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Enhancing information for renewable energy technology deployment in
Brazil, China, and South Africa

Activity 1 Output for Brazil

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Index

Executive Summary.....	7
Brazilian Electric Energy Matrix.....	7
The Primary Energy Matrix.....	7
Wind and Solar Energy Resource Assessment.....	8
Wind Energy.....	8
Solar Energy.....	9
Chapter 1 (Task 1.1)	
Review of National Solar and Wind Energy Resource Assessments in Brazil	10
1.1 Wind Energy Resource Assessments	10
1.1.1 Brazilian Atlas for Wind Energy.....	10
1.1.2 Wind Energy Overview for the Brazil.....	11
1.1.3 Wind Energy Atlas for the Rio Grande do Sul.....	12
1.1.4 Wind Energy Atlas for the Rio de Janeiro.....	12
1.1.5 Wind Energy Atlas for the Alagoas.....	13
1.1.6 Wind Energy Atlas for the São Paulo.....	13
1.1.7 Wind Map for the Paraná.....	14
1.1.8 Wind Energy Atlas for the Maranhão.....	14
1.1.9 Wind Energy Atlas for the Brazilian Northeast Region.....	15
1.1.10 Solar and Wind Energy Resource Assessment in Brazil – SWERA Project Report.....	16



1.2 Solar Energy Resource Assessments	16
1.2.1 Brazilian Atlas for Solar Energy.....	17
1.2.2 Solar Radiation Atlas of Brazil.....	17
1.2.3 Brazilian Solarimetric Atlas Ground Database.....	18
1.2.4 Brazilian Atlas for Electricity.....	18
Chapter 2 (Task 1.2)	
Description of policies and technologies	20
2.1 Review of National Policies to Promote Solar and Wind Energy in Brazil.....	20
2.1.1 National Laws.....	20
2.1.1.1 Program of Incentive for Alternative Energy (PROINFA).....	20
2.1.1.2 Emergency Program of Wind Energy (PROEÓLICA).....	21
2.1.1.3 Program of Universalization Electric Power (Light for All).....	22
2.1.1.4 National Electricity Conservation Program (PROCEL).....	23
2.1.1.5 Public Policy Programs and Incentives for Solar Heaters.....	24
2.1.1.6 National Policy for Alternative Energy.....	24
2.1.1.7 Solar Heaters in National Habitation Programs.....	25
2.1.1.8 Solar Heaters in Buildings supported by PNH and PAC.....	26
2.1.1.9 Alternative Energy for Isolated Systems Program (FAIS), Solar Energy for Water Heating Program (PAES), and Distributed Generations Program (PGD).....	26
2.1.1.10 Brazilian Program for Solar Heaters – PROSOL.....	27
2.1.1.11 Eletrobrás / GTZ Technical Cooperation Project	28
2.1.1.12 PL630/03 – Renewable Sources of Energy.....	29
2.1.1.13 PL6311/09 – REINFA –Incentive Program for Development and Exploitation of Alternative Sources of Energy.....	30



2.1.2 Regional Laws promoting or regulating solar heaters systems.....	30
2.1.2.1 City of São Paulo.....	30
2.1.2.2 State of São Paulo (SP).....	31
2.1.2.3 City of Piracicaba, SP	32
2.1.2.4 City of Peruíbe, SP	32
2.1.2.5 City of Campinas, SP.....	33
2.1.2.6 City of Assis, SP.....	33
2.1.2.7 City of Americana, SP.....	34
2.1.2.8 City of Araçatuba, SP.....	35
2.1.2.9 City of Araraquara, SP.....	35
2.1.2.10 City of Franca, SP	36
2.1.2.11 City of São José dos Campos, SP	36
2.1.2.12 City of Rio de Janeiro, RJ.....	37
2.1.2.13 State of Rio de Janeiro (RJ).....	37
2.1.2.14 City of Belo Horizonte, MG	38
2.1.2.15 City of Juiz de Fora, MG	39
2.1.2.16 City of Ponte Nova, MG.....	39
2.1.2.17 City of Uberaba, MG.....	40
2.1.2.18 City of Curitiba, PR.....	40
2.1.2.19 City of Curitiba, PR.....	41
2.1.2.20 City of Campo Grande, MS.....	42
2.1.2.21 City of Porto Alegre, RS.....	42
2.1.2.22 State of Ceará (CE).....	43



2.1.2.23 State of Minas Gerais (MG).....	43
2.2 Review of Wind Energy Technologies in use in Brazil.....	44
2.2.1 Wind Farms Osório/Índios/Sangradouro, Rio Grande do Sul – South of Brazil.....	44
2.2.2 Wind Farm in Bom Jardim da Serra, Santa Catarina – South of Brazil....	45
2.2.3 Wind Farm in Água Doce, Santa Catarina – South of Brazil.....	46
2.2.4 Wind Farm in Horizonte, Santa Catarina – South of Brazil.....	47
2.2.5 Wind Farm of Palmas, Paraná – South of Brazil.....	47
2.2.6 Wind Farm of Morro do Camelinho, Minas Gerais – Southeast Region of Brazil.....	48
2.2.7 Wind Farm in Olinda, Pernambuco – Northeast Region of Brazil.....	49
2.2.8 Wind Farm of Fernando de Noronha, Pernambuco – Northeast Region of Brazil.....	49
2.2.9 Wind Farm Millennium, Paraíba – Northeast Region of Brazil.....	50
2.2.10 Wind Farm in Macaú, Rio Grande do Norte – Northeast Region of Brazil.....	50
2.2.11 Wind Farm in Rio do Fogo, Rio Grande do Norte – Northeast Region of Brazil.....	51
2.2.12 Wind Farm in Muçuripe, Ceará – Northeast Region of Brazil.....	52
2.2.13 Wind Farm in Prainha, Ceará – Northeast Region of Brazil.....	52
2.2.14 Wind Farm in Taíba, Ceará – Northeast Region of Brazil.....	53
2.2.15 Wind Farm in Beberibe, Ceará – Northeast Region of Brazil.....	53
2.2.16 Wind Farm of Pedra do Sal, Piauí – Northeast Region of Brazil.....	54
2.2.17 Wind Farm in Rio do Choró, Ceará – Northeast Region of Brazil.....	54
2.2.18 Wind Farm in Paracuru, Ceará – Northeast Region of Brazil.....	55



2.2.19 Vale dos Ventos Wind Farm, Paraíba – Northeast Region of Brazil	55
Chapter 3	
Survey of project developers and project financiers	56
3.1 Wind Energy	56
3.1.1 Developers.....	57
3.1.2 Financiers.....	61
3.2 Solar Energy	64
3.2.1 PV Solar Systems.....	64
3.2.1 Solar Water Heater Systems.....	65



Executive Summary

Basic National Information

Surface Area	• 8,514,877 km ²
Population	• 186.8 million
Language	• Portuguese
Gross National Product	• 1300 billion US\$
Domestic Energy Supply	• 239.4 million toe
Domestic Electric Energy Supply	• 444.6 TWh

Brazilian Electric Energy Matrix

The 6.0% increase in the total consumption of electricity was an important key aspect concerning the performance of the Brazilian energy sector in 2007. The total domestic electric energy supply that year reached 444.6 TWh in Brazil. From this total, 75% are from hydroelectric plants. If other renewable sources are included, such as wind, sugar cane bagass, and other biomass resources, 80% of the electricity generated in Brazil are from renewable sources; this share is among the highest in the world.

The Primary Energy Matrix

The outstanding development in renewable energy exploitation in Brazil was the production of ethanol from sugarcane, with a 388,700 barrels/day in 2007, a 27% growth with respect to 2006. About 16% of the primary energy is derived from ethanol and other byproducts of sugar cane, most of it to attend the automotive energy demand. Wood and natural charcoal are also important with a 12% share. Hydroelectricity represents about 15% of the primary energy matrix. On the whole, Brazil ranks an outstanding 46% of renewable sources in its primary energy matrix, which significantly contrasts with the global average of 12.9%, and with the 6.7% average observed in OECD countries.



Wind and Solar Energy Resource Assessment

There are several publications and data centers with important information on wind and solar energy resources in Brazil. Most are privately owned and are therefore property. Nevertheless some of them are public domain, such as wind and solar atlas, data from ground meteorological stations and platforms solar and wind towers. They can be found at: <http://swera.unep.net/> and <http://www.cptec.inpe.br/sonda/>.

The expertise and technical resources (computing facilities, satellite image processing, field work) for the assessment of solar and wind energy resources are located in research institutions, such as INPE (National Institute for Space Research) and also in several universities in the country.

According to the latest information from these sources, Brazil has a total wind energy potential of at least 143.5GW/year; half of it in the coastal northeast region. As for solar, the entire country is well suited for solar energy exploitation in all of its arrangements. The daily solar irradiation ranges from more than 4 kWh/m² to about 7 kWh/m² all year long.

Wind Energy

The total wind energy capacity installed in Brazil until mid 2009 was about 440MW, the largest in Latin America, being responsible for nearly 50% of the total capacity, yet, this installed capacity corresponds to less than 3% of the total capacity estimated for Brazil: 146.5GW/year. There are today 17 wind plants installed and in operation, ranging from 0.3MW to 50MW, and most of them located in the Brazilian Northeast and South regions, where the wind energy resource assessment indicates more economic feasibility. Since the implementation of the national program for incentives for wind, small hydro and biomass energies called PROINFA (Alternative Energy Sources Incentive Program) in 2002, there has been a tenfold increment of the national capacity from about 29MW in 2005. Yet, this increment is far behind the ones observed in other developing countries such as China (6GW) and India (8GW).

Brazil has developed a high-quality industrial capacity to produce wind turbines from small 250W stand-alone unities up to 2.3MW both for the local market and to export (about 50% of its annual production).



Solar Energy

Today, solar energy for water heating is by far the most widespread application of solar energy in Brazil. Local solar heating industry is well developed and able to supply the growing market as the natural barrier of lack of information on this technology is being removed. Currently more than 2.2 million m² of heating solar collectors have been installed.

Government incentive programs were created to promote large-scale use of solar water heating systems. The major one is the National Electricity Conservation Program (PROCEL), which was created to promote a more efficient production and consumption of electricity, so as to reduce costs and support investments in this sector. The use of solar energy for residential water heating is one of the modalities embraced by PROCEL since it was shown that the maximum solar heating is closely related to the peak hours demand and to the total energy consumption.

Brazil is particularly well suited for the application of grid-connected PV due to both considerable solar resource availability and high value that can be attributed to PV in commercial areas of urban centers. Commercial urban regions with high midday air-conditioning loads have normally a demand curve in a good match with the solar irradiance curve. Another important factor in this analysis is the comparison between the peak load values in summer and winter. The greater the demand in summertime compared to the demand in wintertime, the more closely the load is likely to match the actual solar resource. This is the typical picture of most main large cities in Brazil.

There are currently only a few hundreds of mini-grids operated by independent power producers (IPPs) or local state utilities in the Brazilian Amazon, that cover the main share of this demand, which is however only a small proportion of the country's total energy consumption. All the electricity are produced in fossil fuel power plants. Most of the sites where those IPPs operate are not easily accessible, increasing cost and decreasing reliability of supply. The potential for using PV, however, is huge, and can be estimated in tens to hundreds of MWp in the Amazon Region alone, even if only a fraction of the 286 existing Diesel oil power plants with a total installed capacity of over 620MVA would adopt some PV to an optimum Diesel / PV mix. Nevertheless, solar energy is not even mentioned in the major national program for renewables, the PROINFA.

Chapter 1 (Task 1.1)

Review of National Solar and Wind Energy Resource Assessments in Brazil

1.1 Wind Energy Resource Assessments

Several studies were developed to evaluate the wind energy resources in the Brazilian territory. The national and regional Wind Atlases listed here were products of these research efforts supported by Brazilian government initiative to generate a reliable database necessary for planning and boosting the wind energy exploitation. These publications have pointed out areas as possible places for wind exploitation and a further assessment was needed and then conducted. The Northeast region of the country and some states of the South and Southeast regions are the main areas of interest. The outcome can be seen in the following list:

- Brazilian Atlas for Wind Energy
- Wind Energy Overview for the Brazil
- Wind Energy Atlas for the Rio Grande do Sul
- Wind Energy Atlas for the Rio de Janeiro
- Wind Energy Atlas for the Alagoas
- Wind Energy Atlas for the São Paulo
- Wind Energy Atlas for the Maranhão
- Wind Energy Atlas for the Brazilian Northeast Region
- Solar and Wind Energy Resource Assessment in Brazil – SWERA Project Report

The detailed information on each one of them are organized next.

1.1.1 Brazilian Atlas for Wind Energy

Identification	
Title	Atlas do Potencial Eólico Brasileiro (Brazilian Atlas of Wind Energy)
Year	2001
Scope	Brazil
Sponsor	MME – ELETROBRAS – CEPEL – CRESESB

Approach	
Methodology	The wind potential mapping process was developed by numeric modeling with mesoscale model MASS/MesoMap together with limit-layer model WindMap.
Validation	45 ground sites with anemometers operating at 50m high
Resolution	1km
Main findings	Maps of annual and seasonal average for wind velocity and direction. The Weibull parameters and wind resource potential are also presented.
Availability	
Custodian	CRESESB
Format	Printed Book
Accessibility	Available to buy in CRESESB website
Price	US\$ 18,00

1.1.2 Wind Energy Overview for the Brazil

Identification	
Title	Wind Energy Overview for the Brazil
Year	2003
Scope	Brazil
Sponsor	ANEEL
Approach	
Methodology	Numeric modeling by using mesoscale model MM5 together with WAsP.
Validation	Comparison with digital anemometers throughout Brazilian territory.
Resolution	1km
Main findings	Annual and seasonal wind velocity and direction at 50m high for the Brazilian territory and Northeast region.
Availability	
Custodian	ANEEL
Format	Printed Book
Accessibility	More information at www.aneel.gov.br/
Price	Free of charge

1.1.3 Wind Energy Atlas for the Rio Grande do Sul

Identification	
Title	Wind Atlas of Rio Grande do Sul
Year	2003
Scope	Territory of the state of Rio Grande do Sul
Sponsor	State Company for Electricity State Government of Rio Grande do Sul
Approach	
Methodology	The wind potential mapping process was developed by using data acquired by a network of anemometers and data provided by a numeric modeling with mesoscale model MASS/MesoMap together with limit-layer model WindMap.
Validation	Twenty two wind towers with measurements acquired along 2 years. The anemometers were at 50m height.
Resolution	1km x 1km
Main findings	Thematic maps for the annual and seasonal average of the wind speed and direction for 50m, 75m, and 100m height daytime regime and the Weibull distribution parameters .
Availability	
Custodian	State Government of Rio Grande do Sul
Format	Digital - html format and pdf file
Accessibility	It can be accessed in http://www.semc.rs.gov.br/atlas/
Price	Free of charge

1.1.4 Wind Energy Atlas for the Rio de Janeiro

Identification	
Title	Wind Atlas of Rio de Janeiro
Year	2003
Scope	Territory of the stated of Rio de Janeiro
Sponsor	SEINPE-ELETROBOLT
Approach	
Methodology	The wind potential mapping process was developed by using data acquired by a network of anemometers and data provided by a numeric modeling with mesoscale model MASS/MesoMap together with limit-layer model WindMap.
Validation	Five anemometric towers with 40m and 61m height. Data were acquired along 22 months. Three towers were installed in the lakes region and 2 towers in the north along the shore.
Resolution	200m x 200m

Main findings	Thematic maps for the annual and seasonal average of the wind speed and direction for 50m, 75m, and 100m height over the terrain, daytime regime and the Weibull distribution parameters.
Availability	
Custodian	SEINPE
Format	Printed Book and CR-ROM
Accessibility	Public
Price	Free of charge

1.1.5 Wind Energy Atlas for the Alagoas

Identification	
Title	Wind Atlas of Alagoas
Year	2009
Scope	Territory of the state of Alagoas
Sponsor	ELETROBRAS, Technology Institute for Development (LACTEC) and University of Alagoas (UFAL).
Approach	
Methodology	Not available
Validation	In progress
Resolution	Not available
Main findings	In progress
Availability	
Custodian	ELETROBRAS
Format	Not published at the moment.
Accessibility	Not available
Price	Not available

1.1.6 Wind Energy Atlas for the São Paulo

Identification	
Title	Wind Atlas of São Paulo
Year	Service contracted in 2008
Scope	State of São Paulo
Sponsor	Metropolitan Company for Water and Energy (EMAE)
Approach	
Methodology	WAsP/KAMM method.
Validation	Seven wind towers between 50m to 100m.
Resolution	200m X 200m
Main findings	In progress

Availability	
Custodian	Metropolitan Company for Water and Energy (EMAE)
Format	Not available
Accessibility	Not available
Price	Not available

1.1.7 Wind Map for the Paraná

Identification	
Title	Potential Wind Atlas of the State of Paraná
Year	1st edition in 1999, updated in August, 2009
Scope	Paraná state
Sponsor	COPEL - Companhia Paranaense de Energia
Approach	
Methodology	Not available
Validation	34 wind farms (one with 100 meters height).
Resolution	Not available
Main findings	The electricity generation from wind in Paraná can reach 3375 megawatts (9.3 million megawatt-hours of electricity per year - approximately 40% of the consumption in Paraná). The areas mapped the South-Center area as the best potential wind sites. Nevertheless, the north and west regions have presented a larger wind resource than estimates in the first atlas edition.
Availability	
Custodian	COPEL - Companhia Paranaense de Energia
Format	Not available
Accessibility	Not available
Price	Not available

1.1.8 Wind Energy Atlas for the Maranhão

Identification	
Title	Wind Atlas of Maranhão
Year	Planning
Scope	Territory of the state of Maranhão
Sponsor	State Government of Maranhão and University of Maranhão.
Approach	
Methodology	Not available
Validation	In progress
Resolution	Not available

Main findings	In progress
Availability	
Custodian	State Government of Maranhão
Format	Not available
Accessibility	Not ready
Price	Not available

1.1.9 Wind Energy Atlas for the Brazilian Northeast Region

Identification	
Title	Wind Atlas for the Northeast Region of Brazil
Year	1998
Scope	Northeast of Brazil
Sponsor	ANEEL
Approach	
Methodology	The first version of the WANEb project includes a description of the wind resource for Northeast of Brazil and a preliminary wind assessment using reliable wind data from the Brazilian Wind Energy Centre, electricity companies and selected meteorological stations.
Validation	Data from 13 wind energy tower and 2 conventional meteorological stations.
Resolution	Not Available
Main findings	<ul style="list-style-type: none"> • Description of the trade wind front trajectory in the Northeast of Brazil, and model it for wind power applications; • Characterisation of the mesoscale circulation, defining typical wind climate using a dynamical numerical model; • Identification of the regional windy areas for siting wind turbines; • Classification of the regional roughness length for wind energy application, using remote sensing analysis; • Modeling land-sea breeze circulation and daily speed variation;
Availability	
Custodian	ANEEL
Format	Printed Book
Accessibility	Information at http://www.eolica.org.br/Waneb.htm
Price	Free of Charge

1.1.10 Solar and Wind Energy Resource Assessment in Brazil – SWERA Project Report

Identification	
Title	Solar and Wind Energy Resource Assessment in Brazil – SWERA Project Report.
Year	2008
Scope	Brazil
Sponsor	UNEP/GEF
Approach	
Methodology	The mesoscale model ETA was used for winds maps and BRASIL-SR model was adopted for solar energy assessment.
Validation	Database acquired from 1995 to 2005 all around the Brazilian Territory were used to validate the solar energy resource assessment. Ground data acquired at airports, at automatic weather stations (AWS) and at SONDA network sites were used to validate the wind energy assessment.
Resolution	10 km
Main findings	This report demonstrate the long-term potential for the large scale use of solar and wind energies in Brazil. It is one of the outputs of Project SWERA for Brazil. It provides high quality information in suitable formats on solar and wind energy resources, along with the tools needed to apply these data in ways that facilitate energy policies and investments.
Availability	
Custodian	INPE/CEPEL
Format	Printed Book and PDF file
Accessibility	Available from http://sonda.cptec.inpe.br
Price	Free of charge

1.2 Solar Energy Resource Assessments

The solar energy has not received so much attention from Brazilian government policies as the wind energy. Even so, there are efforts toward the knowledge of the Brazilian solar resource in order to stimulate investments and technology development in this area.

The following publications are the result of those research efforts:

- Brazilian Atlas for Solar Energy
- Solar Radiation Atlas of Brazil
- Brazilian Solarimetric Atlas Ground Database

- Brazilian Atlas for Electricity

1.2.1 Brazilian Atlas for Solar Energy

Identification	
Title	Brazilian Atlas for Solar Energy
Year	2006
Scope	Brazil
Sponsor	UNEP/GEF
Approach	
Methodology	Using the radiative transfer model BRASIL-SR and a geo-referenced database of environmental and socio-economic data provided by several national and international partners.
Validation	Data collected at 8 ground sites of the SONDA network (http://sonda.cptec.inpe.br) and at 98 sites of automatic weather stations network distributed throughout the Brazilian territory.
Resolution	10km
Main findings	Digital and printed maps of global, diffuse, normal direct and PAR components of solar irradiation. Solar energy scenarios were prepared using GIS tools. The typical meteorological year for themain Brazilian cities were developed, too.
Availability	
Custodian	INPE
Format	Printed Book, PDF file and Digital database
Accessibility	Available for download at http://swera.unep.net/ and www.cptec.inpe.br/sonda/
Price	Free of charge

1.2.2 Solar Radiation Atlas of Brazil

Identification	
Title	Solar Radiation Atlas of Brazil
Year	1998
Scope	Brazil
Sponsor	INMET
Approach	
Methodology	Estimates provided by BRASIL-SR model based on satellite data.
Validation	Database acquired on 22 ground sites operated by the Brazilian Institute for Meteorology (INMET) and 10 ground sites operated in cooperation by Solar Energy Laboratory of the University of Santa Catarina (LABSOLAR/UFSC) and Brazilian Institute for Space Research (INPE).

Resolution	50km
Main findings	All solar irradiation components (global, diffuse and normal direct) presented in maps and charts.
Availability	
Custodian	INMET
Format	Printed Book
Accessibility	Public
Price	R\$ 30,00 (US\$10,00) Available at INMET's website: http://www.inmet.gov.br/ or http://www.inmet.gov.br/html/informacoes/publicacoes/

1.2.3 Brazilian Solarimetric Atlas Ground Database

Identification	
Title	Brazilian Solarimetric Atlas Ground Database
Year	2000
Scope	Brazil
Sponsor	MME / ELETROBRÁS / CEPEL / CRESESB
Approach	
Methodology	Ground data acquired in more than 500 sites throughout Brazilian territory by using pyranometers and actinographers.
Validation	Not available
Resolution	Not available
Main findings	Isolines Charts and Maps for daily and monthly global solar irradiation and insolation.
Availability	
Custodian	CRESESB
Format	Printed Book
Accessibility	Public
Price	R\$ 30,00 plus mailing costs Available from CRESESB website: http://www.cresesb.cepel.br/

1.2.4 Brazilian Atlas for Electricity

Identification	
Title	Brazilian Atlas of Electricity – 2nd edition
Year	2005
Scope	Brazil
Sponsor	Brazilian Agency for Electric Energy (ANEEL)

Approach	
Methodology	Based on data acquired in 1998-2002 period. Main source of data are: demographic census, energy utilities and stakeholders, several government and private organizations. Focused on the production, transmission and distribution of electric energy and the socioeconomic and environmental impacts of different sources and technologies for energy supply. Took on account historical data of electricity generation and consumption.
Validation	Not available
Resolution	Not available
Main findings	Targets and forecasts for conventional and alternative energy sources in the future electricity generation.
Availability	
Custodian	ANEEL
Format	Printed Book
Accessibility	Public
Price	Free of Charge

Chapter 2 (Task 1.2)

Description of policies and technologies

2.1 Review of National Policies to Promote Solar and Wind Energy in Brazil

2.1.1 National Laws.

- Program of Incentive for Alternative Energy (PROINFA)
- Emergency Program of Wind Energy (PROEÓLICA)
- Program Light for All
- National Electricity Conservation Program (PROCEL)
- Public Policy Programs and Incentives for Solar Heaters
- National Policy for Alternative Energy
- Solar Heaters in National Habitation Programs
- Solar Heaters in Buildings supported by PNH and PAC
- Alternative Energy for Isolated Systems Program (FAIS), Solar Energy for Water Heating Program (PAES), and Distributed Generations Program (PGD)
- Brazilian Program for Solar Heaters – PROSOL
- Eletrobrás / GTZ Technical Cooperation Project

2.1.1.1 Program of Incentive for Alternative Energy (PROINFA)

Identification	
Title	LAW N° 10438
Year	2002
Jurisdiction	Federal
Goal	Promote the use of renewable technologies (specifically wind, biomass and small hydro) through incentives and subsidies.
Status	Published on April 22nd., 2002
Design	
Resource	Biomass, Small Hydro and Wind
Sector	Electricity

Instrument	Funding with long-term interest by National Economic and Social Development Bank (BNDES); 20 years contracts with guaranteed return of 70% of the energy and full protection to risk in energy market, investments in R&T.
Nature	Strategic – short term measure to boost up the renewable energy market.
Implementation and enforcement	
Agency	Ministry of Mines and Energy - MME.
Budget	Not available
Staff	Not available
Sanctions	Not available
Results	
Planned	Total Power of 3,300 MW to be incorporated into the National Integrated Power System (SIN): 1,100 MW from wind energy; 1,100 MW from small hydroelectric plants (PCH); and 1,100 MW from biomass thermoelectric plants. The power plants will generate nearly 12.000 GWh/year, energy enough to supply 3.2% of the annual country consumption.
Actual	Total Power of 2,074 MW: 425 MW from wind energy; 1,135 MW from PCHs; and 514 MW from biomass thermoelectric plants.
Forecasts	Total Power of 3,299 MW: 1,423 MW from wind energy; 1,191 MW from PCHs; and 685 MW from biomass thermoelectric plants.
Comments	Some articles were change when Law no. 10762 was published at November 11th. 2003 in order to create the Emergency Program to Support Electricity Companies. Some articles were changed when Law no. 11488 was published at June 15th. 2007. The Law no. 11488 provides for Special Regime for Infrastructure Development other provisions.

2.1.1.2 Emergency Program of Wind Energy (PROEÓLICA)

Identification	
Title	CGE Resolution nº 24
Year	2001
Jurisdiction	Federal
Goal	Adding 1,050 megawatts of wind capacity to the national grid by December 2003.
Status	Published on July 6th, 2001
Design	
Resource	Wind
Sector	Electricity

Instrument	Under Proeólica, the federal government guarantees a purchase of wind-generated electricity by state utility Eletrobras for at least 15 years.
Nature	Emergency
Implementation and enforcement	
Agency	Power Crisis Management Chamber
Budget	Not available
Staff	Not available
Sanctions	Not available
Results	
Planned	Not available
Actual	1,050 MW
Forecasts	Not available
Comments	In July 2001, in the midst of the electricity crisis brought on by persistent drought, the Power Crisis Management Chamber established the PRÓEÓLICA emergency wind energy program. The rule of law does not promote a long-term establishment of a wind industry in Brazil, but has created an incentive for the importation of wind turbines.

2.1.1.3 Program of Universalization Electric Power (Light for All)

Identification	
Title	Decree N° 4873
Year	2003
Jurisdiction	Federal
Goal	The program intends to deliver electricity in remote regions and rural areas not reached by the interconnected distribution system. It does not directly addresses wind and solar energy but considers both viable in remote areas far from the electricity grid.
Status	Published on November 11th., 2003
Design	
Resource	Energy resources in general but with a strong link with solar and wind for remote areas.
Sector	Electricity
Instrument	Energy Development Account (CDE); other Federal, State and Municipal Resources, and stakeholders of electricity sector.
Nature	Strategic – short term measure to improve the access to electricity and social development of remote and rural regions.
Implementation and enforcement	
Agency	Ministry of Mines and Energy - MME.
Budget	US\$7billion
Staff	Not available
Sanctions	Not available

Results	
Planned	Reach 100% of Brazilians with access to the electricity services until 2008.
Actual	Program is behind schedule. Decree no. 6442, published at April 25th., 2008, extends this decree until 2010.
Forecasts	Not available
Comments	http://www.elektrobras.gov.br/EM_Programas_Proinfra/default.asp

2.1.1.4 National Electricity Conservation Program (PROCEL)

Identification	
Title	Interministerial Ordinance MME/MIC n° 1.877
Year	1985
Jurisdiction	Federal
Goal	Provides for National Electricity Conservation Program (PROCEL) in order to arrange and manage actions and procedures aiming at the conservation of energy.
Status	Published on December 30th., 1985
Design	
Resource	Solar
Sector	Electricity
Instrument	Decree n° 1.040, published on January 11th., 1994, provides for the official financial agents, the inclusion among the priority lines of credit and financing of projects for the conservation and rational use of energy and increase energy efficiency, including research projects and technological development. Decree published on December 08th., 1993, that provides for the creation of the Energy Efficiency Label (Label PROCEL) to identify products that have optimum levels of energy efficiency, and the National Award for Conservation and Rational Use of Energy for the recognition of contributions towards the conservation and rational use of energy. Law no. 9991, published on July 24th., 2001, provides for investments in R&D in energy efficiency under responsibility of energy companies.
Nature	Strategic – short term measure to improve the energy efficiency and to promote rational use of energy.
Implementation and enforcement	
Agency	ELETROBRAS
Budget	About \$16 million for 2008
Staff	Not available
Sanctions	Not available

Results	
Planned	To support energy efficiency projects in energy utilities (generation, transmission and distribution) and final users.
Actual	Ongoing
Forecasts	Reduction of up to 18% of the electricity demand in 2018
Comments	http://www.eletrabras.com/pci/main.asp?TeamID={1C05658A-8C93-46EA-AC53-7ED9022085E2}

2.1.1.5 Public Policy Programs and Incentives for Solar Heaters

Identification	
Title	LAW Project
Year	2005
Jurisdiction	Federal
Goal	Provides for the obligation of using solar water heaters in projects for popular housing, and authorizes the Executive Power to create Public Policy Programs and Incentives for deployment and use such equipment in building installations.
Status	Submitted to the Legislative Hall of Brazil.
Design	
Resource	Solar
Sector	Water Heating
Instrument	Will be proposed after regulation by the Executive of Federal government.
Nature	Mandatory for new buildings projects, voluntary for other buildings.
Implementation and enforcement	
Agency	Will be established after regulation by the Executive of Federal government.
Budget	Not available
Staff	Not available
Sanctions	Subjected to rules yet to be defined
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.1.6 National Policy for Alternative Energy

Identification	
Title	LAW Project N° 523
Year	2007

Jurisdiction	Federal
Goal	Provides the National Policy for Alternative Energy among other provisions.
Status	Submitted to the Legislative Hall of the Brazil
Design	
Resource	Biomass, Hydro, Solar and Wind
Sector	Water Heating, Liquid Fuels, Transportation, Electricity
Instrument	Federal Tax Incentives, Funding support with long-term interest, Government Investments in R&T.
Nature	Mandatory deadline for the adequacy
Implementation and enforcement	
Agency	Will be established after regulation by the Executive of Federal government.
Budget	Not available
Staff	Not available
Sanctions	Will be established after regulation by the Executive of Federal government.
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.1.7 Solar Heaters in National Habitation Programs

Identification	
Title	LAW Project N° 478330
Year	2007
Jurisdiction	Federal
Goal	Provides the requirement for using solar water heating in buildings financed with resources from SBPE, FGTS, FAT and OGU -- general budget at all levels of government.
Status	Submitted to the Legislative Hall of Brazil.
Design	
Resource	Solar
Sector	Water Heating
Instrument	Not available
Nature	Mandatory
Implementation and enforcement	
Agency	Will be established after regulation by the Executive of Federal government.
Budget	Not available
Staff	Not available

Sanctions	The Building Permit will not be granted. Others Sanctions will be established after regulation by Federal government.
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.1.8 Solar Heaters in Buildings supported by PNH and PAC

Identification	
Title	LAW Project N° 550307
Year	2007
Jurisdiction	Federal
Goal	Provides for the requirement of solar heaters in popular housing financed by National Habitation Plan (PNH) and National Accelerated Growth Program (PAC), and non-residential buildings including government and military buildings.
Status	Submitted to the Legislative Hall of the Brazil.
Design	
Resource	Solar
Sector	Water Heating
Instrument	National Accelerated Growth Program and the National Habitation Plan
Nature	Mandatory
Implementation and enforcement	
Agency	Will be established after regulation by the Executive of Federal government.
Budget	Not available
Staff	Not available
Sanctions	The Certificate of Occupancy will not be granted. Others Sanctions will be established after regulation by Federal government.
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.1.9 Alternative Energy for Isolated Systems Program (FAIS), Solar Energy for Water Heating Program (PAES), and Distributed Generations Program (PGD)

Identification	
Title	LAW Project N° 1563
Year	2007
Jurisdiction	Federal
Goal	Provides for renewable energy resources in order to promote the distributed generation; Modifies the Law no. 10438 in order to increase the renewable energy share in the Brazilian Energy Matrix.
Status	Submitted to the Legislative Hall of the Brazil.
Design	
Resource	Solar
Sector	Water Heating
Instrument	Alternative Energy for Isolated Systems Program (FAIS); Solar Energy for Water Heating Program (PAES); and Distributed Generations Program (PGD)
Nature	Mandatory
Implementation and enforcement	
Agency	Ministry of Mines and Energy
Budget	Not available
Staff	Not available
Sanctions	Fine and Higher prices for electricity final consumers after deadlines
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.1.10 Brazilian Program for Solar Heaters – PROSOL

Identification	
Title	LAW Project N° 550266
Year	2008
Jurisdiction	Federal
Goal	Provides the Brazilian Program for Solar Heaters – PROSOL.
Status	Submitted to the Legislative Hall of the Brazil.
Design	
Resource	Solar
Sector	Water Heating

Instrument	National Fund of Promotion to the Use of Solar Energy – FUNSOL – supported by 0,1% of Annual Gross Revenue of Electricity companies.
Nature	Mandatory
Implementation and enforcement	
Agency	Will be established after regulation by the Executive of Federal government.
Budget	Not available
Staff	Not available
Sanctions	Not available
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	www.camara.gov.br/sileg/MostrarIntegra.asp?CodTeor=5465

2.1.1.11 Eletrobrás / GTZ Technical Cooperation Project

Identification	
Title	Under the Law 10.438
Year	2005
Jurisdiction	Federal
Goal	Provides for helping power distribution utilities located in the North and Northeast of Brazil to achieve the goals of the Program of Universalization Electric Power (Law 10.438/2002) through the use of Renewable Energy.
Status	Ongoing. Pilot projects implemented.
Design	
Resource	Solar, wind and biomass
Sector	Countryside electrification / photovoltaic
Instrument	DEP - Management Department of Eletrobrás for Universalization Program (email: depp@eletrobras.com)
Nature	Mandatory
Implementation and enforcement	
Agency	Ministry of Mines and Energy and Eletrobrás
Budget	Not available
Staff	Not available
Sanctions	Not available
Results	
Planned	25,000 electric connections
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.1.12 PL630/03 – Renewable Sources of Energy

Identification	
Title	LAW Project N° 630/03
Year	2009
Jurisdiction	Federal
Goal	Provides incentives for energy production from renewable sources and alternative fuels, encourages the development of research related to these energy sources, and establishes the National Fund for Research and Development of Alternative Sources and Renewable Energy.
Status	Ongoing at the Legislative Hall of the Brazil.
Design	
Resource	Solar , Wind, Biomass and Hydrogen
Sector	Energy production
Instrument	Royalties from oil; net operating revenues resulting from the operation of termo power plants using fossil fuels; federal resources, electricity tax, and others resources will constitute National Fund for Research and Development of Alternative Sources and Renewable Energy. Tax incentives.
Nature	Mandatory
Implementation and enforcement	
Agency	Ministry of Mines and Energy
Budget	Not available
Staff	Not available
Sanctions	Not available
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	

2.1.1.13 PL6311/09 – REINFA – Incentive Program for Development and Exploitation of Alternative Sources of Energy

Identification	
Title	LAW Project N° 630/03
Year	2009
Jurisdiction	Federal
Goal	Provides the incentive program for the promotion of development and exploitation of alternative sources of energy and sets out measures to stimulate the production and consumption of clean energy.
Status	Ongoing at the Legislative Hall of the Brazil.
Design	
Resource	Renewable sources of energy
Sector	Energy production
Instrument	Tax incentives for R&D in renewable energy, storage and generation technology and devices with better efficiency and others.
Nature	Mandatory
Implementation and enforcement	
Agency	Ministry of Mines and Energy
Budget	Not available
Staff	Not available
Sanctions	Not available
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	

2.1.2 Regional Laws promoting or regulating solar heaters systems.

2.1.2.1 City of São Paulo

Identification	
Title	DECREE N° 49.148, DE 21 DE JANEIRO DE 2008
Year	2008
Jurisdiction	Municipal

Goal	Regulates Law No. 14459 of July 3rd., 2007, which establishes for the installation of heating system for water solar energy in new buildings of Municipality of São Paulo.
Status	Approved and Published in January 21st., 2008
Design	
Resource	Solar.
Sector	Water heating.
Instrument	Not available
Nature	Mandatory
Implementation and enforcement	
Agency	Executive of Municipality of São Paulo
Budget	Not available
Staff	Not available
Sanctions	Ban of construction and/or Certificate of Occupancy will not be granted
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.2.2 State of São Paulo (SP)

Identification	
Title	LAW Project N° 326
Year	2007
Jurisdiction	State
Goal	Provides for the installation of solar heaters in public buildings.
Status	Ongoing at the Legislative Hall of the State of São Paulo.
Design	
Resource	Solar
Sector	Water Heating
Instrument	Not available
Nature	Mandatory
Implementation and enforcement	
Agency	Executive of the State of São Paulo
Budget	Not available
Staff	Not available
Sanctions	Will be established after regulation by the Executive of the São Paulo State.
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available

Comments	Not available
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2.1.2.3 City of Piracicaba, SP

Identification	
Title	LAW Project N° 278
Year	2006
Jurisdiction	Municipal
Goal	Provides for the Program of Incentives for the Use of Solar Energy in Urban Constructions
Status	Ongoing at the Legislative Hall of the Piracicaba
Design	
Resource	Solar
Sector	Water Heating and PV systems
Instrument	Municipal Tax Incentives
Nature	Voluntary
Implementation and enforcement	
Agency	Not available
Budget	Not available
Staff	Not available
Sanctions	Not available
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.2.4 City of Peruíbe, SP

Identification	
Title	LAW N° 2883
Year	2007
Jurisdiction	Municipal
Goal	Provides for the installation of solar heaters in residences, hospitals, schools and other buildings of private or public nature.
Status	Approved and Published in November 9th., 2007
Design	
Resource	Solar
Sector	Water heating
Instrument	Not available
Nature	Mandatory
Implementation and enforcement	
Agency	Executive of Municipality of Peruíbe

Budget	Not available
Staff	Not available
Sanctions	Ban of construction and/or Certificate of Occupancy will not be granted
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.2.5 City of Campinas, SP

Identification	
Title	Law number 07
Year	2007
Jurisdiction	Municipal
Goal	Provides for the requirement of solar heaters in new buildings in Campinas area.
Status	Ongoing at the Legislative Hall of the Campinas
Design	
Resource	Solar
Sector	Water heating
Instrument	Not available
Nature	Mandatory
Implementation and enforcement	
Agency	Executive of Municipality of Campinas
Budget	Not available
Staff	Not available
Sanctions	Ban of construction and/or Certificate of Occupancy will not be granted
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.2.6 City of Assis, SP

Identification	
Title	LAW N° 0097
Year	2007
Jurisdiction	Municipal

Goal	Provides for tax incentives to boost up the adoption of solar energy for water heating and other uses in urban buildings.
Status	Submitted to the Legislative Hall of Assis
Design	
Resource	Solar
Sector	Water heating and Photovoltaic
Instrument	Tax Incentives
Nature	Voluntary
Implementation and enforcement	
Agency	Executive of Municipality of Assis
Budget	Not available
Staff	Not available
Sanctions	Not available
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.2.7 City of Americana, SP

Identification	
Title	Law number 168
Year	2005
Jurisdiction	Municipal
Goal	Provides for the installation of solar heaters in new buildings.
Status	Submitted to the Legislative Hall of Americana
Design	
Resource	Solar
Sector	Water heating
Instrument	Not available
Nature	Mandatory
Implementation and enforcement	
Agency	Executive of Municipality of the city of Americana
Budget	Not available
Staff	Not available
Sanctions	Ban of construction and/or Certificate of Occupancy will not be granted
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.2.8 City of Araçatuba, SP

Identification	
Title	Law number 90
Year	2007
Jurisdiction	Municipal
Goal	Provides for the installation of solar heaters in new buildings.
Status	Submitted to the Legislative Hall of the city of Araçatuba.
Design	
Resource	Solar
Sector	Water heating
Instrument	Not available
Nature	Mandatory
Implementation and enforcement	
Agency	Executive of Municipality of Araçatuba
Budget	Not available
Staff	Not available
Sanctions	Ban of construction and/or Certificate of Occupancy will not be granted
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.2.9 City of Araraquara, SP

Identification	
Title	Law number 0072
Year	2007
Jurisdiction	Municipal
Goal	Provides for the installation of solar heaters in new buildings.
Status	Submitted to the Legislative Hall of the city of Araraquara
Design	
Resource	Solar
Sector	Water heating
Instrument	Not available
Nature	Mandatory
Implementation and enforcement	
Agency	Executive of Municipality of Araraquara
Budget	Not available
Staff	Not available
Sanctions	Ban of construction and/or Certificate of Occupancy will not be granted

Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.2.10 City of Franca, SP

Identification	
Title	Law number 009
Year	2007
Jurisdiction	Municipal
Goal	Provides for the installation of solar heaters in new buildings.
Status	Submitted to the Legislative Hall of the city of Franca
Design	
Resource	Solar
Sector	Water heating
Instrument	Not available
Nature	Mandatory
Implementation and enforcement	
Agency	Executive of Municipality of Franca
Budget	Not available
Staff	Not available
Sanctions	Ban of construction and/or Certificate of Occupancy will not be granted
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.2.11 City of São José dos Campos, SP

Identification	
Title	Law number 39
Year	2006
Jurisdiction	Municipal
Goal	Provides for tax incentives to boost up the adoption of solar energy for water heating and other uses in urban buildings.
Status	Submitted to the Legislative Hall of the São José dos Campos.
Design	
Resource	Solar
Sector	Water heating and PV

Instrument	Tax Incentives
Nature	Mandatory
Implementation and enforcement	
Agency	Executive of Municipality of São José dos Campos
Budget	Not available
Staff	Not available
Sanctions	Not available
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.2.12 City of Rio de Janeiro, RJ

Identification	
Title	LAW Project N° 1221
Year	2007
Jurisdiction	Municipal
Goal	Provides for the installation of the solar systems for water heating.
Status	Submitted to the Legislative Hall of the city of Rio de Janeiro.
Design	
Resource	Solar
Sector	Water Heating
Instrument	Tax incentive to be established in the regulation and awareness programs
Nature	Mandatory
Implementation and enforcement	
Agency	Executive of Municipality of Rio de Janeiro
Budget	Not available
Staff	Not available
Sanctions	Ban of construction and/or Certificate of Occupancy will not be granted
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.2.13 State of Rio de Janeiro (RJ)

Identification	
Title	LAW N° 5184

Year	2008
Jurisdiction	State of the Rio de Janeiro
Goal	Provides for the installation of solar heaters in buildings of a public nature within the State of Rio de Janeiro.
Status	Approved and Published in January 2nd., 2008
Design	
Resource	Solar
Sector	Water Heating
Instrument	Not available
Nature	Mandatory
Implementation and enforcement	
Agency	Executive of the State of Rio de Janeiro
Budget	Not available
Staff	Not available
Sanctions	Will be established after regulation by the Executive of the State of Rio de Janeiro.
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available

2.1.2.14 City of Belo Horizonte, MG

Identification	
Title	LAW Project N° 1390
Year	2007
Jurisdiction	Municipal
Goal	Provides for the installation of the solar heaters in urban buildings.
Status	Submitted to the Legislative Hall of the Belo Horizonte
Design	
Resource	Solar
Sector	Water Heating
Instrument	Not available
Nature	Mandatory
Implementation and enforcement	
Agency	Executive of Municipality of Belo Horizonte
Budget	Not available
Staff	Not available
Sanctions	Ban of construction and/or Certificate of Occupancy will not be granted
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available

Comments	Not available
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2.1.2.15 City of Juiz de Fora, MG

Identification	
Title	LAW Project N° 31
Year	2006
Jurisdiction	Municipal
Goal	Provides for the installation of the heating water by solar energy in residences, hospitals, schools and any other buildings of a public nature.
Status	Ongoing at the Legislative Hall of the city of Juiz de Fora
Design	
Resource	Solar
Sector	Water heating
Instrument	IPTU tax incentive (10% off)
Nature	Voluntary
Implementation and enforcement	
Agency	Executive of Municipality of Juiz de Fora
Budget	Not available
Staff	Not available
Sanctions	Will be established after regulation by the Executive of Municipality of Juiz de Fora.
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.2.16 City of Ponte Nova, MG

Identification	
Title	Law number 1
Year	2007
Jurisdiction	Municipal
Goal	Provides for the installation of solar heaters in new buildings larger than 150 m2 of Municipality of Ponte Nova.
Status	Submitted to the Legislative Hall of Ponte Nova.
Design	
Resource	Solar
Sector	Water heating
Instrument	Not available
Nature	Mandatory

Implementation and enforcement	
Agency	Executive of Municipality of Ponte Nova
Budget	Not available
Staff	Not available
Sanctions	Ban of construction and/or Certificate of Occupancy will not be granted
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.2.17 City of Uberaba, MG

Identification	
Title	Law number 354
Year	2007
Jurisdiction	Municipal
Goal	Provides for the installation of solar heaters in buildings.
Status	Submitted to the Legislative Hall of city of Uberaba
Design	
Resource	Solar
Sector	Water heating
Instrument	Tax Incentives
Nature	Mandatory with deadlines to be regulated
Implementation and enforcement	
Agency	Executive of Municipality of Uberaba
Budget	Not available
Staff	Not available
Sanctions	Ban of construction and/or Certificate of Occupancy will not be granted
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

.1.2.18 City of Curitiba, PR

Identification	
Title	LAW Project N° 05.00236
Year	2006
Jurisdiction	Municipal
Goal	Provides for the Program of Incentives to the Use of Solar Energy in Urban Constructions.
Status	Ongoing at the Legislative Hall of the city of Curitiba
Design	
Resource	Solar
Sector	Water Heating and PV systems
Instrument	Municipal Tax Incentives
Nature	Voluntary
Implementation and enforcement	
Agency	Executive of Municipality of Curitiba
Budget	Not available
Staff	Not available
Sanctions	Not Applicable
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.2.19 City of Curitiba, PR

Identification	
Title	LAW Project N° 05-00245- 2007
Year	2007
Jurisdiction	Municipal
Goal	Provides the Municipal Policy for Global Warming and Climate Change, Alternative Energy and other provisions. Provides for the obligation of using of energy systems with high efficiency in buildings.
Status	Ongoing at the Legislative Hall of the Curitiba.
Design	
Resource	Renewable energy and Energy Efficiency
Sector	Water Heating, Transportation, Electricity
Instrument	Municipal Tax Incentives
Nature	Mandatory with deadlines for the adequacy
Implementation and enforcement	
Agency	Executive of Municipality of Curitiba

Budget	Not available
Staff	Not available
Sanctions	The Certificate of Occupancy will not be granted for new building without energy systems according established in Law. Provides 5 years to adequacy for buildings in use. Fines: R\$500,00 for residential buildings and R\$1000,00 for other buildings.
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.2.20 City of Campo Grande, MS

Identification	
Title	LAW Project N° 6260
Year	2007
Jurisdiction	Municipal
Goal	Provides for the Incentives Program for Solar Energy Adoption in Urban Buildings
Status	Submitted to the Legislative Hall of the city of Campo Grande
Design	
Resource	Solar
Sector	Water Heating and PV systems
Instrument	Municipal Tax Incentives
Nature	Voluntary
Implementation and enforcement	
Agency	Executive of Municipality of Campo Grande.
Budget	Not available
Staff	Not available
Sanctions	Not applicable
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.2.21 City of Porto Alegre, RS

Identification	
Title	LAW N° 0022
Year	2006
Jurisdiction	Municipal
Goal	Provides for tax incentives to boost up the adoption of solar energy for water heating and other uses in urban buildings.
Status	Ongoing at the Legislative Hall of Porto Alegre
Design	
Resource	Solar
Sector	Water heating and Photovoltaic
Instrument	Tax Incentives
Nature	Voluntary
Implementation and enforcement	
Agency	Executive of Municipality of Porto Alegre
Budget	Not available
Staff	Not available
Sanctions	Not applicable
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.2.22 State of Ceará (CE)

Identification	
Title	LAW Project N° 375
Year	2007
Jurisdiction	State of Ceará
Goal	Provides the State Policy for Solar Energy.
Status	Ongoing at the Legislative Hall of the State of Ceará.
Design	
Resource	Solar
Sector	Water Heating and PV
Instrument	Tax Incentives, Funding with long-term interest, Government Investments in R&T.
Nature	Voluntary
Implementation and enforcement	
Agency	Will be established after regulation.
Budget	Not available
Staff	Not available

Sanctions	Will be established after regulation.
Results	
Planned	Not available
Actual	Not available
Forecasts	Not available
Comments	Not available

2.1.2.23 State of Minas Gerais (MG)

Identification	
Title	Project Luz Solar
Year	1999
Jurisdiction	State of Minas Gerais
Goal	Supply countryside areas far from the electric distribution network with electric power generated by photovoltaic systems.
Status	2005 complete
Design	
Resource	Solar
Sector	PV
Instrument	CEMIG (Energy Company of Minas Gerais) with partnership of the Ministry of Mines and Energy, through the PRODEEM (Energy Development Program of the States and Municipalities), the State Department of Mines and Energy, the Municipalities and the Germand Bank KfW.
Nature	Voluntary
Implementation and enforcement	
Agency	CEMIG
Budget	USD 7,830,000
Staff	Not available
Sanctions	Not available
Results	
Planned	Not available
Actual	10,000 systems installed
Forecasts	Not available
Comments	The program prioritized the East of the state and the Jequitinhonha Valley, difficult access areas with a low HDI

2.2 Review of Wind Energy Technologies in use in Brazil

2.2.1 Wind Farms Osório/Índios/Sangradouro, Rio Grande do Sul – South of Brazil

Identification	
Name	Wind farms of Osório, Sangradouro e Índios
Manufacturer	Wobben Windpower
Output	150 MW (each wind farm generates 50 MW)
Release year	December 2006
Warranty	3 – 5 years
Operation	
Owner	Ventos do Sul Energia S.A.
Adoption year	2006
Rationale	Grid connection. All production is delivered to the SIN (National Interconnected System). Power Purchase Agreement for 20 years.
Lifetime	25 - 30 years
Incidents	
Comments	<p>Financed as established by PROINFA rules. Osório project received an investment of approximately US\$ 300 million.</p> <p>It is planned in Osório a new wind farm which should double the current output. More 242 MW is also planned in Palmares do Sul. Now under the responsibility of Enerfin, new facilities will have an estimated investment in US\$ 500 million. Enerfin, which controls Ventos do Sul, is the wind arm of the Spanish Elecnor.</p>

2.2.2 Wind Farm in Bom Jardim da Serra, Santa Catarina – South of Brazil

Identification	
Name	Wind Farm of Bom Jardim da Serra
Manufacturer	Step 1 - Wobben Windpower Step 2 - IMPSA
Output	Step 1 – 0.6 MW Step 2 – 91.9 MW Total – 92.5 MW

Release year	Step 1 – 2002 Step 2 – end of 2009 (forecast)
Warranty	Step 1 - 3 – 5 years
Operation step 1	
Owner	Parque Eólico de Santa Catarina Ltda
Adoption year	2002
Rationale	Grid connection
Lifetime	20 – 25 years
Incidents	Not available
Comments	Financed as established by PROINFA rules
Operation step 2	
Owner	IMPSA
Adoption year	2009 (forecast)
Rationale	Grid connection
Lifetime	20 – 25 years
Incidents	Not available
Comments	Financed as established by PROINFA rules Power purchase agreement (PPA) for 20 years signed with Eletrobrás. Step 2 will receive investments around 290 million USD from IMPSA.

2.2.3 Wind Farm in Água Doce, Santa Catarina – South of Brazil

Identification	
Name	Wind Farm of Água Doce
Manufacturer	Step 1 - Wobben Windpower Step 2 - IMPSA
Output	Step 1 - 4.8 MW Step 2 – 125.8 MW Total – 130.6 MW
Release year	Step 1 – 2006 Step 2 - end of 2009 (forecast)
Warranty	3 – 5 years
Operation step 1	
Owner	EDP Renováveis Brasil / Central Nacional de Energia Eólica Ltda – CENAEEL
Adoption year	2006
Rationale	Grid connection
Lifetime	20 –25 years
Incidents	Not available

Comments	Financed as established in PROINFA rules CENAEEL has a 20-year PPA (power purchase agreement) with CELESC (Centrais Eletricas de Santa Catarina), signed in 2002. Project by Camargo Schubert Wind Engineering.
Operation step 2	
Owner	IMPSA
Adoption year	2009 (forecast)
Rationale	Grid connection
Lifetime	20 –25 years
Incidents	Not available
Comments	Financed as established by PROINFA rules. Power purchase agreement (PPA) signed with Eletrobrás for 20 years. Step 2 will receive investments around 420 million USD from IMPSA. On February 2009, EDP Renováveis Brasil S.A. (manage by Enernova), acquired CENAEEL (Central Nacional da Energia Eólica S.A.) at a cost of R\$51.3 million and net debt of R\$12.9 million.

2.2.4 Wind Farm in Horizonte, Santa Catarina – South of Brazil

Identification	
Name	Wind Farm of Horizonte
Manufacturer	Wobben Windpower
Output	4,8 MW
Release year	2003
Warranty	3 – 5 years
Operation	
Owner	EDP Renováveis Brasil / Central Nacional de Energia Eólica Ltda – CENAEEL
Adoption year	February 2004
Rationale	Grid connection
Lifetime	20 – 25 years
Incidents	Not available
Comments	Power purchase agreement with CELESC for 20 years. On February 2009, EDP Renováveis Brasil S.A. (manage by Enernova), acquired CENAEEL (Central Nacional da Energia Eólica S.A.) at a cost of R\$51.3 million and net debt of R\$12.9 million.

2.2.5 Wind Farm of Palmas, Paraná – South of Brazil

Identification	
Name	Wind Farm of Palmas
Manufacturer	Wobben Windpower
Output	2,5 MW
Release year	1999
Warranty	3 – 5 years
Operation	
Owner	Centrais Eólicas do Paraná Ltda
Adoption year	1999
Rationale	Grid connection
Lifetime	20 – 25 years
Incidents	Not available
Comments	The Centrais Eólicas do Paraná Ltda is a joint company of Paraná's Energy Company (COPEL) (30%) and Wobben Wind Power (70%), - a Brazilian subsidiary of the German Enercom. According to Wobben, the investment was around US\$ 1 million per installed MW.

2.2.6 Wind Farm of Morro do Camelinho, Minas Gerais – Southeast Region of Brazil

Identification	
Name	Central Eólica Experimental do Morro do Camelinho (Experimental Centre of Wind of Morro do Camelinho)
Manufacturer	CEMIG Geração e Transmissão S/A
Output	1,0 MW
Release year	1994
Warranty	3 – 5 years
Operation	
Owner	CEMIG Geração e Transmissão S/A
Adoption year	1994
Rationale	Grid connection
Lifetime	20 – 25 years
Incidents	In February 1998, the measurements made by DEWI showed that the wind turbines control system were not well adapted to the special wind conditions of this site. Changes in the parameter setting controls improved the operational behaviour of the turbines. Those improvements decreased the numbers of long stand still periods considerably.

Comments	Total cost: US\$ (US\$ 790,000 were paid by the German Government Eldorado Program and US\$ 750,000 were financed by CEMIG.
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2.2.7 Wind Farm in Olinda, Pernambuco – Northeast Region of Brazil

Identification	
Name	Eólica Olinda
Manufacturer	Wind World A/S (Denmark)
Output	0.25 MW
Release year	1999
Warranty	3 – 5 years
Operation	
Owner	Brazilian Centre for Wind Energy – FADE/UFPE
Adoption year	1999
Rationale	Grid connection
Lifetime	20 – 25 years
Incidents	Not available
Comments	Not available

2.2.8 Wind Farm of Fernando de Noronha, Pernambuco – Northeast Region of Brazil

Identification	
Name	Wind Farm of Fernando de Noronha
Manufacturer	Vestas
Output	0.3 MW
Release year	1999
Warranty	3 – 5 years
Operation	
Owner	Brazilian Centre for Wind Energy – FADE/UFPE
Adoption year	May / 2000
Rationale	Grid connection
Lifetime	20 – 25 years
Incidents	In March 2009, a lightning hit a wind turbine in Fernando de Noronha. The propeller of the turbine and the generator were damaged.

Comments	<p>The wind farm of Fernando de Noronha is a wind/diesel hybrid power system composed by an wind turbine 225 kW, an wind turbine 75 kW and a Power Station. It comprises the greatest operating wind/diesel hybrid power system in Latin America.</p> <p>The turbine produces about 20% of the power of the archipelago of Fernando de Noronha.</p>
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2.2.9 Wind Farm Millennium, Paraíba – Northeast Region of Brazil

Identification	
Name	Millennium Wind Farm
Manufacturer	Step 1 - Wobben Windpower Step 2 -
Output	Step 1 - 10.2 MW Step 2 – 35 MW
Release year	Step 1 - November 2007 Step 2 – Start in 2010
Warranty	3 – 5 years
Operation	
Owner	SPE Millennium Central Geradora Eólica S/A
Adoption year	Step 1 - 2007
Rationale	Grid connection
Lifetime	20 – 25 years
Incidents	Not available
Comments	<p>Step 1 - Financed as established by PROINFA rules. To develop the Millennium project, Pacific Hydro acquired SES Ltda., a wind projects local company headquartered in Natal, whose name changed to Pacific Hydro Brasil Ltda. Power Purchase Agreement with Eletrobras for 20 years. Millennium Wind Farm is Pacific Hydro's first renewable energy development in Brazil (US\$30 million). Pacific Hydro is a wholly owned subsidiary of the Australian Infrastructure Fund managed by Industry Funds Management (IFM).</p> <p>Step 2 - Total estimated investment - US\$ 54 million.</p>

2.2.10 Wind Farm in Macaú, Rio Grande do Norte – Northeast Region of Brazil

Identification	
Name	Macau
Manufacturer	Wobben Windpower
Output	1,8 MW
Release year	2003
Warranty	3 – 5 years
Operation	
Owner	Petróleo Brasileiro S/A - PETROBRAS
Adoption year	Not available
Rationale	Grid connection
Lifetime	20 – 25 years
Incidents	Not available
Comments	Not available

2.2.11 Wind Farm in Rio do Fogo, Rio Grande do Norte – Northeast Region of Brazil

Identification	
Name	RNIS – Rio do Fogo
Manufacturer	Wobben Windpower
Output	49,6 MW
Release year	July 2006
Warranty	3 – 5 years
Operation	
Owner	Energias Renováveis do Brasil S.A. – ENERBRASIL IBERDROLA
Adoption year	Not available
Rationale	Grid connection
Lifetime	20 –25 years
Incidents	Not available
Comments	Financed as part of PROINFA.

2.2.12 Wind Farm in Muçuripe, Ceará – Northeast Region of Brazil

Identification	
Name	Mucuripe
Manufacturer	Wobben Windpower
Output	2,4 MW
Release year	2002
Warranty	3 – 5 years
Operation	
Owner	Wobben Wind Power Industry and Trade Ltda.
Adoption year	Not available
Rationale	Grid connection
Lifetime	20 – 25 years
Incidents	Not available
Comments	Not available

2.2.13 Wind Farm in Prainha, Ceará – Northeast Region of Brazil

Identification	
Name	Eólica de Prainha
Manufacturer	Wobben Windpower
Output	10 MW
Release year	1999
Warranty	3 – 5 years
Operation	
Owner	Wobben Wind Power Industry and Trade Ltda.
Adoption year	Not available
Rationale	Grid connection
Lifetime	20 – 25 years
Incidents	Not available
Comments	Not available

2.2.14 Wind Farm in Taíba, Ceará – Northeast Region of Brazil

Identification	
Name	Eólica de Taíba
Manufacturer	Wobben Windpower
Output	5 MW
Release year	1998
Warranty	3 – 5 years
Operation	
Owner	Wobben Wind Power Industry and Trade Ltda.
Adoption year	Not available
Rationale	Grid connection
Lifetime	20 – 25 years
Incidents	Not available
Comments	Not available

2.2.15 Wind Farm in Beberibe, Ceará – Northeast Region of Brazil

Identification	
Name	Parque Eólico de Beberibe
Manufacturer	Wobben Windpower
Output	25,6 MW
Release year	March 2008
Warranty	3 – 5 years
Operation	
Owner	Eco Energy Beberibe S.A.
Adoption year	September 2008
Rationale	Grid connection
Lifetime	20 – 25 years
Incidents	Not available
Comments	Financed as established by PROINFA rules

2.2.16 Wind Farm of Pedra do Sal, Piauí – Northeast Region of Brazil

Identification	
Name	Wind Park of Pedra do Sal
Manufacturer	Wobben Windpower
Output	17.85 MW
Release year	December 2008
Warranty	3 – 5 years
Operation	
Owner	Tractebel Energia (belongs to the GDF Suez Group)
Adoption year	2008
Rationale	Grid connection
Lifetime	20 – 25 years
Incidents	Not available
Comments	<p>Financed as established by PROINFA rules. Power Purchase Agreement of 20 years with Eletrobrás.</p> <p>The project is included in the Growth Acceleration Program (PAC), with total investment of US\$ 45 million. BNDES funds account for 69.47% of total investment. The remaining amount will come from the Special Purpose Company (SPC) formed to manage the powerplant, owned by Tractebel Energia S/A.</p>

2.2.17 Wind Farm in Rio do Choró, Ceará – Northeast Region of Brazil

Identification	
Name	Foz do Rio Choró – Beberibe, Ceará
Manufacturer	Suzlon
Output	25,2 MW
Release year	Not available
Warranty	3 – 5 years
Operation	
Owner	Siif Five Energy Generation and Trade S/A
Adoption year	January 2009
Rationale	Grid connection
Lifetime	20 years
Incidents	Not available
Comments	Financed as established by PROINFA rules

2.2.18 Wind Farm in Paracuru, Ceará – Northeast Region of Brazil

Identification	
Name	Paracuru
Manufacturer	Suzlon
Output	23,4 MW
Release year	Not available
Warranty	3 -5 years
Operation	
Owner	Eólica Paracuru Energy Generation and Trade S/A (subsidiary of Siif Five Energy Generation and Trade S/A)
Adoption year	December 2008
Rationale	Grid connection
Lifetime	20 years
Incidents	
Comments	Financed as established by PROINFA rules

2.2.19 Vale dos Ventos Wind Farm, Paraíba – Northeast Region of Brazil

Identification	
Name	Vale dos Ventos Wind Farm
Manufacturer	Enercon - Wobben
Output	48 MW
Release year	2009
Warranty	3 -5 years
Operation	
Owner	Pacific Hydro
Adoption year	Not available
Rationale	Not available
Lifetime	Not available
Incidents	Not available
Comments	Power Purchase Agreement with Eletrobrás for 20 years. Total investment - US\$ 150 million. The Vale dos Ventos Wind Farm consists of 60 wind turbines (800KW) which are hosted by five sugar cane farmers. As the generators and roads that make up the wind farm take around only five percent of land, farming is able to continue uninterrupted.

Chapter 3

Survey of project developers and project financiers

3.1 Wind Energy

Since the criteria for risk management was found to be similar for all developers, these criteria are listed in Table 3.1.

Table 3.1 – Criteria for Risk Management adopted by wind energy developers.

Risk management	
Criterion 1	Authorization by ANEEL (Brazilian Agency for Electrical Energy) to act as Independent Energy Producer.
Importance	Very Important. A national requirement to be an independent electricity producer.
Criterion 2	Proof of ownership for the exploitation area or leasing contract for a period not less than 20 years, both registered in the real estate notary's office
Importance	Very Important.
Criterion 3	At least 60% of the plant value in equipments and services should be manufactured in Brazil
Importance	Very important. It is a PROINFA criteria to be qualified as an energy producer and to obtain governmental loan and other benefits regulated by Law no. 10438 (PROINFA).
Criterion 4	The grid should be able to cope with the additional electricity being fed into the grid according to the ONS (National operator of Electrical System) or utilities
Importance	Very important
Criterion 5	Environmental License issued by IBAMA (Brazilian Institute for Environment/ Ministry of the Environment) or other authorized state institute
Importance	Very important.
Criterion 6	Reliable wind measurements for at least one full year certified by an independent wind energy auditor internationally accredited according to the IEA (International Energy Agency) rules.
Importance	Very important. It is a requirement for asking the benefits and resources from PROINFA. It is very important to evaluate if the project is economic feasible.

3.1.1 Developers

Identification	
Name	Wobben Windpower Industry and Trade Ltda. (subsidiary of the ENERCON GmbH).
Business	First Brazilian large wind turbine manufacturer. Projects, builds, assembles, operates, provide technical assistance and maintains Wind Power Plants. Wobben has teams of Brazilian technicians specialized in operation and maintenance of wind farms. The first Independent Power Producer authorized by ANEEL with 4 wind farms in their own operation.
Presence	One of the leaders in the international market for wind turbines. The Brazilian facilities supply the internal market and exports the major part of its production. In Brazil, Wobben supplied turbines to 16 wind farms (9 from PROINFA), since 1998, a 338 MW total.
Focus	Onshore wind
Base	International Private company Main facility to manufacture wind turbines and its components is located in São Paulo state: Av. Fernando Stecca, 100 – Zona Industrial Sorocaba City – 18087-450 – Brazil +55 15 3337-1211, +55 15 3228-3887 fax, http://www.wobben.com.br Second facility is located at Pecém City in Ceará state.

Identification	
Name	Vestas Wind Systems A/S
Business	Vestas' core business comprises the development, manufacture, sale and maintenance of wind technology. The competencies cover everything from site studies to service and maintenance.
Presence	Vestas is the world leader in delivering wind energy. The company has already installed over 39,000 wind turbines in 63 countries on five continents, generating more than 60 million MWh a year.
Focus	Independent wind system supplier
Base	Vestas Brazil Avenida das Nações Unidas, 12901 Centro Empresarial Nações Unidas (CENU) - Torre Norte 04578-910 Brooklin Novo - Sao Paulo City - Brazil +55 11 2755-8000, +55 11 3508-1304 fax vestas-brazil@vestas.com http://www.vestas.com/

Identification	
Name	Brazilian Centre for Wind Energy – CBEE
Business	R&D on wind energy; wind energy assessment; design and projects for wind farms and electricity generation; design and projects for irrigation systems; design and projects for hybrid generation systems (wind/solar/diesel)
Presence	Pernambuco (Brazilian state in Northeast Region).
Focus	Generate knowledge and know-how on wind energy matter; Stimulate the wind energy adoption.
Base	University of Pernambuco - UFPE

Identification	
Name	Eco Energy Beberibe Ltda
Business	Electricity generation; Wind Energy; Renewable energy advisory
Presence	Ceará (Brazilian state in Northeast Region)
Focus	Onshore wind energy
Base	São Paulo, SP

Identification	
Name	EDP Renováveis Brasil / Central Nacional de Energia Eólica Ltda – CENAEEL
Business	Electricity generation and Wind Energy
Presence	Santa Catarina State
Focus	Electricity generation
Base	Av. Piassanguaba 2590, 04060-003 São Paulo, SP http://www.energiasdobrasil.com.br/energia/index.asp

Identification	
Name	Renewable Energy of Brazil – ENERBRASIL IBERDROLA S. A.
Business	Electricity generation and distribution
Presence	Rio Grande do Norte (Brazilian state in Northeast Region)
Focus	Onshore Wind Energy
Base	Rio de Janeiro, RJ

Identification	
Name	Petróleo Brasileiro S/A – PETROBRAS
Business	Fossil fuels production and distribution; Biomass fuels production and distribution; R&D in alternative sources of energy.
Presence	27 countries around the world
Focus	Exploitation, production, refining and transportation of oil and its derivatives in Brazil and abroad.
Base	Rio de Janeiro, RJ

Identification	
Name	SIIF Energias do Brasil
Business	Wind energy projects: development, construction and operation of wind farms.
Presence	Brazilian Northeast Region
Focus	Wind energy
Base	Avenida Santos Dumont, 1789 - 19º andar – Aldeota Fortaleza – Ceará – Brazil 60150-160 +55 85 3266-5200, +55 85 3266-5225 fax siif@siif.com.br http://www.siif.com.br/

Identification	
Name	PRO-TEC Sistemas Eólicos
Business	Installation, Maintenance, Operation on hybrid systems of wind, solar and diesel
Presence	Brazilian Northeast Region.
Focus	Wind and solar energy systems.
Base	Recife , PE

Identification	
Name	Pacific Hydro
Business	Committed to producing electricity through the innovative commercialization of renewable energy resources.
Presence	Australia, Philippines, Fiji Islands, Chile and Brazil
Focus	Electricity generation and distribution
Base	R. Paulo Barros de Góis, 1840, sala 1501 - Lagoa Nova Natal City - Rio Grande do Norte – 59064-460 – Brazil +55 84 4009-0100, +55 84 4009 0109 fax http://www.pacifichydro.com.au/

Identification	
Name	Suzlon Energia Eolica do Brasil Ltda
Business	Wind industry. Research & Development, manufacturing, marketing & sales, EPC project delivery and lifetime operations & maintenance services for wind turbine generators.
Presence	In 21 countries, among them: USA, Australia, Belgium, Brazil (7 wind farms), China, Denmark, Germany, Greece, India, Spain.
Focus	Wind Energy
Base	Rua Eduardo Saboia, 399 – Papicu Fortaleza City – Ceará - Brazil 60175-145

Identification	
Name	IMPSA
Business	Manufacturer/Installer. Global company dedicated to prepare integral solutions for the electricity generation from renewable resources, ports and different industrial processes.
Presence	Argentina, Brazil, Chile, Ecuador, Colombia, Venezuela, USA, Malaysia, China, Vietnam, and India. On September 6, 2008 IMPSA inaugurated a Wind Turbine Manufacturer plant in Pernambuco. The initial investment was USD\$ 145 million. The plant is located in the port complex of Suape, has an area of 27 hectares and it was built in eight months. It should be expanded in 2010.
Focus	Wind and Hydro Energy
Base	Carril Rodriguez Peña, 2451 Godoy Cruz – Mendoza State – Argentina M5503AHY http://www.impsa.com/

Identification	
Name	Companhia Energética de Minas Gerais – CEMIG
Business	Electricity generation and distribution, natural gas distribution; R&D on renewable energy, wind energy and data distribution.
Presence	Minas Gerais state. It has a minor role in 10 other states in Brazil and Chile.
Focus	Electricity generation, transmission and distribution.
Base	Av. Barbacena, 1200 - Santo Agostinho Belo Horizonte – Minas Gerais – Brazil 30190-131 http://www.cemig.com.br/

Identification	
Name	Centrais Elétricas de Santa Catarina S/A – CELESC
Business	Electricity generation and distribution
Presence	State of Santa Catarina
Focus	Small Hydro Plants. Onshore Wind Energy
Base	Av. Itamarati, 160 – Itacorubi 88034-900 - Florianópolis - SC +55 48 3231 5000 / 3231 6000, +55 48 3231 6530 fax celesc@celesc.com.br http://portal.celesc.com.br/portal/home/

Identification	
Name	Centrais Eólicas do Paraná Companhia Paranaense de Energia – COPEL
Business	Electricity generation and distribution
Presence	Paraná state
Focus	Onshore Wind Energy
Base	Rua Coronel Dulcídio, 800 – Batel Curitiba – PR – Brazil +55 41 3322–3535 80420-170 http://www.copel.com/

3.1.2 Financiers

Identification	
Name	Brazilian Agency for Electric Energy – ANEEL
Business	Linked to Ministry of Mines and Energy. Regulate and oversee the generation, transmission, distribution and marketing of electric power; Grant, allow and authorize facilities and services of energy; Ensure the quality of service and require investment; Stimulate competition between operators and ensure widespread service in the Brazilian territory; Support R&D in several areas of knowledge of electricity generation, distribution and conservation.
Presence	Brazil
Focus	R&D on Electricity Generation and Services
Base	Brasília, DF
Risk management	
Criterion 1	Technology, Products and Services generated by R&D projects
Importance	High
Criterion 2	Increase the scope of the distribution services of electricity
Importance	High

Identification	
Name	National Economic and Social Development Bank (BNDES)
Business	Investment Bank Funding and supporting social programs, agriculture, infrastructure projects including energy sector.
Presence	It is a government financier institution linked to Ministry of Development, Industry and Abroad Trade.
Focus	Infrastructure development.
Base	Brazil

Risk management	
Criterion 1	The wind farm should be in accordance with the PROINFA requirements regulated by Law no. 10438.
Importance	High
Criterion 2	The MME (Ministry of Mines and Energy) should announce the wind farm project as Enable to PROINFA.
Importance	High

Identification	
Name	Ministry of Science and Technology from Germany
Business	Government
Presence	Minas Gerais State
Focus	Onshore Wind Energy
Base	Germany
Risk management	
Criterion 1	Renewable energy projects in developing countries
Importance	High

Identification	
Name	Citi Group
Business	Banking Services. Investments
Presence	Global
Focus	Energy Projects
Base	399 Park Avenue. New York, NY 10043. U.S.A.
Risk management	
Criterion 1	Unknown
Importance	

Identification	
Name	Black River Asset
Business	Global asset management company that provides institutional investors with alternative investment opportunities.
Presence	Global
Focus	Energy Projects
Base	623 Fifth Avenue, 27th. Floor. New York, NY 10022 New York, NY 10022
Risk management	
Criterion 1	Unknown
Importance	

Identification	
Name	Liberty Mutual Insurance Company
Business	Insurance company.
Presence	Global
Focus	Insurance
Base	2009 Liberty Mutual Insurance Company, 175 Berkeley Street, Boston, MA 02116
Risk management	
Criterion 1	Unknown
Importance	

Identification	
Name	Financiadora de Estudos e Projetos (FINEP)
Business	Financing studies and projects
Presence	Brazil
Focus	R&D and Innovation
Base	Brasilia – DF
Risk management	
Criterion 1	Straigh grant
Importance	High

Identification	
Name	Constitutional Financing Funds for Northeast (FNE) / Banco do Nordeste do Brazil SA (BNB)
Business	Financing of economic infrastructure: non-governmental initiatives can also be financed in areas such as energy, telecommunications, transportation, gas production, gas pipelines and others.
Presence	Northeast of Brazil, and some municipalities in the North of Minas Gerais and Espirito Santo states
Focus	Investment in infrastructure and development
Base	Agencies in all Northeast states and some other. http://www.bnb.gov.br/
Risk management	
Criterion 1	Unknown
Importance	

Identification	
Name	Espirito Santo Investment
Business	Investment
Presence	Not available
Focus	Investment

Base	BES Investimento do Brasil S/A Av. Brigadeiro Faria Lima, 3729 - 6º andar São Paulo City – São Paulo – Brazil 04538-905 +55 11 3074-7444, +55 11 3074-7469 besinvestimento@besinvestimento.com.br http://www.besinvestimento.com.br/
Risk management	
Criterion 1	Unknown
Importance	

3.2 Solar Energy

3.2.1 PV Solar Systems

The main PV solar energy project developers in Brazil are located in South and Southeast regions of the country. Most of the PV systems developers are electricity utilities and research institutes. All of them are small systems installed for demonstration or educational purpose. Table 3.2.1 presents a short description of the PV systems in operation in Brazil.

Table 3.2.1 PV systems in operation in Brazil.

Owner / Developer	Location	Adoption Year	Output
CHESF	Recife – PE	1995	11kWp
LABSOLAR / UFSC	Florianópolis – SC	1997	1,97kWp
LSF – IEE / USP	São Paulo - SP	1998	0,75kWp
Centro de Convivência / UFSC	Florianópolis - SC	2000	1,1kWp
LSF – IEE / USP	São Paulo - SP	2001	6,3kWp
CEPEL	Rio de Janeiro - RJ	2002	16,3kWp
Intercâmbio Eletromecânico - IEM	Porto Alegre - RS	2002	3kWp
LSF – IEE / USP	São Paulo - SP	2003	6,0kWp
CELESC	Florianópolis - SC	2003	1,4kWp
CELESC	Lages – SC	2004	1,4kWp
CELESC	Tubarão - SC	2004	1,4kWp
Centro de Cultura e Eventos / UFSC	Florianópolis - SC	2004	10,8kWp
Lab. Energia Solar / UFRGS	Porto Alegre - RS	2004	4,8kWp
LSF – IEE / USP	São Paulo - SP	2004	3,0kWp
Lab. de Sementes / CEMIG	Belo Horizonte - MG	2005	3,15kWp
Casa Eficiente / ELETROSUL	Florianópolis - SC	2006	2,25kWp
Greenpeace	São Paulo – SP	2007	2,9kWp
CEFET-MG	Belo Horizonte -	2007	3,24kWp

	MG		
Motor Z / Grupo Zeppini	S. Bernardo do Campo - SP	2008	2,45kWp
Fundição Estrela / Grupo Zeppini	S. Bernardo do Campo - SP	2008	14,7kWp
ELETROSUL	Florianópolis - SC	2009	11,9kWp
HU– UFSC / TRACTEBEL	Florianópolis - SC	2009	1,99kWp
Colégio de Aplicação – UFSC / TRACTEBEL	Florianópolis - SC	2009	1,99kWp
Aeroporto Hercílio Luz – UFSC / TRACTEBEL	Florianópolis - SC	2009	2,12kWp

3.2.1 Solar Water Heater Systems

Water heating is the major application of solar energy in Brazil. Government incentive programs were created to promote large-scale use of solar water heating systems. Currently more than 2.2 million m² of solar heating collectors have been installed and the solar heating industry is well developed and capable to supply the growing domestic market. The major barrier to increase the adoption of solar water heating system is linked to the lack of information on this technology. The major developers are listed bellow. There are no specific credit lines for financing solar heating in homes, industry or public buildings.

Identification	
Name	Laboratory for Building Environment – University of Paraná
Business	Research and Development
Presence	Paraná (state of Brazilian South Region)
Focus	Solar Energy (PV and Heating)
Base	Curitiba – Paraná. Brazil

Identification	
Name	Alternative Energy Research Team – University of Pernambuco
Business	Research and Development
Presence	Pernambuco (state of Brazilian Northeast Region)
Focus	Alternative Energy Resources
Base	Recife – Pernambuco. Brazil

Identification	
Name	Solar Energy Lab. – University of Paraíba
Business	Research and Development
Presence	Paraíba (state of Brazilian Northeast Region)
Focus	Alternative Energy Resources
Base	João Pessoa – Paraíba. Brazil

Identification	
Name	Alternative Energy Research Team – University of Uberlândia
Business	Research and Development
Presence	Minas Gerais (state of Brazilian Northeast Region)
Focus	Alternative Energy Resources and Rural Electricity
Base	Uberlândia – Minas Gerais. Brazil

Identification	
Name	Wind Energy Laboratory –Fluminense University
Business	Research and Development
Presence	Rio de Janeiro
Focus	Renewable Energy
Base	Rio de Janeiro

Identification	
Name	Solar Energy Laboratory – University of Rio Grande Do Sul
Business	Research and Development
Presence	Rio Grande do Sul (state of Brazilian South Region)
Focus	Solar Energy
Base	Porto Alegre – Rio Grande do Sul. Brazil

Identification	
Name	Technology Research Institute (IPT)
Business	Research and Development
Presence	São Paulo (state of Brazilian South Region)
Focus	Alternative Energy Resources
Base	São Paulo – São Paulo. Brazil

Identification	
Name	Solar Energy Lab. (LABSOLAR) / University of Santa Catarina
Business	Research and Development
Presence	Santa Catarina (state of Brazilian South Region)
Focus	Solar Energy (PV and Heating)
Base	Florianópolis City – Santa Catarina – Brazil

Identification	
Name	Solar Energy Research Team / Pontifícia Universidade Católica (PUC/MG)
Business	Research and Development
Presence	Minas Gerais (state of Brazilian South Region)
Focus	Solar Energy Resources
Base	Belo Horizonte – Minas Gerais. Brazil

Identification	
Name	JMS Industrial Ltda
Business	Manufacturer and Representative
Presence	Minas Gerais (state of Brazilian Southeast Region)
Focus	Solar Water Heating
Base	Contagem – Minas Gerais. Brazil

Identification	
Name	Maxtemper Solar Energy
Business	Manufacturer and Representative
Presence	Minas Gerais (state of Brazilian Southeast Region)
Focus	Solar Water Heating
Base	Belo Horizonte – Minas Gerais. Brazil

Identification	
Name	Solágua Industry and Trade Ltda.
Business	Manufacturer and Representative
Presence	Espírito Santo (state of Brazilian Southeast Region)
Focus	Solar Water Heating
Base	Serra – Espírito Santo. Brazil

Identification	
Name	Solar Minas Ltda.
Business	Manufacturer and Representative
Presence	Minas Gerais (state of Brazilian Southeast Region)
Focus	Solar Water Heating
Base	Poços de Caldas – Minas Gerais. Brazil

Identification	
Name	Solares Aquecimento Solar
Business	Manufacturer and Representative
Presence	Santa Catarina (state of Brazilian Southeast Region)
Focus	Solar Water Heating
Base	Florianópolis – Santa Catarina. Brazil

Identification	
Name	Solarpress Sistemas de Aquecimento e Energia Ltda
Business	Manufacturer and Representative
Presence	São Paulo (state of Brazilian Southeast Region)
Focus	Solar Water Heating
Base	Vargem Grande Paulista – São Paulo. Brazil

Identification	
Name	Solartec Industrial Ltda.
Business	Manufacturer and Representative
Presence	São Paulo (state of Brazilian Southeast Region)
Focus	Solar Water Heating
Base	Ribeirão Preto – São Paulo. Brazil

Identification	
Name	Soletrol Industry and Trade Ltda
Business	Manufacturer and Representative
Presence	São Paulo (state of Brazilian Southeast Region)
Focus	Solar Water Heating
Base	São Manoel – São Paulo. Brazil

Identification	
Name	Tecnosol Aquecedores e Hidráulica Ltda.
Business	Manufacturer and Representative
Presence	São Paulo (state of Brazilian Southeast Region)
Focus	Solar Water Heating
Base	Cotia – São Paulo. Brazil

Identification	
Name	Transsen Industry and Trada Ltda.
Business	Manufacturer and Representative
Presence	São Paulo (state of Brazilian Southeast Region)
Focus	Solar Water Heating
Base	Birigui – São Paulo. Brazil

Identification	
Name	Tuma Industrial Ltda.
Business	Manufacturer and Representative
Presence	Minas Gerais (state of Brazilian Southeast Region)
Focus	Solar Water Heating
Base	Belo Horizonte – Minas Gerais. Brazil

Identification	
Name	Unasol Aquecimento Solar
Business	Manufacturer and Representative
Presence	Santa Catarina (state of Brazilian South Region)
Focus	Solar Water Heating
Base	São José – Santa Catarina. Brazil

Identification	
Name	Unipac Industry and Trade Ltda.
Business	Manufacturer and Representative
Presence	São Paulo (state of Brazilian Southeast Region)
Focus	Solar Water Heating
Base	Pompéia – São Paulo. Brazil

Identification	
Name	Unisol Aquecedores Solares
Business	Manufacturer and Representative
Presence	São Paulo (state of Brazilian Southeast Region)
Focus	Solar Water Heating
Base	Brodowski – São Paulo. Brazil

Identification	
Name	Pantho Industrial Ltda.
Business	Manufacturer and Representative
Presence	Minas Gerais (state of Brazilian Southeast Region)
Focus	Solar Water Heating
Base	Belo Horizonte – Minas Gerais. Brazil

Identification	
Name	Sodramar Industry and Trade Ltda
Business	Manufacturer and Representative
Presence	São Paulo (state of Brazilian Southeast Region)
Focus	Solar Water Heating
Base	Diadema – São Paulo. Brazil

Identification	
Name	Aquasolis Tecnologia Solar e Construções Ltda.
Business	Manufacturer and Representative
Presence	Minas Gerais
Focus	Solar Water Heating
Base	Belo Horizonte – Minas Gerais. Brazil

Identification	
Name	ALTERNATIVA SOLAR LTDA.
Business	Manufacturer and Representative
Presence	Minas Gerais
Focus	Solar Water Heating
Base	Belo Horizonte – Minas Gerais. Brazil

Identification	
Name	Alpina Termoplásticos Ltda.
Business	Manufacturer and Representative
Presence	São Paulo
Focus	Solar Water Heating
Base	São Paulo – São Paulo. Brazil

Identification	
Name	E2 SOLAR
Business	Manufacturer and Representative
Presence	São Paulo
Focus	Solar Water Heating
Base	São Paulo – São Paulo. Brazil