environmental Protection Strengthened

In 2005, the average mine recovery for the nationwide mines is about 10% higher than that of 2000. Under the circumstance of increasing drilling-resistance reserves, crude oil recovery still remains at a quite high level. Tce consumption for thermal power supply decreased from 392g/kwh in 2000 to 370k/kwh in 2005. The total volume of dust emission reduced 32% comparing with that of 1980. Some water shortage areas achieved "zero discharge" for waste water. SO₂ emissions of unit electrostatic charge reduced 40% comparing with that of 1990.

1.2 Main Problems and Challenges

The period of the 11th Five-Year Plan is a key period to advance China into a moderately prosperous society in an all-round way. In the new era and at the new stage, there are new opportunities for energy development; however, it also faces severe challenges.

1.2.1 Consumption Demand Rises Continuously; Resource Constraint More and More Serious

Though energy resource is relatively abundant in China, however, the per-capita share is quite low, especially for oil and natural gas, which accounts only for 7.7% and

7.1% respectively of that in the world. With the rapid and smooth development of the national economy, and upgrade of rural and urban residents' consumption structure, it is assumed that the energy consumption will keep on mounting up, and the conflict of resource constraint will be more serious.

1.2.2 Inappropriate Energy Mix Results in Sustainable Development Challenges

At present, coal consumption accounts for 69% of China's primary energy consumption, which is 42% higher than the world average. Coal dominated energy consumption structure and the relative extensive economic growth mode have brought about a lot of environmental and social issues. The sustainable development of the economic society is facing severe challenges.

1.2.3 Big Fluctuation in International Market; Hidden Security Danger Increasing

In recent few years, with sharp fluctuation and continuous ascending of the international oil price, China's economic and social development has been impacted in various aspects. Since the construction of China's strategic oil reserve system is just started, our ability to respond to supply disruptions is relatively poor. There are more and more factors that affecting safe supply of power and natural gas. The situation of coal mine safety production looks very cloudy and it's a heavy task to maintain energy safety.

1.2.4 Energy Efficiency Needs Improvement; Energy Efficiency and Reduction a Big Challenge

There is an enormous gap between China's energy efficiency and the international advanced level. The outline of the 11th Five-Year Plan put forward the target of reducing 20% of energy consumption per unit GDP by the year of 2010. On the one hand, in view of the potential of improving China's industrial structural readjustment and technological management level, it is possible to achieve the abovementioned goal through efforts. On the other hand, since China is still in the historical era of expediting industrialization and urbanization development, energy-intensive industry will keep covering a relative large percentage. Therefore, it is a hard task in the long run to change energy production and consumption mix, increase energy efficiency and reduce energy consumption.

1.2.5 Rocky Road Ahead for China's self-Innovation due to Low Development of Science and Technology

Scientific and technological development is the fundamental approach to resolve energy issues. Comparing with advanced countries in the world, China is much lagged on its high-tech and cutting-edge technology in energy. Hence there is still a long way

to go for the country's self-innovation on energy science and technology.

1.2.6 System Restrictions Severe; Reform Needs to be Deepened

Bearing heavy social burdens, coal enterprises are lack of competitiveness. There are still a lot of problems to be solved to improve the market system of crude oil, finished oil and natural gas. The power sector reform measures are to be further implemented.

1.2.7 Energy Problem in the Rural Areas in China Serious; Backward Situation Pending to be Solved

One of the main problems for rural energy is the low commercialization level of residential energy consumption; another is disparities of regional development: rural areas of Western China are in shortage of energy in common, and the energy consumption situation in the east and central mountainous areas and the poverty-stricken areas also needs to be improved. Besides, there are still more than 10 million people without power supply in the country. Hence, it is the inexorable requirements to build the socialist new countryside to speed up rural energy construction and improve the condition of energy use and access for rural residents.

Chapter II Guidelines and Objectives

2.1 Guidelines

Under the guidance of Deng Xiaoping Theory and the important thought of Three Represents, use the two Strategic Thoughts of scientific development outlook and the building of the socialist harmonious society to guide energy work. The focus of energy strategies should be put on conservation. Domestic supply will be the main action. At the same time, we should develop diverse energy resources, protect the environment, enhance international cooperation of mutual benefit, ensure the stable supply of economical and clean energies, and support China's sustainable economic and social development with sustainable energy development.

2.1.1 Development Goal

2.1.2 Total Energy Consumption and Structure

By the year of 2010, China's total primary energy consumption is aimed at about 2.7 billion tce, with annual average increase rate of 4%. Coal, oil, natural gas, nuclear power, hydropower and other renewable energy account for 66.1%, 20.5%, 5.3%, 0.9%, 6.8% and 0.4% of the total energy consumption respectively. The proportion of coal and oil drops by 3.0% and 0.5% respectively comparing with that of 2005, while

the percentage of natural gas, nuclear power, hydropower and other renewable energy increases by 2.5%, 0.1%, 0.6% and 0.3% respectively.

2.1.3 Total Production of Energy and its Composition

By the year of 2010 the target of primary energy production is 2.446 billion tce, with annual growth rate of 3.5%. Coal, oil, natural gas, nuclear power, hydropower and other renewable energy cover 74.7%, 11.3%, 5.0%, 1.0%, 7.5% and 0.5% respectively. The percentage of coal and oil drops by 1.8% and 1.3% respectively comparing with that of 2005, while the percentage of natural gas, nuclear power, hydropower and other renewable energy increases 1.8%, 0.1%, 0.8% and 0.4% respectively.

Chapter III Key Areas of Development

According to the energy situation, under the guidance of “structural optimization, regional coordination, balance of production and sales volume and keeping options for the future”, the overall arrangement for China’s energy construction during the 11th Five-Year Plan is as following: develop coal industry in an ordered manner; speed up exploitation and development of oil and gas; positively develop hydropower, optimize the development of thermal power and promote nuclear power plant generation with the precondition of doing a good job on environmental protection and resettlement; devote great efforts to develop renewable energy. Speed up exploitation and development of coal energy in the west, southwest and northwest areas of China (refers to as “Sanxi Area” thereafter), oil and gas energy in central and western China, offshore area as well as hydropower in Southwestern Area in a moderate manner; boost the output capacity of the energy bases; optimize development of coal resource in Eastern area and oil and onshore gas and oil resource; stabilize production capacity; relieve pressure on energy transportation. Focus on construction of the following five major energy projects.

3.1 Energy Base Construction Project

3.1.1 Development of Coal Bases in an Ordered Manner

Speed up development of the six major premium steaming coal bases, i.e.: Shendong Coal Mine, Shaanbei Coal Base, Huanglong (including Huating), Jinbei, Jindong, Ningdong Coal Base, focusing on construction of huge modern coal mine in a scaled manner. Carry on protective exploitation of Jinzhong Coking Coal Base; construct large-scale coal mines and integrate medium and small-scale ones, keep reasonable exploitative intensity. Keep production continuity of the old coal mines in the three coal mine bases in Luxi, Jizhong and Henan and stabilize production scale. Promote construction and improvement of the coal mine bases in Huaibei-Huainan coalfield; improve coal supply capacity to an appropriate extent. Speed up development of Mongdong (Northeast) Coal Mine Base; prioritize the construction of large-scale

modern open coal mines in the eastern area of Inner Mongolia. Speed up development of Yunnan & Guizhou coal bases so as to meet the demands of power transmission from the west to the east.

3.1.2 Speed up Construction of Oil and Gas Bases

In the light of the policy of “exploiting potentials of Eastern China, promoting the development of Western China, speeding up offshore exploitation and developing Southern China”, through innovation on geological theories, application of new technologies and intensification of inputs, the output of the national crude oil, natural gas is to reach 193 mtce and 92 billion cubic meters respectively by the year of 2010.

3.1.3 Take Initiative to Develop Hydropower Bases

Build large-scale hydropower bases according to the rolling development mechanism of cascade hydropower. The upper reaches of the Yellow River, upper and middle reaches of Yangtze River and its main and branch waterways, Lancang River, Hongshui River, Wujiang River basins, etc. are potentially exploitable objects. Develop medium and small sized hydropower stations in remote areas where there are abundant water resources.

3.1.4 Optimize Construction of Coal and Power Bases

Based on the policy of “West-East Power Transmitting, adjusting allocation of hydro and thermal power production, enhancing support and ensuring safety”, the priorities are to optimize construction of the coal and power bases where there are rich coal resources in Shanxi, Shaanxi, Inner Mongolia, Guizhou, Eastern Yunnan etc, and carry on “west-east power transmission”. Arrange pit-mouth power plant rationally in Henan and Ningxia, facilitate the optimization of regional hydro and thermal power production allocation in the region. Speed up pit-mouth power plant construction in Huaibei-Huainan of Anhui Province, implementing the strategy of "sending power from Anhui to east". In the east and central parts, the focus should be put on the construction of power plants at ports, road crossing sections, central load power plants as well as power stations that are in favor of enhancing power transmission capacity. The stability and safety of the operation of the power grid will be strengthened.

3.1.5 Speed up Construction of Nuclear Power Bases

During the 11th Five-Year period, the construction of Tianwan Phase I and Guangdong Ling'ao nuclear power plant Phase II will be completed; Zhejiang Sanmen Nuclear Station Project, Guangdong Yangjiang Nuclear Station Project, etc. will be started. Preparatory work will be done for the first stage of a group of nuclear station projects. Great support should be offered for the power station pilot project on high temperature gas-cooled reactor.

3.2 Energy Storage and Transportation Project

3.2.1 Coal Transportation Channel and Ports

During the 11th Five-Year Plan period, with the increase of coal production and sales volume, the pattern of China's "transporting coal from North to South, transferring coal from West to East" is more and more obvious. It is required to fully tap the potentials on the current railway and port facilities. The focus should be put on capacity expansion of the coal transportation channel in the Sanxi Area and coal shipping terminals in the Northern coastal area, and construction planning of new channels for "transferring coal from West to East". It is required to further enhance the construction of coal uploading and downloading terminals and freight transfer stations in Eastern China, Southeastern China and Southern China. It should also make best use of the Yangtze River and Jing-Hang Canal and strengthen coal transportation capacity in Northwestern, Southwestern and Central China.

3.2.2 Oil and Gas Transmission Network

During the 11th Five-Year plan period, according to the pattern of "transmitting oil and gas from west to east, sending oil and gas from northeast to south, landing offshore oil and gas on shore", the construction of key oil and gas pipelines will be enhanced; multi-tracks and key inter-connection lines needed will be newly built; the construction of transportation terminals and strategic reserves facilities will be accelerated; a key national oil and gas piping network and a network for key areas will be built step by step.

3.2.3 Power Grid Facilities

Firstly, based on the policy of "focusing on the transmission of hydropower and with moderate and appropriate transmission of coal-fired power", three main pipelines under the West-East power supply program will continue to be constructed. Secondly, regional power grid network construction will be strengthened so as to promote and facilitate the interconnection of power grids in major regions. By the year of 2010, it is aimed to preliminarily achieve nationwide power grid interconnection except for Tibet, Xinjiang and Taiwan etc. Thirdly, the development and rehabilitation of urban and rural power network will be promoted so as to formulate safe and reliable power distribution network. Fourthly, the harmonious development of secondary system and primary system will be promoted.

3.3 Oil Alternative Project

Based on the policy of "tapping the resource advantage, replying upon sci-tech progress, promoting oil alternative project actively and safely", it is to facilitate development of coal-based synfuel, biomass liquid fuel as well as coal chemical

engineering technologies and work on key demonstration projects in an ordered way through overall planning, so that to pave the way for the development of oil alternative industries in the 12th Five-Year period and even a longer run beyond.

3.4 Commercialization of Renewable Energy Industry

During the 11th Five-Year period, the development focus will be put on renewable energy resources where the potential is big, such as wind power generation, biomass power generation, biomass molding fuel, and solar energy unitization etc.. It is expected that the scaled development of renewable energy will generate the commercialization of the renewable energy industry.

3.5 New Rural Energy Project

In the light of the policy of “diversified development based on the actual situation”, while speeding up construction of small hydropower and rural power network, such renewable energy power such as wind power, biomass power, solar power which are suitable for the use in the villages, towns, townships and of the rural households should also be developed massively. By the year of 2010, the number of small wind turbines to be used by towns and villages should reach 0.3 million sets with a total installed capacity of 75MW. There will be 40 million household biogas digesters and 4700 biogas plants for animal livestock farms. Biogas production will attain to 16 billion cubic meters for the rural areas across China. The quantity of retained solar heaters in rural area will attain to 50 million square meters and the number of retained solar furnace will reach one million sets.

Chapter IV: Energy Conservation and Environmental Protection

The realization of energy saving and environmental protection goals will have to rely on the joint efforts from the whole society, the basic function from science and technology. It shall stick to the principle of changing the economic growth pattern and increase the quality and benefits of economy growth. While direct energy saving and environmental protection measures are enforced, large-scale of circulated economy shall be developed. The development and breeding of high tech industry should be accelerated. The proportion of modern service industry in the national economy should be increased. Indirect energy conservation and environmental protection contributions should be increased through optimization of economy structure.

4.1 Main Objectives

4.1.1 Overall Indicators

The unit GDP consumption (2005 constant price, same for below) for 2010 will be reduced from 1.22 ton/tce in 2005 to about 0.98 tce. The energy efficiency rate during the 11th Five-Year Plan Period will be 4.4%, which means SO₂ reduction of 8.4 million tons and CO₂ (from coal burning) of 360 million tons.

4.1.2 Key Energy Consumption Products (Working Load) and Energy Consumption Equipment Indicators

By 2010, the environmental status of key energy consumption sectors and unit energy consumption indicator for main products (working load) shall in general reach or be close to the advanced international level at the initial period of this century. The energy efficiency rate of main energy consumption equipment shall reach the advanced international level at the mid period of the 1920's. The energy efficiency rate of some automobiles, electric appliances for household use shall reach the advanced international level.

Column 2: unit energy consumption indicator for main products (working load)

	Unit	2000	2005	2010
Coal consumption for thermal power supply	gce/kwh	392	370	355
Energy consumption per ton of steel	kgce/t	906	760	730
Comparable energy consumption per ton of steel	kgce/t	784	700	685
Specific energy consumption of 10 kinds of nonferrous metal	tce/t	4.809	4.665	4.595
Specific energy consumption for aluminum	tce/t	9.923	9.595	9.471
Specific energy consumption for copper	tce/t	4.707	4.388	4.256
Oil refining unit energy factor	kgce/t.factor	14	13	12
Specific energy consumption of ethylene plant	kg standard oil/t	848	700	650
Specific energy consumption by synthetic ammonia	kgce/t	1372	1210	1140
Specific energy consumption by soda	kgce/t	1553	1503	1400
Specific energy consumption by cement	kgce/t	181	159	148

Specific energy consumption by construction ceramics	kgce/m ₂	10.04	9.9	9.2
Specific energy consumption by railway transportation	ton/mt km	10.41	9.65	9.4

Column 3: Energy efficiency indicators for main energy consumption equipment

	Unit	2000	2010
Coal-fired industrial boilers (operational)	%	65	70-80
Small and medium size generators (design)	%	87	90-92
Wind turbine (design)	%	70-80	80-85
Pump (design)	%	75-80	83-87
Air compressor (design)	%	75	80-84
Room air conditioner (energy efficiency rate)		2.4	3.2-4
Refrigerator energy efficiency indicator (EEI)	%	80	62-50
Cooking stove of household use (heat efficiency)	%	55	60-65
Gas water heater of household use (heat efficiency)	%	80	90-95
Economic status of average automobile fuel burning	L/100 km	9.5	8.2-6.7

4.1.3 Energy Sector Indicators

By 2010, the average coal source recovery of the coal mines nationwide will reach 50%, an increase of 4 percentage points: both the use rate of coal gangue and mine water will reach 70%, an increase of 27 and 26 percentage points respectively; the emission of mine water will 100% reach the emission standard, which is an increase of 20 percentage points; the closed circulation rate of coal washing waste water will increase to 90%, which is an increase of 5 percentage points. The collection rate of crude oil shall be maintained at about 32%. Energy consumption for thermal power plants is 355 gce/kwh, a reduction of 15 grams. The auxiliary power ratio of the power plants is 4.5%, which decreases by 1.4 percentage points; the line loss rate is 7%, a decrease of 0.18 percentage points; the overall emission of SO₂ of the power plants will go down by over 10%.

4.2 Main Areas

During the 11th Five-Year Plan period, the goal is to advance the progress in all areas,

but with an emphasis on tasks of priorities. The focus shall be energy conservation and environmental protection for key industries, transportation, construction, commercial and residential fields. Ten key projects shall be organized and implemented. These projects include rehabilitation of coal-fired industrial boilers or kiln furnace; regional co-generation; use of residual heat and pressure; oil saving and oil alternatives; energy efficiency in generation units; optimum energy system; building efficiency; green lighting; energy efficiency for governmental administrative organizations; energy efficiency monitoring and technical service system. The implementation of the ten key projects will realize a saving of 560 million tce and bring obvious environmental and economic benefits.

4.3 Priorities of the Energy Sector

4.3.1 Coal Industry

Small coal mines with backward technology, low efficiency, wasteful use of resources and severe pollution problems will be retired gradually. Instead, new technologies, new equipment and new materials shall be utilized to improve the existing coal mine, select new coal mines and establish large modern coal mines. By 2010, the average coal resource recovery will be increased from 46% in 2005 to 50%; the number of small coal mines will be reduced from 22,000 to about 10,000. The pollution source will be reduced dramatically; such issues as underground leakage and ground subsidence etc. will be mitigated effectively.

Integrated use of coal resources shall be implemented based on the circulated economy development concept. By 2010, the use of coal gangue will be increased from 150 million tons in 2005 to 390 million tons, with an increase of 27%; the use of mine water will be increased from 1,100 million m³ to 3,600 million m³, with an increase of 26%; the standard compliance rate of mine water discharge will be increased from 80% to 100%. The use of coal mine methane will be increased from 1,000 million m³ to 8,700 million m³.

Ecological and environmental protection in the coal mines will be well implemented. Specialized plans will be developed. Studies will be carried out on the establishment of a compensation mechanism for ecology rehabilitation in the coal mine areas. More investment will be channeled for this effort. By 2010, the rehabilitation area for the coal mines will be increased from 9,000 ha to 22,000 ha; water and soil erosion treatment area will be increased from 11,000 ha to 26,000 ha. The degradation of eco-environment will be put under control.

4.3.2 Oil and Natural Gas Industry

Environmental evaluation and review will be enhanced for oil and natural gas projects. It is greatly encouraged to develop technologies for mine recovery, oil production system optimization, heavy oil production, water injection system optimization, integrated energy conservation for the tight line transportation for oil and gas, recycling and use of oil field associated gas. It is strictly prohibited to explore and develop oil and gas field without associated gas and wodd oil recycling facilities. By the year 2010, the crude oil recovery will be maintained at about 32%. The specific consumption for oil and gas field exploration, in particular the auxiliary ration of oil and gas of the oil and gas field will be further reduced. Environmental pollution issues generated by gas flaring and waster water discharge will be solved in general.

It is important to do a good job in oil saving and alternative options. Fuel oil (light oil) will be replaced by clean coal, oil coke and natural gas. Fuel driven small units will retire. Fuel economic standard and associated policies on automobile will be implemented. Clean automobile action plan will be implemented. Hybrid power automobile will be developed. Gas-fired automobiles will be encouraged. These automobiles can include, for example, urban public bus and taxi etc.

4.3.3 Power Industry

Large scale of super- (ultra-) critical units with a capacity of 600MW or above, and large IGCC units shall be developed. High efficient and clean energy generation technology will be used to improve and rehabilitate the existing thermal power generation units. Small power plants will be replaced by big ones, or small power plants should retire. Cogeneration for heat and power, multi-generation for heat, power and cool (CCHP) and heat, electricity and gas multi-generation system (tri-generation) will be encouraged and promoted. In areas where industrial heat supply is the main focus, back pressure units for heat supply shall be established to best fit the local conditions. In areas where there is concentrated heat or the potential is big, high efficient and environmentally friendly co-generation units of 300MW will be built. In small- and medium-sized cities, tri-generation shall be developed with circulated fluidized bed (CFB) as the main technology; distributed cogeneration and multi-generation of heat, power and refrigeration with clean energy as the fuel will be developed; distributed small coal-fired boilers for heat shall be rehabilitated for central heat supply. By 2010, standard coal consumption for thermal power plants will be reduced from 370 g/kwh to 355 g/kwh; the auxiliary power ratio of the power plants will be reduced from 5.9% to 4.5%; central heat supply coverage for cities will increase from 30% to 40%; newly addition of cogeneration units of over 40GW; the annual energy saving is over 35 million tce. Contributions will be made for the improvement of city air quality.

More attention shall be given in the process of hydropower development. High efficient dust removal facilities must be installed along with new power plant construction. Rehabilitation of retrofit power plants shall be accelerated in the field of

dust removal. The reliability, stability and dust removal efficiency of the retrofit power plants should be improved. The emission of SO₂ should be strictly controlled through the use of low-sulfur fuel, installation of desulfurization equipment etc.. Low nitrogen combustion technology shall be promoted. The pilot scale of nitrogen removal from flue gas shall be expanded so as to encourage thermal power plants to reduce the emission of NO_x. By 2010, the dust emission for thermal power plants are expected to be controlled at an amount of 1.2 g/kwh, SO₂ emission down to 2.7 g/kwh and 100% of compliance on waste water discharge rate of the power plants.

The highly energy intensive old equipment for transmission, transformers and distribution shall be gradually replaced by advanced equipment and technology. Cross-region grid connection should be strengthened and economic operational technology for power grids shall be extended and used. Effective measures should be taken to mitigate the environmental impact imposed by electromagnetic field. By 2010, the electric network loss should be reduced to about 7%.

Chapter V: Advancement of Science and Technology

A guiding principle for science and technology advancement focuses on *self innovation; frog leaping for some key areas; paying attention to current development and playing a leadership for future development*. An innovative new system for energy development will be developed. Under such a new system, industries will be the dominating party and market the orientation. Production, study and research will be integrated and combined. Advanced technology with practicability will be given a priority in the development. The technological level of the energy industry will need to be augmented. The research and development of frontier technologies should be enhanced so as to lay a basis for future energy development.

5.1 Advanced Technology with Practicability be Developed as a Priority

Column 4: Key advanced technologies to be developed during the 11th Five-Year Plan

	Key elements
Resource exploration & development	High efficient coal mine development; exploration & development of oil and gas resources in complicated geological conditions; exploration & development of onshore oil and gas resources; coal bed methane development
Clean use of coal	Coal washing and selection; clean and high efficient generation; coal-based liquid fuel and chemical industry technology
Nuclear stations	Large and advanced PWR nuclear power plant technology at the capacity of 1GW
Ultra large scale power	Flexible power transmission; high grade power transmission; batch type

distribution and transmission and secondary system of power grid	power grid connection; power quality monitoring and control; large scale inter-connected power grid safety control and automatic dispatch technology of power grid etc.
Scaled development and use of renewable energy at low cost	Large-scale wind turbine units; biomass generation; biogas generation; fuel ethanol; bio diesel, biomass solid fuel; key techniques in solar energy development and utilization

5.2 Research on Frontier Energy Technologies

Colum 5: Key frontier technologies to be developed during the 11th Five-Year plan

	Key elements
Hydrogen energy and fuel battery	Hydrogen making from fossil energy and renewable energy at high efficiency and low cost; hydrogen storage, transmission and distribution at high efficiency and low cost; key technologies in fuel batteries
Distributed energy system (DES)	Terminal energy transformation, energy storage, integrated technology for heat, power and refrigeration for micro gas turbine; new power circulation
Future nuclear power	high temperature gas cooled reactor; fast breeder reactor and nuclear fusion reactor
Gas hydrates	Geology theory for gas hydrates; resource exploration and assessment; well drilling and safe mining technology etc.

Chapter VI: Safeguard Measures

6.1 Increase Investment in Exploration; Strengthen Resource Availability

Implementation will be followed to *the Numerous Comments and Decisions from the State Council on Promoting the Healthy Development of Coal Mine Industries*. The system on paid use of resources should be improved; input should be increased for the basic geological exploration and coal resource availability and safety be further strengthened.

Incentive policies for investment in oil and gas resource exploration and development should be developed. The development and use of tail mines and difficult reserves should be encouraged. Block bidding and exit mechanism for oil and gas should be established and improved on a gradual basis.

More input should be invested for resource survey in hydropower, wind and biomass so as to provide a resource basis for the accelerated development and use of new energy and renewable energy.

6.2 Make Best Use of Planning and Control; Standardize Development

Procedures

Energy planning adjusting and public disclosure system should be established and improved. Various energy planning should be made on a rolling basis and disclosed publicly for implementation. The governmental regulation and industrial activities should be standardized and subject to the monitoring by the social public. The related planning made by local and sectoral institutions will need to be consistent with the national energy development plan.

Strict project verification and approval system and record filing system should be established. The departments of national land and environmental protection will not proceed with related approval, license issuing procedures for those projects which are not in compliance with the national energy development plan. Nor should the financial institutions provide lending to these owners. The project verification and record filing system shall be further improved so as to formulate more scientific, standard and transparent management methods.

6.3 Accelerate Development of Laws and Regulations; Improve Sectoral

Management

Revisions of related laws and regulations, such as *Coal Law*, *Electricity Law*, *Energy Conservation Law* should be completed. New laws and regulations such as *the Energy Law*, *Oil and Natural Gas Law*, *National Administration Regulation on Oil Reserve* should be drafted and promulgated. Laws and regulations for the energy sector should be improved at the soonest so as to comply with the socialist market system.

Sound access system for the coal industry should be established so as to standardize coal resource exploration and development, production and operational activities. Coal resources should be consolidated to promote the industrial restructuring and retire low-efficiency small mines. The industries shall be guided to increase input to accelerate coal mine gas extraction and use and safety improvement. Equipment needs to be updated to improve safety and production conditions.

The regulation on oil and gas industry should be strengthened and market access system improved. The natural gas policy should be developed so as to enhance the demand side management and ensure gas supply security.

The power market regulation system and operational rules should be improved and fair competition market environment be created. Power grid and generation companies should be guided to enhance the management, reduce energy consumption and increase energy efficiency, reduce the cost and improve the service so as to provide stable, reliable and high quality power service with reasonable price.

6.4 Deepen System Reform; Improve Pricing System

We should continue to promote the coal industries to improve their modern corporate system, reduce the social responsibilities of the enterprises and increase their competitiveness. The circulation system should be improved and modern coal trading market should be established.

The price of finished oil should be streamlined gradually. The gas price shall be further adjusted and strengthened so as to guide proper use of oil and gas resources and promote resource saving and development.

In accordance with the power sector reform plans approved by the State Council, the results of separation of generation from power grids should be consolidated. The separation of secondary power grid from the main grid should be accelerated. Regional power market development should be promoted. Pilots on direct trading between large users and power generation companies should be continued. The separation between transmission and distribution should be realized gradually. The power tariff reform should be deepened. Transmission and distribution tariff should be improved. Competitive power grid connection should be accelerated. A categorized power sale tariff system should be established based on the power supply quality, the purpose of power use and the different generation grid tariff.

The compulsory market share system for the renewable energy power should be developed. Discount policies on renewable energy power tariff should be improved and implemented. Tax and revenue policies which could benefit the production and use of renewable energy resources should be implemented.

6.5 Strengthen Resources Saving; Protect Ecological Environment

The mine resource recovery should be increased. A resource tax fee levying and collection method which relates to recovery shall be implemented. The monitoring and regulation system should be improved. Enterprises will be promoted to enhance management, increase input, improve equipment and improve energy resource recovery.

Circulated economy should be developed. The enterprises should be encouraged to make best use of bad quality coal, the byproducts from coal washing and processing,

coal mine gas and mine water. Integrated utilization business should be developed to best fit the local situations. Cogeneration industry policies should be improved. The large and medium sized cities and industrial zones where the heat load is relatively concentrated are encouraged to implement cogeneration to provide central heating. Heat supply boilers with scattered locations will gradually retire. The overall energy efficiency should be increased and the environment be protected.

The compensation mechanism which aims to rehabilitate and recover the ecological environment of the mining areas should be established. Clean coal production standard should be set up. The responsibilities of the enterprises vs. the government should be clearly stated. There should be more input in ecosystem protection and treatment.

The power dispatch approach should be reformed and restructured. A fair and economic merit-order dispatch approach which is beneficial to energy efficiency, environmental protection should be implemented. This way the enterprises will be encouraged to accelerate the development of high efficient and clean generation units, retire and improve low-efficiency retrofit units which need intensive energy consumption and generate high emissions. The overall energy efficiency and environmental protection level as a whole in the power sector will be eventually improved.

6.6 Further Open-up to the Outside World; Enhance International Cooperation

The Industrial Guidance Catalogue for Foreign Investment should be revised at the appropriate time, with a primary aim to introduce modern technology and management and improve the open-up policy for the energy sector. International cooperation in the field of energy shall be made based on the principles of mutual benefits.

6.7 Establish Emergency Plan; Enhance Security Plan

The establishment of governmental oil reserve should be accelerated. Corporate compulsory reserve should be set up at the right time. It is encouraged to develop commercial oil reserve, gradually improve oil reserve system. In order to handle large-scale power grid failure, as well as oil and gas supply failure, pre-warning system and emergency plan for energy should be established.