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THE EXPANSION OF DISTRIBUTED GENERATION IN BRAZIL: ANALYSIS OF THE CURRENT INCENTIVES AND THE RISKS FOR INVESTORS

MARCO AURÉLIO LENZI CASTRO

ADVISOR: PROF. JOHN FORRER

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1. INTRODUCTION

The Brazilian electric energy matrix is characterized by the expressive participation of renewable sources in its structure, especially the hydraulics that corresponds to 71% of the installed capacity in Brazil. Besides, energy sources such as biomass correspond to 3.7%, and the wind energy answer for only 0.2%.

The hydroelectric power plants, which are considered with installed power above 30 MW, are responsible for 97.6% of the hydraulics sources. Therefore, the Small Hydroelectric Power Plants - SHPs (with installed power ratings over 1 MW and equal to or less than 30 MW) and the Mini Hydroelectric Power Plants - MHPs (under 1 MW) still have a small participation in the Brazilian energy market.

In order to increase the distributed generation in the country, legal and regulatory incentives were designed to stimulate those plants, allowing larger access to bank financings, reducing the energy commercialization costs and celebrating energy purchase and sale contracts for long period, through energy auctions or the national program for renewable electric energy (Proinfa).

Besides, the establishment of the Clean Development Mechanism (CDM), through the Kyoto Protocol, opened the possibility for investors in renewable sources in Brazil to obtaining an additional income, through the sale of carbon credits for great companies installed at developed countries, which have to follow the established goals to reduce the greenhouse gases emissions in their countries.

However, investors are still exposed to risks from different sources: fulfill all Proinfa's commitments, difficulties on getting banks financings, face long environmental licensing process for each power plant and also obtain the definition of the connection point in the distribution grid.

In conclusion, the objective of this study is analyzing the current incentives, detailing the Brazilian Federal laws and ANEEL’s resolutions, as well as the national program - Proinfa, and the risks associated to the investors for the expansion of distributed generation, especially for the following renewable energy sources: biomass, wind power and small hydroelectric power plant.

In addition, it will be presented the renewable energy policy adopted in the California State after the energy crisis of 2001, in order to increase the participation of those sources in the electric energy matrix.

2. CHARACTERISTICS OF BRAZILIAN ELECTRIC SECTOR

Brazilian electric energy matrix is mostly based on renewable energy sources, specially the available great hydraulics resources. Figure 1 illustrates all electric energy sources that are used in Brazil.

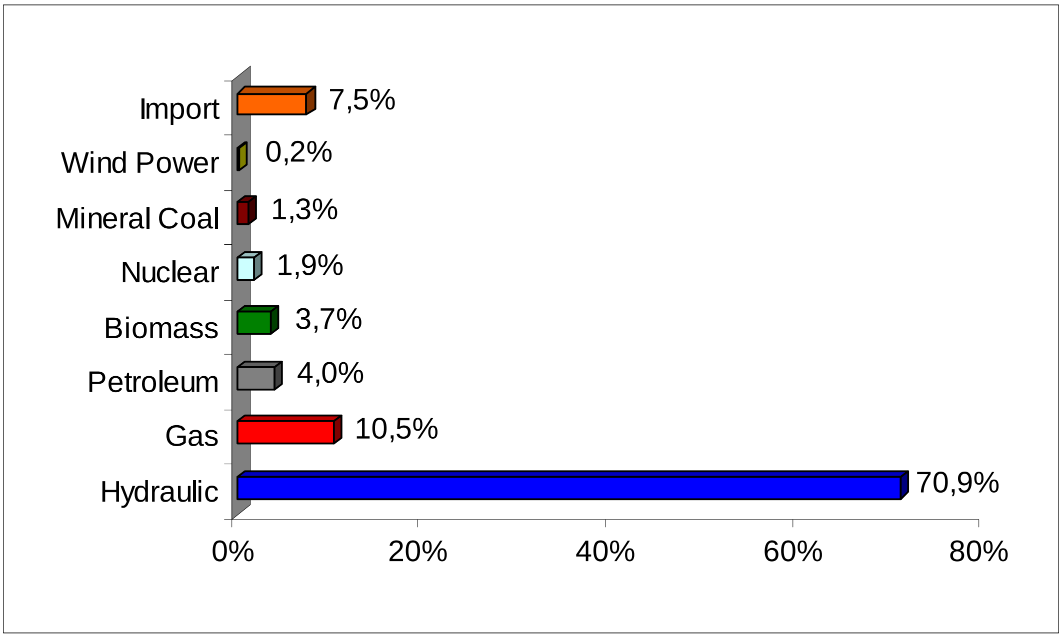

Figure 1: Brazilian Electric Energy Matrix [1]

Additionally, it must be registered the increasing of thermal generation, that burns fossil fuels such as natural gas and diesel oil, and specially the one who uses different types of biomass as energy source, like sugar cane. On the other hand, the participation of nuclear generation is not very important.

With reference to energy produced by wind power plants, it can be observed that there is a low participation in electric energy matrix, with only 15 plants operating. However there were 108 new plants authorized by Brazilian Electricity Regulatory Agency – ANEEL in October of 2007 and it is hold a higher participation of this source on the next years.

As the hydroelectric power plants are located far from the load, it is necessary to have long transmission grids to carry these energy blocks to the load centers.

However, Brazilian electric system is not totally interconnected because part of the north region is isolated from the national interlinked system.

Nowadays interconnected transmission grid has about 84 thousand km of extension. Figure 2 illustrates the increasing of transmission lines since 2000.

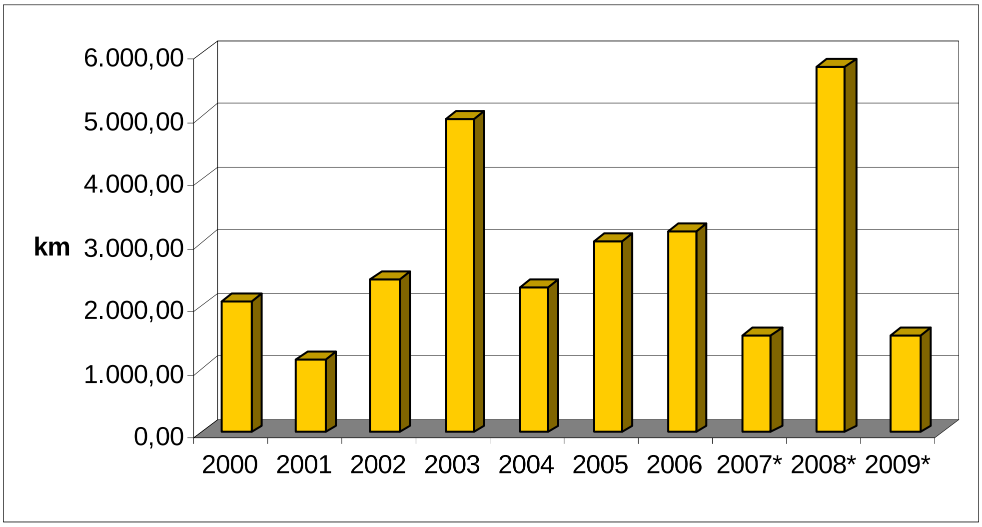

Figure 2: Transmission Lines Increase [1]

The transmission grid increase shown in Figure 2 has been permitting energy exchanges among all regions, which have different but complementary hydrological regimes. The data from 2007, 2008 and 2009 refer to the new lines that should be done at these years according to ANEEL's authorization.

On the other hand, Figure 3 shows the maximum load demand evolution for the interlinked system, according to Brazilian Independent System Operator - ONS. The data from 2007 refers to the maximum registered value until October.

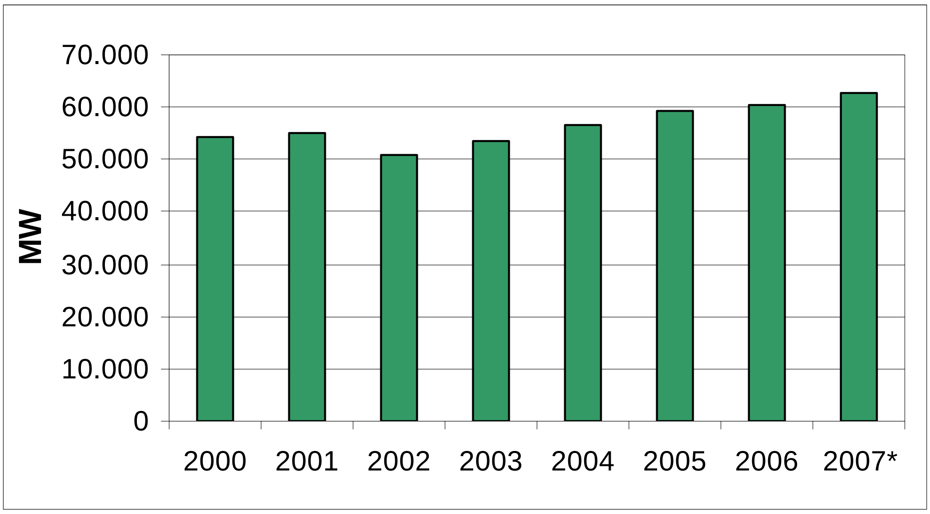

Figure 3: Maximum Load Demand

In order to answer the load increase, Figure 4 presents the evolution of Brazilian installed power plants, up to October of 2007.

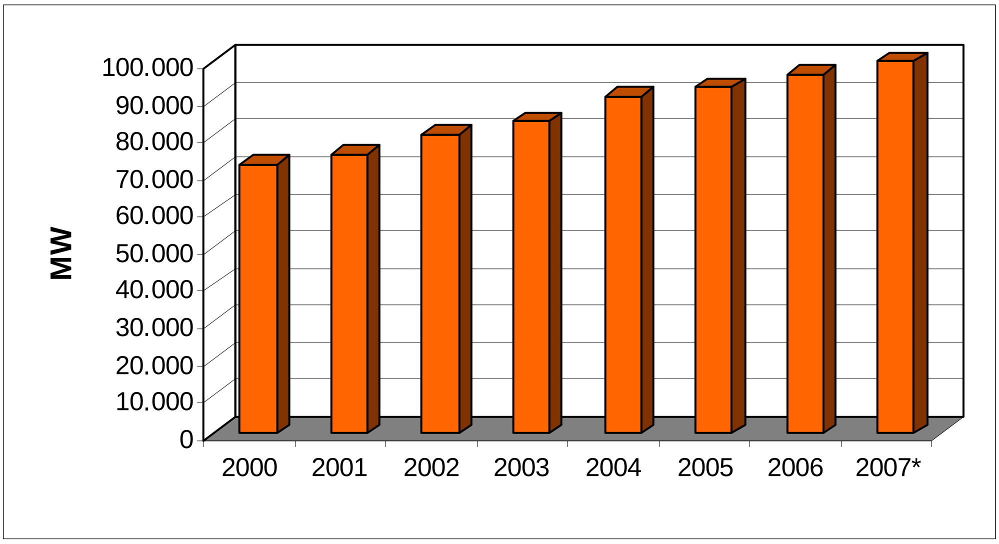

Figure 4: Generation Installed Power Increase [1]

Figure 5 illustrates the forecast of new power plants operation, divided into three categories by ANEEL: without restrictions, moderate restrictions and serious restrictions.

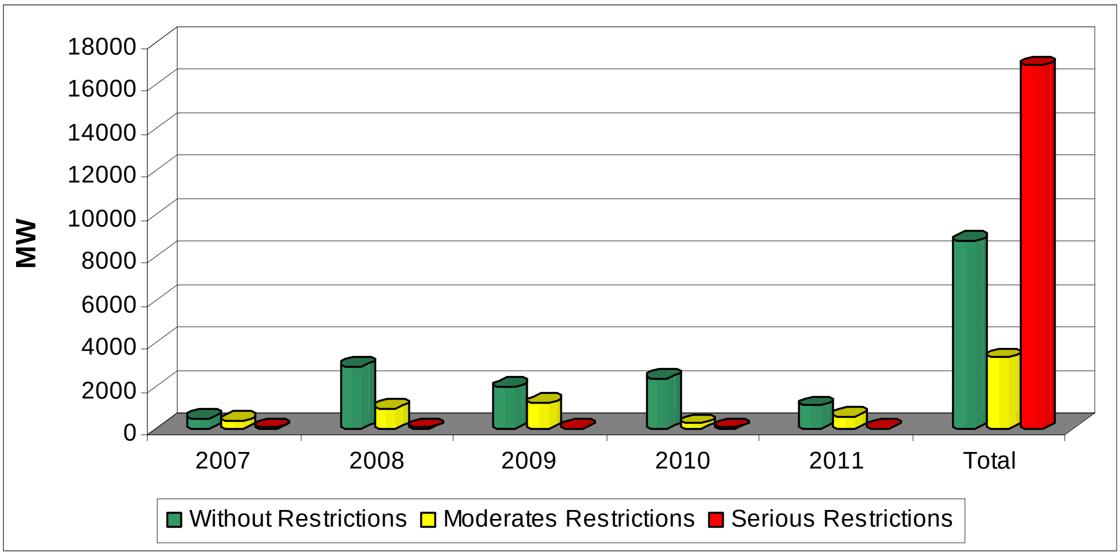

Figure 5: New Power Plants Forecast [1]

For plants classified as without restrictions, it means that they have assign the concession contracts, have a valid environmental license and are following the construction schedules.

Those enterprises that belong to moderate restrictions group have present delay into environmental license attainment, or do not have initiated the construction. At least, the plants classified as serious restrictions have judicial impediments or environmental serious problems. As presented in Figure 5, there are 16.9 GW with serious restrictions and without forecast to be solved.

Figure 6 presents the estimated hydroelectric potential for each Brazilian hydrographic basin, which totalizes 263 GW, but only 75.6 GW (28,7%) of this potential have been utilized.

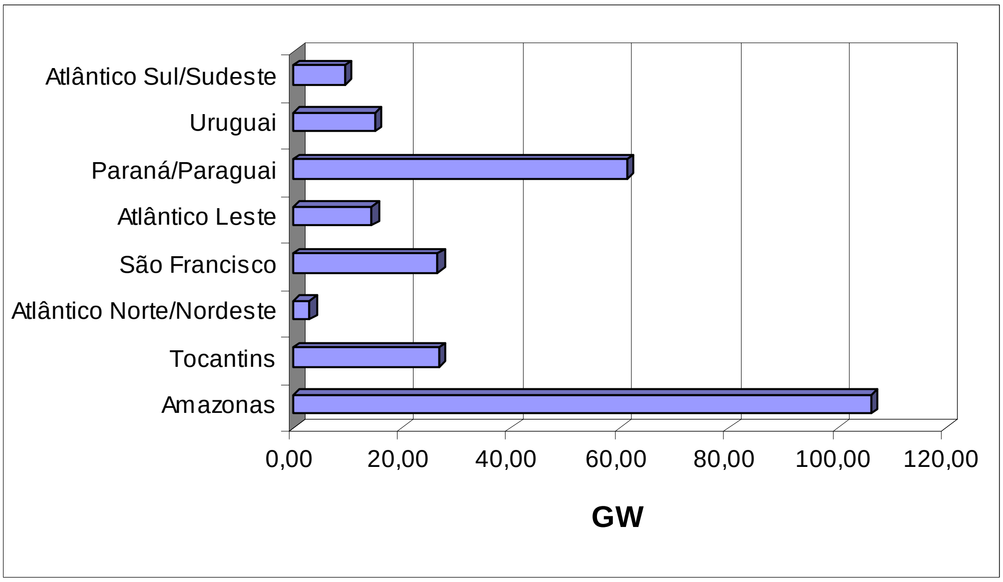

Figure 6: Brazilian Estimated Hydroelectric Potential [1]

However, hydroelectric power plants constructions are getting more difficult to be done, especially on Amazon region, because of the rigorous environmental legislation. Therefore, it is necessary to improve the generation capacity, giving priority to projects that have minimum environmental impact and with lower building costs.

2.1 DISTRIBUTED GENERATION

2.1.1 Introduction [3], [4]

Distributed generation is installed next to the load, and could use many types of energy sources (renewable and non-renewable), without any power limitation. It can be useful to supply isolated consumers or be connected to the distribution grid, supplying others loads. The main benefits of distributed generation are:

- reduce or postpone the investments on transmission system;
- could be build in less time than hydroelectric power plants;
- low environmental impact;
- improves the tension level on the grid and permits loss reduction;
- is an alternative to supply part of the demand with lower costs;

- could provide ancillaries services, by generating reactive energy;
- increases the distribution system security, allowing the supply of some loads in case of problems with the centralized generation.

On the other hand, there are some disadvantages that come with the spread of distributed generation, such as:

- rise the complexity of the central generation because distribution system will receive energy from big plants, which are commanded by ISO, and energy produced by small power plants that are next to the load;
- necessity of changing the procedures that are used by distribution companies to operate, control and protect their grids;
- difficult on controlling the tension level of the lines;
- rise the harmonic distortion, which means that energy quality could be reduced especially where wind power plants are installed.

Therefore the inputs of generation units on distribution grid must be well planned, always looking for the best connection point, projecting and installing the adequate protections.

2.1.2 Distributed Generation Types [1]

There are many types and technologies for local electrical energy generation, which means close to consumers. For instance, it can be listed the following types:

- ✓ Small Hydroelectric Power Plants – SHPs;
- ✓ Biomass;
- ✓ Wind Power Plants;
- ✓ Solar;
- ✓ Urban Waste;
- ✓ Fossil Fuels.

Despite the great variety of techniques, this study will focus on SHPs, biomass and wind power, showing their main characteristics and discuss the current opportunities for investors.

2.1.3 SHPs Main Characteristics [1], [2], [6], [13]

SHPs are small hydroelectric power plants, and in Brazil, have installed power between 1 MW and 30 MW and their reservoir must occupy less than 3 km² of area, according to ANEEL's Resolution nº 652/2003. These plants must have authorization from ANEEL to produce energy for their own consume or sell it to the market.

In October of 2007, there were 289 SHPs operating in the country, which correspond to 1786 MW of installed power. Besides, there are 67 new enterprises under construction, or 1210 MW from this renewable energy source.

The main benefits of a SHP are:

- small reservoir, which means less environmental impacts;
- low generated energy cost;
- uses renewable source, which has no cost and do not produce greenhouse effects emissions;
- needs short period for construction (18 to 24 months);
- uses national equipments, reducing costs and giving incentives for local industry;
- lower connection costs to distribution grid;
- loss reduction on the distribution line.

SHPs present two huge advantages when compared with natural gas, diesel oil or mineral coal thermoelectrics:

- less environmental impact, because SHPs do not produce pollutant gases;

- uses a renewable fuel (water), that is abundant in Brazil, allowing costs reduction.

The average cost to construct a SHP is about R$ 4,200/kW (or about US$ 2,200/kW), without considering the costs to install the exclusive line to connect the plant to distribution system.

Another point that must be considered is that ANEEL has simplified the river inventory study demands for those plants, as well as for basic and executive projects, which have less complexity when compared with a hydroelectric enterprise. Then, there is no need to have a public process to sell the enterprise, but only give an authorization to the investor, what can considerably reduce the time to receive the approval from ANEEL.

Figures 7, 8 and 9 illustrate SHP Mourão 1 (8.2 MW) and SHP Primavera (18.2 MW) barrages, and also the machine house of SHP Ilhéus (2.5 MW), respectively.

Figure 7: SHP Mourão 1

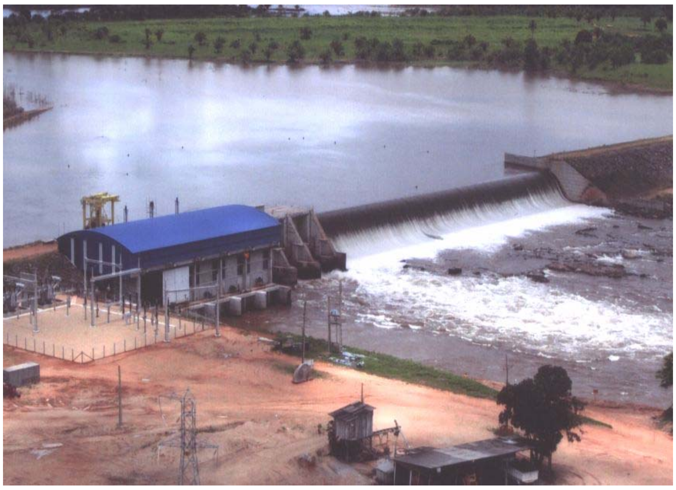

Figure 8: SHP Primavera

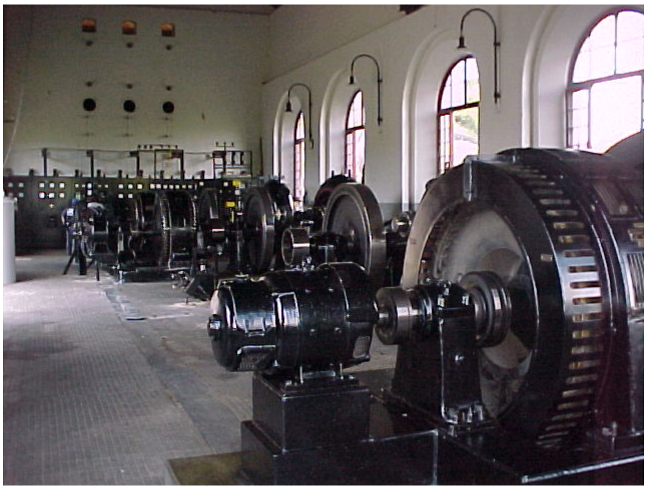

Figure 9: SHP Ilhéus

2.1.4 Biomass [3], [4], [6]

The expression biomass refers to products that have vegetal (such agricultural products and pieces of wood), animal or human origin (urban waste), which means organic material than can be used to generate electrical energy, especially throw cogeneration, which can be defined as the simultaneous mechanic or electric power and useful heat by a unique heat source.

In November of 2007, there were 3,984 MW of installed power distributed into 279 biomass generation enterprises. Figure 10 presents the participation of each type of biomass on the installed power of these plants.

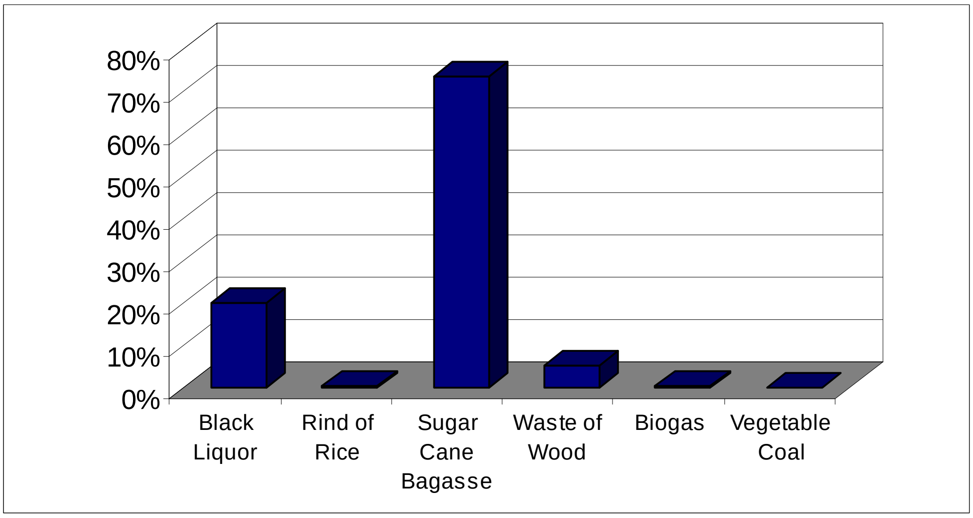

Figure 10: Participation of each type of biomass [1]

As shown in Figure 10 plants that use sugar cane bagasse represent 73.5% (or 2,926MW) of the total installed power from biomass power plants. Therefore it will be presented the main characteristics of the energy generation from sugar cane bagasse.

2.1.4.1 Sugar Cane Bagasse [19], [20]

Figure 11 illustrates the rise of sugar cane production in the last years.

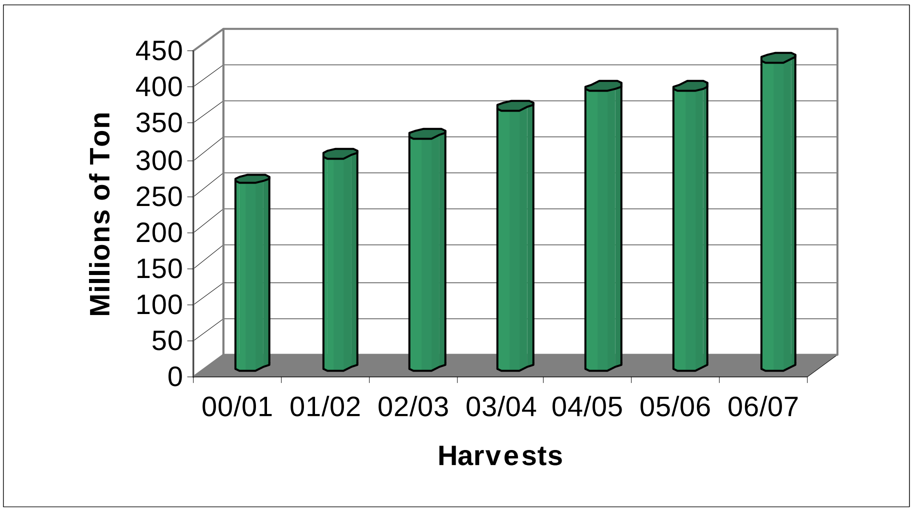

Figure 11: Sugar cane production [20]

Based on Figure 11, it is possible to see the increase of sugar cane production and one explanation is the rise of productivity on sugar cane plantation. Besides the alcohol and sugar prices on their markets also have stimulated the producers to invest more on this plantation.

In addition, Brazilian energy market has been presenting as a good investment option, which has been contributing to the increase on sugar cane production.

Therefore the owners of these plants produce alcohol, sugar and utilize the sugar cane bagasse as a fuel to generate energy on their thermoelectric power plants, using cogeneration to increase the process efficiency and reduce costs. Through this technique, first they guarantee energy to their loads and then sell the excess on the market.

Figure 12 presents the sugar cane bagasse and Figure 13 illustrates Santa Elisa thermoelectric power plants, with 62 MW installed, which is an example of a plants that uses sugar cane to produce alcohol, sugar and energy through the bagasse.

Figure 12: Sugar cane bagasse

Figure 13: Santa Elisa plant

The average cost to build a new plant is about R$ 2,800/kW (or about US$ 1,474/kW), without considering the costs to install the substation and the exclusive line to connect the plant to distribution system.

Considering an average energy production about 60 kWh for each sugar cane ton [19], it will be found a theoretical generation potential of 25,560 GWh/year for 2006/2007 harvest or 2,918 MW average, what corresponds to a sum of tree hydroelectric plants year production: Furnas (598 MW average), Itumbiara (1,015 MW average) and São Simão (1,281 MW average).

The main benefits of generate electrical energy from sugar cane bagasse are:

- lower energy cost than coal and diesel oil thermoelectric plants;
- use of renewable energy source;
- plants are located next to load centre, reducing transmission costs and the loss in the lines;
- lower environmental impact;
- short period to build a plant;

- as the harvest period is from April to November, which is the same period of lower outflows to hydroelectric reservoirs, it is a great opportunity to use this type of plants to complement the energy generation.

2.1.5 Wind Power [1], [2], [18]

Wind power is a complementary energy source to conventional ones (hydraulic and thermal), due to the high variation of wind availability during the day. Figure 14 shows the installed power of actual plants and the forecast for new ones, following the ANEEL's classification about the restriction.

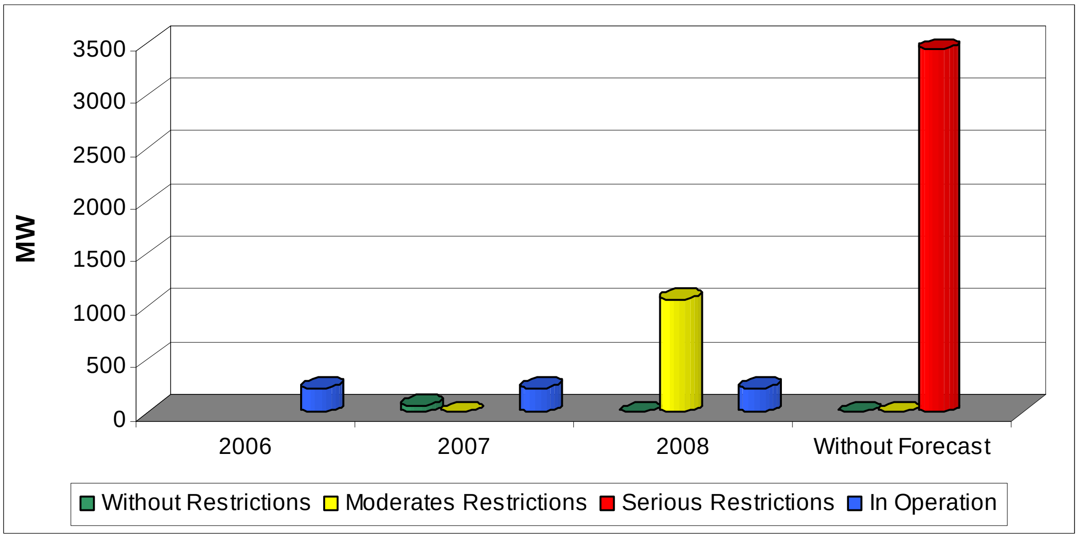

Figure 14: New wind power plants forecast [1]

As illustrated in Figure 14, in October of 2007 there were 58 plants, which means 3441 MW, that have serious restrictions to be start the construction, and only 15 wind power plants are operating at this moment. Figure 15 presents a Brazilian wind power potential map, measured at 50 m height.

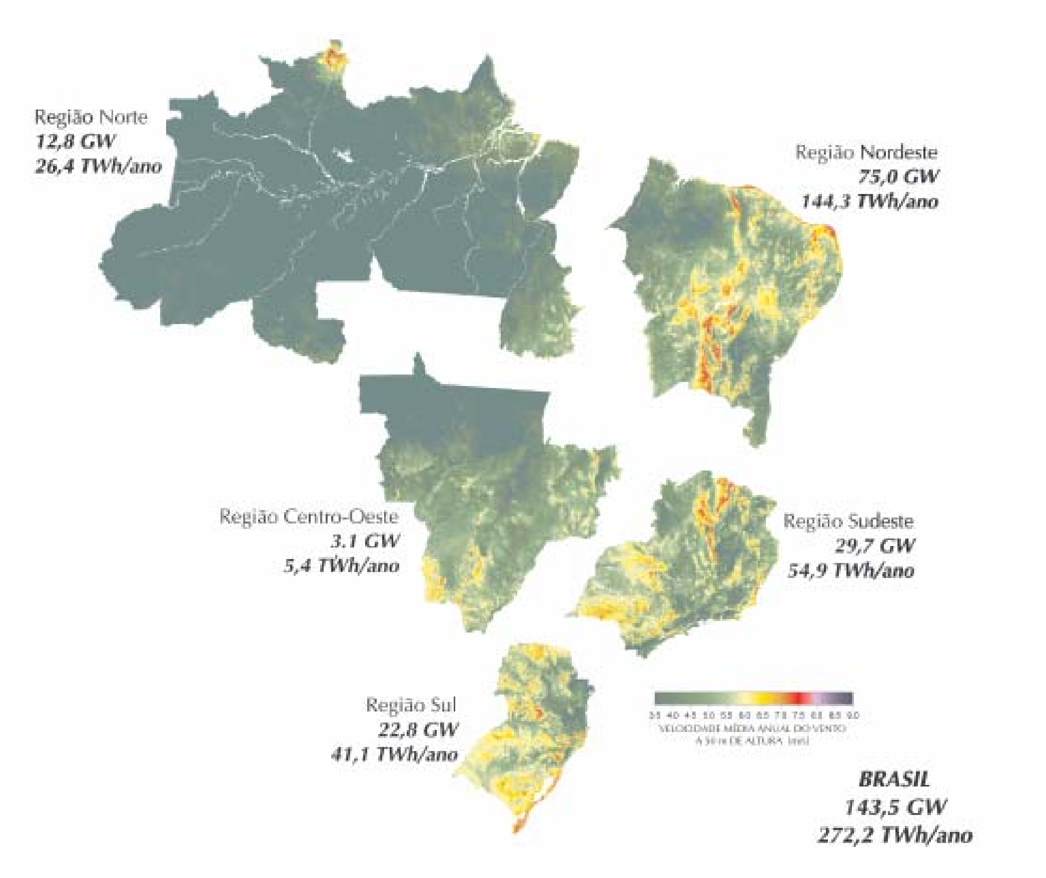

Figure 15: Brazilian wind power potential [22]

According to Figure 16 Brazilian Northeast region has the major wind power potential with 75 GW, or 52% of all. On the other hand, the Center-West has the lower potential of the country with 3.1 GW.

Additionally, wind incidence on Northeast region is higher during the period of lower outflows to hydroelectric reservoirs on São Francisco River, which responds for 98% of all region generation.

The average cost to build a new plant is about R$ 2,000/kW (US$ 1,053/kW), without considering the costs to install the substation, build an exclusive line to connect the plant to distribution system and the purchase of the land where all turbines will be installed.

Besides to avoid turbulence between the turbines and to guarantee the best performance of the engines, it is necessary to have a reasonable space between towers, based on shovel diameter (which can reach 80 m). Then it results on a big land to be bought and this cost could be very high, depending on the installed power of the plant.

The main benefits of wind power plants are:

- use of renewable energy source, without costs and do not produce pollutant gases;
- lower environmental impact;
- short period to build a plant (about 6 months);
- use the great Brazilian wind power potential, especially on Northeast region.

Figures 16 and 17 presents pictures of Mucuripe (2.4 MW) and Rio do Fogo (49.3 MW) wind power plants.

Figure 16: Mucuripe wind power plant

Figure 17: Rio do Fogo wind power plant

3. LEGAL AND REGULATORY INCENTIVES TO DISTRIBUTED GENERATION

3.1 BRAZILIAN NATIONAL PROGRAM FOR DISTRIBUTED GENERATION – PROINFA [23], [24]

Brazilian Federal Law nº 10,438/2002 created a national program designed to stimulate the use of renewable energy resources – Proinfa, especially: Small Hydroelectric Power Plants – SHPs, biomass and wind power. In addition this program seeks to reduce greenhouse gas emissions, based on Kyoto Protocol.

Initially the first part of this program aimed to hire 3000 MW in June of 2004, divided into equal parts among those energy sources, and the plants should be operating until December of 2006. Furthermore Eletrobrás has contracted each plant and the energy costs will be transferred to all consumers of interlinked system throw tariff, except for low income consumers.

Then Federal Law nº 10,762/2003 postponed the dead line for December of 2008, and Decree nº 5,025/2004, has established more rules for Proinfa. In addition ANEEL has published the following resolutions detailing the rules and allowing the program to be done:

- Resolution nº 56/2004, established the conditions to those plants access the transmission and distribution systems;
- Resolution nº 62/2004, established the procedures to calculate the reference energy for distributed generation plants that could be interested to join Proinfa;
- Resolution nº 65/2004, published the reference energy for each plant that were allowed to participate in Proinfa's public selection;
- Resolutions nº 111/2004 and nº 127/2004, defined the procedures for dividing the energy costs among consumer of all distribution companies and their respective values.

Therefore Eletrobrás has done two public calls for investors who might be interested to join the first stage of Proinfa, according the following conditions:

i) preferential choice for new enterprises, especially those which had the oldest environmental licenses;
ii) possibility of contracting the energy that will be produced by the expansion of actual biomass thermoelectric plant;
iii) the energy price were defined by MME based on Brazilian average tariff, and all contracts will guarantee the purchase for 20 years;
iv) guarantee of financing by National Bank for Social and Economic Development - BNDES, which could have reached 70% of total cost;
v) guarantee of full payment for at least 70% of generation by the plant during the financing period;
vi) enterprises must have at least 60% of national equipments and services;
vii) Eletrobrás will represent all generators on CCEE, taking all short-run markets risks when plants generation become inferior to contract values;
viii) each distributed generation type had limits to be contracted for each Brazilian State, which was 20% for biomass and wind power and 15% for SHP, in order to provide development in all regions;
ix) all contracts must have special clause to reduce the energy price if the generator receive another benefits besides Proinfa, which includes the carbon credits selling.

Table 1 illustrates the economics values established for each source in June of 2004 and the present values in September of 2007 through IGP-M index.

Table 1: Economic Value for Each Energy Source [14]

Source	**Specification**	**R$/MWh jun/04**	**R$/MWh sept/07**
SHP		117.02	136.60
Wind Power	Maximum price	204.35	238.54
	Minimum price	180.18	210.32
Biomass	Sugar cane	93.77	109.46
	Shell of rice	103.20	120.47
	Waste of wood	101.35	118.31
	Landfil gas	169.08	197.37

Table 2 presents the main results from Proinfa's first stage and Figure 18 illustrates the percentage participation of each source on total contracted power.

Table 2: Results of 1st Proinfa's Stage [1],[14]

Sources	Enterprises	Contracted Power (MW)	Energy (GWh/year)	Investment (R$ billions)
SHP	63	1191	6,541	3.60
Wind Power	54	1423	3,72	5.53
Biomass	27	685	2,276	1.01
Total	144	3299	12,537	10.14

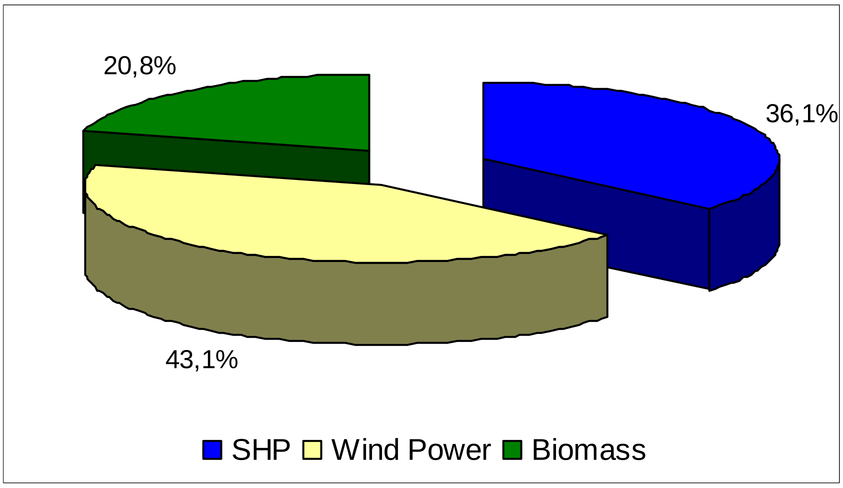

Figure 18: Participation of each source in Proinfa

According to Table 2 the global contraction goal was reached but there were not enough interested investors on biomass because the established price for this type generation was lower than investor's expectations. Therefore the biomass goal was redistributed between SHP and wind power, as presented in Table 2.

Figure 19 presents the actual situation of the plants that were included in Proinfa, showing the perspectives until 2008.

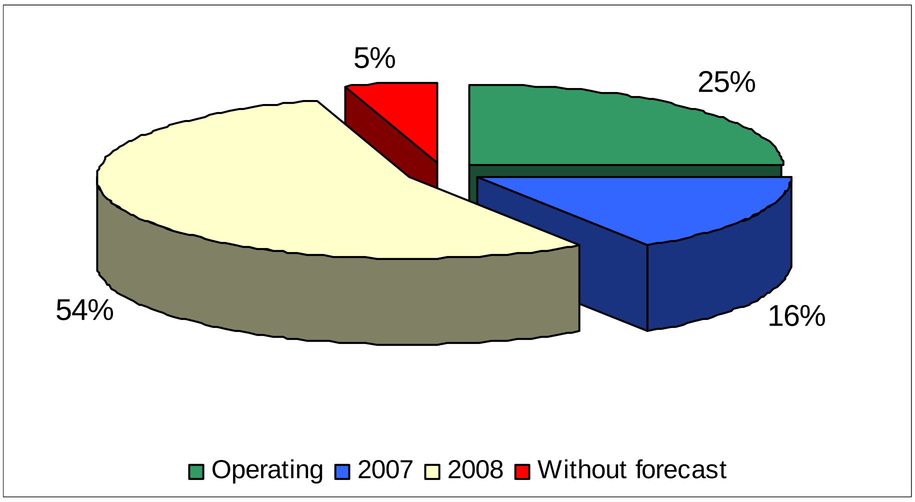

Figure 20: Actual situation of Proinfa's Power Plants [1]

Based on Figure 20, there can be known that 25% of those plants are already operating and only 5% present serious restrictions and do not have any perspectives to be done.

Figure 21, 22 and 23 shows the situation of each energy source inside Proinfa.

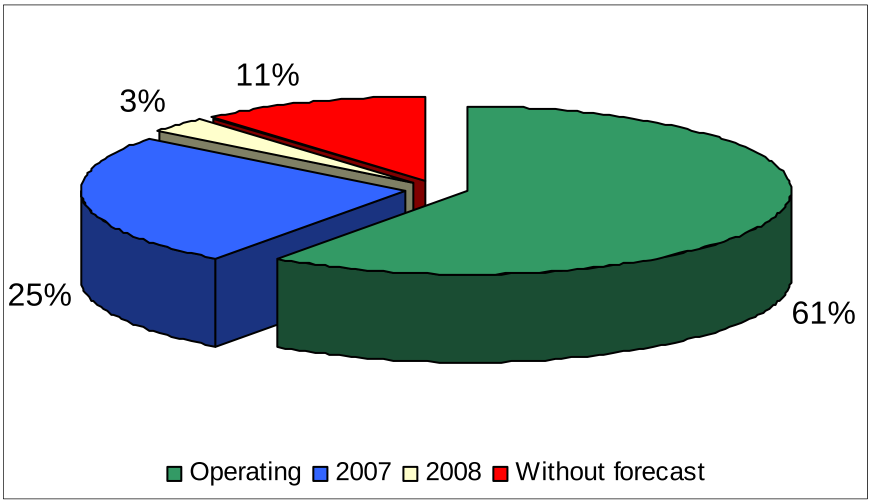

Figure 21: Proinfa - situation of Biomass Power Plants [1]

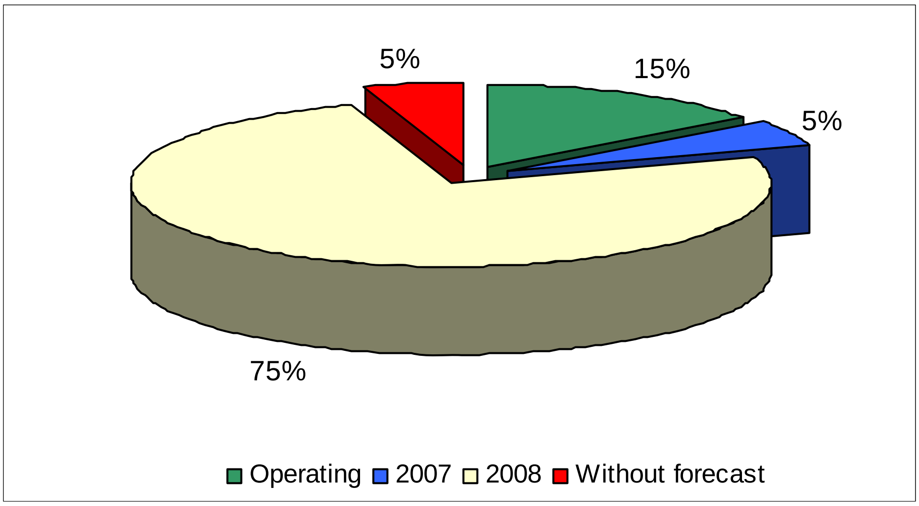

Figure 22: Proinfa - situation of Wind Power Plants [1]

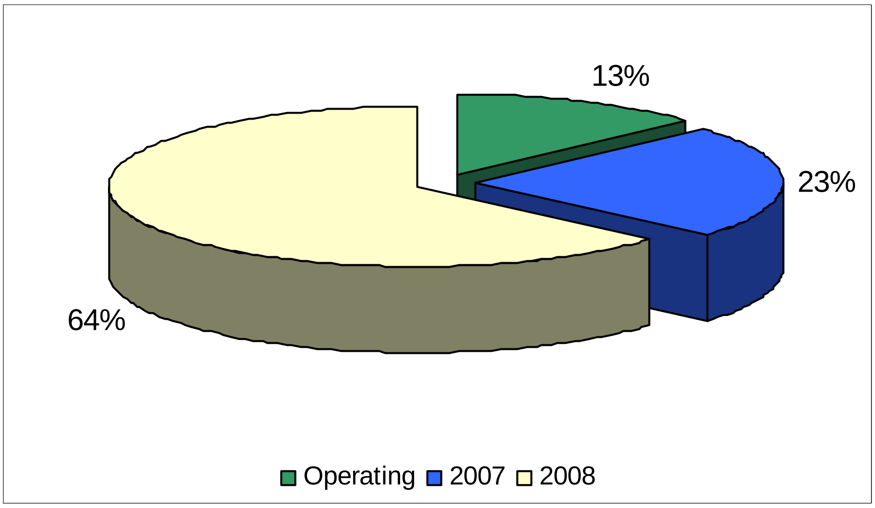

Figure 23: Proinfa - situation of SHPs [1]

In addition Federal Law nº 10,438/2002 has forecasted a second stage for Proinfa which would seeks to reach the following goals: supply 10% of energy market by distributed generation, 20 years after the conclusion of the first stage, but there is no regulation about that yet.

Therefore those plants would be contracted for 20 years by Eletrobrás, just like the first stage, but the price would be established by MME based on weighted average costs from hydroelectric and natural gas thermoelectric power plants, which is very different from the first stage rules. At least, it will be demand that 90% of all equipments and services must be national.

3.2 OTHERS CURRENT INCENTIVES IN BRAZIL [23], [24], [26], [32]

Beyond Proinfa there are others legal and regulatory incentives for alternatives energy sources. Therefore there will be presented the main benefits for enterprises for small plants, fewer than 30 MW, that are classified as SHP or use wind power, biomass, solar or qualified cogeneration:

- ✓ 50% reduction on distribution or transmission tariff applied to generation and for consume;
- ✓ possibility of selling energy for free consumers (which have demands above 3 MW);
- ✓ possibility of selling energy for especial consumers (which have demands above 500 kW on interlinked system and 50 kW on isolated system);
- ✓ SHPs do not have the obligation for paying financial compensation to the cities that might be damaged by theirs small reservoirs, which are not applied to hydroelectric power plants;
- ✓ possibility to receive income as subsidy for substituting thermal generation through diesel oil on isolated system by renewable energy sources;
- ✓ possibility for SHPs getting into MRE, which is as mechanism to reduce the hydrological risks for the participants on interlinked system;
- ✓ exemption from annual investment on Resource and Development, which is an obligation for others generation that must apply 1% of their annual income;
- ✓ possibility to sell energy on annual public auctions for all distribution companies, that are promoted by MME and organized by ANEEL;
- ✓ possibility to sell energy on especial auctions for alternative generation;
- ✓ possibility to sell energy directly to distribution companies through public calling, but this type of commercialization are limited to 10% of their market.

3.3 RENEWABLE ENERGY POLICY OF CALIFORNIA [46], [48]

After the energy crisis faced in 2001, California established in 2002 its Renewable Portfolio Standard Program (RPS), with the goal of increasing the percentage of renewable energy in the state's electricity matrix to 20 percent by 2017. However, the California Energy Commission (CEC) recommended accelerating that goal to 2010, and then the goal was increased to 33 percent by 2020, supported by State's Energy Action Plan.

Table 3 provides a summary of RPS contracts approved by California Public Utilities Commission (CPUC) since 2002, from California's three large utilities – Pacific Gas & Electric (PG&E), Southern California Edison (SCE), and San Diego Gas & Electric (SDG&E), considering that 2007 data are updated until may.

Table 3: Contracts Approved by CPUC [48]

Year	PG&E	SCE	SDG&E
2002	119 MW (4 contracts)	268 MW (5 contracts)	239 MW (15 contracts)
2003	44 MW (3 contracts)	687 MW (8 contracts)	40 MW (1 contract)
2004	371 MW (6 contracts)	-	580 MW (6 contracts)
2005	180 MW (7 contracts)	205 MW (11 contracts)	193 MW (6 contracts)
2006	219 MW (6 contracts)	-	-
2007	2 MW (1 contract)	-	-
Total	**935 MW (27 contracts)**	**1160 MW (24 contracts)**	**1052 MW (28 contracts)**

Besides, it was created the Emerging Renewable Program (ERP) to help develop a self-sustaining market for renewable energy systems across California. Through this program, the Energy Commission provides funding to offset the cost of purchasing and installing new renewable energy systems using emerging renewable technologies.

The ERP provides electricity consumers with a financial incentive to install renewable energy systems on their property. The financial incentive varies based on system size, technology, and type of installation. The incentive is paid once the system is installed and operating.

The goal of the ERP is to reduce the net cost of on-site renewable energy systems to end-use consumers, and thereby stimulate demand and increased sales of such systems. Increased sales are expected to encourage manufacturers, sellers, and installers to expand operations, improve distribution, and reduce system costs.

To qualify for an incentive, both the consumer and the renewable energy system must satisfy a number of requirements. Consumer must receive electricity distribution service of installation from an electrical utility and the renewable energy system must utilize an emerging renewable technology, such as fuel cells (the conversion of sewer gas, landfill gas, or other renewable sources of hydrogen or hydrogen rich gases into electricity by a direct chemical process) or small wind turbines (50 kW or less).

The system must also be interconnected to the utility distribution grid, must use new components that are certified or tested to be reliable, and must come with a five-year warranty. In addition, the renewable energy system must generate electricity to supply consumer's load.

The rebates offered through this program are based on the generating capacity of a system and vary by system size, technology, and type of installation. The incentive must be used to reduce the purchase or lease cost of the eligible system, or the cost of electricity produced by the eligible system for the on site customer. Table 4 lists the rebate levels available for 2007 by size category and technology type.

Table 4: Rebates for 2007 [46]

Technology Type	Size	Rebate
Fuel Cells	< 30 kW	$ 3.00 per watt
Wind	First 7.5 kW	$ 2.50 per watt
	> 7.5 kW and < 30 kW	$ 1.50 per watt

In addition, the California Public Utilities Commission created in March of 2001 the Self-Generation Incentive Program (SGIP) to offer financial incentives to their customers who install certain types of distributed generation facilities to meet all or a portion of their energy needs. SGIP provides rebates for systems sized up to 5 MW. Generation technologies involved in the SGIP include photovoltaic (solar) systems, microturbines, fuel cells, and wind turbines.

Table 5 presents the Self-generation program results until September of 2007 per technology.

Table 5: Results per distributed generation technology [50]

	Number of Plants	Power (MW)
Photovoltaic	1150	212.9
Fuel Cell	32	21.2
Gas Turbine	10	23.1
IC Engine	249	161.6
Microturbine	140	26.9
Wind Turbine	5	3.4
Total	1586	449.1

Figure 24 presents the percentile participation of each alternative generation technology described on Table 5 in the total power that has been installed.

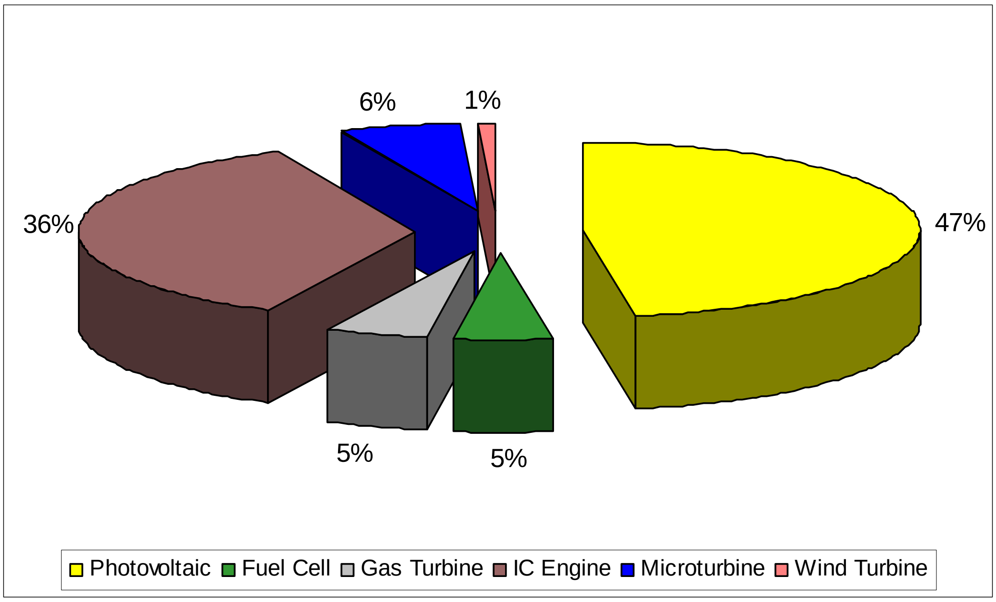

Figure 24: Percentile Participation of each Distributed Generation Technology

Table 6 presents the list of the main fuel utilized in those power plants, showing the number of plants and the total power for each fuel.

Table 6: Sef-generation program: types of fuels [50]

Fuel	Number of Plants	Power (MW)
Biogas	6	2.0
Landfill Gas	9	4.8
Natural Gas	373	205.5
Waste Gas	1	0.8
Sun	1150	212.9
Wind	5	3.4
Others	42	19.7
Total	1586	449.1

Figure 25 illustrates the participation of each fuel described on Table 6 in the total installed power of those plants.

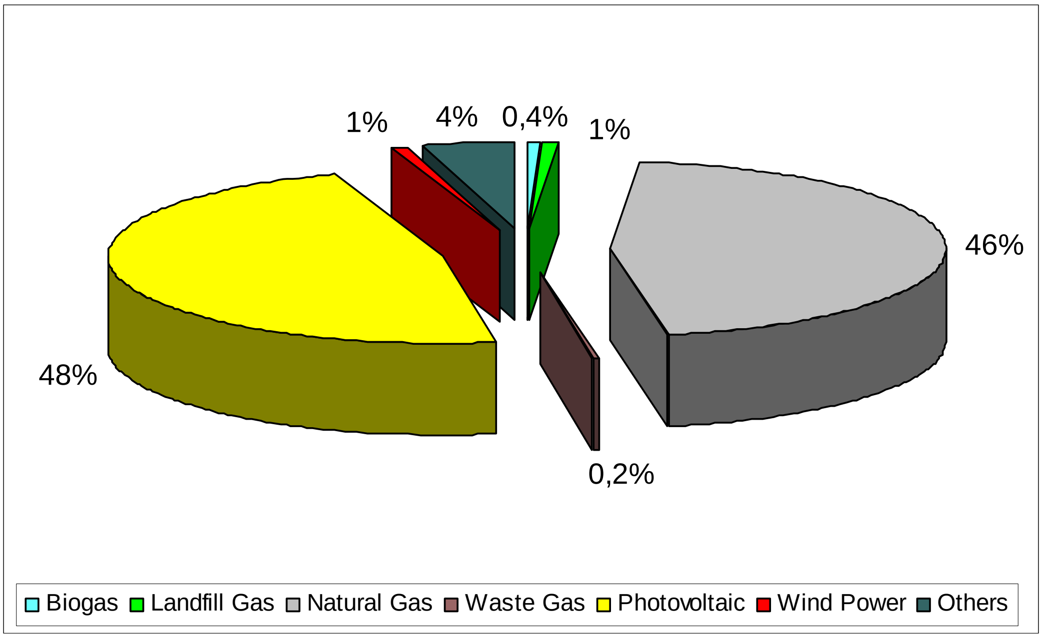

Figure 25: Percentile Participation of each Fuel in the Sefl-generation program

Besides, the California Public Utilities Commission (CPUC) launched the California Solar Initiative (CSI) on January of 2007, which has a goal to create 3,000 MW of new, solar-produced electricity by 2017 - moving the state toward a cleaner energy future and helping lower the cost of solar systems for consumers. The budget for this program is $3.3 billion over 10 years.

The California Solar Initiative has three distinct program components, each with a portion of the statewide budget and solar installation goals:

• CPUC directs solar incentives to customers of the distribution companies for existing homes and existing and new commercial, industrial, and agricultural properties. This program component is allocated $2,167 million over 10 years, and the goal is to reach 1,940 MW by 2016. This goal includes 1,750 MW from the mainstream incentive program and 190 MW from the low-income resident incentive program.

• California Energy Commission advances solar in new home construction, through its New Solar Homes Partnership. This program component is authorized $400 million over 10 years, with a goal of 360 MW.

• Each electricity distribution company has to offer an equivalent incentive program, an aggregate commitment of $784 million over 10 years, toward a goal of 660 MW.

Therefore Table 7 presents the Gross System Power for 2006, showing the participation of each electrical energy source and including the amount that was imported by others states.

Table 7: Gross System Power for 2006 [46]

Fuel Type	California (GWh)	Import (GWh)	Total (GWh)
Coal	17.573	28.662	46.235
Large Hydro	43.088	12.951	56.039
Natural Gas	106.968	15.258	122.226
Nuclear	31.959	6.191	38.150
Renewables	30.514	1.701	32.215
Biomass	5.735	550	6.285
Geothermal	13.448	260	13.708
Small Hydro	5.788	448	6.236
Solar	616	0	616
Wind	4.927	443	5.370
TOTAL	230.102	64.763	294.865

However Table 7 does not include the electricity produced by many small-scale photovoltaic installations throughout the state which might add another 203.3 GWh, based on Energy Commission's Renewable Energy Program records. Figure 27 presents the participation of each source in the Electric Energy Matrix of California, including all the imports.

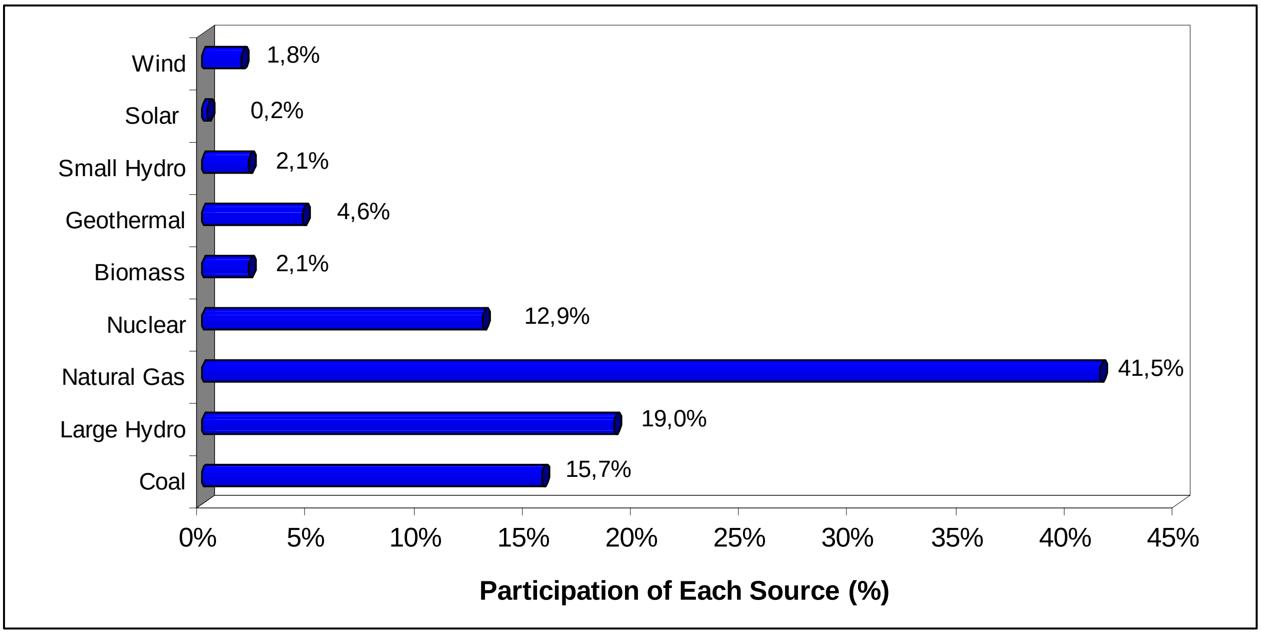

Figure 26: California Electric Energy Matrix [46]

However, transmission system could be a major barrier to achieving the goal of 33% for 2020. In an effort to overcome this obstacle, the state of California has launched a renewable transmission planning initiative based on a proactive assessment of renewable resources and their transmission needs.

As renewable energy resources are often located far from the grid and load centers, such wind power plants, it is required an extensive and expensive transmission upgrades. In order to achieve cost-savings through economies of scale, and to limit environmental impacts and ultimate build-out time, large transmission projects are needed to access large geographic areas of developable, economic renewable resource potential. Integrating procurement and transmission planning will help avoid piecemealed transmission solutions.

4. CLEAN DEVELOPMENT MECHANISM

4.1 INTRODUCTION [15], [36]

Kyoto Protocol, adopted in December of 1997, has established targets for voluntary reduction of greenhouse gases emissions – GHG (CO_2, CH_4 e N_2O) for countries listed in Annex I of United Nations Framework Convention on Climate Change – UNFCCC, which means an average decrease of 5% on 1990 GHG levels to be done among 2008 and 2012.

The Clean Development Mechanism – CDM has been created by article 12 of Kyoto Protocol to assist the develop countries listed on Annex I in meeting their GHG emission reduction commitments or removal of CO_2, and at the same time, allowing developing countries (non-Annex) to implement sustainable projects.

Therefore governs and firms from developed countries can use CDM to invest in projects that will be done in developing countries seeking to reduce GHG emissions and get a Certified Emission Reductions (CERs), which are measured in metric tons of carbon dioxide equivalent (CO_2 equivalent).

The CERs represent credits that can be use by countries from Annex I that have ratified Kyoto Protocol, to achieve part of their GHG emission reduction targets with lower costs than projects in their own countries.

Then CDM seeks to allow investments in more efficient technologies, in replacement of fossil energy sources by renewable ones, in rational use of electric energy, forestation and reforestation, among others possible actions.

Besides CDM Kyoto Protocol has established two additional mechanisms to stimulate the countries to invest in GHG emission reduction, which are: Joint Implementation and Emissions Trading. However those mechanisms are restricted to countries listed in Annex I.

Joint Implementation (article 6 of Kyoto Protocol) consists in transference or acquisition of Emissions Reduction Units (ERUs) from projects that have reduced human activities emissions in many economy sectors. Therefore it allows one Annex I country to invest in projects that will be done in another country listed in Annex I.

On the other hand, Emissions Trading (article 17 of Kyoto Protocol) refers to carbon credits commercialization among Annex I countries, but not directly related to any project.

Therefore CDM is the unique mechanism that allows voluntary participation of developing countries, and Brazil has a huge potential to implement many types of GHG emission reduction or CO_2 removal projects, what can attract the available resources from developed countries that have difficulties to meet Kyoto Protocol's targets.

The CDM project activities, as well as GHG emission reduction or CO_2 removal, have to be submitted to gauge and verification process through the following institutions:

- ✓ CDM Executive Board – supervises CDM and has the following responsibilities: (i) accreditation of Designated Operational Entities; (ii) registry of CDM project activities; (iii) emission of CERs; (iv) development and maintenance of CDM registry; (v) establishment and improvement of methodologies related to baselines, monitoring and leakage.

- ✓ Designated National Authority (DNA) - certifies that the participation is voluntary and that project activities contribute to the sustainable development of the country. DNA in Brazil is represented by Interministerial Committee for Global Climate Change that is chaired by Minister of Science and Technology and the vice-Chair is the Minister of the Environment.

- ✓ Designated Operational Entities (DOE) - domestic or international entities accredited by the Executive Board and have the following responsibilities:

  a) validate CDM project activities according with the Marrakech decisions;
  b) verify and certify emission reductions and removals of CO2;
  c) maintain a public list of CDM project activities;
  d) submit an annual report to Executive Board;
  e) make information about CDM projects publicly available, unless deemed proprietary or confidential by project participants.

In order to receive CERs from activities projects there must be done the following steps of the Project Cycle:

- Preparation of the Project Design Document (PDD);
- Validation/Approval;
- Registration;
- Monitoring;
- Verification/Certification
- Issuance and approval of the CERs

Brazilian Interministerial Committee analyzes the validation report (prepared by DOE) and the contribution of the project activity for sustainable development of the country, based on the following criteria:

- Income distribution;
- Local environmental sustainability;
- Work conditions and employment generation;
- Qualification and technology development;
- Regional integration and connection with others sectors;

4.2 CURRENT SITUATION OF CDM PROJECTS [18], [36], [37]

There were 824 projects registered in October of 2007 on CDM Executive Board and 51 were requesting registration. Figure 27 presents the space distribution of CDM registered projects.

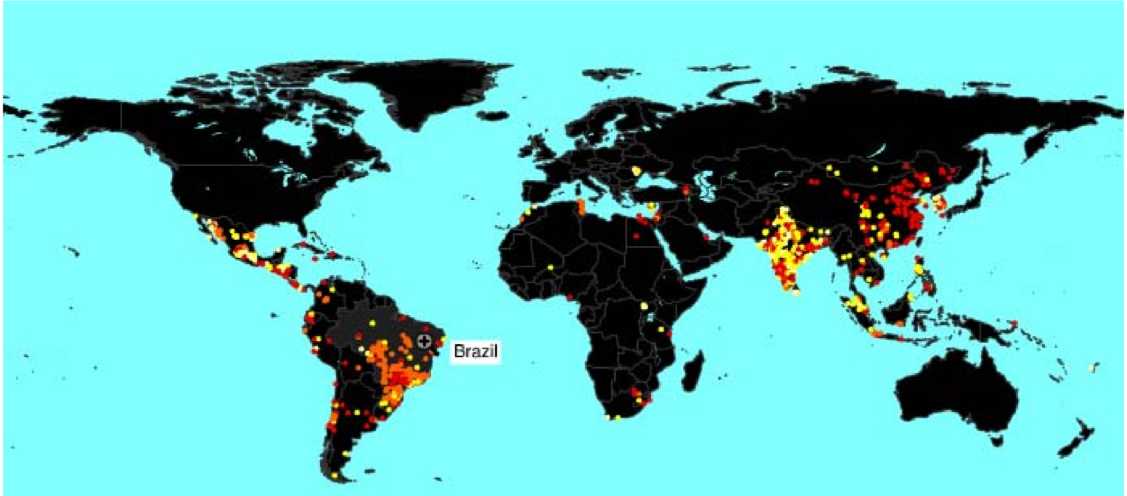

Figure 27: CDM Registered Projects [37]

Figure 28 illustrates the number of registers for Brazil, China, India and Mexico.

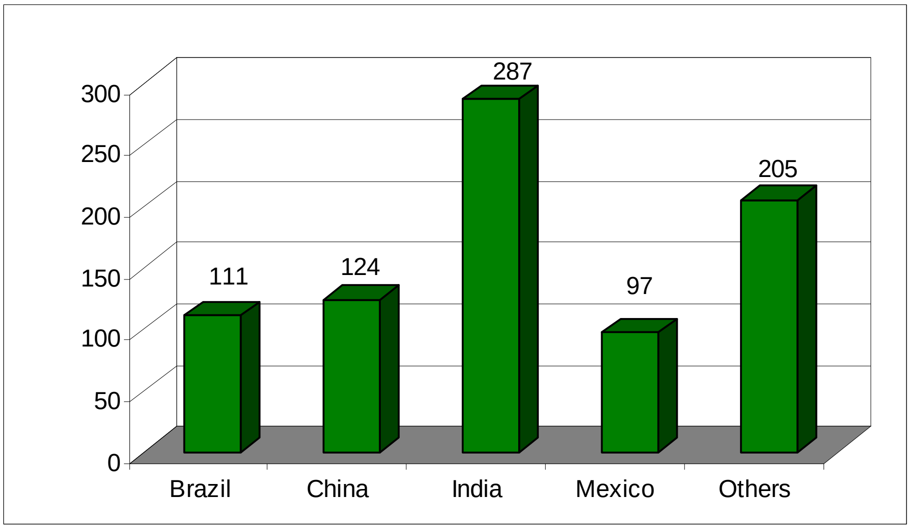

Figure 28: Number of Registered Projects per Country

Figure 29 presents the distribution of registered project per category.

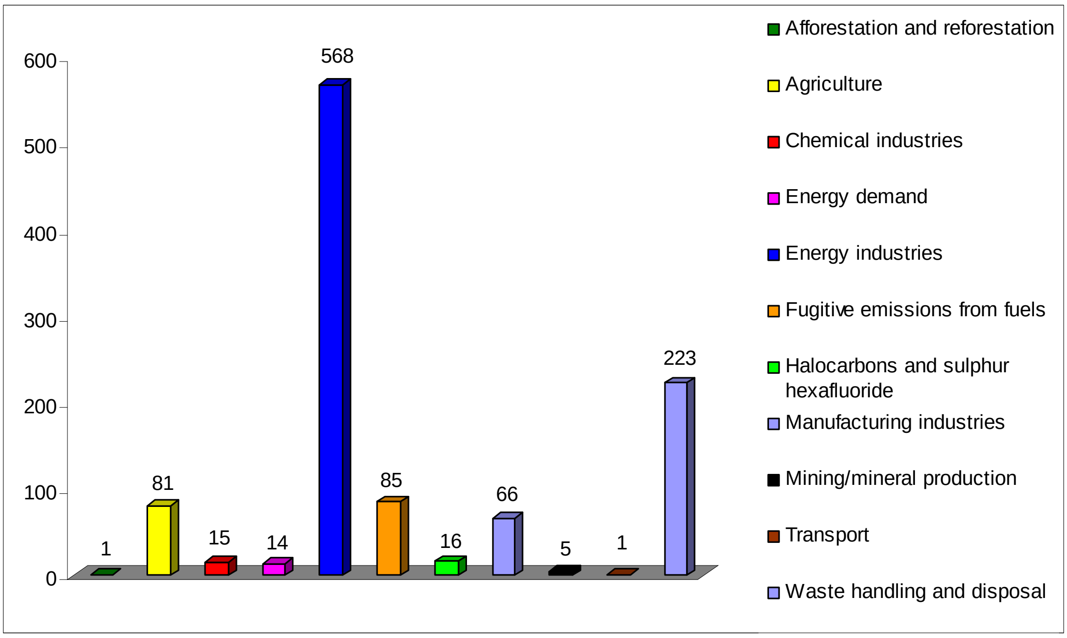

Figure 29: Types of Registered Projects

According to Figure 29 projects in Energy Industries area, which are focus on renewable and non-renewable energy sources (but less pollutant), represent 53% of all registered projects.

In October there were 245 projects passing through validation/approval process on Brazilian DNA. Figure 30 presents the distribution of these projects per category.

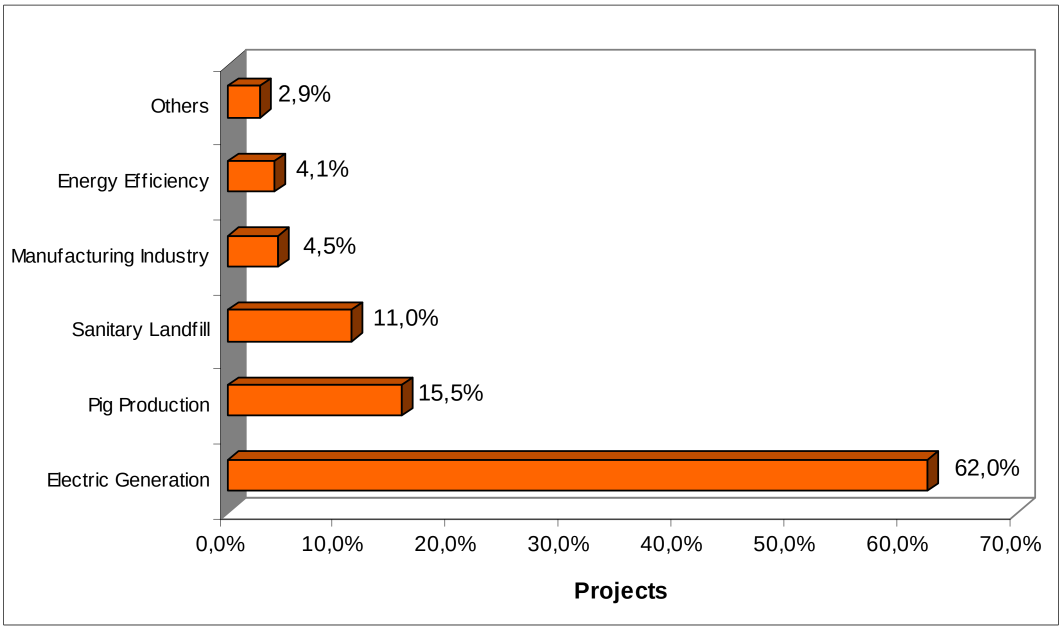

Figure 30: Brazilian Projects

Based on Figure 30, there can be verified that 62% of those projects belong to Energy Industries category and the annual emission reductions forecasts for those projects represent about 43.9% of all, as illustrated in Figure 31.

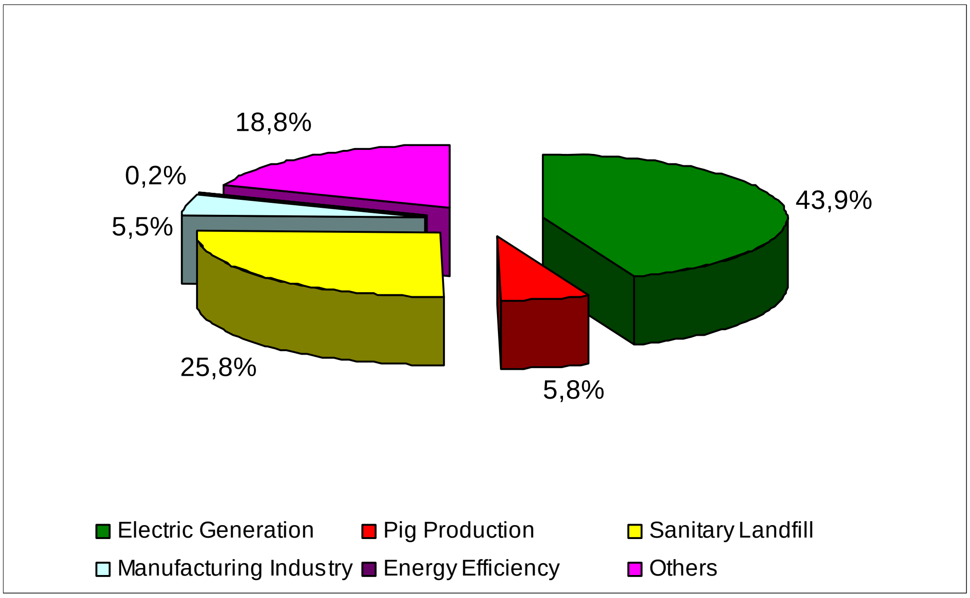

Figure 31: Percentage of Gases Emission Reduction

On the other hand, it is quite expensive to submit a project for DNA validation and get thought the others steps, including receive a certification from DOE and finally obtain the CER, what can make a project impracticable. The estimated cost for a CDM project varies between US$ 250,000 and US$ 300,000.

Nevertheless the price of each CER avoided for the project, or tCO2 equivalent, can reach attractive values for the enterpriser, depending on carbon market situation. For example, the average prices for contracts that were done in May of 2007 and will be running in 2008 were about €20.00/tCO2 equivalent on European Climate Exchange.

Based on this price there can be used as an example the SHP Passo do Meio, with 30 W and an estimated annual generation of 156,204 MWh, which project were approved on CDM Executive Board, can avoid about 43,472 tCO2 equivalent/year and could receive €869,440 for annual income, as a result of selling carbon credits.

Additionally, an real example of well done CDM project is the Bandeirantes sanitary landfill in São Paulo, which generate energy with the methane gas produced by the landfill, has sold 808,450 CERs for a Dutch Bank through an auction lead by Bolsa de Mercadorias e Futuros (BMF) from São Paulo and will receive R$ 34 millions, or €16.20/tCO2.

Considering a contract with an average period of 10 years for CDM projects, and depending on the amount of CER of each enterprise and their prices, the higher costs for getting the project certification could be recovered very fast, resulting on additional and interesting incomes for those plants.

Finally, Brazilian projects included in Energy Industries area totalize 2,634 MW of installed power and are distributed among several energy sources, as presented in Figure 32. Especial emphasis must be done to biomass projects and their huge potential to obtain an additional income from carbon credits sells.

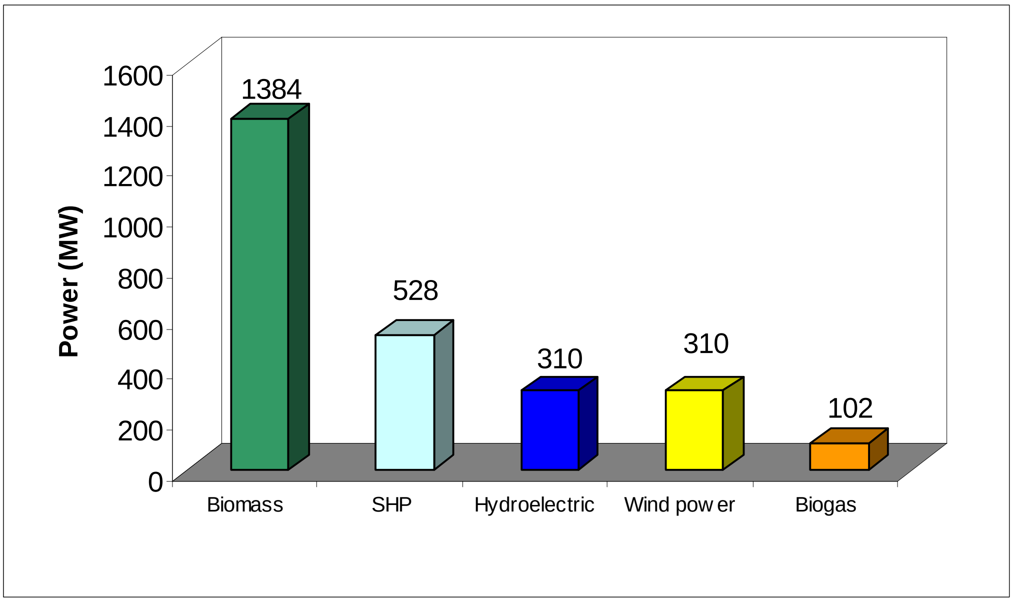

Figure 32: Installed Power by Source

5. ENERGY AUCTIONS [25], [28]

The New Institutional Model of Brazilian Electric Sector were introduced by Federal Law nº 10,848/2004, and regulated by Decree nº 5,163/2004, which changed significantly the rules of energy commercialization through the creation of two distinct frameworks:

- Regulated Contracting Environment (RCE)
- Free Contracting Environment (FCE)

5.1 REGULATED CONTRACTING ENVIRONMENT (RCE) [38]

This environment concentrates all public energy purchases and selling from distribution companies (buyers) and generators (sellers). Distribution companies are only allowed to buy energy from regulated environment and must supply 100% of their markets. On the other hand, generators must guarantee 100% of electricity, with their own production or buying contracts.

Therefore all distribution utilities have to sign a power purchase agreement (PPA) with all sellers (generators), through Brazilian Electric Power Commercialization Chamber (CCEE) supervising.

At this environment generators will assume all hydrological risks on energy delivery contracts and distribution companies will answer for all risks on energy availability contracts, which will be, in consequence, transferred for their consumers through regulated tariff.

As distribution companies can only purchase energy through public auctions, except for bilateral contracts that were celebrated before Federal Law nº 10,848/2004, and the compulsory annual acquisition of Binational Itaipu's energy for South, Southeast and Center-West regions, ANEEL promotes three types of auctions that are executed by CCEE:

- ✓ Energy from Existing Power Plants;
- ✓ Energy from New Power Plants;
- ✓ Energy Adjustment (only for existing power plants).

New power plants do not have a public authorization before the auction or an existing plant can receive this classification in a very particular case, considering only the new generation unit, which represents the installed capacity increase of this unit.

The total energy amount to be auctioned and the list of hydroelectric and thermoelectric power plants that would able to participate the auction are defined by MME, based on market forecasts made by distribution utilities and on planning studies made by Brazilian Researching Energy Company (EPE).

5.2 FREE CONTRACTING ENVIRONMENT (FCE) [38]

This environment concentrates energy purchase and selling through bilateral contracts, among generators, energy retailers, free consumers, with freedom to negotiate their prices and contracts period, but without distribution utilities participation.

In Brazil free consumer must have at least 3 MW of demand, and since 1995, the new one can be attended by any tension level and choose other energy supplier, different from local distribution company.

In addition consumers with installed power between 500 kW and 3000 kW can also be included in FCE, although they have to buy energy directly from renewable sources, like SHPs, biomass, wind power and solar or buy it from a retailer, which has to guarantee that this energy belongs to renewable sources.

Generators can sell their assured energies in FCE through the following options:

- ✓ exclusives selling auctions for free consumers or purchasing auctions organized by consumers;
- ✓ auctions or public calls for others sellers (to cover their contracts).

5.3 ELECTRIC ENERGY CONTRACTING [38]

5.3.1 General Aspects

Distribution utilities have to forecast their market five years before it happens and inform MME, showing the participation of potential free consumers. Figure 33 illustrates the ways to sell energy in Regulated Contracting Environment.

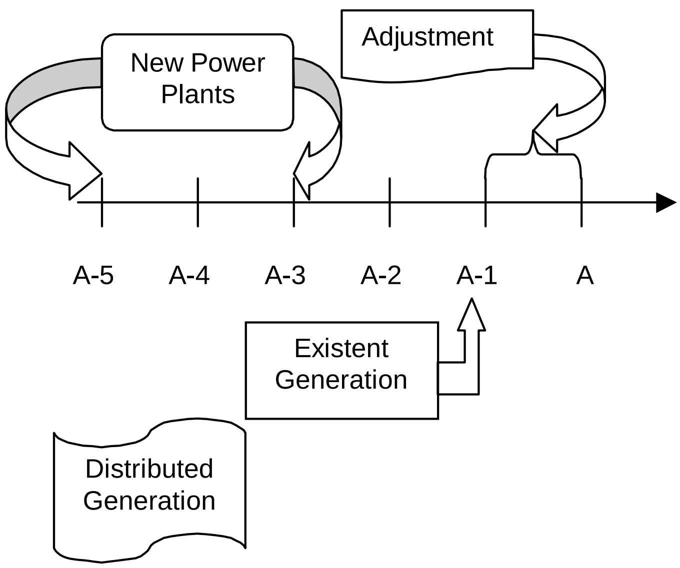

Figure 33: Energy contracting types in RCE

According to New Institutional Model for Brazilian Electric Sector, new power plants will be responsible for attending load expansion and their energy will be sold though three auctions types, as shown in Figure 34:

- Five years before the year where the energy is needed (A-5);
- Three years before the year where the energy is needed (A-3)

Those long-term contracts (A-5 and A-3) have the duration between 15 (thermal) and 30 (hydraulic plants) years, starting the energy delivery on year A.

For the first case, distribution companies will be allowed to pass all energy acquisition costs to consumers. But for energy contracted in A-3 auctions, distribution companies will only receive for all purchase costs if the limit of 2% their energy market would be respected.

The existing energy contracting, which involves plants that were generating in the year 2000, will also be done by public auctions with duration between 3 and 15 years, delivering the energy on January of the following year.

At least the energy adjustment auctions will be done to complement a small part of distribution market foreseen for year A and that were not covered by the others auctions, limited to 1% of total load.

This auction will be done in year A with a participation of public generators, independent generators and retails as sellers, considering that all contracts would have up to 2 years of duration and the delivery must start in 4 months.

5.3.2 Auctions Done After 2004 [1], [39], [40]

After Law nº 10,848/2004 and until October of 2007, there were 5 existent energy auctions, 6 adjustments auctions, 5 new power plants auctions and 1 exclusive auction for renewable energy sources.

Therefore the first ones existent energy auctions negotiated huge energy amounts, because it was necessary to re-contract energy for all current market. On the other hand, the quantity of energy that were sold in new power plants auctions was lower, once the objective was to attend market rise forecasts for following years. In addition, as adjustment auction aims to attend less than 1% of distribution market the negotiated amount were very modest.

Tables 8 and 9 present the main results of the main auctions.

Table 8: Summary of 5 Existent Energy Auctions

		Offered Products									
		2005		2006		2007		2008		2009	
Number of Sellers	Contract Period (years)	Number of Lots	Average Price R$/MWh	Number of Lots	Average Price R$/MWh	Number of Lots	Average Price R$/MWh	Number of Lots	Average Price R$/MWh	Number of Lots	Average Price R$/MWh
18	8	9054	57.51	6782	67.33	1.172	75.46				
16	8							1325	83.13	0	-
13	3			102	62.95						
15	8									1166	94.91
6	8					204	104.74				

Table 9: Summary of 5 New Power Plant Auctions

					Offered Products									
					2008		2009		2010		2011		2012	
Date of the Auction	Power Plant Type	New Plants	Existent Plant or with ANEEL's Authorization	Contract Period (years)	Number of Lots	Average Price R$/MWh	Number of Lots	Average Price R$/MWh	Number of Lots	Average Price R$/MWh	Number of Lots	Average Price R$/MWh	Number of Lots	Average Price R$/MWh
12/16/2005	Hydroelectric	7	15	30	71	106.95	46	113.89	891	114.83				
	Thermoelectric	6	23	15	561	132.26	855	129.26	862	121.81				
6/29/2006	Hydroelectric	0	15	30			1.028	126.77						
	Thermoelectric	11	5	15			654	132.39						
10/10/2006	Hydroelectric	2	4	30							569	136.2		
	Thermoelectric	7	2	15							535	137.44		
7/26/2007	Hydroelectric	0	0	30					-	-				
	Thermoelectric	11	1	15					1304	134.67				
10/16/2007	Hydroelectric		5	30									715	129.14
	Thermoelectric	4	1	15									1597	128.37

An energy lot that were negotiated, as shown in tables 8 and 9, corresponds to 1MW average, or 8760 MWh per year, and the prices are referred to time of each auction without any monetary correction.

With respect to existent energy auctions, as the sellers were the old hydroelectric plants owners which were aimed to re-contract their energy amount the final prices were relatively low, because those enterprises have their construction cost already amortized. In addition, these auctions resulted on energy delivery contracts and generators have taken all hydrological risks.

For new power plants auctions there were signed energy quantity contracts for generators, which uses hydraulic source and energy availability contracts for thermal generators.

According to the rules thermoelectric plants receives a fix income every month, as insurance, and if they would be called by ONS to produce energy, because the water price has reached their energy cost, they will even receive extra money for paying their operational costs. So all consumers will take this risk from distribution companies and pay for these expensive generations in order to support the load supply through national interlinked electric system.

As presented in Table 9, on the 1st new power plant auction it was sold energy from 7 biomass plants, with 31 lots to 2008 and 66 lots to 2009. On the 2nd auction it was sold only 1 lot from 1 SHP and 60 lots from 5 biomass plants. Besides, the 3rd auction negotiated 61 lots from 4 biomass plants.

The 4th auction has sold only thermal products for delivery in 2010 (1304 lots) and without any biomass plant, but just oil fuel that will receive for their availability to increase the system security.

However the hydroelectric plants appeared again on the 5th auction, which scheduled products for 2012. They have sold about 30% of the all lots negotiated, and thermoelectric plants get the major part. But there were not any SHP, biomass or wind power interested in selling their energy in this auction.

At least, the 1st exclusive auction for renewable sources aimed to complete the contracted energy for 2010, considering the load rise. So it was designed an especial auction that sellers must offer energy that would be produced by wind power, biomass plants or SHPs.

Therefore EPE had technically qualified 87 new enterprises for this especial auction, but only 38 had deposited the financial guarantee established for this auction and were qualified by ANEEL.

Table 10 presents a comparison between the number of plants that were initially qualified by EPE and the participants of the auctions, by energy source and with the respective installed powers. In addition, Table 11 illustrates the main results of this auction.

Table 10: Plants qualified by EPE x Plants qualified by ANEEL

Source	Qualified Plants EPE	Qualified Power - EPE (MW)	Qualified Plants ANEEL	Qualified Power - ANEEL (MW)	Maximum Auction Price R$/MWh
SHP	54	844	19	350.62	135.00
Biomass	24	1019	19	814.38	140.00
Wind Power	9	939	0	0	140.00
Total	**87**	**2802**	**38**	**1165**	

Table 11: Summary of 1st Renewable Energy Auction

Date of the Auction	Type of Source	New Power Plants	Installed Power (MW)	Contract Period (years)	Offered Product 2010 Number of Lots	Offered Product 2010 Avarege Price R$/MWh
6/18/2007	SHP	6	96.74	30	46	134.99
	Biomass	12	541.9	15	140	138.85

As presented in Table 11 there were negotiated only 186 energy lots for 2010, which corresponds to 18 new small plants with 639 MW. Among them there are 115 lots for sugar cane biomass and 25 lots for animal waste biomass. Besides, the final price of each product was very close to its initial value, which means that there was not much competition among the few investors.

Finally the result of this auction had frustrated the market expectations, especially when compared with the number of enterprises qualified by EPE, and the distribution company demand (989 MW) [45]. Besides none of the wind power plants had deposited the auction guarantee, which represented a lost of 939 MW from dispute, and the SHPs and biomass participation were inferior to their potential.

6. INVESTORS’ RISKS VERSUS CURRENT OPPORTUNITIES

As presented in Chapter 1, Brazil has a huge potential to produce electric energy through renewable sources, especially hydroelectric, wind power and biomass, but they are not completely explored.

The following items will evaluate the main risks and current opportunities that renewable energy investors face, with particular attention to SHP, wind power and sugar cane biomass.

6.1 SHPS RISKS

In November of 2007 there were 174 enterprises that have already received ANEEL’s authorization but have not started building the plants, which would represent 2,607 MW of installed power.

As presented in Chapter 1 it is necessary about 18 to 24 months to build a SHP, which is much less than the time for a hydroelectric power plant (5 years). Besides, the environmental impacts are lower too, which gives more velocity on the environmental process to obtain the enterprise license, reducing the costs and minimizing the risks of construction delays.

With respect of plant financing, BNDES has an especial credit line for renewable energy projects and has guaranteed financing for all Proinfa’s plants. Similarly the Bank of Brazil offers financing for generation enterprises, reducing the investors’ risk.

On the other hand some enterprises face problems to connect their power plant to distribution grid. The ANEEL’s Authorization Act defines the connection point of the plant at a specific distribution line, and according to current rules the entrepreneur has to pay for its exclusive use line construction until the connection point, including the protection and measure equipments.

However if would be necessary to reinforce the current line, the distribution company must pay for that and these costs will be incorporated to their asset, which means that their consumers will pay through tariff.

In case of having conflicts between the plant owner and the distribution company about the definition of connection point and its costs, ANEEL could be asked to mediate the situation.

Another point that usually gives many doubts to investors is the tariff of transport that plants have to pay, especially the current incentives, which were presented in Chapter 2 the main legal and regulatory incentives, including the reduction at least 50% on those values for SHP, wind power and biomass generators and for free consumers who have purchased from these alternatives energy sources.

In addition, the average energy cost for a SHP is about 114 R$/MWh [44], which is inferior to the final prices of new power plants auctions and the 1^{st} exclusive auction for renewable sources, as presented in Chapter 4. When compared to the prices that were contracted in Proinfa, the average energy cost is still lower.

Besides Proinfa and energy auctions guarantee long-term contracts of 20 and 30 years for SHP, respectively, what give conditions to obtain lower tax in financing and guarantee cash flow during the contract period, reducing the investors' risk.

On the other hand, the Free Contracting Environment (FCE) has become an attractive market for generators, especially because of free consumers increased in the last years and answer for 18% of interlinked system consume.

Then despite energy price variation in short run market and the fact that those contracts duration are shorten than Regulated Contracting Environment (RCR), there are good opportunities in FCE.

Finally, as shown in Chapter 3, Clean Development Mechanism can provide an extra income for renewable energy projects for approximately 10 years, through the carbon credits sale that were obtained from the enterprises.

However there are many SHPs that have been authorized by ANEEL to change their society control lately and there is a great number of plants that have received ANEEL's authorization many years ago, but have not even started the construction.

Therefore, based on the information presented in this study, there might be inferred that there are sufficiently legal and regulatory incentives to turn SHP investment viable in Brazil. Besides, ANEEL is analyzing carefully the possibility to annul the authorizations of all enterprises that have not started plant construction yet and even have no perspective to begin it.

6.2 RISKS FOR BIOMASS POWER PLANTS

The average energy cost for a thermoelectric power plant that uses sugar cane bagasse is about R$ 110/MWh for new plants and R$ 138/MWh for old plants that need retrofit [44]. Then the enterpriser will only sell his product if the offer were higher than his production costs.

Based on the results of Proinfa (Chapter 3) and the 1st auction for renewable energy sources (Chapter 5), it might be inferred that the maximum selling prices established by MME for biomass were not very attractive to enterprisers, because they could not cover their production costs.

On the other hand, a simple analyze of the sugar cane harvest rise in the last years (Chapter 1) and the great interest in installing turbines in their alcohol and sugar plants to produce electric energy indicate that energy market became very attractive to these investors, offering good business perspectives.

Besides investors have the opportunity to insert their biomass power plants in CDM projects and receive an extra income from carbon credits sale that were obtained from the enterprises.

It should be pointed out that those plants have lower environment risks, because the occupied area is reduced and most of them adopt special procedures to treat their wastes and minimize the environment impacts.

In addition, similarly to SHP, BNDES has a specific financing credit line for biomass power plants, which reduce the financing risks for investors. Also there are others incentives for those plants, such as the discount of at least 50% on energy transport tariffs for generators and for free consumers who have purchased their energy, as presented in Chapter 2.

Therefore, based on all information presented in this study, there might be inferred that biomass power plants risks can be managed and mitigated especially for sugar cane bagasse. Then the maximum established price for this source in the auctions might be limiting the expansion of these plants, or the investors might be planning to sell in FCE and get better prices.

6.3 RISKS FOR WIND POWER PLANTS

As presented in Chapter 1 Brazilian wind power potential is extremely huge (about 143.5 GW), especially in Northeast region with 75 GW. However the production cost of this type of plant is still high (about R$ 200/MWh) and represents the greater barrier to its expansion through the country.

In order to incentive this type of generation Proinfa has established an attractive price, between R$ 180.18/MWh and R$ 204.35/MWh (in 2004) as presented in Table 1, and the result was very positive because the initial contracting target has been exceeded.

But among all rules established, one can be considered crucial because those enterprises must have at least 60% of national equipments and services, and there are only two national turbine industries in Brazil. So the current equipments are higher than prices included in the projects and the investors do not have enough options. Besides, the contracts have stipulated penalties for construction delays.

Therefore there are real risks for these investors in Proinfa, because they could have reduced their income and those wind power plants might be considered as economically non viable.

In addition the new power plants auctions and the exclusive renewable were not considered interesting by wind power investors, because the established prices were inferior to Proinfa and even to their average generation costs.

On the other hand, investors have the opportunity to insert their plants in CDM projects and receive an extra income from carbon credits sale that were obtained from the enterprises.

Finally to make possible the expansion of wind power plants in the country there could be created other incentives or better conditions to commercialize their energy such as an exclusive auction for these enterprises with reasonable prices or even the implementation of Proinfa's second stage, but reducing the demands for national equipments and services.

7. CONCLUSION

This study aimed to analyze the current incentives for distributed generation in Brazil, presenting the main risks and opportunities for investors, with focuses on biomass, wind power and small hydroelectric power plants (SHPs).

Chapter 2 has presented an overview of Brazilian Electric System, which is based on renewable energy sources, emphasizing the benefits of distributed generation and describing the main characteristics of each source, pointing out their growth potential and their average building costs.

Chapter 3 has presented the legal and regulatory incentives that were created to stimulate the expansion of distributed generation in Brazil, detailing Proinfa and its results already obtained. Besides, it was illustrated the renewable energy policy of the California State, which was developed after the energy crisis of 2001, showing their effort to increase the participation of renewable energy and achieve the goal of 33% state's electricity matrix by 2020.

Chapter 4 has shown the Clean Development Mechanism – CDM, established by Kyoto Protocol, and presented the current opportunities for energy generation projects in developing countries (such as Brazil) based on renewable sources to sell of carbon credits for great companies installed at developed countries, which have goals for greenhouse gases emissions reduction in their countries.

Chapter 5 has presented the energy auctions that have been done in Brazil since 2004, after another change in the Brazilian electric model, showing the main results, emphasizing the participation of SHPs, biomass and wind power in those auctions and highlighting the first energy auction for alternative sources, done in June of 2007.

Chapter 6 has discussed the risks associated to distributed generation investors, based on all information presented in this study.

Therefore, there might be inferred that there are sufficiently legal and regulatory incentives to turn SHP investment viable in Brazil, and that biomass power plants risks can be managed and mitigated especially for sugar cane bagasse.

However, there are real risks for investors in wind power, because Proinfa's contracts have established a minimum percentage 60% of national equipments and services in those plants, and as there are only two industries in Brazil for wind turbines, the cost is higher then it was planned before and those plants could never be done.

Besides, as the average generation cost for those plants are higher than the maximum prices for the energy auctions, investors do not feel stimulated to allocate their resources in those projects.

Thus the great Brazilian wind power potential would probably continue almost unexplored, and to attend the load increase it would be necessary to invest in others energy sources that would provoke more environment impacts.

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