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TERNA Wind Energy Programme

Energy-policy Framework Conditions for Electricity Markets and Renewable Energies

23 Country Analyses
Chapter China

Eschborn, September 2007

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New Edition of the TERNA Country Survey

Since the first edition of the TERNA country survey appeared in 1999, there has been a distinct heightening of public and political awareness of the consequences of climate change and of energy provision as a key factor in sustainable development. In Germany and other industrialised countries, a political tailwind, effective promotion mechanisms and rising energy prices have created the conditions for a dynamic market in which renewable forms of energy are exhibiting high growth rates within the energy mix. In 2006, global new investment in renewables amounted to US$ 70.9 billion – an increase of 43 % over 2005.

Strong economic development in many emerging countries has triggered rapidly rising demand for energy and competition on the international oil market. Against the background of the rising cost of fossil fuels, supply risks and damage to the environment, the significance of renewable energy as a means of generating electricity is growing – also in developing and emerging countries: according to analyses conducted by the Renewable Energy Policy Network for the 21st Century (REN21), 39 countries have set expansion targets for renewable energy sources and introduced promotion mechanisms, nine of which are developing or emerging countries. Of total new investment in renewable energy around the world, US$ 15 billion was invested in developing and emerging countries. Nevertheless, the majority of countries still have a long road ahead of them before they overcome existing barriers to the successful introduction of renewable forms of energy.

The German and European market acts as the driving force for the wind energy industry and provides an indispensable background of experience. However, growth in the industry is also increasingly apparent in developing and emerging countries. It is the successes in countries such as India, China and Brazil which encourage commitment beyond the borders of industrialised nations. In those three countries there is a growing proportion of local content in the systems and equipment they produce – and not only for supply to their own domestic markets.

A number of other countries though, too, are erecting their first wind farms, thereby establishing the basis for gaining experience to be utilised in future markets.

To help interested players gain access to the new markets, this survey provides detailed descriptions of the framework conditions for electricity markets and renewable energy in 23 developing and emerging countries.

Latin America	Africa/Middle East	Asia
Argentina	Egypt	Bangladesh
Brazil	Ethiopia	China
Caribbean States	Jordan	India
Chile	Morocco	Indonesia
Colombia	Namibia	Pakistan
Costa Rica	South Africa	Philippines
Dominican Republic	Tunisia	Viet Nam
Mexico		
Nicaragua		

This latest country survey and the previous editions are available on our homepage: www.gtz.de/wind. For the first time, the publication is also available on CD-ROM. For information on how to obtain this, again, go to the homepage.

Our grateful thanks go to a large number of GTZ staff members and other experts in the field for their help in putting this information together.

Eschborn, September 2007

Legal Information

1. The data used in this study is based on both publicly accessible sources of information (publications, specialist articles, internet sites, conference papers etc.) and non-public papers (for example internal expert reports from promoting institutions), as well as personal interviews with experts (for example officials at energy ministries in the investigated countries and project staff at promoting institutions). Although all information has been checked as far as possible, errors cannot be ruled out. Neither the GTZ nor the authors can therefore provide any guarantee of the accuracy of the data included in this study; no liability can be accepted for any loss or damage resulting from use of the data included in the study.

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The TERNA Wind Energy Programme

There is great potential for generating electricity from renewable energy sources in many developing and emerging countries. Obstacles to the exploitation of such sources include a lack of knowledge of framework conditions in the energy industry and insufficient transparency with regard to the prior experience and interests of national actors.

The purpose of the TERNA (Technical Expertise for Renewable Energy Application) wind energy programme, implemented by GTZ on behalf of the Federal German Ministry for Economic Cooperation and Development (BMZ), is to assist partners in developing and emerging countries in planning and developing wind power projects. Since 1988 the TERNA programme has pursued the twin goals of laying the foundations for sound investment decisions while at the same time enabling partners to assess wind energy potentials, plan wind energy projects and improve energy-policy frameworks for renewable forms of energy.

The TERNA wind energy programme's partners are institutions in developing and emerging countries that are interested in commercial exploitation of wind power. These include, for example, ministries or government institutions which have the mandate to develop BOT/BOO projects, state-owned or private energy supply companies (utilities) and private enterprises (independent power producers).

TERNA offers its partners expertise and experience. In order to initiate wind power projects, favourable sites must be identified and their wind energy potential ascertained. To do this, wind measurements are normally taken over a period of at least twelve months and wind reports are drawn up. If promising wind speeds are found, the next step is to conduct project studies investigating the technical design and economic feasibility. TERNA also provides advice to partners on matters of finance, thus closing the gap between potential investors and offers of funding from national and international donors.

If required, CDM baseline studies can be prepared and advice can be offered to potential operators on setting up an efficient operator structure. In order to ensure as much transfer of know-how as possible, efforts are made to ensure cooperation between international and local experts, for example when preparing the studies.

In successful cases, TERNA initiates investment-ready wind farm projects by this method. TERNA itself is not involved in financing. In addition to the activities that are tied to specific locations, TERNA advises its partners on how to establish suitable framework conditions for the promotion of renewable energy sources.

Up until 2007, TERNA has been active in over ten countries around the world.

Further information on GTZ's TERNA wind energy programme, the application procedure etc. is available at www.gtz.de/wind or directly from:

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18 China

18.1 Electricity Market

Installed capacity

In the course of 2006, installed power generating capacity in the People's Republic of China was increased by about 112 GW to reach almost 622 GW by the end of the year. This is equivalent to approximately five times the installed capacity in Germany. Capacity is continuing to be expanded at a fast rate. By 2010, according to the 11th five-year plan, there is set to be a total additional build of another 200 GW. The rate of expansion is fuelling fears, however, that far more than this planned volume will actually be put in place. Government representatives are attempting to prevent this, though, by increasing controls applied in relation to approval procedures for new projects.

Numerous existing small power plants of up to 300 MW are being modernised or shut down in favour of building new medium-sized power stations rated at between 300 and 600 MW and large power stations with a capacity of over 1000 MW.

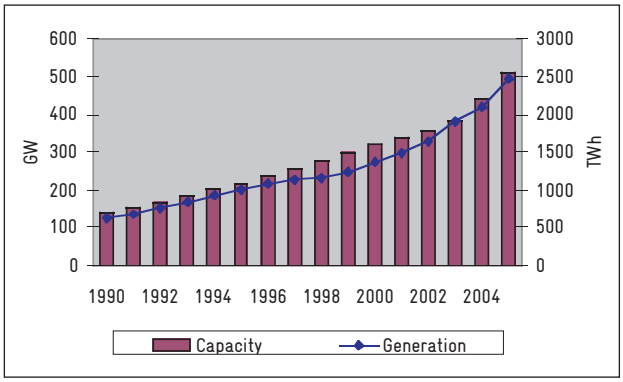

Abb. 1: Electricity generation and capacity; China; 1990–2005; GW, TWh[1]

Power generation

Gross electricity generation has more than quadrupled since 1990, and by 2006 production totalled 2,834 TWh. This makes China the world's second largest electricity producer after the USA.

Most electricity is generated in thermal power stations (80 to 83 %), primarily on the basis of hard coal[2], but increasingly also fuelled by natural gas and supplemented by oil-fired systems Hydropower contributes between 15 and 18 %, depending on hydraulic availability. Nuclear energy accounts for a share of about one per cent, while wind power is still well below 1 %. Not including the large hydroelectric plants, the proportion of renewable forms of energy in China's overall energy mix is significantly less than 2 %.

Even if the average net efficiency of publicly owned coal-fired power stations has been improved to about 34-35 % in recent years, environmental pollution caused by SO_2[3], NO_X and particles remains substantial on account of the fact that the power stations are only partly equipped with air pollution control facilities. Since 2004 however, tighter emission standards have been in force, making desulphurisation a requirement for new plants. In locations close to urban centres the emission standards for existing plants have been tightened, so retrofitting of flue gas cleaning systems has become necessary here too.

China's total CO_2 emissions amounted to about 5.05 billion tonnes in 2005. It is assumed that China will overtake the USA as the world's largest CO_2 emitter as soon as 2008, when the figure is expected to be over 6,000 billion tonnes. The burning of coal in all its uses accounts for roughly 77% of these emissions.

By 2010, natural gas, water and wind, together with nuclear power, are supposed to increase their share to 38 % of total power generation. However, the Chinese Government is keeping to coal as the basis for power generation, its resolve reinforced by the country's huge reserves and the relatively low cost of extracting them.

1 Source: China Electrical Council, 2006.
2 In terms of both the extraction and consumption of coal, China is at the head of any global comparison table.
3 China is the world's largest emitter of SO_2.

That said, thermal electricity generation is being relocated primarily to the mining regions in order to reduce emissions in conurbations and to replace coal transport by electricity transmission ('coal-by-wire' programme). As a new natural gas pipeline has been installed, the aim is also to increase the share of gas used for electricity generation in conurbations. In the meantime there are a relatively large number of gas pipelines that have been recently installed or are under construction. About eight new nuclear reactors were built in 2006, an indication of China's progress towards increasing the share of nuclear power to between 2.5 and 4.5 % by 2020 (from 6,948 MW in 2006 to about 40 GW in 2020). The Chinese Government intends to increase the contribution made by renewables to total energy supply – including large-scale hydropower – from 7.5 % in 2005 to 16 % in 2020, and is earmarking investment totalling US $ 187 billion for that purpose.[4]

Power transmission and distribution

In recent years the existing isolated grids have increasingly been integrated into the 12 regional interconnected grids. These are supposed to be merged initially to form three networks and ultimately by 2020 a single national interconnected grid. In the coming years the government is planning greater efficiency improvements in the transmission and distribution networks. Internal consumption at the production facilities and network losses currently account for about 15 % of gross electricity generated.

Electricity consumption

Net electricity consumption reached a little over 2,800 TWh in 2006. This is equivalent to annual per capita consumption of roughly 1,450 kWh.[5] The growth rate in consumption was over 15 % per year in 2003 and 2004, and in the industrial regions of the Yangtze delta as much as 25 %. Growth in demand slackened off slightly in 2005, reaching a rate of 13.5 %. In the long term it is expected that annual growth rates will average 5 %. The International Energy Agency is forecasting a rise in electricity demand of about 260 % between 2000 and 2030.

By far the most significant consumer group is industry, which accounts for 66 % of electricity consumption. Households are responsible for 15 % of total consumption, while 13 % is attributable to the service sector (including transport) and 6 % to the primary sector (agriculture, forestry and mining). The sustained high rate of economic growth at about 9 % per year results not only in increasing power demand for production but also by private households, as incomes rise. It is expected that private households and the service sector will account for a growing share as time goes on.

For a long time the entire country was affected by electricity shortages and power failures. During periods of peak load in particular it is still the case that the demand for electricity might not be met. In the southern Chinese province of Guangdong – the main centre for light industry and the electronics industry – most companies have now bought their own diesel generators.

The Government of China has linked the endeavour to quadruple GDP by 2020 with the objective of no more than doubling total energy consumption in that time. To this end, the 11th five-year plan for 2006-2010 pursues the aim of reducing energy intensity by 20 %.

Electricity prices

The average national purchase price for electricity across all consumer groups was the equivalent of 5 euro cents/kWh in 2005. The purchase price varies considerably from one province to another: in Shanghai, a load centre, the average price was 5.7 euro cents/kWh, while in the sparsely populated western provinces it was 2.5 euro cents/ kWh. Broken down according to customer groups, commercial customers pay the highest prices, at about 7.7 euro cents/kWh; the prices for interruptible supplies to agricultural customers or for customers in poor regions are the lowest, down as far as 1.8 euro cents/kWh. Domestic electricity prices are somewhere in the middle, as are those for large-scale industry. As the supply costs for these groups differ widely, the pricing is plainly not cost-oriented. Households are favoured by the price policy. Increasingly, a day-night differentiation is being introduced, also for households, for the purposes of load management.

4 These figures were quoted by the Deputy Director General of the Energy Bureau of the NDRC, Wu Guihui, at the end of October 2006 at the Great Renewable Energy Forum in Beijing.

5 By way of comparison: per capita electricity consumption in Germany is approximately 6,400 kWh per year.

As the price of coal has continued to rise, the price-setting authorities have been induced to adjust electricity prices, to the extent that average consumer prices in 2004 had already reached 2.9 euro cents/kWh. The producers were promised automatic adjustments. A new, transparent price system is being trialled in a pilot area, according to which a separate, cost-based tariff is set for each of generation, transmission and distribution.[6]

If this system, which is a prerequisite for further vertical disintegration of the utility companies, is put into practice, the costs of power generation will also become more easily identifiable. Presently the production costs for electricity generated from coal are quoted as 3.5 euro cents/kWh, which implies a narrow margin for transmission and distribution. It is worthy of note that until now by far the largest share of the electricity output has gone to bulk purchasers.

18.2 Market Actors

Up to the time of the electricity sector reform in 2003, the State Power Corporation of China (SPC), created in 1997, was the dominant enterprise with about half the generating capacity, 90 % of the transmission lines above 220 kV, and a majority of the distribution networks. The unbundling of SPC led to the creation of eleven state-owned enterprises, comprising five generating companies, two network operators (interconnected grid operator and holding company for distributors) and four other companies providing supporting services (for example engineering).

Generating companies

The five power generating companies that emerged from SPC each received 30,000-37,000 MW of capacity and hence 45 % of total capacity in 2003. One of these five enterprises, the Guodian Group, was assigned a large proportion of existing wind power capacity, which in turn it concentrated in its subsidiary Long Yuan.

The remaining 55 % is distributed among about 40 other electricity producers, between which a process of concentration is taking place. Industrial self-generators own power station capacity totalling roughly 30 GW. The electricity producers are increasingly supposed to enter into competition with each other. The regulations stipulate that no generating company in any one area (balance group) is permitted to own more than 20 % of the generating capacity.

Grid-operating companies

The two newly created grid-operating companies still currently act as a single buyer. They buy the electricity from the generators, manage transmission and distribution and supply the end customers.

The South China Grid Corporation (SCGC) operates in five southern provinces, centred on Guangzhou. In the other twenty provinces responsibility lies with the State Grid Corporation (SGC) and its subsidiaries. The transmission grids are being integrated to form five regional grids. SGC is also responsible for management of the Lhasa Power Grid in Tibet.

Other Actors

Energy-policy institutions

The responsibilities of government institutions were reorganised in 2003. The State Asset Supervision Administration Commission (SASAC) was a new body set up under a resolution by the National People's Congress. It is responsible for supervision of the assets, performance, finances and management personnel of the state-owned companies and therefore for the most important enterprises in the electricity sector. The amalgamation of three ministries produced the Ministry of Commerce (MOFCOM) and the National Development and Reform Commission (NDRC). The new MOFCOM is responsible for domestic and foreign trade, including issues of equal treatment of foreign and Chinese enterprises.

6 See also the comments in the section headed Legal Framework.

The NDRC is the most powerful decision-making body on economic matters within the Chinese government apparatus, and among other things deals with price control and approval of investments. Within the NDRC the Energy Bureau (EB) was set up for the express purpose of assuming political responsibility for the energy sector – including the field of security of energy supply. Objectives, strategies, policy regulations etc. that specifically relate to developments in the renewable energy sector in China are covered by a separate subsection of the EB. Responsibility for energy efficiency was delegated to the environment department in the NDRC.

Environmental protection and conservation of natural resources

The State Environmental Protection Administration (SEPA) is responsible for defining and monitoring compliance with environmental regulations. This environmental body is represented at all levels (national to local). Alongside this, the Ministry of Land and Resources, the Ministry of Water Resources and the State Forestry Administration (SFA) are responsible for matters relating to natural resources. The Ministry of Agriculture is also a point of contact for rural energy supplies and bioenergy/biofuels. It runs offices down to the district level.

As well as the executive, the environment committee of the National People's Congress, i.e. the legislative, is increasingly concerning itself with energy-related and environmental issues on its own initiative.

New regulatory authority for electricity

A separate regulatory authority, the China State Electric Power Regulatory Commission (SERC), was created to regulate the electricity industry. The primary tasks of the SERC are supervision of the reform process and consistent regulation of enterprises in the power sector. Its functions do still overlap to some extent with those of the price-setting authorities in the NDRC.

Energy research

The Ministry of Science and Technology (MOST) participates actively in formulating and implementing energy policy with research and demonstration projects. Among the institutions allocated to MOST are Tsinghua University, with several energy institutes. The Academies of Science, Engineering and Social Studies also have a series of research institutes investigating energy matters. The Development Research Centre (DRC), which answers to the State Council, also has strategic significance. The Energy Research Institute (ERI) is formally tied to the NDRC, and occupies a position of considerable importance in the debate on energy policy and how it should be implemented.

18.3 Legal Framework

Over the past two decades China's electricity sector has undergone major changes.

Reforms within the power sector

Political responsibility had already been separated from operational responsibility in 1998, but then the reforms of 2003 created an entirely new institutional landscape. The reforms are set out in the policy known as Document No. 5 adopted by the State Council in April 2002, and have been implemented in stages since then (for example the unbundling of generating and grid-operating functions). A further major reform step, the unbundling of transmission and distribution and of other functions, is expected in a few years.

The requirement to set up a national regulatory authority for the power sector (China Electric Power Regulatory Commission) was implemented quickly.[7]

The planned measures to improve the policy framework, in particular relating to environmental protection and the promotion of renewable energy, were implemented in 2004 and 2005. Approval procedures were speeded up. After a certain delay, the price reforms mentioned above have now also begun to be put in place.

7 See also the section on energy-policy institutions under Other Actors.

The NDRC issued provisional arrangements for these in April 2005. As a further reform step it was announced in 2005 that individual regional markets will be able to operate in organised competition and bulk consumers will be able to obtain supplies directly from generating companies. The conditions for self-generation are to be improved over the long term. The various reform steps are ultimately supposed to lead to a comprehensive amendment of the Electric Power Law, currently at the planning stage.

Foreign involvement in the energy sector

A number of measures have been taken in the past to encourage the investment of foreign capital in China's energy sector. Since the mid-1990s the Chinese Government has permitted the direct investment of foreign capital in power generation. In 2004 there was a further opening allowing the commitment of both domestic and foreign private capital for investment in and operation of infrastructure (with the exception of the field of electricity transmission).

The supply of plant and systems to the Chinese market from outside the country is not only subject to the regulations on foreign trade, which have been defined with increasingly greater clarity in the course of China joining the WTO, but also to specific access restrictions. It should be noted, for example, that China pursues a policy of localisation of manufacture for all technologies that attain a certain significance on the Chinese market: as a rule this applies to high-efficiency coal-fired power stations, gas turbines, desulphurisation plants, wind generators and photovoltaic systems. The government uses various steering instruments to achieve localisation. The objective of encouraging local content is to consolidate manufacturing and development capability in the country. Often this is achieved by requiring a partnership (joint venture) to be established with a Chinese company. The purchase of licenses from foreign manufacturers is also very common. When entire plants are bought, this is done with the aim of testing them.

Market access for service providers has generally been improved. On the whole though it is still considered difficult, apart from the fact that it is rarely customary in China to pay for independent consulting services (with the exception of the feasibility studies that are always required). The institutional environment for foreign developers continues to be accompanied by considerable risks.

18.4 Policy Promoting Renewable Energy Sources

The central use of renewable energy for electricity generation is not yet competitive in China without state intervention. The situation is somewhat different with respect to decentralised power generation from small-scale hydropower, wind power or photovoltaic systems in remote areas, and the use of agro-industrial wastes in combined heat and power stations (cogeneration plants). Policy promoting renewable energy was given new impetus with the Beijing Declaration on Renewable Energy for Sustainable Development[8] formulated at the renewable energy conference in Beijing in November 2005. For example, it is now required of all energy supply companies – apart from operators of large-scale hydroelectric schemes – with an installed capacity of over 5 GW that 5 % of their power generation must be based on renewable forms of energy by 2010.

8 This contains a demand to international financial institutions and governments to offer greater assistance for renewable energies as the key to economic development.

Previous promotion of electricity from wind energy

Since the mid-1990s there has been a series of measures and regulations promoting grid-connected wind energy. To support the financing of wind power projects, for example, the government provides low-interest loans provided that the equipment originates from domestic production. Furthermore, in 2002 the rate of value-added tax for wind-generated electricity was halved from 17 % to 8.5 %. The import of wind turbines is presently exempt from customs duties. Most of the existing installations however have very different pricing and infeed arrangements in each individual case, which means that different costs and conditions have to be taken into account. The state's efforts to promote electricity generated from wind power have been given added weight with the national roadmap for wind energy development through to 2020 that has been in place since May 2005.

Large-scale wind-energy projects rated at over 50 MW are within the sphere of responsibility of the central government body, the NDRC. For smaller projects with a capacity of below 50 MW, authority to grant licences, for example, rests at the provincial level. In this range, in particular, private enterprises are also to be found among the investors alongside state-owned utility companies.

Competitive tendering for large projects

For some years now one important means of promoting the use of wind energy has been the government-run invitations to tender for large projects of over 100 MW on a concession basis. Given a minimum term of 25 years, the concessions are meant on the one hand to guarantee investors long-term feed-in tariffs while on the other also keeping electricity generating costs down. The respective feed-in tariff for a wind farm is broken down into two phases: The best price obtained during the tendering process is applicable for the first 30,000 full-load hours. After that, remuneration is aligned with the market price for electricity. The government has promised financial support to investors in large-scale projects in the form of tax relief and favourable borrowing terms – including for grid expansion. As well as that, local grid operators are obliged to purchase the energy generated in the wind farms, while the local governments provide the access roads to the wind farms. For the concessionaires themselves the granting of the concessions is linked with various requirements, such as an obligation to use turbines with a rating of at least 600 kW and to put their wind farms into operation within three years.

Although the invitations to tender are public and geared to the international market, to date the investors have all been national and primarily governmental or part-state-owned enterprises.[9] The first round of bidding was completed in 2003.

Bidding round	Project name	Region	Capacity	Offer price	
			MW	yuan/kWh	€-ct/kWh
1. (2003)	Huilai	Guangdong	100	0.501	4.8
	Rudong I	Jiangsu	100	0.436	4.2
2. (2004)	Huitengxile	Inner-Mongolia	100	0.426	4.1
	Rudong II	Jiangsu	150	0.519	5.0
	Tongyu A+B	Jilin	400	0.509	4.9
3. (2005)	Dongtai	Jiangsu	200	0.487	4.7
	Anxi	Gansu	100	0.462	4.5
	Jimo[10]	Shandong	150	0.726	7.0
	Dafeng	Jiangsu	200	0.462	4.5

Tab. 1: Results of competitive tendering for wind farm concessions in China; 2003–2005[11]

Up to now the state-owned energy suppliers have entered the bidding rounds with offer prices below the average rates of remuneration. In some cases they have even been set below the production costs, and are offset by cross-subsidies.

9 One concession was granted to a private-sector company.
10 This tendering process was called off because the offer prices were too high.
11 Source: Loy 2006.

Renewable Energy Law

The National People's Congress adopted the Renewable Energy Law on 28 February 2005. It came into force on 1 January 2006, and provides a new basis for promoting the development and use of renewable energy. The main provisions of the law encompass the following:

- Definition of renewable energy as non-fossil forms of energy such as wind, solar, hydropower, biomass, geothermal, ocean power etc.
- Scope: in addition to electricity supplies, it also covers other forms of energy such as water heating and renewable fuels.
- Establishment of the areas of responsibility for implementation of the law:
  - for the energy authorities in the various provinces, for example setting targets for renewable energy;
  - preparation of development and supply plans is the responsibility of all levels of government (central, provincial, local); the main areas of responsibility, such as for the approval of such plans, are placed at the central government level;
  - feed-in prices are set via NDRC price authorities in their respective territories.
- Fundamental provisions such as:
  - the requirement to obtain a licence to construct a power-generating facility on the basis of renewable energy;
  - the need to conduct a competitive tendering process if there is more than one applicant for a project licence;
  - permission for grid operators to pass on additional costs arising from the obligation to purchase power – for example as a result of grid connection costs – to the customer in the form of appropriate grid usage charges;
  - the stipulation that fiscal and tax measures such as low-interest loans, tax concessions or a development fund for renewable energy are to be made available in order for example to support projects to supply energy to remote rural regions.
- The obligation on the part of grid operators:
  - to offer a grid connection service;
  - to purchase the power from approved projects in their grid area according to the statutory feed-in tariff or at the accepted offer price in the particular case;
  - to sign a feed-in agreement and, in the event that they are unable to meet their purchase obligation, to pay compensation.

The Chinese Renewable Energy Law is a framework law and merely codifies fundamental provisions. The essential, decisive details are to be specified in a total of twelve implementing regulations without which the law is not able to exhibit its intended effects. Some have already been introduced by the NDRC, such as provisions relating to the feed-in tariffs including the apportionment of costs for grid-linked projects.[12] Although the subsidies[13] for certain biomass projects have already been fixed at 2.4 euro cents/kWh for 15 years from the time the plant starts operation, for the present there is no sign of similar feed-in tariffs for solar or ocean power nor geothermal energy.[14] The implementation provisions for wind energy stipulate competitive tendering instead of fixed remuneration for setting the pricing. The winning bidders in such cases receive long-term power purchase agreements.

No provisions have been put in place yet on the development of a renewable energy fund, on technical standards or on a national compensatory mechanism between the grid operators. It is already certain that the national compensatory mechanism will be designed to take account of the differences both in income levels and in energy consumption. Furthermore, the additional costs arising as a result of the Chinese Renewable Energy Law will be borne by a price premium for all electricity customers – with the exception of customers from the counties and lower administrative districts and those working in agriculture.

12 Further information is available on the website of the Australian Business Council for Sustainable Energy.
13 The basic price for such subsidies is formed from the average electricity generating costs using lignite.
14 This feed-in regulation for biomass can only be used for projects which have not been set up following a public tendering process and which use less than 20% fossil fuels in their operational sequence.

Clean Development Mechanism

China ratified the Kyoto Protocol in 2002 as a non-Annex I Party.[15] As a result it is able to convert direct emission reductions and avoided emissions into financial gain through the Clean Development Mechanism (CDM). In the meantime CDM revenue has become an important factor in the financing of projects – although its significance does vary from one renewable energy technology to another. Whereas the sale of certified emission reductions (CERs)[16] for projects harnessing wind power or hydropower can meet about 10 % of project costs, the sale of CERS to finance projects utilising landfill gas for example can cover the costs in full. All of the wind power projects initiated so far are already using CDM revenue as a central component of their financial planning. For example, the operating company of China's third-largest wind farm, Huitengxile in Inner Mongolia, is covering 8 % of the financing for the current expansion through an emissions fund. Most projects in China are developed on behalf of individual buyers through consultants and/or in a process of cooperation between buyers and individual project owners.[17]

As the world's (at present) second-largest CO_2 emitter, and in view of the rising demand for energy, China presents a broad field for action in terms of CDM measures. A recently published CDM guide for China[18] assumes that the country potentially makes up at least 50 % of the global CDM market. Also, the NDRC identified renewable energy as one of the three main areas for CDM projects. Along with the Ministry of Science and Technology and Tsinghua University, the Climate Change Office (China's Designated National Authority) in the NDRC is the point of contact for such projects. It is responsible for the approval of all CDM projects – irrespective of their size and importance. The number of CDM projects approved (at the national level) in China was 524 in mid-June 2007.

Of these, most are to be found in the wind power and small-scale hydropower categories, while landfill gas, for example, is still heavily underrepresented. Of the total of 87 projects registered with the CDM Executive Board of the Framework Convention on Climate Change (UNFCCC), 65 were from the field of renewable energy, comprising 40 wind energy projects, 17 relatively small hydropower projects, five bioenergy projects and three landfill gas plants. CERs (certified emission reductions) have already been issued for 13 projects, including for seven wind power projects with a total of 0.4 million CERs. All in all, projects based on renewable energy would have the potential to generate 7.5 billion CERs in China by 2020. One fundamental prerequisite for CDM projects in the country is however majority Chinese ownership.

18.5 Status of Renewable Energy Sources

The development status of renewable energy sources for electricity generation in China is well advanced in some fields, but distinctly lagging in others.

As far as grid-coupled electricity generation on the basis of renewable energy sources is concerned, small-scale hydropower is by far the most important type. Grid-connected electricity generation on the basis of biomass, geothermal energy, solar energy and tidal power[19] is increasing, but to date has still not reached a level of notable significance. As regards non-grid-coupled applications, there are currently more than half a million installations providing energy to individual households in China, powered one third each by small wind energy units, photovoltaics and micro-hydropower systems. More than one million inhabitants in small settlement centres are supplied with electricity generated from renewable energy (small-scale hydro, PV systems and PV/wind hybrid systems) in isolated schemes.

15 Annex I Parties are subject to requirements to reduce their greenhouse gas emissions. The Annex I countries primarily comprise the members of the OECD.

16 A CER is equivalent to a saving of one tonne of CO_2.

17 The Delegations of German Industry & Commerce in Beijing (AHK) publish a CDM project list that is regularly updated and can be obtained directly from the AHK on request.

18 The CDM Country Guide for China was drawn up by the Institute for Global Environmental Strategies in Japan in cooperation with CERC – downloadable from www.iges.or.jp.

19 Tidal power plants have been in operation along the coast of Zhejiang and Jiangsu for a number of years.

Hydropower

China has the world's largest hydropower potential, concentrated in the west of the country. The large distances between those areas and the industrial conglomerations in which electricity is needed make it more difficult to utilise these resources and raise the requirements to be met for transmitting power towards the east and south coasts.

Installed capacity and expansion plans

At the end of 2006 the total installed capacity of all hydropower plants in China was 128 GW. The technically utilisable hydropower potential is quantified at 676 GW. It is planned to increase the installed hydropower capacity to 190 GW and 290 GW by the years 2010 and 2020 respectively. According to a long-term forecast, hydropower is envisaged as achieving a share of over 20 % of total electricity production by 2020.

The capacity of large hydropower plants is to be expanded in future. In addition to the gigantic Three Gorges power plant on the Yangtze, which will have a capacity of 18.2 GW after it is completed in 2009, it is planned to build a further twelve hydropower plants on the upper reaches of the Yangtze over the next two decades. Just the hydropower projects on the Jinsha River and the tributaries of the Yalong and Dadu alone are supposed to provide additional capacity of 90 GW. These government expansion plans easily hide the fact that criticism of the use of large-scale hydropower is growing in China. Such criticism is triggered among other things by the poor economic performance of existing large hydroelectric schemes, such as China's second-largest power plant at the Ertan dam.

Small and micro hydropower

In China a small hydropower plant is officially defined as being one with a capacity of up to 50 MW.[20] Such plants are mostly operated in isolated networks by the Ministry of Water Resources (MWR). At present there are over 42,000 small, mini and micro hydropower plants in operation with a total capacity of 38.5 GW. The total potential for exploitable capacity across the country is estimated at 125 GW. An area of particular interest is the southwest of the country, where not only 65 % of all administrative districts are to be found but also 50 % of the still unutilised potential for small hydropower. When the isolated networks are connected to the supraregional power grid, many small hydropower plants will be taken out of service. On the other hand, in central and west China there is now once again a strong trend towards building new plants that feed electricity into the grid. Currently about 2 GW of additional capacity is being installed each year.

The technology of small hydropower plants is considered very far advanced in China, and production figures are among the highest in the world. Because of their low price, they are also exported. However, wider distribution on foreign markets is impeded above all by product quality, which is judged to be low. Other aspects considered to be in need of improvement are process measurement and control of small hydropower plants and their operation in practice.

Wind energy

Topping the world league with an estimated onshore wind potential of 250 GW[21], China shows great promise for the exploitation of wind energy. Windy locations are to be found above all in the steppe and desert areas in the west and north of the country, and in coastal regions. The technical potential for offshore locations has been quantified at an additional 750 GW[22] by the Chinese Wind Energy Association.

20 Official classification according to the Promotion Law of Renewable Energy Development and Utilization.

21 According to information supplied by the Chinese Wind Energy Association, the potential of 250 GW refers to wind resources at a height of 10 m. According to the Association, the potential doubles at a height of 50 m and more.

22 The wind data obtained from over 900 meteorological stations does not always satisfy international standards, however. This applies in particular to the identification of specific locations for wind power projects.

Wind data

Between 2002 and 2005, wind measurements were taken at ten locations as part of a UNDP/GEF project. These locations are classified as pilot projects within the framework of the national wind energy development roadmap and are to be given priority in receiving state assistance when wind farms are built.

China is also participating in the multinational Solar and Wind Energy Resources Assessment (SWERA) project, supported by UNEP, which is meant to improve the availability of wind data at the regional level. A wind atlas for southeast China has already been drawn up as part of the SWERA programme, and further regions are due to be added.[23] GTZ supported wind measurements in Hubei province under the TERNA wind energy programme between 2000 and 2002.

Wind energy use to date

Additional wind power installations had been built at a low rate in recent years, but now there is a veritable boom in the industry: At the end of 2005, installed capacity exceeded the 1 GW threshold for the first time, at 1.26 GW.[24] In 2006 China was able to more than double its installed capacity in wind energy, which reached over 2.6 GW by the end of 2006.

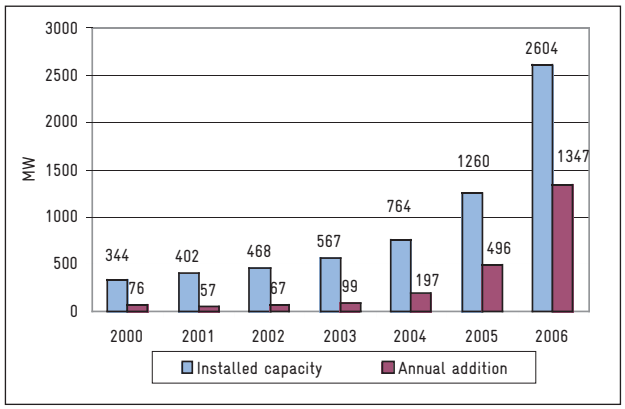

Abb. 2: Installed capacities and annual additional construction of grid-coupled wind power installations; China 2000-2006; MW[25]

Expansion targets

According to targets set in the 11th five-year plan (2006-2010), a total of 5 GW of wind power capacity is to be installed by 2010. The concession projects operated by the NDRC provide for 100 MW to be constructed at each of selected locations. By 2020, wind power capacity is supposed to be raised to a total of 30 GW. Certain functionaries in the energy sector even suggest a wind energy capacity of 40 GW by 2020. On the part of industry there is talk of figures of 170 GW being attainable.[26]

Obstacles to the expansion of wind power

Until the early part of the decade, most of the installed wind power capacity was largely based on bilateral or multinational promotion programmes and funding, and less on the country's own commitment.

Expansion of the wind power sector has been faced with a series of obstacles in the past:

- lack of transparency in permit-issuing procedures
- slow decision-making and approval processes
- sub-optimal legal framework
- high import duties
- the local content requirement stating that wind turbines and their components must largely (70 %) originate from Chinese production[27]
- major frictional problems between institutions
- frequent, usually annual renegotiation of power purchase agreements with remuneration trending downwards
- lack of protection for intellectual property in the case of local production

23 For further information on SWERA see http://swera.unep.net. The Wind Energy Resource Atlas of Southeast China is available at www.rsvp.nrel.gov/wind_resources.html.

24 Up to the end of 2005, 61 wind farms were built in China and 1864 wind turbines were installed.

25 Data source: Chinese Wind Energy Association 2005, Global Wind Energy Council 2007.

26 Source: Hongwen et al. 2006 (CREIA, Greenpeace, GWEC).

27 China intends to build up a competitive wind power industry. In addition it would like to avoid heavy dependence on imports in the provision of energy resources and facilities.

Some of the obstacles have been overcome through the Chinese Renewable Energy Law and its associated implementing regulations. Quite gradually, reliable political framework conditions are being established through which private-sector approaches in the wind power industry are encouraged, as is the commercial development of wind farms. Because of the discrepancy between the objectives for the expansion of renewable energy in China by 2020 and the capacity actually available to achieve those objectives, international cooperation arrangements and business relationships are also gaining central importance. This applies especially to the wind power sector. Until now the development of wind farms, for example, has been hampered by considerable shortages of expertise in a great variety of fields, relating to both human resources and technical issues.

Manufacture of wind turbines in China

Although larger systems rated at 100 kW or over have only been built for about twelve years, either in the context of joint ventures or under licence, China already has the capability of manufacturing all turbines up to a capacity of 750 kW itself. Presently there are more than five national manufacturers of turbines in the 600-660 kW class with a high proportion of indigenous components.[28] In mid-2004 the local content for 600 kW turbines was about 96% and for 750 kW models roughly 64%.

Demand for these types of turbine has been rather low in the past, however, as imported systems are generally cheaper and have a reputation for better quality.[29] At the end of 2002, 11% (54 MW) of total installed capacity originated from domestic production. Through a series of new joint ventures the manufacture of turbines and their components has increased further, reaching a share of about 28% by the end of 2005. Altogether the wind power sector now includes 30 national manufacturers; only few of these produce turbines in the megawatt class. Until now about 90% of such turbines have been imported.

Within the framework of joint ventures, the German manufacturers REpower and Fuhrländer also gained a foothold in China with production in the megawatt range in 2006.

Small off-grid installations

The total capacity of small, off-grid wind power systems (< 3 kW) is about 42 MW. About 250,000 small wind generating systems (0.1-3 kW) were installed in the off-grid sector up to the end of 2002. With 22 producers (end of 2002), China is the world's largest manufacturer of such systems, but these are mainly deployed in the domestic market.

Biomass

The considerable biomass resources available for energy purposes, chiefly in the form of harvest residues, firewood, forest timber residues and organic wastes, were estimated at over 5,500 TWh for the year 2001. Only one third of this potential is used, and this primarily for thermal purposes. China is expecting a further increase in the amount of forest timber residues through the implementation of two ongoing programmes, the Natural Forest Protection Programme and the Sloping Cropland Conversion Programme.

Biomass has been used as an energy source in small stoves and furnaces since time immemorial in all rural areas of Asia, and can be developed to generate electricity in China. There is also thought to be considerable market potential in this segment.[30] By 2006 the installed capacity for power generation from biomass had already reached 2 GW. There are mainly two processes that come into consideration for larger-scale applications: the use of organic materials (mostly bagasse) in combined heat and power stations with steam turbines, and the conversion of biogas into electricity in gas engines.

28 Three manufacturers are engaged in mass production, another three manufacturers have developed prototypes. These also include Nordex, which has a production plant in Xian, and Goldwind, which produces turbines designed by the German manufacturer REpower under licence.

29 At the end of 2002, 11% (54 MW) of the total installed capacity originated from domestic production. In 2002, 28 MW of the total of 67 MW of newly installed plants was purchased from local production.

30 Within the framework of the previous five-year plan (2001–2005) and the 863 Program promoting high-technology R&D, for example, the focus was on developing biomass plants for electricity generation.

Converting bagasse into electricity

For many years now it has been common practice in China's sugar industry to use bagasse to produce its own electricity in its larger factories. Over 800 MW of capacity is installed in the sugar provinces of Guangdong and Guangxi alone. It is not common, however, for this branch of industry to feed surplus power into the grid. According to estimates in a World Bank report, a potential of 700 to 900 MW of electrical energy that could be exploited with clear financial gain is available just in the areas mentioned above and Yunnan. However, a series of impediments hamper expansion of bagasse-generated electricity, including power for feeding into the grid:

- the currently poor economic situation in the Chinese sugar industry, leaving no scope for investment
- a lack of low-interest, long-term loans (low-interest loans with a term of three years were only provided for on-site electricity supply up to 1999)
- the fact that a standardised set of rules on electricity supply and remuneration did not enter into force until 2006
- the seasonal nature of sugar production (and hence of bagasse availability), which only runs for about five months a year

Biogas plants and their promotion

China is the world leader in the use of biogas plants on the basis of anaerobic fermentation. In addition to millions of small and micro plants, which chiefly help to minimise slurry problems on farms, there are some 1500 large-scale plants, including more than 150 in which the organic content of industrial wastewater (from paper, sugar and pharmaceutical industries and from alcohol and food production) is gasified. In 2005 the total number of users of small and micro biogas plants rose from 12 to 17 million – with as many as 12 million of these being used at the household level alone.

A preferential rate of value-added tax applies to biogas, reduced by 4% to 13%. This includes both the cost of biogas production and the cost of equipment. Energy generation from biogas is supported in China's agriculture industry by low-interest loans totalling US$ 33 million, committed by the Asian Development Bank (ADB) at the end of 2002.

Use of landfill gas

With support from the UNDP/GEF project Promoting Methane Recovery and Utilisation from Mixed Municipal Refuse, landfill sites in several municipalities are being examined for their suitability for converting landfill gases into electricity. The relevant studies were completed in mid-2004. There is also great potential for CDM projects in this connection. A first pilot plant in Anshan has already been completed and began operation in mid-2004. At present about 100 million tonnes of residential waste is generated each year, 80% of which is disposed of in landfills.

Enterprises and research institutes

There are now some 200 enterprises manufacturing biomass plants and their components. The Biomass Development Center (Beijing) is very important in the research sector; it brings together a large number of technical institutes as members. There is a network of political and scientific institutions and enterprises for developing, demonstrating and disseminating biomass technologies.

Solar energy

China's potential for solar energy applications is large. The average mean solar irradiation per day is over 4 kWh/m^2. Especially in the west of the country the sun usually shines for over 3,000 hours a year.

Market for photovoltaics

By the end of 2006 the installed capacity of PV systems had reached 65 MW. Approximately half of this was used for supplying electricity to households in remote rural regions of China. By 2010, the installed capacity in these regions alone could reach 300 MW.[31] The PV market for rural households in remote locations is growing at an annual rate of some 20 %. Current forecasts work on the assumption that this market will continue to grow and in the short term (by 2010) will also be the largest PV application market. In the medium to long term it is expected that grid-connected PV systems in the major cities[32] will play an increasingly important role, as will large-scale centralised installations in the deserts of China. Because of the various rural electrification and development projects, this is a continuing upward trend. The target for 2020 is a total of 1.8 GW of installed capacity in the form of photovoltaic systems.

Local production of PV equipment

In 2004, solar cells with a capacity of 65 MW_p were manufactured in China. In 2006 the production capacity had increased to 960 MW_p. Development in China's solar module sector has also accelerated. While the production figures for 2004 were put at around 100 MW_p, as much as 2,500 MW_p was planned for 2007. In order to avoid the global production bottlenecks in cells and modules, it is also planned to expand solar silicon production to 1,500 MW_p. A large proportion of the PV systems produced in the country are exported. The largest companies in the PV sector include the Chinese company Wuxi Shangde Solar Energy Power Co. and the Chinese-Australian joint venture Suntech Power, which has been ranked among the world's ten largest cell manufacturers since 2004. Nanjing CEEG PV Tech. established China's largest PV production facility in 2005. This manufacturing plant is designed to achieve an output capacity of 600 MW. The target for 2007 is an output of 300 MW_p. Together with the two Chinese PV manufacturers – Yingli Solar and Suntech Power – the company intends to increase its production to 1,500 MW by 2008-2010.

Grid-coupled solar systems

Only a few individual larger systems are connected to the electricity grid. In 2004 the country's largest system to date went on line in Shenzhen, with a total capacity of 1 MW. There are currently plans for the first large-scale PV plant, which will serve as a pilot plant in the province of Xinjiang Gansu, with an installed capacity of 8 MW_p. The financing of the project has not yet been clarified, however.

Obstacles to further development

Various obstacles stand in the way of faster growth in the number of installed systems, however:

- only state-supported system suppliers enjoy public-sector promotion; generally loans are rare for system suppliers and installers
- poor maintenance and service provision reduces the service life of the systems
- there is no institutional basis for granting loans or financing solar home systems

There are other obstacles impeding further development in China's PV industry, but overcoming these obstacles can present opportunities to foreign cooperation for technical and financial investment. These relate to:

- a shortage of high-quality inverters, especially in the larger output format
- a shortage of high-quality, long-lasting storage batteries for power supply systems in outlying regions

31 Chinese Renewable Energy Industries Association (CREIA) (2001): New and Renewable Sources of Energy in China – Technologies and Products. About 260 MW is supposed to be installed (off-grid) in the course of the 11th five-year plan.

32 In Shanghai for example there are plans for a 100,000-roof programme. With a view to the Olympic Games in 2008 there are also a large number of options for expanding the PV market in Beijing.

Solar thermal energy

The use of solar thermal energy for heating water is already very widespread in China. At 55 GW_{th}, the country has more than 60 % of the world's installed capacity in this field. New installations in 2006 alone amounted to 10.5 GW_{th} – 80 % of all the solar-thermal capacity added in the world. This comprised a growth in collector area of 15 million m^2 to a total of 90 million m^2 by the end of 2006. In that year, solar heat was being harnessed on almost 50 million Chinese roofs. It is envisaged that the area of collectors used to produce hot water will be expanded to 150 million m^2 by 2010 and 300 million m^2 by 2020.

With around one thousand manufacturers throughout China, the local industry for solar hot-water systems is highly significant. However, only about 10 % of these manufacturers are competitive, a fact which is primarily linked to the brand quality of the systems and the sales and service strategies. The main sales markets for solar water heaters are to be found precisely in the niche between urban and rural areas. This includes, for example, the suburbs of major cities and also districts surrounding small towns.

To date, solar thermal systems have not been used for generating electricity in China. This is supposed to change in future, among other things through a separate research and development programme for this sector as part of the 11th five-year plan. Furthermore, the first solar thermal electricity-generating power plant is being planned in the north of China, through Chinese-German cooperation.[33] After the first construction phase the US $ 2.5 billion project is supposed to have a capacity of 50 MW, and by 2020 it is expected to be expanded to an installed capacity of 1 GW.

Geothermal energy

Despite substantial resources, there has been virtually no development of electricity generation from geothermal sources in China so far. The potential that can be used directly to generate electricity due to high temperatures (> 150 °C) is estimated at 5.8 GW. Potentially utilisable resources are located along the eastern coast facing Taiwan (Taiwan geothermal zone) and in the Yunnan geothermal zone in Tibet. The installed capacity is only 30 MW, shared between a 25 MW geothermal power station in Yangbajing in Tibet and a number of smaller demonstration projects.

255 locations suitable for geothermal electricity production have been identified in China, and by 2010 ten of these are to be developed with a power generation potential of 300 MW.

18.6 Rural Electrification

The bodies that are particularly active in the field of non-grid-coupled rural electricity supply, apart from the large state-owned grid operators, are the National Reform and Development Commission (NDRC) and the Ministry of Water Resources (MWR), with small hydropower plants.

Degree of electrification

Approximately 98 % of the population of China can now be supplied with electricity thanks to grid expansion and rural electrification programmes. Of the remaining 30 million people without a power connection, especially in the provinces in the west and north of the country,[34] about 23 million are to be provided with a basic electricity supply in a capacity range of around 100 W[35] by 2010 within the framework of the highly ambitious Brightness Programme.

33 The technology for the project is being provided by the German company Solar Millennium AG.

34 Tibet is the province in which by far the largest proportion of households (approx. 80%) have no access to electricity.

35 The rating of 100 W should be seen as a guide value. In some areas, for example, solar home systems with an output of 20 W are used for lighting purposes.

In the peripheral territories renewable energies represent an economic alternative to grid supply and a more appropriate and environmentally sound option than conventional diesel-fuelled facilities. The demand for energy in remote areas correlates particularly well with the available potential for solar and wind energy as well as micro hydropower, to the extent that these alternative forms of energy appear predestined to electrify rural areas in China. The high concentration of supply in some regions even makes it possible to harness the potential of renewable energies for grid-linked electricity generation. This applies especially to wind energy.

The provision of electricity supplies to rural regions using renewable energy is receiving new impetus from the government's stated objective of creating modest prosperity for the whole population of China by 2020 ("xiaokang").[36] This is aimed at overcoming the increasing disparity between the newly rich in the cities of China and the great majority of the rural population – among other things by improving the balance in economic and social development.

Township and Village Electrification Programmes

There are currently several national promotion programmes being implemented to improve rural electricity supplies, some with bilateral and multinational support.[37]

One of the most ambitious programmes on any global scale is the Township Electrification Programme (Song Dian Dao Xiang), which the NDRC launched in 2002 as an implementation measure within the National Brightness Programme. It aimed to electrify 1,000 towns in a total of 11 provinces within two years. Based on funding of some US$ 560 million, almost 20 MW of PV systems and hybrid PV/wind systems as well as 274 MW of small hydropower plants were installed and connected to mini electricity grids in about 721 communities up to the end of 2004. Some plants have not yet been completed. In the meantime small hydropower provides an output of 293 MW, distributed among a total of 268 plants.

The local electrification measures were usually each preceded by a tendering process and competition between private companies. Responsibility for power generation and maintenance of the installed systems was then usually passed on to the local or regional authorities. Electricity prices typically vary between 4.9 and 19 euro cents/kWh from one province to another. The fact that at these prices sales revenue is still below operating costs could change in future as a result of the electricity price premiums introduced with the Renewable Energy Law.

Whereas it proved possible to reach nearly all of the towns in China with the Township Electrification Programme, the electrification of many villages has yet to be completed. Under the Village Electrification Programme (Song Dian Dao Cun), some 20,000 villages are to receive PV village systems and solar home systems amounting to a total of 265 MW between 2006 and 2010. Funding of about US$ 2 billion is planned for this. By 2015 the rural regions of China are supposed to be fully electrified.

The Brightness Programme is receiving technical and financial support from GTZ and KfW. In the long term the aim is that sustainable and self-supporting electricity supply systems should develop on a commercial basis. GTZ is also transferring expertise to local teaching staff, who in turn then train local technicians responsible for operating and maintaining the installations.

Because of the extremely tight time-frame within which the demanding target figures had to be achieved when the generating and grid systems were installed, some of the equipment chosen was of poor quality and inadequately dimensioned. In order to identify technical problems as soon as possible, when the first signs appear, and to determine the influence of electrification on the users' living and working conditions, a comprehensive technical and socio-economic monitoring system is being set up, also with GTZ support.

36 This objective was formulated by President Hu Jintao and Premier Wen Jiabao.

37 Including a GTZ project to improve general conditions valued at EUR 7.1 million, a KfW promotion scheme worth EUR 18.2 million financing village electricity systems, and the Silk Road Illumination Project promoted by the Dutch government worth EUR 13.8 million, in which Shell is also participating.

18.7 International Cooperation Programmes and Projects

Capacity Building for the Rapid Commercialisation of Renewable Energy (CCRE)

From 1999 to 2005 the Capacity Building for the Rapid Commercialisation of Renewable Energy (CCRE) project was implemented by the UNDP, assisted by GEF funds. It aimed to establish commercial industrial sectors in the field of renewable energies.[38] With financial support from the Australian and Dutch governments, the project contributed to institution building and the implementation of demonstration projects. The Chinese Renewable Energy Industries Association (CREIA) was established within the scope of the project. This body sees itself as an intermediary between industry and public authorities and in this role aims to bring national and international project developers and investors together. Further measures also included training of technical staff, policy consultancy, demonstration plants and product certification.

China Renewable Energy Scale-up Programme (CRESP)

The China Renewable Energy Scale-up Programme, which the Government of China developed in cooperation with the World Bank and the Global Environment Facility (GEF), was launched in June 2005. Starting out from the basis of the policy objectives of expanding the use of renewable energy, it aims to enhance the cost-effectiveness of renewable energy use and to remove both institutional and economic barriers that have hindered the use of such energy sources in the past. Its central focus is placed on large-scale technologies based on wind and biomass. The first of a total of three project phases will see trialling of the implementation of binding rules and regulations for the energy market in four provinces, supported by the GEF with a budget of US$ 40.22 million.

Renewable Energy Development Project (REDP)

The Renewable Energy Development Project (REDP) has been supported by the World Bank and the GEF since 2001 and is aimed at developing the market for photovoltaic technologies and verifying the potential for commercial development of wind power in coastal regions. In addition to PV and wind, the project includes a third component on technical improvements.

Within the context of the PV component of the REDP, local solar companies are receiving financial and institutional assistance to enable them to procure, install and maintain 300,000 to 400,000 solar home systems with a total capacity of 10 MW_p. These systems are to be sold to households in rural regions of six provinces in the northwest, with a subsidy of US$ 1.50 being granted per W_p sold. Altogether a subsidy of US$ 27 million has been agreed. By the end of 2004 about 175,000 systems had been sold and installed, with a total capacity of 3.5 MW_p. Under the Village Electrification Programme it is planned to provide financial support amounting to up to US$ 20 million for a pilot phase in the provinces of Xinjiang, Inner Mongolia and Tibet.

In order to promote the development of wind power the REDP is supporting the construction of two wind farms totalling 20 MW in the vicinity of Shanghai with a low-interest loan of US$ 13 million. The project is expected to be concluded at the end of June 2008.

Cooperation with Germany

Financial and technical assistance from German institutions for the use of renewable energy is largely provided in China's rural regions. While it is true that the German Federal Ministry for Economic Cooperation and Development (BMZ) has cut its total contributions to technical and financial cooperation in the light of China's growing economic capability, it is now for the most part focussing support on two domains: the conservation and sustainable management of natural resources, and sustainable economic development.

38 It focussed on PV and wind hybrid systems for municipal networks, biogas from industrial and agricultural residues, solar thermal applications, grid-coupled wind power plants, and bagasse-fired CHP schemes.

Since the end of 2001, GTZ together with the NDRC (formerly SDPC) has been implementing a programme to promote the use of renewable energy sources in the provinces of Qinghai, Yunnan and Gansu and the Autonomous Region of Tibet under the title Renewable Energies in Rural Areas. In particular this has provided support to the Township Electrification Programme by training teaching staff to train local operators, and through quality assurance measures and other services. A results monitoring system was set up to verify the socioeconomic impacts of improved rural energy provision. The NDRC will provide advisory services on matters of system design and tariff structuring. The project term is expected to end in September 2007.

KfW is contributing financial cooperation funds towards the installation of approximately 300 hybrid PV/diesel village electricity units for decentralised power supply in the provinces of Xinjiang, Qinghai, Yunnan and Gansu. For these systems, too, local maintenance structures will be set up and technicians trained within the framework of technical and financial cooperation. The expansion of wind energy capacity in China has been promoted by KfW with government bilateral financial cooperation funds and with its own market resources through extensive programmes to build wind farms (in Hainan, Zhejiang, Guangdong, Shandong, Inner Mongolia and Xinjiang).

To support these projects and the national expansion programmes, the China Long Yuan Power Group and the China Electric Power Research Institute (CEPRI) together with GTZ are currently setting up a national Wind Energy Training and Research Project. The centre's priority areas are training, advisory services and applied research, with the objective of improving the technical capacities of private and governmental institutions for a nationwide expansion of grid-connected wind energy.

The Government of China has received support in spelling out the legal framework under the TERNA wind energy programme and within other projects, including in particular the arrangements for feed-in tariffs and the compensatory mechanism specified under the Renewable Energy Law.

Exchange rate (December 2006):
1 Chinese renminbi yuan (CNY) = 0.096 euro (EUR)
1 EUR = 10.39 CNY

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18.10 Annex

Allocation of the target figures of 30 GW of wind energy by 2020 in China (MW)

No.	Province	Installed capacity end 2004 (MW)	New build 2005 (MW)	Total capacity 2005 (MW)	New build 2010 (MW)	Total capacity 2010 (MW)	New build 2015 (MW)	Total capacity 2015 (MW)	New build 2020 (MW)	Total capacity 2020 (MW)
1	Hebei (incl. Beijing)	35.1	84.5	119.6	1,000	1,120	600	1,720	780	2,500
2	Jiangsu				450	450	700	1,150	850	2,000
3	Inner Mongolia	135.1	30	165.1	230	400	1,000	1,400	600	2,000
4	Fujian	12.8	9.4	22.2	150	170	500	670	830	1,500
5	Guangdong	86.4	21.5	107.9	150	260	500	760	740	1,500
6	Liaoning	126.5		126.5	100	230	320	550	650	1,200
7	Gansu	52.2	11.9	64.1	100	160	200	360	640	1,000
8	Xinjiang	113.1	8.5	121.6	100	220	200	420	580	1,000
9	Jilin	30.1		30.1	300	330	300	630	370	1,000
10	Zhejiang	34.5		34.5	50	80	100	180	620	800
11	Shandong	33.6	2.3	35.8	170	210	200	410	390	800
12	Shanghai	4.9	19.5	24.4	100	120	200	320	280	600
13	Heilongjiang	36.3		36.3	50	90	100	190	410	600
14	Jiangxi						100	100	400	500
15	Ningxia	55.3	35.2	90.5	50	140	100	240	160	400
16	Hainan	8.8		8.8		10	130	140	260	400
17	Guangxi						50	50	150	200
18	Shanxi						50			
19	Guizhou									
20	Shaanxi									
21	Henan									
22	Tianjin									
23	Hubei		13.6	13.6		13.6	100	110	40	150
24	Yunnan						50	50	100	150
25	Hunan						50	50	100	150
26	Chongqing						50	50	50	100
27	Sichuan						50	50	50	100
28	Tibet						50	50	50	100
29	Anhui						50	50	50	100
	Total	**764.4**	**236.3**	**1,000**	**3,000**	**4,000**	**6,000**	**10,000**	**10,000**	**20,000**

There is great potential for generating electricity from renewable energy sources in many developing and emerging countries. Obstacles to the exploitation of such sources and to the involvement of foreign investors include a lack of knowledge of framework conditions in the energy industry and insufficient transparency with regard to the prior experience and interests of national actors. This fourth, updated and expanded edition is aimed at overcoming barriers such as these.

The electricity markets and their respective actors are investigated for 23 countries in various regions: Latin America, Africa – Middle East and Asia. The country studies analyse the energy-policy framework conditions and closely examine the status of and promotion policy for electricity generation on the basis of hydropower, wind power, solar power, biomass and geothermal energy. The chapters on each country are rounded off by information about rural electrification.

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