



# Energy-policy Framework Conditions for Electricity Markets and Renewable Energies

## 23 Country Analyses Chapter Viet Nam

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 21<sup>st</sup> 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](http://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](http://www.gtz.de/wind) or directly from:

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## 23 Viet Nam

### 23.1 Electricity Market

#### Installed capacity

At the end of 2005 the total installed capacity of the state-owned power utility, Electricity of Viet Nam (EVN), and independent power producers amounted to 11,340 MW. Independent power producers accounted for about 22% of the total. The availability of some power stations is low, however, due to their age.

From the late 1980s to the early part of the current decade, hydroelectric schemes made up more than 50% of the installed power generating capacity. Since 2003, the central role of hydropower as a primary energy source has been supplanted by fossil energy sources: natural gas, coal and oil. It is nevertheless expected that hydropower will continue to occupy a dominant position in the future. Viet Nam is a net energy exporter and is likely to remain so until 2020. Viet Nam has offshore oil and gas resources in the south of the country, coal in the north<sup>2</sup> and hydropower potential that has so far been only partially exploited along the mountain range stretching from north to south.

Year	Hydropower		Coal		Oil (thermal power stations)		Gas turbines (natural gas and oil)		Diesel		Independent power producers		Total MW
	MW	%	MW	%	MW	%	MW	%	MW	%	MW	%	
2001	4,145	50.5	645	8.0	198	2.4	2,322	28.0	296	3.5	612	7.5	8,227
2002	4,187	48.0	1,245	14.0	198	2.0	2,322	26.0	296	3.0	612	7.0	8,860
2003	4,155	42.0	1,245	12.6	198	2.0	2,489	25.1	288	2.9	1,521	15.3	9,896
2004	4,155	36.6	1,245	11.0	198	1.7	2,939	25.9	285	2.5	2,518	22.2	11,340
2005	4,155	36.6	1,245	11.0	198	1.7	2,939	25.9	285	2.5	2,518	22.2	11,340

Tab. 1: Installed capacity; Viet Nam; 2001-2005; MW, %<sup>1</sup>

#### Power generation

In 2005 electricity generation reached 52 TWh, about 70% higher than the figure for 2001. The share of total generation contributed by independent power producers was just over 21%. This growing share in recent years is primarily attributable to the commissioning of two natural gas-based power stations at the Phu My Power Generation Complex.<sup>3</sup> The category of independent power producers (IPPs) encompasses all plants owned by private foreign companies, domestic enterprises or joint ventures (including with EVN). By 2010 Viet Nam would like to raise the proportion of power generation capacity provided by independent producers to at least 30%.

1 Source: EVN 2006.

2 The coal deposits are concentrated mainly in Quang Ninh Province, in the north-east of the country.

3 Two plants, Phu My 2.2 and 3, were financed by foreign consortia.

Year	Hydropower		Coal		Oil (thermal power stations)		Gas turbines (natural gas and oil)		Diesel		Independent power producers		Total TWh
	TWh	%	TWh	%	TWh	%	TWh	%	TWh	%	TWh	%	
2001	18.21	59.5	3.21	10.5	1.11	3.7	5.84	19.1	0.10	0.3	2.13	6.9	30.6
2002	18.19	50.8	4.88	13.6	1.01	2.9	9.50	26.5	0.10	0.3	2.1	5.9	35.8
2003	18.97	46.5	7.22	17.7	0.89	2.2	12.13	29.7	0.05	0.1	1.56	3.8	40.8
2004	17.64	38.2	7.20	15.2	0.60	1.3	14.88	32.2	0.05	0.1	6.08	13.1	46.2
2005	16.13	31.0	8.13	15.6	0.68	1.3	16.21	31.1	0.04	0.1	10.87	20.9	52.05

**Tab. 2: Power production by generating source; Viet Nam; 2001-2005; TWh, %<sup>4</sup>**

### Power transmission and distribution

A 500-kV transmission line in the north-south direction serves as a backbone for central electricity supply. Because of the rapid growth in demand for power, a second 500-kV line running parallel along a large section has been built; it was completed in 2006.<sup>5</sup> By 2015 it is planned that the 220-kV and 110-kV transmission grids should be expanded by about 4,500 km and 4,700 km respectively. Expansion of the transmission network up to 2010 is being supported by the World Bank with a loan of US\$ 200 million. The Asian Development Bank (ADB) is financing expansion of the transmission and distribution network in the north of the country with a US\$ 360 million loan.

Cross-border electricity trade with the neighbouring countries of Cambodia, China and Laos has so far been possible to only a limited extent owing to inadequate or non-existent transmission capacity, but according to the World Bank such trade will play a key role in future in view of the anticipated deficit in domestic production. A 2,000-MW supply contract with Laos has already been signed. The electricity is supposed to be transmitted via several 500-kV lines from 2008 onwards. Since August 2004 Viet Nam has also imported electricity from China via various 110-kV transmission lines. By the end of 2006, imports from China had amounted to 1 TWh. Through the further expansion of transmission capacity, imports are set to grow to between 1.2 and 1.3 TWh per year.

### Degree of electrification

The existing power transmission and distribution grids reach approximately 93.5% of the population. Some 5.5 million of the total of 84 million Vietnamese still have no access to electricity. For a large proportion of the remaining households, it is probable that electrification can only be achieved through off-grid supply schemes.

### Electricity consumption

From 2000 to 2004, the amount of electricity sold to end customer rose from 22.4 to 39.7 TWh (not including IPPs).<sup>6</sup> The two groups primarily responsible for the increase in consumption were households and industry. Per capita electricity consumption remains at a low level, at about 500 kWh (2005), despite the demand for electricity tripling over the past decade. Demand in the Hanoi and Ho Chi Minh City conurbations is far above demand in rural areas. Power consumption in the central area of the country in particular lags well behind that in other parts. As a result of successes in rural electrification and the growth in urban population, some 30 million new electricity customers were added between 1996 and 2004.

<sup>4</sup> Source: EVN 2006.

<sup>5</sup> This is the section between Pleiku in the centre of the country and Phu Lam north of Hanoi.

<sup>6</sup> EVN does not include the independent power producers in the statistics for power purchased according to end customer.

Year	Households		Commerce/Other		Industry and construction		Agriculture		Total
	TWh	%	TWh	%	TWh	%	TWh	%	
2000	11.0	49.0	1.9	8.0	9.1	41.0	0.4	2.0	22.4
2004	17.7	45.0	3.5	9.0	17.9	45.0	0.6	1.0	39.7

**Tab. 3: Power consumption by consumer category (EVN, not including IPPs); 2000, 2004; TWh, %<sup>7</sup>**

For 2006, EVN was expecting demand to be around 60 TWh. Because of the lack of generating capacity, about 2.4 TWh would have to be imported. By 2009 there are expected to be serious disruptions to power supplies, especially in the north of the country.

According to the draft of the sixth energy sector development plan, demand for electricity will grow by about 15 to 16% per year up until 2010. In the period from 2011 to 2015 the anticipated rate of increase is 11%, with a downward trend. According to information from the Ministry of Industry, domestic production will not be able to meet the demand for power even in the medium term. It is estimated that total demand in 2010 will amount to 93 TWh, while only 85.8 TWh can be produced in the country itself. By 2020, if the trend continues unchanged, the power deficit will have grown to 36 TWh.

### Power losses

Over the past decade it has proved possible to reduce the substantial technical losses in transmission and distribution from 21.4% in 1995 to 12.2% in 2004. There is still further potential for reducing losses, however. The figure could be pushed to below 10% by improving power factors, transformers and transmission cabling. At the end of 2006 the Prime Minister set a target of reducing power losses to 8% by 2010. Non-technical losses, including the theft of electricity, are relatively low in comparison with other countries.

### Electricity prices

Electricity prices have remained unchanged since 2002. The widely differentiated consumer tariffs make a distinction above all in the production and service sector between a standard tariff and a (high) peak rate and a (low) off-peak rate. The peak rate is about three times higher than the off-peak rate. A comparatively small difference is made between the purchase of high voltage and low-voltage current.

Households	VND and euro cents/kWh			
	Since 2002		From 2007	
Year	VND	€ ct	VND	€ ct
First 100 kWh	550	2.70	550	2.70
+ next 50 kWh	900	4.42	1,100	5.39
+ next 50 kWh	1,210	5.94	1,470	7.21
+ next 100 kWh	1,340	6.57	1,600	7.85
+ over 301 kWh	1,400	6.87	1,720	8.44
+ over 401 kWh	–	–	1,780	8.73

Tab. 4: Excerpt from the EVN electricity tariffs for households; VND/kWh; euro cents/kWh<sup>8</sup>

The plan to raise electricity prices, signed by the Prime Minister on 4 December 2006, envisages staged tariff increases in the period up to 2010. According to this, the price of electricity will rise from an average of 3.84 euro cents/kWh (VND 783/kWh) in 2006 to 4.13 euro cents/kWh (VND 842/kWh) from January 2007, an increase of 7.6% over the previous year. Originally the price rise was to have been pushed through a year prior to that. Under the new scheme, the standard tariff remains unchanged and only the peak rate is raised by 20%. In January 2008 the average electricity price is to be increased to 4.37 euro cents/kWh (VND 890/kWh). From 2010 onwards the price of electricity is supposed to find its own level on the market, within the limits specified by the regulator.

One of the goals that the government is pursuing through the increase in electricity prices is to close the gap to long-term marginal costs and thereby make the Vietnamese electricity market more attractive to private foreign investors, with the aim of being able to satisfy rapidly rising demand.

### Electricity prices in rural areas

Rural municipalities that obtain power from the public power grid continue to pay a standard nationwide rate of 3.43 euro cents/kWh (VND 700/kWh). To cover distribution costs, however, the government also allows for a certain leeway up or down.<sup>9</sup> In the long term, though, according to the new electricity law (see below) any existing cross-subsidies between the urban and rural population are supposed to be phased out. At present, between 55% and 75% of the cost of electricity in rural areas is met by subsidies.

### Expansion planning

Between 1995 and 2004 demand for electricity grew at an annual rate of around 15%, almost twice as fast as general economic growth. In the light of persistently strong economic performance, the power sector is looking to further expand generating capacity. EVN assumes that at least 1,700 MW of new capacity would have to come on-stream every year in order to meet demand. Revising the estimates for the development of the energy sector given in the fifth plan, which were too low, even in 2004 EVN expected that capacity would have to be expanded to about 25,500 MW by 2010 and to 42,000 MW by 2020. The national Master Plan on the development of power generating capacity provides for 35 large power plants to be built between 2001 and 2010.

Serious shortfalls in electricity supply have already occurred, in the summer of both 2005 and 2006.<sup>10</sup> According to information from EVN it will only be possible to meet two-thirds of demand in 2007. This means that some 500-570 MW of output will be lacking this year, which in part is supposed to be made up by imports. According to the draft of the 6th master plan, investment amounting to almost US\$ 80 billion will be required in the electricity sector by 2025.

<sup>8</sup> Sources: 2002 figures: World Bank, 2006. 2007 figures: VietNamNet Bridge (<http://english.vietnamnet.vn/>).

<sup>9</sup> According to EVN, 98.9% of rural municipalities obtain electricity at a price below VND 700 per kWh.

<sup>10</sup> In order to secure electricity supply through to the end of the dry season in April, the Hoa Binh and Thac Ba power plants were able to provide only a limited amount of water for agriculture from their storage reservoirs. Many rice farmers had to put off the start of sowing as a result.

## 23.2 Market Actors

Since the new Electricity Law came into force in 2005<sup>11</sup> the Vietnamese electricity market has been undergoing a period of upheaval, which not least has had an effect on the structure of the largest market player, the state-owned enterprise EVN. EVN was founded in 1995 as a nationwide power supplier after the transmission grids in the north and south were linked up. The company's financial accounts are strictly separated from the national budget. Apart from funds for resettlement in the case of hydropower projects, the organisation does not receive any form of state subsidies for investment or day-to-day operations. It is only in relation to rural electrification that EVN is granted loans on better-than-usual terms.

Eight subsidiaries with their own separate spheres of activity deal with the transmission and distribution of electricity. Of these, three companies operate on the regional level (PC1 in the north, PC2 in the south, PC3 in the central region) and five in the country's major cities (PC Hanoi, PC Ho Chi Minh City, PC Dong Nai, PC Ninh Binh and PC Hai Phong). In seven provinces, mainly in the south, there are also distribution companies at the provincial and district level.<sup>12</sup> EVN is answerable to the Ministry of Industry (MOI), which is in charge of energy policy and planning.

### Independent power producers

Decree 45/2001/ND-CP granted both Vietnamese and foreign investors the possibility of feeding into the national power grid as independent power producers, provided they have a power purchase contract with EVN. The contract must be negotiated with EVN on a bilateral basis. EVN attaches importance to ensuring that the results of the negotiations are treated confidentially. The remuneration ranges between 2.3 and 3.6 euro cents/kWh, as laid down by the Ministry of Industry. The number of independent power producers will rise in future because of the further phasing-out of restrictions on private investors.

The sale of shares in power plants from EVN holdings presents another possible means for private investors to participate in the market. In the power generation sector, EVN intends to concentrate in future on power plants with a capacity of over 100 MW. Smaller plants are to be financed through private investors.

## Other Actors in the Energy Sector

### Regulatory authority

The liberalisation of the electricity market will bring with it important tasks for the new regulatory authority, which will answer to the Ministry of Industry. The key functions planned for the authority include the licensing of market operators, advising the Ministry of Industry on matters concerning market and industry structure, laying down the price structure and ensuring there is sufficient production capacity. The Electricity Law has not defined the regulatory framework in any great detail. The date when the regulatory authority is due to commence its work has not yet been fixed.

## 23.3 Legal Framework

### Energy and electricity market policy

The government tries to anticipate developments in the energy and electricity sector within the framework of master plans. The plans cover a period of ten years, and incorporate a forecast for the coming 20 years. The fifth master plan deals with the development of the energy sector in the period 2001-2010 and gives a forecast through to 2020. It was revised early on, in 2003, on account of power consumption already being above expectations. Further modifications were implemented through Decision No. 176/2004/QD-TTg. The sixth master plan is presently being drawn up with support from the Japanese development agency JICA.<sup>13</sup>

11 For more details see section headed Legal Framework.

12 EVN plans to create a national integrated power grid by 2020 by connecting the individual regional power grids.

13 Originally it was to be introduced by the government by the end of 2006 and was to be valid for the period from 2006 to 2015. By the spring of 2007, however, the new plan had not yet been approved by the government.

The focus of attention in this is to be placed on the development of hydropower, the commercial exploitation of gas and coal resources, the development of alternative energy sources and stimulation of electricity imports from Laos and China. At the provincial level the responsible People's Committees also draw up regional plans, which must be in conformance with the national objectives.

### **New Electricity Law**

In the past, necessary decisions on the electricity sector were taken by the Prime Minister through ad hoc directives. The new Electricity Law, which is meant to introduce changes in the power sector in both the operational and regulatory sphere, was adopted in November 2004 and entered into force in July 2005,<sup>14</sup> thus launching a far-reaching programme to reform the energy sector. The objectives of the new legislation include the diversification of investment and the establishment of a competitively organised market. Aspects that have so far not been regulated are the form that the spot market for electricity should take, the specific role and organisational structure of the regulatory authority, and the terms for licensing the market actors.

The new Electricity Law implies the separation of the production, transmission and sales spheres. In the field of production, the power stations owned by EVN are to enter into competition with independent power producers step by step. In the first phase of the liberalisation process the independent producers are not participating in competition because they have purchase contracts negotiated bilaterally with EVN. In future the power stations will feed into the transmission grid under the supervision of a National Load Dispatch Centre (NLDC). The mechanisms of a freely organised market are to be trialled in the production sector early on, starting at the beginning of 2007. According to the latest deliberations in December 2006, the generating plants in which EVN holds 100% of the shares are to be the first to participate directly in market action so as to be able to gather experience of the free market. It is intended that this should reduce production costs and selling prices.

Plants belonging to IPPs and the Phu My Power Generation Complex<sup>15</sup> on the other hand are to submit price quotations through electricity trading companies.

The monopoly position of the state-owned enterprise is only to be maintained for large hydropower plants, future nuclear power plants and the electricity transmission sector.<sup>16</sup> The various transmission companies at the regional level, which are all wholly owned by EVN, will be merged in the coming years to form an independent state-owned transmission company. The restructuring programme for EVN is due to be completed in 2008. In the first phase of liberalisation only EVN will be able to purchase electricity from the producers, acting as a single buyer.

The liberalisation of the electricity market will extend over two decades and be implemented in several stages. In the production sector, full competition between state-owned power stations and plants belonging to independent power producers is supposed to be established by 2015. According to government plans it is also intended that a wholesale market will be set up in the period between 2015 and 2020. After 2020 a spot market is to be created on which electricity can be traded on an hourly basis and the price of electricity finds its own level according to supply and demand.

### **Participation of foreign investors**

A government decree (Decree No. 95/2001/QĐ-TTg) in June 2001 gave foreign investors the opportunity to acquire financial interests in the power generation sector (up to 20% of total capacity). The first foreign capital investments in two large-scale power generation projects were approved in May and September 2001. Plants 2.2. (Électricité de France) and 3. (BP) at the Phu My Power Generation Complex have been in operation since 2004; each has a capacity of 720 MW. Foreign participation is welcome in the shape of IPPs, BOT contracts or joint ventures with national companies. Foreign investment is seen as desirable within the framework of the new Electricity Law, and in particular joint ventures between Vietnamese companies and foreign investors.

<sup>14</sup> Decrees 105 and 106 from 2005 specify how the new legislation is to be translated into practice.

<sup>15</sup> The Phu My Power Generation Complex is the largest power station in the south of the country, with a total installed capacity of 3,800 MW. Two plants (Phu My 2.2 and 3) are owned by private investors.

<sup>16</sup> See Decree No. 176/2004/QĐ-TTg. No precise details of the size of the hydroelectric schemes are given.

### Impediments to private capital

Private capital investments have been hampered in the past by, among other things, protracted, complicated and opaque approval procedures, shortcomings in development of the legal system (particularly with regard to contractual provisions), disadvantages as compared with state enterprises in obtaining loans, for example, and an unfavourable position in negotiating tariffs with EVN. In principle the framework conditions have changed for the better as a result of the new Electricity Law, but how the liberalisation plans are actually put into practice remains to be seen.

### 23.4 Policy Promoting Renewable Energy Sources

With Decision No. 22 in 1999<sup>17</sup> the Vietnamese Government established the first policy framework for using renewable energy sources for power generation and rural electrification. This decision assigns a special role to the use of renewable energy sources (whether or not the facilities are connected to the grid) according to the principle of minimum cost.

According to this decision, the local authorities in mountainous regions and on islands that still have no link to the national electricity grid are called upon to submit plans for electrification using local, decentralised generating units. In this regard the government supports both domestic and foreign investment in autonomous island-mode supply, provided the rated capacity is below 5 MW. The plans have to be accepted by the People's Committees at the provincial level. Depending on the scale of the project, lower-level authorities may also be responsible for taking the decisions.

### Renewable Energy Action Plan (REAP)

An essential basis for developing renewable energy sources in the electricity sector is the Renewable Energy Action Plan (REAP), a key planning and strategy paper jointly prepared by EVN and the Ministry of Industry with financial and technical assistance from the World Bank and other donors in 1999/2000. To improve the application of renewable forms of energy in the power sector, REAP identifies five fields of action requiring national and international finance for improvement or implementation:

- Policy for renewable energy sources and institutional development
- Individual systems for households and institutions (including social institutions or also small manufacturing enterprises)
- Isolated municipal grids based on hydropower
- Power supply from grid-linked renewable energies
- Technology/market development and resource assessment<sup>18</sup>

REAP envisages a 10-year programme divided into two phases of five years each, coordinated by the Ministry of Industry and with the involvement of the World Bank. In an initial step the necessary political and legal foundations will be laid, a fund set up for the use of renewable energy in remote areas and the requisite personnel and technical capabilities strengthened.

In a second step specific projects will then be implemented, such as the installation of pico hydropower and photovoltaic systems for households and municipalities, the use of small-scale hydropower installations for supplying whole villages and the establishment of grid-linked facilities using renewable forms of energy. Altogether, REAP estimates the cost of all the various planned measures to be about US\$ 240 million, of which some US\$ 180 million is to be allocated to investment in grid-connected facilities.

<sup>17</sup> Decree No. 22-1999/CP-TTg.

<sup>18</sup> Detailed reviews were prepared on the five individual aspects based on numerous background studies.

In the field of individual systems, REAP places the main emphasis on pico hydropower and small photovoltaic systems for off-grid applications where power consumption is low. Of 750,000 households that are not expected to be connected to the EVN grid in the next 10 years, approximately 200,000 lend themselves to supply from such facilities. There are additional needs in schools, health centres, water supply and communications. Particular interest is shown in increasing the share of domestically produced pico hydropower systems and in stabilising the commercial supplier and service infrastructure. Altogether there is expected to be a total installed capacity of between 4 and 12 MW in the first 5 years and another 15 to 33 MW in the second 5 years.

REAP assigns renewable energies a major role in supplying power from small-scale generating companies to the EVN grid or the regional distributors' networks. These small power producers could be public-owned enterprises (provincial government, municipalities) or come from the private sector. A general guideline for the payment of these small suppliers (Small Power Purchase Agreements) has not, however, entered into force yet, so at present individual agreements have to be made.

### Clean Development Mechanism

Viet Nam ratified the Kyoto Protocol in September 2002, one of the first Asian countries to do so. The body responsible for CDM affairs (the Designated National Authority) is the International Cooperation Department (ICD), which is answerable to the Ministry of Natural Resources and Environment (MONRE).<sup>19</sup> The National Executive and Consultative Board (CNECB) was established in April 2003, with members representing various ministries under the chairmanship of MONRE. The role of the CNECB is to advise MONRE on the development and implementation of CDM projects. The Board meets three times a year.

In recent years various capacity-building programmes have been initiated with the object of boosting the efficient and swift implementation of CDM projects. Along with government institutions, these are also meant to build the capacity of private actors to put the Clean Development Mechanism into practice. By the end of 2006, two CDM projects had been registered with the UNFCCC. In February 2006 a project was accepted to extract gas as a by-product of offshore oil production off the southern coast. The only renewable energy project to be included so far is a hydropower scheme in the north of the country rated at 2 MW, registered in June 2006.<sup>20</sup> A further four projects have now been registered with the Vietnamese DNA, two in the field of hydropower and two relating to energy efficiency.

<sup>19</sup> Cf. in this connection the official document 502/BTNMT-HTQT dated 24 March 2003.

<sup>20</sup> For a more detailed description of the projects see <http://cdm.unfccc.int/Projects/MapApp>. As at: 26.12.2006.

## 23.5 Status of Renewable Energy Sources

Viet Nam offers a variety of possible options for the exploitation of renewable energies. The country has rich potential in terms of the use of hydropower, wind power, biomass and solar energy. The central utilisation of large-scale hydropower alone accounts for more than a third of all power generated, but still only part of the available hydropower resources are currently exploited. Small-scale hydropower, wind power and solar energy already make an important contribution to decentralised electricity generation in regions with no connection to the grid.

### Hydropower

Viet Nam's hydropower potential is estimated at approximately 300 TWh/year. Of this, some 80 TWh/year is economically exploitable. Accordingly, only approximately a quarter of the economic potential of hydropower has been utilised so far. Apart from a few exceptions, the as-yet unused potential lies in the development of medium-sized or small plants with a capacity of less than 1,000 MW. In the coming years it is intended that in particular the mountainous centre of the country should be used to generate electricity from hydropower. According to the national power development plan, a total capacity of 5,000 MW is to be installed there by 2010. By 2020 the aim is to have a capacity of 13,000-15,000 MW available through the use of hydropower.

Viet Nam has good production capacity at its disposal in the hydropower sector. The Institute of Materials Science (IMS) at the Vietnamese Academy of Science and Technology has designed innovative small hydroelectric power systems which are also suitable for export. System components for small and micro hydropower plants with a capacity of up to 2 MW are also produced.

### Small and micro hydropower

The current applications span a broad range from micro hydropower systems to supply individual consumers to large-scale hydropower stations. Wide experience has already been gained in micro and small hydropower in Viet Nam and there are many manufacturers available, although product quality is in need of improvement.<sup>21</sup> At present between 100,000 and 150,000 households obtain power from micro hydropower systems. The output of these systems is generally between 100 and 1,000 W. A further 20 MW is available to supply isolated grids, while about 60 MW is fed to the central grid from (commercially run) small-scale hydropower plants with capacities ranging from 100 to 7,500 kW.<sup>22</sup> It is estimated that small and micro hydropower plants produce between 7 and 10% of the country's total hydroelectric output. In 2006 there were 126 small-scale hydropower projects registered with the Ministry of Industry, with a total capacity of 2,100 MW. The draft of the sixth Master Plan envisages an additional 408 projects in small-scale hydropower, with a total capacity of 2,925 MW.

### Isolated grids

In future, the expansion of hydropower use in the lower capacity range is primarily intended to promote the construction of isolated networks run by small providers, cooperatives or municipalities, and which in addition to general power supply will help to speed up expansion in the productive sector in particular.

### Small-scale municipal hydropower

To date, small-scale municipal hydropower based on isolated grids has been installed at more than 300 locations with an aggregate capacity of about 70 MW, while individual plants of between 5 and 200 kW are largely situated in the northern and central parts of the country. However, about 200 of these systems, mostly serving isolated grids, are not in operation due to quality and maintenance problems and a lack of financial resources.

21 The following sizes of plant are distinguished: pico hydro: 100 to 1,000 W; micro hydro: 1,000 W to 5,000 W; mini hydro: 5 to 100 kW; small hydro: 100 kW to 10 MW. Some other classifications are used internationally; for example, pico and micro systems are often used to mean the same thing.

22 Above all in Ha Giang, Cao Bang, Quang Nam and Quang Ngai Provinces.

Many of these facilities were financed with foreign assistance with no account being taken of responsibility for operation and maintenance to assure sustainability. Only a few municipal plants also feed electricity into the grids operated by EVN or the regional distributors. Estimates of the potential for municipal use range between 300 and 600 MW.

### Technical potential for small-scale hydropower

Various sources put the technical potential for small-scale hydropower with a plant capacity of up to 10 MW at between 0.8 and 1.8 GW. There are presently only a few hundred mini and small hydropower plants with capacities of 5 kW to 10 MW. The potential for grid-connected small hydropower plants alone is estimated at 0.4 to 0.6 GW and can in part be tapped by improving existing generating facilities.

### Micro and pico hydropower

Micro and pico hydropower systems with a capacity of less than 5 kW have proliferated greatly since the 1990s, in particular, due to improved trade relations with China, where such equipment is produced cheaply. This is especially so in the northern provinces. Micro-class systems (1-5 kW) are manufactured by various companies in Viet Nam.<sup>23</sup>

Viet Nam has one of the world's largest sales markets for pico systems with an output of up to 1 kW, approximately 100,000 to 150,000 having been sold commercially to date. Currently some 40,000 systems are sold each year, about half to replace existing facilities, and are mainly used to supply individual households or small production centres. About 90% of these systems are imported from China. According to REAP, systems rated from 100 to 500 W are sold at prices of between US\$ 50 and US\$ 100. However, these systems are relatively operator-intensive, lack electrical control circuitry and have an operating life of only 1 to 3 years.

A number of them are also used as battery chargers in interconnected neighbourhoods. The total market is estimated at approximately 200,000 systems.<sup>24</sup>

### Wind energy

Thanks to its geography – a 3,000 km-long coastal strip and its location in the monsoon belt – Viet Nam can draw on considerable wind power resources, although so far these have been barely harnessed at all.

### Wind data

A relatively rough picture of the regional distribution of wind power potential is provided by the Wind Energy Resource Atlas of Southeast Asia, published in 2001. The study, which is largely based on meteorological data<sup>25</sup> in conjunction with a simulation model and not on individual site measurements, identifies suitable windswept regions primarily in the mountainous terrain on the border with Laos and in the coastal provinces south of Da Nang and north of Ho Chi Minh City. Altogether, for approximately 30% of the land area wind energy potential is assessed as sufficient (6-7 m/s mean wind velocity at a height of 65 m) and for another 8.6% it is rated as good to very good (over 7 m/s).

As yet there are no other systematic analyses of wind energy potential. Site measurements were taken in the course of project planning on the south-eastern coast near Nha Trang and on two islands close to Haiphong (Bach Long Vi) and Ho Chi Minh City (Thanh An). A study by the Institute of Energy identifies nine islands with wind speeds of 4.1 to 7.1 m/s at a height of 10 m. According to Nguyen<sup>26</sup> there are 31,000 km<sup>2</sup> of territory suitable for generating electricity from wind energy, and in fact the local conditions in an area of about 865 km<sup>2</sup> are so good that generating costs can be expected to be below 6 US cents/kWh.

23 Advisory services for grid-connected small-scale systems are provided by the Hydro Power Center, which belongs to the Vietnam Institute for Water Resources Research. The HPC manufactures both small and pico systems itself.

24 In the short term, therefore, about 50%–75% of the market volume has already been exhausted. Due to the short lifetime of the systems, however, there will continue to be a corresponding demand in future as well.

25 ASTAE (2001), Wind Energy Resource Atlas of South East Asia. [www.worldbank.org/astae/werasa/windenergy.htm](http://www.worldbank.org/astae/werasa/windenergy.htm)

26 See Nguyen, 2007.

### Wind energy use

Viet Nam can look back on a long tradition of utilising wind energy, although this was limited to small-scale facilities. So far, only a small number of relatively large wind or wind-diesel systems have been installed in localised systems. Smaller wind energy installations are more broadly disseminated. At the end of the 1980s the main focus was on developing systems for households with outputs of 150 to 500 W, under a variety of research programmes.

In the past, small-scale wind generators have been developed in particular by the Research Center for Thermal Equipment and Renewable Energy (RECTERE) at the University of Technology in Ho Chi Minh City. To date about 900 systems have been installed, with individual ratings of 150 to 200 W. These systems have mainly been put up in rural regions, and 90% of the cost is financed by state funds. Only 10% of the systems have been purchased by end customers. As part of the rural electrification programme, the Institute of Energy (IE) was commissioned by the Ministry of Industry to investigate the use of wind energy installations in rural areas and on islands. The systems built by IE are each rated at 150 W and have so far been installed at 30 locations. The Hanoi University of Technology has erected 30 systems with the same rated output.

At the time of writing, only one grid-linked wind power plant had been installed. The 800-kW system from the Spanish manufacturer Gamesa began operation in November 2004. The average wind speed at the site on the island of Bach Long Vi in the South China Sea is 7.2 m/s. This pilot plant was financed from government funds. Apart from a lack of technical know-how, the absence of a regulatory framework is inhibiting the construction of any larger wind farms. According to the fifth Master Plan on development of the energy sector of 2001, the rate of remuneration set by EVN was often below 4 US cents/kWh, consequently deterring investors.

Several wind farms are currently at the planning stage. These include a 50-MW wind farm in Binh Dinh Province, in the centre of the country, which is to be financed by the Danish development assistance organisation DANIDA and will comprise turbines from the German manufacturer Enercon. The wind farm is due to begin operation as soon as 2007. In March 2006 it was also announced that another 50-MW wind farm is to be built in Binh Dinh by a German-Vietnamese joint venture<sup>27</sup> with the aid of a US\$ 65 million loan from KfW Entwicklungsbank (KfW development bank). The turbines for this scheme are also supposed to come from German producers and start generating electricity from mid-2007. As well as these, a 15-MW wind farm in Qui Nhon Province and a standalone 625 kW system in Ninh Thuan are at the design stage. The Vietnamese government envisages the building of about 400 MW of wind power capacity by 2020 within the framework of the fifth Master Plan.

### Biomass

About half of national primary energy needs are met with bioenergy. In rural private households, the share of biomass in the form of fuelwood, charcoal, straw, farm residues and other organic waste amounts to as much as 80%-90%. These sources of energy are largely used for cooking and heating water. Thermal use is also made of biomass in the industrial sector; for example rice husks are used in brickmaking. Further biomass resources could also be developed in particular for combined heat and power plants, using sugarcane bagasse and residue and rice husks.

### Power generation from biomass

According to the fifth Master Plan on development of the energy sector, an additional 250 to 400 MW of electrical output is to be made available from biomass plants by 2010. Of this, 70 to 150 MW could be obtained from generation from rice husks, 150 to 200 MW from bagasse, 30 to 50 MW from waste and other biomass products and five MW from wood residues.<sup>28</sup>

Most of the 42 existing sugar mills, only three of which so far feed electricity into the public grid under individually negotiated agreements, are situated south of Da Nang. Total electrical output amounts to 150 MW. Rice husks have not been used for power generation so far. According to the Institute of Energy, an estimated 2.5 million t of rice husks are available for energy recovery. The potential is put at between 70 and 150 MW. The fact that the waste is widely dispersed does make it much more difficult to use, however. Altogether, Viet Nam has more than 100,000 rice mills, although only about 50 are located in the main growing region of the Mekong Delta with a throughput of more than 5 tonnes per hour. This would be enough for the economic operation of power generating sets of 500 kW or more.

The 3,000 or so biogas installations that are mostly installed in the region of the Red River (northern Viet Nam) and in the Mekong Delta are only used to a relatively small extent for off-grid low-output power generating sets. A major barrier cited is the cost factor, which is said to prevent rural households from purchasing these facilities without subsidies. Also, it is mostly more efficient to put biogas to direct use in productive sectors for thermal purposes.

Apart from the Institute of Energy, those mainly involved in designing, producing and installing biomass facilities have been the Viet Nam Boiler Company (Hanoi), the Research Centre for Thermal Equipment and Renewable Energy (Ho Chi Minh City) and the Can Tho University in the Mekong Delta.

### Solar energy

South and central Viet Nam have good and constant solar irradiation conditions with 4.0 to 5.9 kWh/m<sup>2</sup> per day, while the north is subject to pronounced seasonal fluctuations (2.4 to 5.6 kWh/m<sup>2</sup>).<sup>29</sup> The number of hours of sunshine ranges between 1,800 and 2,700 per year.

### Utilisation of solar energy

Solar energy is mainly used for the decentralised generation of electricity. At the end of 2004, the total capacity of all photovoltaic systems in Viet Nam was approximately 1,100 kW<sub>p</sub>. Most of the systems are rated at between 50 and 1,000 W<sub>p</sub>. PV systems are used in the telecommunications sector and in shipping (around 440 kW<sub>p</sub>). Also at the end of 2004 there were 47 systems installed for battery charging, of the order of 500 to 1,000 W<sub>p</sub>. Systems in the range from 250 to 500 W<sub>p</sub> are primarily used in hospitals, cultural centres and municipal facilities. The number of systems installed in such locations is estimated at 570. Micro systems with capacities of between 50 and 70 W<sub>p</sub> are used by households. In the past five years an estimated 1,270 systems have been installed in the household sector in the southern part of the country alone. All in all there are estimated to be 2,800 systems in operation in this sector. Photovoltaic modules are usually imported, although some system components are also produced locally.

Photovoltaic panels began to be used as early as the mid-1980s, when the National Center for Scientific Research installed several systems near Ho Chi Minh City. An initiative launched by Fondation Énergies pour le Monde (Fondem) brought electrification to fifty villages in the Mekong Delta through solar power. In the communities concerned, small PV systems each with a capacity of 1.5 kW were installed on schools, hospitals and residential buildings. A project initiated in 2000 which received half of its funding from Fondem and a quarter each from the provinces and the operators led to the installation of 550 solar power systems by 2005, each rated at 2 kW. Systems with a total capacity of 19 kW were installed as part of another project in the mountainous province of Dak Lac.

<sup>28</sup> Duc Cuong, 2004.

<sup>29</sup> In the north of the country there are four seasons, while in the south there is only a rainy season and a dry season.

The cost of the systems, which are rated at between 50 watts and 2 kW, was shared between the German Federal State of North Rhine-Westphalia (60%) and the Vietnamese Ministry of Natural Resources and Environment (40%). The only larger PV system so far is a 100-kW facility installed with Japanese assistance and combined with a 25-kW hydropower plant, used for electrification of a remote community.

The equipping of rural households with solar home systems is mainly promoted by Selco-Viet Nam, a subsidiary of the American Solar Electric Light Company, which has been engaged in Viet Nam since 1998. A key role is also played here by the Vietnamese Women's Union, which has been actively engaged from as early as 1993 in harnessing solar energy for households not connected to the mains supply. By the beginning of 1997 it had put about 240 systems into operation with technical assistance from Solarlab and financial support from the American Solar Electric Light Fund. A total of 600 systems have been installed in another large-scale project with Selco-Viet Nam.

Over the coming years it is intended that solar home systems should be further disseminated through two major projects. One project on photovoltaics for rural areas and ethnic minorities has already been approved by the government and is meant to supply electricity to 300 rural communities, with a budget of US\$ 30 million.<sup>30</sup> The project is scheduled to run for three years. In addition, 30,000 solar home systems are to be installed within the framework of the Renewable Energy Action Plan. The budget available for this amounts to US\$ 9.6 million for ten years.

The use of solar energy for heating and cooling is less widespread. Water-heating systems are used in about 1,200 households (2-4 m<sup>2</sup> collector area) and 60 municipalities (10-50 m<sup>2</sup> collector area). There are also systems in operation for the drying of industrial and agricultural products.<sup>31</sup>

### Geothermal energy

The geothermal potential in Viet Nam has hardly been explored to date. According to the latest findings there are 269 locations suitable for the direct utilisation of geothermal heat, with a surface temperature of over 30°C and a total capacity of 649 MW<sub>th</sub>.<sup>32</sup> The geological conditions in the centre of the country could permit the operation of geothermal power plants producing 100 to 200 MW. According to the fifth Master Plan about 200 to 400 MW of geothermal capacity is supposed to have been developed by 2020. As of the end of 2006, however, there were no electricity-generating plants in operation.

## 23.6 Rural Electrification

### Degree of electrification

78% of the population of Viet Nam live in rural areas. At the end of June 2006, 91.5% of all rural households<sup>32</sup> or 97.8% of all rural communities had access to electricity. On the whole the quality of power provision in rural regions is lower than that in urban areas as there is a greater frequency of power failures and the voltage level is not stable.

The government's current plan for rural electrification envisages that 95% of all households are to have an electricity supply by 2010. After the electrification plan is implemented, more than 1,000 remote communities and villages with about 500,000 households and another 2.5 million households in scattered rural settlements will still be without a grid connection. By 2020 the proportion of households with an electricity supply is supposed to be increased to 100%.

30 US\$ 20 million will be provided by Finnish official development assistance.

31 Source: Nguyen, 2005.

32 Source: Lund et al., 2005.

33 This means 12.3 million of a total of 13.5 million households.

### Policy guidelines

Policy guidelines on rural electrification were adopted by the Ministry of Industry at the beginning of 2000. These specify the principles for diversified participation of new (foreign and local) power suppliers through creating incentives for local power supply and the promotion of localised electricity generation. The intention is to both expand networks and install off-grid systems for rural supply according to the principle of minimum costs.

### Opportunities for renewable energies

Some households in rural regions can only be served cost-efficiently by using decentralised renewable energy sources (US\$ 400-500 per connection). These are mainly to be found in 1,100 communities comprising a total of 750,000 households and three million inhabitants which will remain out of reach of the national power grid in the short to medium term and which therefore will have to rely on localised solutions.

Potential has been identified in particular in the expanded use of pico hydropower systems for single houses or settlements in the northern mountain regions and the central coastal zones of the country, and in the dissemination of photovoltaic systems in the central highlands and the Mekong Delta.

### Aims of the Master Plan

The current Master Plan for developing the power sector<sup>34</sup> sets the following targets to be achieved by 2010:

- Additional supply of 1,500 municipalities through grid expansion
- Electrification of a further 400 remote municipalities, primarily in the northern mountain regions and in the central highlands, with localised systems using renewable energies and diesel

### Rural Energy I project

Implementation of the Renewable Energy Action Plan (REAP) in rural areas is substantially supported by the World Bank. The Rural Energy I project was launched at the end of 2001 and ran for a period of five years.<sup>35</sup> By the end of 2004 over 976 municipalities were supposed to have been connected to the public electricity grid in the context of the project, thereby supplying electricity to an additional 500,000 people. By mid-2006 it had not yet proved possible to achieve this target in full. At that time only just under 900 municipalities had received access to electricity for the first time. In conjunction with electrification, two or three people in each municipality underwent training to perform routine jobs and maintenance on the local distribution network. The utilisation of renewable energy sources, above all hydropower, was driven forward by the shaping of standard contractual arrangements with small producers concerning the feeding of power into the grid.

### Rural Energy II project

A follow-on project to implement the second REAP phase was launched in 2004, namely the Rural Energy II project. The project officially commenced in October 2005 and will run until the end of 2011. It is being supported by a US\$ 220 million loan from the World Bank. A grant of US\$ 5.25 million was made available by the GEF.<sup>36</sup> By 2012 it is intended that 2.5 million people will benefit from the activities in 1,200 communities, half of which at present have no access to electricity.

The local power distribution companies are also to be converted into legally recognised entities, and regional actors are to be better integrated into the plans to bring about rural electrification. Rural electricity cooperatives are to be set up in order to enable the local population to take over management of local networks.

Exchange rate (7 January 2006):

10,000 Vietnamese dong (VND) = 0.4906 euro (EUR);

1 US dollar (USD) = EUR 0.7694

34 Master Plan of Power Development for 2001-2010.

35 The project has been granted a loan of US\$ 150 million from the International Development Association (IDA).

36 See Document of the World Bank, Report 29860-VN, October 2004.

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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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