



Energy-policy Framework Conditions for Electricity Markets and Renewable Energies

23 Country Analyses Chapter Argentina

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.
2. The sole authorised user of this study for all forms of use is the GTZ. Duplication or reproduction of all or part of the study (including transfer to data storage media) and distribution for non-commercial purposes is permitted, provided the GTZ and the TERNA Wind Energy Programme are named as the source. Other uses, including duplication, reproduction or distribution of all or part of the study for commercial purposes, require the prior written consent of the GTZ.

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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1 Argentina

1.1 Electricity market

Installed capacity

At the end of 2005, Argentina had power generating capacities totalling 25,674 MW, including 15,598 MW in the form of thermal power stations (fuelled mostly with natural gas), 9,920 MW as hydroelectric facilities¹ and 1,018 MW from nuclear power plants. Excluding major hydropower stations with more than 15 MW, renewable energy sources accounted for a sum total of around 210 MW. Nearly 10,000 MW of the total generating capacity has been newly commissioned since 1992, when the electricity market was liberalised. In recent years, an increasing share of new capacity has been provided in the form of gas-fuelled power plants and new hydroelectric facilities.

Due to deficient maintenance, however, only about 18,000 MW of power generating capacity is actually available. In 2006 the peak load was 17,400 MW, so the system has very little reserve capacity. Supply shortages in the country's main grid, Sistema Argentino de Interconexión (SADI), are partially alleviated via import supply agreements.

Power generation

Approximately 96,650 GWh of electricity were generated in 2005. A breakdown according to primary sources of energy is reflected in the following table:

	Thermal		Hydro		Nuclear		Total
	GWh	%	GWh	%	GWh	%	GWh
2001	38,929	46.9	36,949	44.5	7,059	8.5	82,987
2002	34,945	45.5	35,797	46.7	5,821	7.6	76,637
2003	42,306	50.6	33,737	40.3	7,566	9.1	83,688
2004	52,993	58.1	30,445	33.3	7,869	8.6	91,380
2005	54,845	57.4	34,192	35.4	6,873	7.1	96,650

Tab 1: Power generation according to primary energy source; 2001–2005; GWh²

Exports and imports of electricity in 2005 amounted to 4,140 GWh and 8,017 GWh, respectively.

Power transmission

Technically speaking, the power supply system comprises two interconnected grids: SADI which operates in the north and in the Argentine heartland, and within which the generation companies serving the Mercado Eléctrico Mayorista (MEM) electricity market are organised; and Sistema Interconectado Patagónico (SIP) in Patagonia, which handles electricity generated by the members of Mercado Eléctrico Mayorista Sistema Patagónico (MEMSP). Both grids are managed by CAMMESA.³ In late 2005, the two grids were interconnected by a 500 kV high-tension line running between Choele Choel in Rio Negro province and the more southerly situated Puerto Madryn in Chubut province. Nevertheless, both grids, SADI and SIP, continue to operate independently of each other. The transmission network comprises 500 kV, 220 kV and 132 kV lines,⁴ and the installed capacity is distributed among the various networks as shown in the following table:

¹ Including 974 MW from pumped-storage plants.

² Source: Secretaria de Energía, 2001, 2002, 2003, 2004, 2005; generation figures specific to transmission and distribution networks.

³ Compañía Administradora del Mercado Mayorista Eléctrico Sociedad Anónima (CAMMESA), see section entitled "Regulatory authorities".

⁴ The Cammesa home page offers detailed maps of all the various supply networks: www.cammesa.com/inicio.nsf/marcomemnet. Status: November 22, 2006.

	MEM	MEMSP	On-grid plants	Off-grid plants
	MW			
2001	22,884	801	734	969
2002	23,148	765	619	966
2003	23,272	763	655	988
2004	23,295	801	734	969
2005	23,245	800	660	970

Tab 2: Installed capacity according to supply network; 2001-2005; MW⁵

	Households		Commerce		Industry		Other		Total
	TWh	%	TWh	%	TWh	%	TWh	%	TWh
2001	21.5	30.8	12.7	18.2	27.5	39.5	8.0	11.5	69.7
2002	20.6	30.6	12.3	18.2	26.8	39.8	7.6	11.4	67.3
2003	20.9	29.0	12.1	16.9	29.9	41.4	9.3	12.7	72.2
2004	21.7	28.5	14.1	18.5	31.8	41.6	8.5	11.4	76.3
2005	23.6	29.1	15.7	19.4	32.9	40.6	8.9	11.0	81.1

Tab 3: Power consumption according to user group; 2001-2005; TWh,%⁶

A new link, now under construction, between Comodoro Rivadavia in Chubut and Pico Truncado in Santa Cruz is being installed to integrate the windy regions in southern Patagonia. The vital connection between Puerto Madryn and Pico Truncado is scheduled for completion by the end of 2007. Some 2,000 additional kilometres of supply lines are to be installed in other parts of the country within the next two years.

Argentina had an electrification level of 95 percent in 2006.

Power consumption

As a result of the last recession, demand for power was down 2% in 2002. Since then, however, it recovered three years in a row, showing a 6% increase in 2005. CAMMESA is expecting continued growth of 6% to 8% per year for 2006 to 2008, depending on economic developments.

The most recent report from the Energy Secretariat on future developments in the electricity sector, entitled 'Prospectiva 2002', was published in 2003. It predicted that total consumption would reach 128 TWh by 2012. Accordingly, as much as 1,800 MW of new capacity needs to be added every year of this decade.

Recent years have seen efforts to compensate for the prior absence of investment in the country's supply networks. For example, the government presented two successive national power transmission plans in 2003 and 2004. Due to the fact that, despite growing demand, no new power plants have been constructed in recent years, the risk of power shortages has risen. Part of the cost of grid improvement is covered by a national electricity fund. The money in the fund comes from a surcharge on wholesale power purchases. Loans are also granted by the Inter-American Development Bank (Banco Interamericano de Desarrollo – BID).⁷

Plan Energía Plus

The Plan Energía Plus is the government's attempt to counter a consumption trend characterised by the fact that more than half of demand comes from major commercial and industrial consumers. In effect since 8 November 2006,⁸ the programme is attempting to prevent any further increase in the consumption of individual customers who are already drawing more than 300 kW each.

5 Source: Secretaria de Energía, 2001, 2002, 2003, 2004, 2005.

6 Source: Secretaria de Energía, 2001, 2002, 2003, 2004, 2005.

7 BID has earmarked a 580 million peso line of credit for the NEA-NOA connecting line; the loan would cover roughly 80% of the initial cost of investment.

8 See Resolución SE No. 1281/2006.

The financial incentive is that any increase in consumption beyond that of the 2005 reference level is being made significantly more expensive. However, since the actual penalties for excess consumption have not yet been set, the marginal costs of the power plant with the most expensive production is serving as the basis of calculation for the time being. The main idea is to make major consumers think about saving energy and/or about generating their own electricity to cover additional demand.

Electricity prices

Due to the large number of market participants⁹ and favourable primary energy delivery costs for power producers, the average price of electricity dropped more than 50% during the first six years after 1992. Since 1999, however, prices have been increasing again. While the average electricity market price in MEM was 7.1 euro/MWh (28.9 arg \$/MWh) in 2002, it rose to 13.2 euro/MWh (53.8 arg \$/MWh) by 2004. The prices for electricity from the various distribution networks are detailed on the homepage of the regulatory agency ENRE.¹⁰ Most differences in price are due to transmission bottlenecks.

The rise in electricity tariffs in recent years has been mainly attributable to drops in the availability of hydroelectric power and partial substitution of tendentially cheap natural gas with other types of fuel in response to domestic demand exceeding the national gas production rate. In reaction to the economic crisis and attendant devaluation of the Argentine peso, an upper limit on spot-market prices was introduced in 2002. Due to regulated prices and despite increases in the price of electricity, many producers were barely able to recover their production costs, let alone return a profit.

1.2 Market Actors

The Argentine electricity market is characterised by a large number of market actors at the various levels of generation, transmission and distribution.

Private actors

At the end of 2005 there were a total of 41 power-generating companies, 14 autoproducers, 66 distribution companies, 8 supraregional transmission companies and 2,614 major consumers in the two interconnected grids. In the generating sector, three companies have the biggest market shares: Endesa Costanera, Central Puerto and Yacyreta. Of the 66 distribution companies, the two largest, EDENOR and EDESUR, delivered about 43% of all electricity consumed in 2005. A concession for power transmission via high-tension lines was awarded to Transener SA in 1990 for a contract duration of 95 years. The low voltage grids are operated by six supraregional enterprises.

In addition to the power producers integrated within the SADI and SIP grids, there are also a number of local-level utilities with tie-ins to the interconnected network, but which do not participate in the central load-distribution arrangement. Yet another group is that of the independent power producers, who either feed in to isolated grids or produce for their own consumption.

Due to the large number of actors at all different levels, the Argentine electricity market is characterised by high competitive pressure. All power producers have, as a matter of principle, free and equal access to the grid. Electricity from the public power grid is traded by way of bilateral agreements between producers and distributors and/or major consumers, as well as by way of seasonal subscriber agreements and a short-term spot market with hourly price quotes operating under the supervision of CAMMESA. Some 78 percent of all electricity passing through MEM in 2004 was traded on the spot market.

⁹ See section entitled "Market actors".

¹⁰ See www.enre.gov.ar.

Public-sector actors

Few Argentine electricity generating facilities are still owned by the state. That category includes the two nuclear power plants Atucha I and Embalse and both binational large-scale hydroelectric plants, Yacyreta and Salto Grande. Altogether, the public-sector generation system accounts for approximately 14 percent of the country's total installed generating capacity.

In 2004, in reaction to the recent years' energy crisis, the government established a national energy enterprise called ENARSA (Energía Argentina Sociedad Anónima) in order to establish a regulative state-owned element in an energy market that was almost completely privatised. In addition to securing the government's influence on the oligopolic oil and gas markets, the company was geared to ensuring the availability of basic supplies. The company's potential activities relate primarily to the oil market and secondarily to the gas and electricity markets. Its radius of action encompasses all links of the value-added chain. At the moment, the company's main concern is to develop the oil fields situated off the coast of Argentina. According to its statutes, the state is supposed to hold 53% and the provinces 12%. The remaining 35% were sold to private investors via the stock market.

Other Actors

Regulatory authorities

Independent national- and provincial-level agencies are tasked with regulative responsibility for the natural monopolies of transmission and distribution (national level: ENRE = Ente Nacional Regulador de la Electricidad; regional level: EPRE = Ente Provincial Regulador de la Electricidad). ENRE mediates in the event of conflict between utilities, ensures that federal laws and regulations are implemented, and watches over the conclusion of concession contracts. In addition, ENRE sets the standards for power distribution and the maximum prices of transmission and distribution, and supervises both the generating companies and CAMMESA.

CAMMESA (Compañía Administradora del Mercado Mayorista Electrico Sociedad Anónima) was established as a private, non-commercial company responsible for administrating that part of Argentina's electricity whole sale market that is not covered by bilateral agreements. The power producers' association (AGEERA), the major consumers' association (AGUERRA)¹¹, the power distributors' association (ADEERA), the association of high-tension transmission network operators (ATERRA) and the Energy Secretariat each hold a 20 percent interest in CAMMESA. CAMMESA's main tasks are to regulate supply and demand (load distribution) according to the principle of least (short-term) marginal costs,¹² determine transmission costs and other non-variables, and ensure sufficient reserve capacities.

1.3 Legal Framework

Liberalisation

Argentina's centralised, government-owned and -operated electricity sector was split up into the separate areas of generation, transmission and distribution and incrementally privatised by way of law no. 24,065 of 16 January 1992 ("Electricity Act") and the associated implementing regulation (Decreto 1398/92 of 6 August 1992). Decree 1853 from 1993 did away with the last remaining impediments for foreign investors. With but few exceptions, Argentine companies can now be wholly owned by foreigners, and the companies' profit and capital can be freely exported.

Evolution of electricity market policy

As a result of the economic crisis in 2001 and 2002 and with the resultant energy crisis in the years to follow, regulative elements have now been strengthened in connection with Argentina's energy policy.

11 Major consumers are those who purchase at least 2,000 MWh/a.

12 The minimum marginal cost principle was replaced, with medium-term effect, by the variable production cost principle. Source: CMA, 2006.

Devaluation of the Argentine peso immediately led to more expensive fuel and higher operating costs. In July 2004, in response to a lack of private investment in Argentina's power generation system despite increasing demand for electricity, a fund was established to enable expansion of the power supply volume. The funding consists of a percentage share of the revenues of power-sector enterprises.¹³ New thermal power stations with ratings of 1080 MW and 540 MW, paid for in part with money from that fund, are scheduled to go on line in the latter half of 2007 or in early 2008. The companies that have paid into the fund automatically become pro-rata co-owners of the new power plants.

On 24 August 2006, the Government of Argentina announced a plan to expand the use of nuclear energy through new investments totalling 3.5 billion pesos. The Atucha II power station is to be completed, but also a fourth reactor is to be built and the uranium enrichment programme resumed.

1.4 Policy Promoting Renewable Energy Sources

The government intends to increase to eight percent the share of renewable energies in overall primary energy consumption, although the target year 2013 that was named at the 2004 World Conference on Renewable Energies is proving to be too short a goal. Consequently, the December 2006 law governing the promotion of power generation from renewable energy resources now aims to raise the share of renewable energies to eight percent of the national electricity mix by the end of 2016.

Promotion at the national level

While in the early 1990s the government confined itself to engaging in preparatory activities for the conduct of wind potential studies and/or relevant research, law no. 25,019 of November 1998 was adopted in order to regulate both wind and solar energy. The decision on whether or not to enact such a law was a matter of contention for quite some time, because there was a generally preponderant belief that all support for the energy

sector should cease. Thus, it was with a substantial delay that the law's implementing provisions were initiated in December 1999.¹⁴

The law underscores the nation's interest in the generation of power from wind and solar energy and introduces for the first time national-level assistance to the amount of 0.23 euro cent/kWh (0.01 arg \$/kWh) for wind energy. This subsidy is to be paid in addition to revenues from the sale of energy for the next 15 years. The law also prescribes tax incentives in the form of stretched-out remittance of value-added tax.

At the policy-making level it has become generally accepted that the national law on the promotion of renewable energies does not offer sufficient incentives and therefore needs to be expanded. Following some failed legislative initiatives by several different senators in recent years, congress passed a law on the promotion of power generation from renewable energy sources on 6 December 2006. This law envisages broad-scale promotion of renewable energy sources within the scope of a bonus model. The payments are to be rendered by way of a trust-administrated renewable energy fund. In addition to photovoltaics worth 22 euro cent/kWh (0.9 arg \$/kWh) and wind energy worth 0.37 euro cent/kWh (0.015 arg \$/kWh), the eligible sources of energy also include geothermal energy, tidal energy, biomass, biogas and small-scale hydropower with ratings up to 30 MW, all of which are to receive 0.37 euro cent/kWh (0.015 arg \$/kWh).¹⁵ The period of entitlement is 15 years. The law underscores the political intention to create jobs by promoting the use of renewable energy sources and to increase the national and regional net outputs by using domestic products.

13 Between 2004 and 2006, 65 percent of corporate profits must be paid over to the fund.

14 See Decreto P.E.N. N° 1.597/99.

15 Due, however, to the fact that the remuneration rates are still relatively meagre, it is feared that this law, too, will fail to achieve the rapid development of renewable energy resources.

Promotion at the regional level

As of this writing, the southern province of Chubut¹⁶ (Patagonia) and the province of Buenos Aires¹⁷ were promoting alternative energies at the regional level by paying, respectively, 0.12 and 0.25 euro cent/kWh (0.005/0.01 arg\$/kWh) per generated kilowatt hour of electricity. In Chubut, payment of the bonus depends on how much, in percent, of the equipment is of local origin. As of January 2001, the minimum percentage was 30%, but that was raised to 60% in January of 2003 and, ultimately, to 80% in 2005. As of January 2007, the entire equipment pool must stem from local production.

In August of 2005 Santa Cruz Province adopted the currently most comprehensive law on the promotion of renewable energy sources. Both conventional thermal power generation and power generation from renewable energy sources are eligible for promotion. The law is characterised by broad-scale promotion of various renewable energy technologies, including wind, solar and tidal energy, hydropower (up to plant ratings of 15 MW), biomass and other technologies that are eligible for promotion and not classified as polluting. Here, too, the remuneration depends on how much of the equipment is locally produced. It varies between 0.25 and 0.75 euro cent/kWh (0.01 and 0.03 arg\$/kWh).¹⁸ Various tax incentives are also granted. The aid money stems from a regional energy fund.¹⁹

No other special provisions are in effect for electricity from renewable energy sources. However, some communities with power supply cooperatives are offering land and infrastructure on very easy terms for wind energy projects. The building laws are handled much less strictly than in Germany.

Clean Development Mechanism

Argentina ratified the Kyoto Protocol on 28 September 2001. The Clean Development Mechanism Office OAMD (Oficina Argentina del Mecanismo para un Desarrollo Limpio), which reports to the Secretariat for the Environment and Sustainable Development, is serving as the country's Designated National Authority (DNA) for the Clean Development Mechanism. Decree No. 1070 of September 2005 established a national fund (Fondo Argentino del Carbono – FAC) for the purpose of facilitating the implementation of CDM projects.

Six projects have been registered to date with UNFCCC. An initial project for extracting landfill gas in Villa Dominico, Buenos Aires, was accepted in September 2005. That project aims to utilise existing biogas for local generation of electricity. The output, however, is not intended to be fed into the power grid. Four other landfill-gas projects were registered in 2006.²⁰ The only wind power project to date – a 10 MW system in Comodoro Rivadavia in Chubut Province – was approved in December 2005. Its power output is to be injected into the Patagonian grid by the cooperative SCPLCR (Sociedad Cooperativa Popular Limitada de Comodoro Rivadavia). Three additional projects have also been registered. The CO₂ equivalent prevention effect of all registered projects together amounts to approximately 1.8 million tonnes per annum.

¹⁶ See Law No 4389/1998 and decree No 235/1998.

¹⁷ See Law No 12603/2001.

¹⁸ If all equipment is produced outside the Province of Santa Cruz, only 50% of the full remuneration is granted. If, however, all plant components are of regional origin, 100% remuneration can be claimed. Proportional increments are granted for different percentages of regional production.

¹⁹ See Legislación Provincial No. 2796/2005 (Santa Cruz), Art. 7.

²⁰ The landfill gas project in Olavarría, led by the World Bank; the Norte III project, led by Argentine enterprise Aria.Biz; and the British-Canadian project in González Catán and Ensenada all target the recovery of landfill gas from waste material, and all three projects are being implemented in Buenos Aires Province.

1.5 Status of Renewable Energy Sources

In Argentina, renewable energy producers are concentrating mainly on hydroelectric power from major plants. However, small hydropower plants are also gaining importance, though on a much smaller scale. While developments in the wind energy conversion sector have been rather sluggish in recent years, the government's current plans have earmarked that branch in particular for an upswing. Argentina possesses multiple underutilised potentials for generating heat and electricity from hydro and wind power but also from solar, biomass and geothermal sources.

Hydropower

Most hydroelectric power in Argentina comes from major dams. Depending on precipitation levels, those plants can cover between 35 % and 45 % of the country's electricity requirements. In 2005, small hydropower facilities (up to 15 MW) accounted for a total installed capacity of around 180 MW. Approximately 60 plants, including some 20 micro- and mini-hydropower plants,²¹ produced 675 GWh of electricity. Five miniature plants were installed for experimental purposes in the northern province of Jujuy in connection with the government's PERMER project for renewable energies in the rural electricity market. At present, 2 % of the overall hydroelectric yield comes from mini- and micro-hydropower plants with ratings of 15 MW or less. The Energy Secretariat has identified an additional 120 suitable sites for small-scale hydropower plants with an estimated total capacity of around 276 MW.²² According to an as yet unpublished study, the real potential stands even higher, at approx. 400 MW. Future development of those sites is to be implemented in part via CDM projects.

Wind energy

Argentina has a very large wind energy potential, but most of the best-suited locations are situated in the southern part of the country (Patagonia), which is only sparsely populated and far away from densely populated areas and industrial centres. Grid expansion, i.e. the interconnection between the SEDI and SIP grids, in combination with extension of the 500 kV line into the southern reaches of Patagonia, will improve the framework conditions for the exploitation of wind energy. Primarily, however, the grids are being expanded to accommodate the further development of hydropower in Patagonia. At present, the planned grid capacity appears insufficient to enable full exploitation of Patagonia's full wind energy potential.

According to information provided by the Energy Secretariat, wind energy conversion systems produced 75,381 MWh of electricity in 2005. At the end of 2006, the installed capacity totalled 28 MW. All systems are in the hands of local authorities and cooperatives.

While Argentina played a leading role in the exploitation of wind energy in South America during the 1990s, only little additional capacity has been installed in recent years. In 2002, there was some 26 MW of installed capacity, and no new wind power installations were erected in 2003 because of the economic crisis. The following year, the General Acha plant was expanded by another 900 kW system, and in 2005 two additional 600 kW systems produced by the German company ENERCON were installed in Pico Truncado, Santa Cruz. Also in Pico Truncado, a pilot project launched in February 2005 involves partial powering of a hydrogen production facility with wind-generated electricity. No new wind generators were commissioned in 2006. The licensing procedures for wind farms have not been standardised, so the regulations differ from region to region.

21 For the sake of better differentiation, the Energy Secretariat has introduced the categories micro-hydropower (5-50 kW), mini-hydropower (50-500 kW) and small-hydropower (500-15,000 kW).

22 The Energy Secretariat has published on its own home page a list of planned and implemented small-scale hydropower projects; see <http://energia3.mecon.gov.ar/contenidos/verpagina.php?idpagina=949>; Status: 28 November 2006.

Location	Province	Operator	Qty. WECSs*	Installed capacity [MW]	Ø wind velocity[m/s]	Date of commissioning
Rio Mayo	Chubut	DGSP Pcia. Chubut	4	0.12	–	2/90, presently inoperative
C. Rivadavia	Chubut	PECORSA SCPL	2	0.50	9.4	3/94
Cutral Co	Neuquén	COPELCO	1	0.40	7.2	10/94
Pehuen Co	B.A.	Coop. Punta. Alta	1	0.40	7.3	2/95
Pico Truncado	Santa Cruz	E. Pcial. S. Pub.	10	1.00	–	dismantled
Rada Tilly	Chubut	COAGUA (Coop. de Servicios R.T.)	1	0.40	10.2	3/96
Tandil	B.A.	CRETAL	2	0.80	7.2	5/96
C. Rivadavia	Chubut	SCPL de C. Riv.	8	6.00	9.4	9/97
Darregueira	B.A.	Coop. Darregueira	1	0.75	7.3	9/97
M. Buratovich	B.A.	Coop. M. Buratovich	2	1.20	7.4	10/97
Punta Alta	B.A.	Coop. Punta Alta	3	1.80	7.8	2/95 and 12/98
Claromeco	B.A.	Coop. Claromeco	1	0.75	7.3	12/98
Pico Truncado	Santa Cruz	Municipalidad de P.T.	2	1.20	10.3	2/2001
C. Rivadavia	Chubut	SCPL de C.Riv.	16	10.56	9.4	10/2001
General Acha	La Pampa	COSEGA	2	1.80	7.2	12/2002 and 2/2004
Pico Truncado	Santa Cruz	Municipalidad de P.T.	2	1.20	10.3	5/2005
Total				27.76		

* WECSs = wind energy conversion systems

Tab 4: Wind energy conversion systems in Argentina; MW, m/s; November 2006²³

All wind energy conversion systems installed to date were produced by European companies. The (erstwhile) Danish company NEG Micon²⁴ holds a market share of 44 %, followed by Spanish turbine manufacturer Gamesa (40 %), the Danish enterprise AN Bonus (now Siemens, 11 %) and the German producer ENERCON (5 %).

However, two Argentine enterprises most recently tested some new prototypes. The state-owned enterprise INVAP is designing systems of its own with modest ratings (500, 1,000 and 1,500 watts) and is cooperating with Spain's wind turbine manufacturer Ecotécnia to build wind generators with electric outputs situated between 225 kW and 750 kW. As early as the year 2000, Industrias Metalúrgicas Pescarmona S.A. (IMPISA) initiated a research project termed IMPISA Wind for the purpose of building a large-scale wind power installation with an output of 1 MW. NRG Patagonia is also developing large wind power plants designed specifically for the kind of constant high-speed winds that are encountered in Patagonia. The model system NRG 1500 is supposed to have a rating of 1.5 MW.

²³ Source: Asociación Argentina de Energía Eólica (AAEE), Greenpeace Argentina, 2005.

²⁴ Since acquired by its Danish competitor Vestas.

Planned wind power projects

Demand for domestically produced systems is to be stimulated in part by a National Strategic Plan for Wind Energy that was initiated in 2005 and makes provision for the installation of some 300 MW of capacity within the next three years. The plan is based on an agreement between the Ministry of Planning, Public Investment and Services, the Regional Centre for Wind Energy (Centro Regional de Energía Eólica – CREE) in Chubut province, and the stated-owned and -managed energy enterprise ENARSA. Eighty percent of the wind-power equipment is to be produced in Argentina. However, commitments by private investors are still a long time coming.

Nevertheless, planning at the provincial level is being vigorously pursued, and in July of 2005 Chubut province entered into an agreement for developing the “Vientos de la Patagonia I” project. The first wind farm, with a rating of 50-60 MW, is planned for installation near the City of Comodoro Rivadavia. It was scheduled to join the grid in mid-2006. A similar agreement concerning the “Vientos de la Patagonia II” project with the government of Santa Cruz as project partner is under consideration. Pico Truncado is slated to become the site of a 60 MW wind farm in this case. Other projects are to follow in the provinces of Buenos Aires (100 MW), Neuquén, Rio Negro, La Rioja, Cordoba and San Juan. Considering the only marginally better remuneration provided for by the national law dating from December 2006, it remains to be seen whether those projects actually can be implemented.

In addition, it was announced in November 2005 that the national government and the province of La Rioja are planning a joint venture in the form of a wind farm in the northern part of the province. The equipment is supposed to be domestically produced and supplied by IMPSA. The 70 planned wind turbines with a total rating of approximately 60 MW will require investment of the order of 60 million pesos. The provincial government has signed an agreement, according to which it pledges to provide part of the requisite infrastructure, including a tie-in to the transmission network. Implementation of the project, however, has not yet begun.

In November 2006, the utility company EMGASUD presented a plan for the construction of a thermal power plant with a rating in excess of 400 MW and the installation of a 100 MW wind farm in Chubut province. Both projects were supposed to be launched in February 2007. The total cost comes to 1,240 million pesos. The wind farm, composed of individual 2 MW wind turbines, is supposed to enter service in August of 2008.

Here, too, it remains to be seen whether the planned projects will ever be implemented, because recent years have seen the pronouncement of numerous major wind power projects that in fact came to nothing. It is hoped that the World Wind Energy Conference to be hosted by Argentina in October 2007 will generate new impetus for wind energy.

Wind atlases

Wind atlases are available for two windy provinces in the southern part of the country (Chubut and La Pampa). Compilation of a comprehensive wind atlas for the entire country constitutes an essential component of the national wind energy plan. With a view to improving the planning of wind power projects, the Regional Centre for Wind Energy (CREE)²⁵ in Chubut province was called upon in March of 2005 to compile the atlas. On 3 August 2006 the President of Argentina presented the resultant interactive national wind map, with the help of which the competent ministry is able to pinpoint the windiest prospective sites. This instrument is to be further refined during the second phase of the project. The interactive map is not yet generally available, but it most likely will be published sometime in 2007.

25 The CREE home page (www.eolica.com.ar) provides access to the wind atlases for the Chubut and La Pampa regions. Status: 27 November 2006.

Biomass

Primarily in central rural areas there is substantial biomass potential (e.g. organic residue from the sugar and alcohol industry) for use in the local generation of electricity. The Plan Energía Plus programme offers incentives to cover more demand for electricity in agriculture by way of autonomous generation, with any surplus electricity being injected into the power grid. The incentive to do so stems from the fact that any consumption surpassing that of the reference year 2005 will be considerably more expensive. The Energy Secretariat is presently investigating further-ranging uses.

Solar energy

Solartec S.A. has been producing photovoltaic modules in the City of La Rioja since 1986. The components are purchased from the Japanese company Kyocera. The factory turns out about one megawatt worth of modules annually. The company claims to command a market share of about 80 percent.²⁶ Most solar energy systems in Argentina were installed in connection with the National Renewable Energy for Rural Markets project (PERMER). In all, Argentina has an estimated total installed capacity of 6.5 MW_p in the form of photovoltaic systems. The Energy Secretariat even assumes 9 MW to be more accurate. Some 1.3 MW_p was installed via the PERMER programme. The estimates are based on import data and figures provided by the installation contractors.

In 1987 the national solar metric network, which has been in place since 1979 as the aggregation of all solar measuring stations, monitored the insolation rates at 118 different locations. Ten years later, NSN mapped the mean insolation levels in all of Argentina.²⁷

Geothermal energy

Argentina is believed to have ample geothermal potential. As early as the 1970s, a national commission on geothermal studies was set up to evaluate the potential. To date, 42 potential utility zones have been identified and classified, nearly all of them in the western Andes region.²⁸ The first pilot project dedicated to power generation was commissioned in 1988: the Copahue facility in Neuquén province has a capacity of 670 kW and is connected to the local network of on-grid power plants. For maintenance reasons, however, the facility has been out of operation since 1998. The high cost of development and the remoteness of suitable locations with respect to ultimate consumers are main impediments to the geothermal generation of electricity.

1.6 Rural Electrification

While 5% of Argentina's overall population has no access to electricity, that fraction stands at about 30% in rural areas. Consequently, the national and provincial governments have set up a special fund to pay for electrification promotion programmes. Since untoward transmission factors often preclude a tie-in to the public power grid, there is strong interest in stand-alone solutions involving renewable sources of energy for remote regions. As a rule, only modest capacities are required, so small power generating units are most in demand.

Electrification programme

PAEPRA

In 1995 the Argentine Government (Secretaría de Energía) created the rural electrification programme PAEPRA (Programa de Abastecimiento Eléctrico a la Población Rural de Argentina). The programme grants subsidies to private concessionaires who guarantee via competitive tendering to provide electricity to rural areas for the lowest amount of subsidies, even if off-grid options have to be implemented.

²⁶ Source: J. E. Salgado, Solartec S.A.

²⁷ See Grossi Gallegos 1998. The maps are available at the following Internet address: www.salvador.edu.ar/csoc/idicso/docs/arep_a3_Abr06.pdf; Status: November 20, 2006. Scientific discourse is currently focused on how to find better methods of producing insolation maps for Argentina, cf. Righini et al., 2005.

²⁸ Source: http://www.salvador.edu.ar/csoc/idicso/docs/arep_a4-feb06.pdf; status: 20 November 2006. The article includes a map of the regions that have been evaluated to date.

The concession contracts have a 15-year tenure and can be extended twice thereafter by way of a new tendering process. The electricity tariffs are set at two-year intervals at levels that ensure sufficient profit for the suppliers.

The first two provinces in which the rural electricity market was concessioned according to that model were Jujuy (contractor: EJSSEDA) and Salta (contractor: ESEDSA, a subsidiary of Spanish utility company Unión Fenosa) in the north-western part of the country. Most electrification is effected on the basis of isolated networks or off-grid approaches relying on fossil fuels (diesel generators) and/or renewable sources of energy. Beginning in March 1998 EJSSEDA provided roughly half of its customers with diesel generators, roughly one quarter with micro-hydropower facilities, and the rest with photovoltaic systems. By the end of 1999 more than 40% of the by then over 3,000 customers had electricity from individual or collective photovoltaic power plants.

PERMER

In 1999, PAEPRA was expanded to include as a new component a programme geared specifically to the use of renewable energy sources for rural electrification purposes (Proyecto de Energías Renovables en Mercados Rurales – PERMER). The project aims to broaden the private-sector market for alternative power supply systems and to make the supply of power in rural regions sustainable. PERMER is intended to concentrate on scattered settlements, houses and facilities.²⁹

The six-year project, which runs until mid-2007, involves an estimated total cost of US\$ 120.5 million which will be financed by the World Bank (US\$ 30 million loan), the GEF (US\$ 10 million grant), the Argentine Electricity Investment Development Fund FEDEI (Fondo Especial de Desarrollo Eléctrico del Interior; US\$ 26.5 million subsidy), the concessionaires (US\$ 44 million) and the customers themselves (US\$ 10 million). The consumers have to carry the cost of installation and then render a monthly flat rate that suffices to cover, over the 15-year tenure of the concession, approximately 40 percent of the initial cost plus expenditures for maintenance and batteries. Supplementary subsidies provided to reduce the monthly financial burden for the poorest members of the population gradually decrease in the course of the concession.

It was planned at the beginning of the project to provide electricity to a total of 1.8 million people in 314,000 households and 6,000 institutions and facilities, such as schools, medical centres and police stations. By September of 2006, however, only 2,235 households and 556 public institutions, including schools, were receiving electricity thanks either to expansion of the public grid or to isolated, off-grid solutions.³⁰ At present, 3,440 photovoltaic systems have been installed on private buildings and 690 on public buildings in the provinces of Catamarca, Río Negro, Jujuy, Santiago del Estero, Salta and Tucumán.³¹

Exchange rate (9 March 2007):

1 Argentine peso (ARS) = 0.25 euro (EUR)

1 US dollar = 0.76 EUR

²⁹ Nearly all 23 Argentine provinces have agreed to participate in the project.

For a pertinent list, go to: energia.mecon.gov.ar/permer/conveniotabla.html; status: 20 November 2006.

³⁰ Regarding the present status of the PERMER project, please refer to energia.mecon.gov.ar/permer/Estado.html; Status: 1 December, 2006.

³¹ The project's progress in the various provinces can be tracked at energia.mecon.gov.ar/permer/avance.html; Status: 20 November, 2006.

1.7 Information Sources

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Fuentes renovables de energía en América Latina y el Caribe: Dos años después de la conferencia en Bonn, Septiembre de 2006, Santiago de Chile
- National law no. 25,019 regulating wind and solar energy (Régimen Nacional de Energía Eólica y Solar) of 23 September 1998
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- **Righini, R., H., Grossi Gallegos & C. Raichijk:**
Approach to drawing new global solar irradiation contour maps for Argentina. Renewable Energy, vol. 30, 2005, pp. 1241-1255
- **Secretaria de Energía:**
Informes del sector eléctrico para los años 2000 hasta 2004, Noviembre 2001-2005
- **Secretaria de Energía (2004a):**
Energías Renovables 2004 – Energía Geotérmica.
- **Secretaria de Energía, (2003a):**
Prospectiva 2002, Mayo 2003

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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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