Medium and Long-Term Development Plan for Renewable Energy in China

(Abbreviated Version, English Draft)

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(NDRC)

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Content table

In order to speed up the development of renewable energy, promote energy conservation and reduce pollutants, mitigate climate change, and better meet the requirements of sustainable social and economic development, *the Medium and Long-term Development Plan for Renewable Energy in China* is formulated. It puts forward the guiding principles, objectives and targets, priority sectors, and policies and measures for the development of renewable energy in China up to 2020.

1. Present Situation

1.1 Resource Potential

According to preliminary assessment, the renewable energy sectors with the greatest resource base and development potential in China are hydropower, biomass energy, wind energy, and solar energy.

1.1.1 Hydropower

According to the results of the 2003 Nationwide Hydropower Resource Assessment, China's total potential capacity of technically exploitable hydropower is 540 GW, with an annual power generation potential of 2470 TWh. The total potential capacity of economically feasible hydropower is 400 GW, with an annual power generation potential of 1750 TWh. These hydropower resources are distributed mainly in the nation's western regions, with 70 percent of the total located in Southwest China.

1.1.2 Biomass Energy

China's biomass energy resources include mainly straw and other agricultural wastes, waste from forestry and forest product processing, animal manure, energy crops and plantations, organic effluents from industry, municipal wastewater, municipal solid waste (MSW), etc. Of about 600 million tons of crop straw produced every year, nearly 300 million tons (or around 150 million tons of coal equivalent (tce)), can be used as fuel. Of about 900 million tons of waste from forestry and forest product processing available every year, nearly 300 million tons (or about 200 million tce) can be used for energy production. In addition, there are large areas of marginal lands in China that can be used to cultivate energy crops and plantations. Biogas and MSW are also biomass resources with good potential for development. Presently, the nation's total biomass resource that can potentially be converted into energy is about 500 million tce. With social and economic development, the biomass resource that could potentially be converted into energy is expected to increase to 1 billion tce in the future.

1.1.3 Wind Energy

According to the most recent wind energy resource assessment, the nation's exploitable potential onshore wind capacity is 300 GW. Together with offshore wind resources, the total potential wind capacity is about 1,000 GW. These resource are mainly distributed

in two major “wind belts”: the “Sanbei Region” (or “Three Norths Region,” which includes Northeast China, the north part of North China, and Northwest China), and East China (including coastal areas, offshore areas, and nearby islands). Aside from these, there are also some fragmented areas rich in wind resources distributed in some inland areas of China.

1.1.4 Solar Energy

Two-thirds of China’s territory enjoys over 2,200 hours of sunshine annually, with total solar radiation per unit area of over 5000MJ/m^2. These regions have favorable conditions for solar energy development, with extremely favorable conditions found in West China.

1.1.5 Geothermal Energy

According to preliminary assessment, the geothermal energy resources spread across China are mainly of the low and medium temperature types, which are suitable for industrial-use heat, space heating, agricultural use, use in animal husbandry, etc. High temperature geothermal resources suitable for power generation are relatively less plentiful. They are mainly located in Tibet, Sichuan, and Yunnan and have a total potential power capacity of about 6 GW. According to preliminary estimates, the total exploitable geothermal potential in China is about 3.3 billion tce.

1.2 Present Situation

With many years of development, very strong progress has been achieved in China’s renewable energy field. Hydropower has already become an important component of the power industry, while household biogas digesters are now being used extensively in rural areas. More recently, there has been notable progress in wind power, solar photovoltaic (PV) power, solar thermal conversion, and modern biomass energy applications as well, contributing greatly to the structural adjustment of China’s energy use, to environmental protection, and to speeding up social and economic development.

In 2005, the total amount of renewable energy utilized (excluding traditional uses of biomass energy) in China was about 166 million tce, accounting for 7.5 percent of total national primary energy consumption.

1.2.1 Hydro Energy

By the end of 2005, the total installed capacity of hydropower was 117 GW (including 7 GW of pumped storage hydropower plants), accounting for 23 percent of China’s total installed power capacity. The power generated by hydropower that year was 395.2 TWh, accounting for 16 percent of China’s total power generation. Of the total installed hydropower capacity, the installed capacity of small hydropower was 38 GW, with annual power generation of 130 TWh.

1.2.2 Biomass Energy

***(1) Biogas*:** By the end of 2005, the total number of household biogas digesters reached 18 million, with a total annual production of biogas of about 7 billion m^3. About 1,500 large-scale biogas plants for livestock farms and for organic industrial effluent had also been built, producing about 1 billion m^3 of biogas annually. Biogas technology has now advanced from the stage in which it was dedicated solely to energy utilization. It now enjoys multi-use application, including waste treatment and comprehensive use of biomass. Biogas is now widely integrated with animal husbandry and farming and has become an important means of developing eco-agriculture and strengthening the nation's ecological and environmental development.

(2) *Biomass Power:* By the end of 2005, the installed capacity of biomass power in China reached 2 GW. Of this, the power capacity from sugar cane residue (bagasse) was about 1.7 GW, with that from MSW incineration and land-fill gas power generation being about 200 MW. The rest of the afore-stated installed biomass power capacity was from gasification of agricultural or forestry (and forest product processing) wastes, such as rice husks.

(3) *Liquid Biofuels*: China has already begun to use bio-ethanol as a transport fuel. In 2005, the production capacity for bio-ethanol using food grains as a feedstock was 1.02 million tons. In addition, the technology for producing bio-ethanol from non-food-grain feedstock has already reached the preliminary conditions needed for commercialization. The production capacity of bio-diesel made from waste edible oil from restaurants, edible oil residues from edible oil pressing factories, and edible oil-yielding crops reached 50,000 tons in 2005.

1.2.3 Wind Power

By the end of 2005, more than 60 wind farms had been connected to the power grid in China, with a total installed capacity of 1.26 GW. There were also about 250,000 small wind turbines operating off-grid in remote areas of China. The total installed capacity of these was about 50 MW.

1.2.4 Solar Energy

(1) *Solar Power Generation*: By the end of 2005, the total installed capacity of solar PV power in China was about 70 MW, most of which is used for supplying power to the residents of remote rural areas. *The Township Electrification Program*, implemented from 2002-2003, resulted in the installation of 19 MW of solar PV panels, providing relatively strong stimulation to the utilization of solar PV and to solar cell manufacturing in China. Apart from using solar PV to electrify remote areas and provide power for special applications (such as communication, navigation and transportation), China has now begun to implement BIPV (building-integrated grid-connected PV) demonstration projects.

(2) Solar Water Heaters: By the end of 2005, the annual production capacity of solar water heaters in China was 15 million m^2. The total heat collecting area of solar water heaters installed to date in China had reached 80 million m^2.

2. Guiding Principles

The guiding principles of China's medium and long-term renewable energy development will be to: (1) conscientiously implement the Renewable Energy Law; (2) adopt renewable energy development as one of the key strategic measures to achieve China's goals of establishing a resource-saving, environmentally-friendly society and realizing sustainable development; (3) speed up the development and deployment of hydropower, wind power, solar energy, and biomass energy; (4) promote technical progress; (5) increase market competitiveness; and (6) continuously increase the share of renewable energy in China's overall energy consumption mix.

2.1 Coordinating renewable energy development and deployment with economic, social, and environmental objectives

Renewable energy development should not only focus on scaling-up deployment and increasing the proportion of renewable energy in total energy supply, but also on resolving rural energy problems, promoting a "recyclable" economy, and building a resource-saving, environmentally-friendly society. Most importantly, renewable energy development must attach importance to harmonization with environmental and ecological protection objectives. Renewable energy development should be undertaken taking into consideration the situation of resources and the needs of social and economic development. Undertaken with the prerequisite of protecting the environment and ecological system, planning should be scientific, address local conditions, and be designed to achieve reasonable distribution and orderly implementation. In particular, a lot of attention should be given in the case of the development of biomass energy to the relationship with both grain and the ecological environment. Cultivated land should not be illegally occupied, food grains should not be excessively consumed, and the ecological environment should not be destroyed.

2.2 Ensuring mutual promotion of the market (demand) and industrial development (supply)

For those more newly developed renewable energy sectors with large resource potential and good commercial prospects, such as wind and biomass power, necessary measures should be taken to enlarge market demand, while at the same time increasing the input for technology development. With this two-pronged strategy, sustainable and stable market demand can create conditions beneficial to the development of the renewable energy industry. China should also develop self-dependent innovation abilities as the basis for its renewable energy R&D and industry development system. In this way, it can speed up progress in renewable energy

technology development, raise its ability to manufacture equipment, and, through sustained scaling-up of development, raise the market competitiveness of renewable energy. In sum, the measures mentioned above will form a solid basis for the large-scale development of renewable energy.

2.3 Combining short-term utilization with long-term technology development

Priority should be put on those renewable energy technologies that have both market demand in the short-term and large development potential for the long-term. Importance should be attached to technologies mature in the current market, such as hydropower, biomass power, biogas, biomass pellet fuel, wind power, and solar thermal. At the same time, importance should also be attached to those less mature technologies that have good future prospects, such as solar PV and liquid bio-fuels.

2.4 Combining policy incentives with market mechanisms

The government will adopt economic policy incentive measures to promote the utilization of renewable energy technologies for addressing issues of energy shortage and lack of access to electricity in rural areas, also supporting development of a "recyclable economy". At the same time, the government will set up a market mechanism for promoting renewable energy development, using market measures to stimulate the participation of investors. This will also serve to raise the technical level of renewable energy technologies, promote the development of the renewable energy equipment industry, continuously improve the competitiveness of renewable energy, and cause renewable energy, under the support of the nation's policies, to achieve large-scale development.

3. Objectives and Targets

3.1 Overall Objectives

The overall objectives for China's renewable energy development in the coming 15 years are: to increase the proportion of renewable energy in total energy consumption, to resolve the problem of lack of electricity of people living in remote off-grid areas and the shortage of fuel for daily life needs in rural areas, to stimulate the utilization of organic wastes for energy, and to promote the development of renewable energy industries.

3.2 Specific Objectives

(1) By 2010, China will aim to raise the share of renewable energy in total primary energy consumption to 10 percent. By 2020, it will aim to raise this share to 15 percent. This will be achieved by fully utilizing, to the extent possible, technologically mature and economically feasible renewable energy sources, such as hydropower, biogas, solar

thermal, and geothermal, as well as by promoting the development of the wind power, biomass power, and solar PV industries.

(2) China will also aim to provide electricity to people in remote, off-grid areas and resolve fuel scarcity problems in rural areas through the use of renewable energy, doing so according to local conditions and at the same time effectively protecting the ecological environment. The utilization of organic wastes for energy will be promoted according to the principles of a "recyclable economy," basically eliminating the environmental pollution problems caused by organic wastes.

(3) China will actively promote the development of renewable energy technologies and industries, building up a renewable energy technology innovation system. By 2010, China will basically have achieved the ability to produce domestically the main renewable energy equipment it uses. By 2020, local manufacturing capability based mainly on home-grown Intellectual Property Right (IPR) will be achieved.

4. Priority Sectors

Based on analysis of the resource potential, technological situation, and market demand for all types of renewable energy, the priority sectors for renewable energy development in China up to 2010 and 2020 will be as follows:

4.1 Hydropower

By 2010, China's installed capacity of hydropower will reach 190 GW. By 2020, the nation's installed hydropower capacity will reach 300 GW.

4.2 Biomass Energy

Priorities for biomass energy development will be biomass power generation, biogas, biomass pellets (used directly as fuel), and liquid bio-fuels. By 2010, the installed capacity of biomass power will reach 5.5 GW, the annual use of biomass pellets for fuel will reach 1 million tons, the annual use of biogas will reach 19 billion m^3, the increase (newly added amount) in the use of non-food-grain fuel bio-ethanol will be 2 million tons, and the annual use of bio-diesel will reach 200,000 tons.

By 2020, the installed capacity of biomass power will reach 30 GW, the annual use of biomass pellets as fuel will reach 50 million tons, the annual use of biogas will reach 44 billion m^3, the annual use of fuel bio-ethanol will reach 10 million tons, and the annual use of bio-diesel will reach 2 million tons.

4.2.1 Biomass Power

Biomass power includes power generation using biomass from agriculture and forestry/forest product wastes, MSW, and biogas. The priorities for biomass power development are as follows:

(1) By 2010, the installed capacity of biomass power based on agricultural and forestry wastes and energy crops plantations (bagasse included) will be 4 GW. By 2020, the installed capacity of biomass power based on agricultural and forestry wastes and energy crops plantations (bagasse included) will be 24 GW. Energy plantations will be grown in marginal areas (including barren mountains, barren land, and sandy areas suitable to afforestation) to supply feedstock for agriculture and forestry based biomass power generation.

(2) By 2010, 4,700 large-scale biogas projects on livestock farms and 1,600 biogas projects utilizing industrial organic effluent will be built with a total annual production of 4 billion m^3 biogas and total installed capacity of 1 GW. By 2020, 10,000 large-scale biogas projects on livestock farms and 6,000 biogas projects utilizing industrial organic effluent will be built with a total annual production of 14 billion m^3 biogas and total installed capacity of 3 GW.

(3) By 2010, the installed capacity of power generation based on MSW will be 500 MW. By 2020, the installed capacity of such power generation will be 3 GW. MSW combustion plants will be built in economically-developed but land resource-constrained areas. Landfill gas recovery and power generation facilities will be installed at large and medium-sized landfill sites.

4.2.2 Biomass Pellets

Up to 2010, addressing the integrated priorities of meeting basic rural energy needs and also changing the mix of energy used in rural areas, 500 pilot biomass pellet fuel use areas will be established. By 2010, the annual consumption of biomass pellet fuels around the country will reach 1 million tons. By 2020, the use of biomass pellet fuels in China nationwide will reach 50 million tons. By that time, biomass pellets will have become a widely used form of high quality fuel.

4.2. 3 Biogas and Biomass Gasification

Making full use of biogas technologies and technologies for biomass gasification of agricultural and forestry wastes is an important measure for raising the share of gas in the energy used to meet the daily life needs of rural people. It is also an important measure for resolving the environmental problems associated with rural wastes and organic industrial wastes.

In rural areas, the main emphasis will be put on household biogas digesters. In small and medium-sized towns, as well as livestock farms and in cases of industrial organic effluent, larger scale biogas projects will supply gas in a more concentrated fashion. By 2010, about 40 million rural households (160 million people) will use biogas as their main fuel, while by 2020, 80 million households (300 million people) will do so.

4.2.4 Liquid Bio-fuels

By 2010, China aims to utilize (an additional) 2 million tons of bio-ethanol from non-food-grain feedstock and increase biodiesel use to 200,000 tons. By 2020, China aims to utilize 10 million tons bio-ethanol and 2 million tons biodiesel, replacing 10 million tons of petroleum-based fuel annually.

4.3 Wind Power

Through the large-scale development and establishment of wind farms, China aims to accelerate wind energy technology improvement and industrial development, thus promoting the market competitiveness of wind power.

(1) By 2010, the installed grid-connected wind capacity in China will be 5 GW. About thirty 100 MW-scale wind farms will be established, mainly in the eastern coastal areas and “Sanbei Region” (“Three Norths Region”), thus building up three 1 GW-scale wind farm bases in Jiangsu, Hebei, and Inner Mongolia, respectively. In addition, one or two 100 MW-scale pilot offshore wind projects will be set up.

(2) By 2020, the total installed grid-connected wind capacity in China will be 30 GW. Rich wind energy resources in provinces such as Guangdong, Fujian, Jiangsu, Shandong, Hebei, Inner Mongolia, Liaoning, and Jilin, will be exploited in adjacent swaths, thus establishing a backbone of major wind provinces, each with over 2 GW of capacity installed. Six wind farm bases (Dabancheng in Xinjiang, Yumen in Gansu, the eastern coastal area around Jiangsu and Shanghai, Huitengxile in Inner Mongolia, the Zhangbei Region of Hebei, and Baicheng in Jilin) will be developed each with a GW-level installed capacity. 1 GW offshore wind capacity will be installed.

4.4 Solar Energy

4.4.1 Solar Power

By 2010, the total capacity of solar power in China will be 300 MW. By 2020, it will be 1.8 GW. The key aspects of development will be as follows:

(1) About 100 MW of solar PV will be installed to supply electricity to 1 million agricultural and husbandry households in remote areas. By 2010, then, the accumulated capacity of solar PV for remote rural areas will be 150 MW. By 2020, it will be 300 MW.

(2) At the same time, China will aim to promote grid-connected BIPV in economically developed large and mid-sized cities that are relatively modernized. By 2010, BIPV capacity will be 50 MW; and by 2020 it will be 1 GW.

(3) Finally, China will aim to build relatively large solar PV and solar thermal power stations. By 2010, the grid-connected capacity will be 20 MW (large-scale, grid-

connected solar PV power stations) and 50 MW (solar thermal power stations), respectively. By 2020, the corresponding figures will be 200 MW for grid-connected solar PV power stations and 200 MW for solar thermal power stations. In addition, there is a large potential for solar PV application in communications, meteorology, long distance pipelines, railways, highways, etc. The application of solar PV technologies in these commercial areas will be 30 MW by 2010 and 100 MW by 2020.

4.4.2 Solar Thermal Applications

China aims to promote building-integrated solar thermal systems and pilot solar space heating and cooling technologies in urban areas, and promote household solar water heater, solar building, and solar cookers in rural areas. By 2010, the total heat collecting area of China's solar water heaters will be 150 million m^2, replacing 30 million tce. By 2020, the collector area will reach 300 million m^2, replacing 60 million tce.

4.5 Other Renewable Energy Applications

China will actively promote the development and utilization of geothermal and ocean energies. Geothermal energy resources will be used rationally -- promoted so as to meet environmental protection and water resource protection requirements. Geothermal energy will be used for heating, hot water supply, and geothermal heat pumps. The heat-pump technology will be widely promoted for space heating and cooling in regions needing space cooling in summer and space heating in winter. Geothermal power generation will be developed in areas with high-temperature geothermal resources. R&D for power generation using deeper geothermal resources will be promoted. In the regions of the Yangtze River and in coastal areas, geothermal technology will be used for space heating, air conditioning, and hot water supply by utilization of surface water, underground water, soil, and other shallow geothermal resources. The target of annual geothermal energy utilization will be 4 Mtce by 2010 and 12 Mtce by 2020. The total capacity of tidal power generation will be 100 MW by 2020.

4.6 Rural Renewable Energy Applications

In rural areas, renewable energy applications will be developed to resolve issues of daily use energy for China's vast rural population, to improve rural production and living conditions, and to protect the ecological environment. Use of renewable energy will effectively raise rural incomes and increase the speed of social and economic development in rural areas. The priorities for development are the following:

(1) Supply power to rural areas without electricity: For those areas to which it would not be economic to extend the power grid, full play should be given to the strengths of local resources. In these areas, through the application of small hydro, solar, and wind, as well as other renewables, the basic electricity demand of people without power supply will be solved. In areas with rich resources of small hydropower, top priority will be given to develop small hydropower stations (including micro hydropower stations), resulting in the supply of energy to around 1 million households. In those areas lacking

small hydropower resources, electricity will be supplied to around another 1 million households by means of (depending on local resources) building small-scale off-grid solar PV power stations and wind-PV hybrid power stations, as well as by promoting the use of small household wind turbines, solar (PV) home systems, and wind-PV home systems.

(2) Improve conditions of rural daily-life energy use: Rural living conditions and the quality of rural peoples' lives will be improved by means of utilization of various renewable energy technologies. Small hydropower will serve as a substitute for fuel in those areas rich in small hydro resources. Household biogas digesters, biomass pellet fuel, solar water heaters, and other renewable energy technologies will also be used to supply clean energy to rural areas. By 2010, 30 percent of rural households will use clean renewable energy, with 40 million rural household biogas digesters, and 50 million m^2 of solar water heater collector area in use in rural areas. By 2020, 70 percent of rural households will use clean renewable energy, with 80 million rural household biogas digesters, and 100 million m^2 of solar water heater collector area in use in rural areas.

(3) Establish Pilot Green Energy Counties: Adopting the principles of flexibility, diversification, and taking action suitable to local circumstances, China will establish pilot Green Energy Counties in areas with abundant renewable energy resources, striving to make full use of all kinds of renewable energy. The criteria for a Green Energy County will be: (a) more than 50 percent of household energy comes from renewable energy, and (b) various biomass residues and wastes are treated and utilized in reasonable ways. The Green Energy County pilot program will be combined with promotion activities for each of biogas, biomass pellets, and solar energy. The number of green energy counties will be 50 by 2010 and 500 by 2020.

5. National Policies and Measures

In order to achieve the objectives and targets of the Plan, the following policies and measures will be adopted to support the development of renewable energy:

(1) Establish sustainable and stable market demand: Sustainable and stable renewable energy market growth, expansion of renewable energy utilization, technical progress, and development of renewable energy manufacturing industries will be stimulated by means of: favorable price policies, mandated market share (MMS) policies, government investment, government concession programs, and other measures. These measures will be adopted under the principles of integrated government guidance, policy support, and market stimulation. The measures will ensure that the medium and long-term objectives and targets for renewable energy are met.

The MMS policies will be adopted for non-hydro renewable power generation according to the following targets: In areas covered by large scale power grids, non-hydro renewable power generation's share of total power generation will reach 1 percent by 2010 and over 3 percent by 2020. Power generators with self-owned installed capacity of over 5 GW will be required to have a non-hydro renewable energy installed power

capacity (self-owned that accounts for 3 percent of their total capacity by 2010 and for over 8 percent of their total self-owned capacity by 2020.

(2) Improve the market environment: According to the Renewable Energy Law, China's state power grid companies and petrol whole-sales companies have the responsibility of purchasing, respectively, renewable power and liquid bio-fuels. The energy administrative authorities under the State Council are responsible for formulating all kinds of regulations for grid connection operation and management of renewable power generation. The state power grid companies are responsible for construction of transmission lines for renewable power stations. The organizations responsible for power dispatch must, according to the trends of renewable power generation, reasonably arrange for power generation and dispatch, so that renewable energy resources are utilized as much as possible. Within the areas designated by the state for the sale of liquid bio-fuels, all of those companies involved in the sale of petroleum as transport fuel must blend bio-fuel (bio-ethanol and/or bio-diesel) in the required proportion with its gasoline and/or diesel products. Blended liquid bio-fuels will be adopted as soon as possible across the whole country.

The administrative authorities under the State Council responsible for the construction industry and the Standardization Administration of China will take responsibility for developing national standards for solar systems in buildings, and update the relevant construction standards, engineering specifications, and management regulations of urban construction to create good conditions for the development of solar systems in buildings. In the towns with rich solar resources, through the use of necessary policy measures, the market share of solar thermal technologies will be driven up.

(3) Set renewable power tariff and cost-sharing policies: The administrative authorities under the State Council that are responsible for prices will set and improve the renewable energy price policy system. They will do so based on the different technical and regional characteristics of various renewable energy technologies. They will also do so based on the principles of benefitting renewable energy development and being economically reasonable. Further, they will adjust the prices at appropriate times according to the situation of development of renewable energy technologies. For concession power projects determined by tender, the bid-winning price shall be adopted as the renewable energy power price and may be subsequently adjusted according to the market situation. All of the excess expense of renewable power over conventional power borne by the grid companies in their purchase of renewable power will be passed to all of society by a surcharge to the retail price of power.

(4) Increase fiscal input and tax incentives: According to the Renewable Energy Law, the central government financial authority is to set up a renewable energy fund. The scale of investment in the fund will be determined according to the requirements for developing renewable energy and the financial strength of the nation. At the local level and also according to the requirements of the Renewable Energy Law, the financial authorizes should, according to local circumstances, also allocate the necessary funds to support renewable energy development. The government should support the

development and deployment of renewable energy, including wind, solar, hydro, biomass, geothermal, ocean, etc., through preferential tax policies. The government should also support R&D for renewable energy technologies and equipment manufacturing through appropriate favorable tax policies for relevant enterprises.

(5) Accelerate technology improvement and industry development: Renewable energy technology improvement and industry development should be promoted through the integration of various renewable energy technology resources (e.g. research institutes), improvement of the technology and industry service systems, speeding up of human resource development, and increasing in all aspects technical innovation capabilities and service levels. Innovation capabilities of China's research organizations and enterprises in core renewable energy technologies will be raised by putting scientific research related to renewable energy, technology development, and industrialization into all kinds of national scientific and technological development plans and by arranging for renewable energy projects to be included in the nation's high technology industrialization programs and its programs for supporting manufacturing of key equipment. On the basis of bringing in foreign technology from abroad, the capacity to absorb and innovate should be strengthened, so that, as soon as possible, self-dependent innovation capabilities are achieved. By 2010, a basic system of renewable energy technologies and industry will have been established, so that equipment capabilities based mainly on domestic manufacturing will have been established. By 2020, a relatively complete renewable energy technology and industry system will have been established, so that a domestic manufacturing capability based mainly on China's own IPRs will have been established, satisfying the needs for deploying renewable energy on a large scale in China.