Survey of the Electricity Market Focusing on Distributed Generation

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Introduction

The present report describes the main characteristics of the Free Contracting Environment (ACL) for the commercialization of power, also known as the free market, and the tariffs used in the Regulated Contracting Environment, also known as the captive market, with the purpose of assessing the possibility of implementing in Brazil distributed power generation through photovoltaic projects.

The study also indicates the states that are already offering tariff parity, which enables residential consumers to benefit from photovoltaic generation without incurring in extra costs. It also shows that for the Brazilian scenario the metering system in the net-metering mode is more feasible than the feed-in tariff model.

1. The Free Contracting Environment (ACL)

1.1 Description of the Basic Characteristics of the Free Market

The new Model[1] for the electricity sector defines that electricity must be traded in one of two environments of the market, the Regulated Contracting Environment – ACR and the Free Contracting Environment – ACL.

Contracting under the ACR is formalized through regulated bilateral agreements called Power Purchase Agreements within the Regulated Environment (CCEAR), entered into by sellers (marketers, generators, IPP´s or self-producers) and buyers (distributors) during public auctions for the commercialization of power.

The free environment – ACL is governed by free negotiations between generators, marketers, free consumers, importers, and exporters of power, and the purchase and sales are contracted through bilateral agreements.

Generators (whether public utilities, IPPs or Self-Producers) and Marketers may sell power in both environments, thus maintaining competition in generation. Besides, all contracts, under either ACR or ACL, are filed at the CCEE and used as a basis for accounting and dispute settlements in the spot market.

Free Electricity Market[2]

Established toward the end of the 90´s, the free market covers approximately 28% of the total volume of electricity in the National Interconnected System and operates parallel to the regulated environment.

The free market includes three types of agents:

Independent Power Producers:

Power generators operating individual projects authorized by ANEEL. They can sell their output directly to consumers and marketers.

Marketers:

Companies which are independent or associated to groups of generators and/or distributors. They buy power and sell it to free consumers or mediate contracts and deals between buyers and sellers.

[1] www.ccee.org.br

[2] http://www.deltaenergia.com.br/index.php?texto=15

Participants of the free market negotiate their power agreements bilaterally, and trading conditions (price, schedules, etc....) are not subject to determinations of the National Electricity Agency (Aneel). ANEEL, however, regulates several other aspects of this free market.

Free Consumers:

Customers who can choose their providers and negotiate all contract provisions, including price. To purchase conventional energy, they must forcefully contract over 3 MW (megawatts) of power – a condition which enables them to also buy power from alternative sources. Those with contracted demand between 0.5 MW and 3 MW can only buy alternative (or incentivized) power.

CONSUMPTION LOAD	CONNECTION VOLTAGE	IMPLEMEN-TATION DATE	DESCRIPTION
Less than 500 kW	-----	-----	Captive consumer.
Greater than 500 and less than 3000 kW	-----	-----	Free consumer, can purchase only from “alternative sources“.
Greater than 3000 kW	Less than 69 kW	Before July 7, 1995	Free consumer, can purchase only from “alternative sources“.
Greater than 3000 kW	Less than 69 kW	After July 7, 1995	Potentially free consumer.
Greater than 3000 kW	Greater than 69 kW	-----	Potentially free consumer.

Table 1 – classification of consumers[3]

1.2. Development Stages of the ACL Since its Creation

The reform of the Brazilian Power Sector began in 1993 with Law 8.631 that extinguished the tariff balancing mode and created the supply agreements between generators and distributors, further reinforced with the enactment of Law 9.074 that created the Independent Power Producer and the concept of the Free Consumer.

In 1996, the Brazilian Power Sector Restructuring Project (RE-SEB Project) was implemented and coordinated by the Ministry of Mines and Energy.

The main conclusions of the project were the need to unbundle the power companies, splitting them into generation, transmission, and distribution segments to encourage competition in the generation and commercialization segments, and to maintain government regulation of the distribution and transmission segments, considered to be natural monopolies.

[3] http://www.poupenergia.com.br/mercado.htm

The creation of a regulator (the National Electricity Agency – ANEEL), of an operator for the national power system (National Electrical System Operator – ONS), and of an environment in which power purchasing and selling transactions could take place (the Wholesale Electricity Market – MAE) became necessary.

Completed in August 1998, the RE-SEB Project defined the conceptual and institutional framework of the model to be adopted for the Brazilian Electricity Sector.

In 2001, the electricity sector suffered a serious supply crisis that culminated with a rationing plan. This event led to a series of discussions about the future of the electricity sector. With views to adjusting the model that was being implemented, the Electricity Sector Model Recovery Committee was formed in 2002, and its work resulted in a set of propositions to change the Brazilian power sector.

Throughout 2003 and 2004, the Federal Government launched the framework of a new model for the Brazilian power sector, supported by Laws 10.847 and 10.848 of March 15, 2004 and Decree 5.163 of July 30, 2004.

The new model defined the creation of an institution that would be responsible for long-term planning of the sector (the Energy Research Company – EPE), one institution to permanently assess power supply security (the Power Sector Monitoring Committee – CMSE), and another still to ensure continuity of the MAE activities related to the marketing of electricity in the interconnected system (the Chamber for Electrical Energy Commercialization – CCEE).

Concerning the marketing of power, two spheres were established for executing power purchasing and selling contracts, the Regulated Contracting Environment (ACR), which includes Generators and Distributors of electricity, and the Free Contracting Environment (ACL), with Generators, Marketers, Importers, Exporters, and Free Consumers.

Other important changes include the designation of the Ministry of Mines and Energy (MME) as the Granting Authority and broader empowerment for the ONS.

The new electricity sector model aims at achieving three main goals:

- To ensure power supply security
- To offer affordable tariffs
- To provide social inclusion within the Brazilian Power Sector, especially by means of universal access programs

The model includes a set of measures to be complied with by the different Agents, such as the requirement for distributors and free consumers to contract their entire demand, a new methodology for estimating the collateral of the power selling contracts, contracting of hydro plants and thermal plants in sufficient number to bring a better balance between security and cost of supply, and the permanent monitoring of supply security, all aimed towards the identification of eventual imbalances between supply and demand.

To provide affordable tariffs, the model allows distributors to buy electricity in public auctions within the regulated environment – favoring the lowest prices, in order to reduce the cost of purchasing power they transfer to their captive consumers.

Social inclusion seeks to provide universal access to electricity and ensures that the benefits are brought to all citizens who are not covered by the service, subsidizing low-income consumers so that they can afford to pay for the power they use.

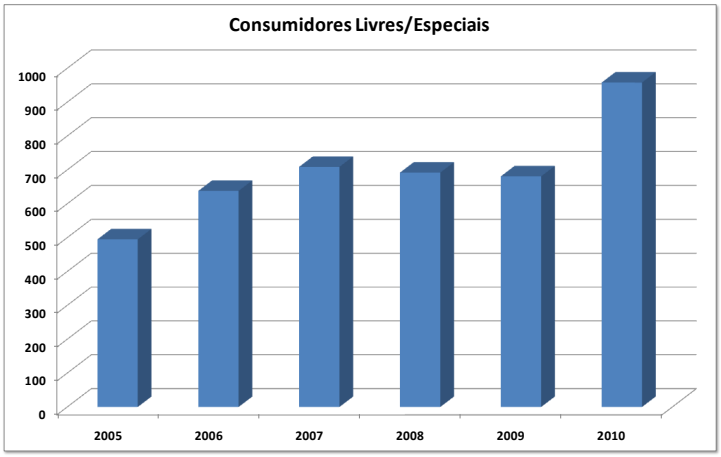
Evolution

Approximately 2000 consumers are estimated to have the necessary conditions to be free consumers, and currently 950 of them are represented at the CCEE. Potentially free (special) consumers, that is, those who can buy power from alternative sources, are estimated to be close to 10,000 in all of Brazil. However, this is an estimate, considering that such information is confidential for the distributors and is not disclosed to CCEE or even to ANEEL.

According to some power marketers, approximately 28% of the regulated market has the necessary conditions to migrate to the free market, be it as free consumers or as consumers of alternative power, that is, an average of 10,000 MW.

Currently, approximately 72% of the power market is traded in the regulated market (ACR) and 28% in the free contracting environment (ACL). The composition of the ACL is 17% free consumers, 2% special consumers, 6% self-producers and IPPs, and 2% power-intensive consumers.

Free / Special Consumers



Source: ABRACEEL

That is, the alternative energy market can be greatly expanded, and that is where the photovoltaic potential could be exploited with the upcoming tariff parity scenario and the discounts of the TUSD (Distribution System Usage Tariff), currently between 20 and 30 BRL/MWh, due to the reduction for alternative sources established by Regulation no. 77 of 50%, which can reach 100% depending on ongoing discussions in ANEEL.

1.3. Barriers for the ACL and Expected Changes

For the traditional commercial projects aimed at selling power and with a minimum output of 500 kWp, or 1 MWp, the conditions required by the CCEE to operate in the free market are not barriers for selling power.

On the other hand, for the smaller projects, especially those smaller than 500 kWp, owned by a legal entity or by a natural person (captive consumer) and not specifically aimed at commercializing power (this being merely a secondary activity), there are a series of barriers that result in extremely high costs for commercialization contracts, thus rendering such activity

unfeasible, especially because they do not count with the necessary resources to sell the power they produce. Some of these barriers are listed below:

Process for Registering the Agent at the CCEE – obligations and bureaucracy are too complex for an individual consumer to market the photovoltaic power he generates;

Filing of Contracts – demands too much work and time for very small volumes of power compared to the IPPs;

Collateral and Warranties – large requirements for very small volumes of generated output, not encouraging for the agents;

Metering – the current requirements in module 12.2 of the network procedures represent more than twice the cost of small photovoltaic generation plants, besides demanding extremely expensive metering equipment to comply with the utility companies´ technical standards.

The CCEE, ANEEL, and the MME have not announced any changes in the foreseeable horizon that might benefit the marketing of photovoltaic solar energy by small power producers by means of formally reducing barriers for these new agents.

Recently, ANEEL launched a public consultation procedure (No. 015/2010) that received contributions from 39 agents in the segment and from civil society organizations. In the submitted documents, the agency described its perspective of the existing barriers and of the necessary regulatory changes to enable the introduction of small output generators in the electricity network.

The regulator shall proceed to analyze the contributions and later summon a public hearing to collect more information and to present the regulatory changes that are possible, since any broader changes, more specifically in laws and decrees, are within the scope of the federal government, through the MME and the House of Representatives, as would be the case of a program for subsidies and incentives for feed-in tariffs. In the case of net-metering procedures, some additional changes may be introduced by ANEEL.

1.4. Rules and Stages of the Power Commercialization Process within the ACL

Power generators, marketers, importers, exporters, and free consumers participate in the Free Contracting Environment – ACL. In this environment there is freedom to define the volumes of power purchased and sold, as well as respective prices, and the deals are contracted by means of bilateral agreements.

The power marketing process is carried out according to parameters defined by Law 10848/2004 and Decrees nos. 5163/2004 and 5177/2004 and by ANEEL Regulation 109/2004, which created the Chamber of Electrical Energy Commercialization (CCEE).

The commercial relationship between agents participating in the CCEE is predominantly ruled by power purchasing and selling agreements, and all contracts entered into by the agents within the scope of the National Interconnected System must be filed at the CCEE. This register includes only the parties involved, the volumes of power, and the contract period; the contract prices are not filed at the CCEE and are only discussed between the parties in their bilateral settlement arrangements.

The CCEE estimates any differences between what was produced or consumed and what was contracted. Any existing positive or negative differences are settled in the Spot Market and valued according to the Difference Settlement Price (PLD), which is defined on a weekly basis for each load level and each submarket, based on the marginal cost for operating the system, which in turn is limited by a minimum and a maximum price.

Responsibilities of the CCEE include[4]*:*

- Maintaining a record of all contracts negociated in the regulated market (regulated Contracting Environment, ACR) and in the free market (Free Contracting Environment, ACL);
- Consolidating metering and recording of generation and consumption data for all CCEE agents;
- Accounting of all traded volumes of power, consumers and generators, and performing the financial settling of the differences;
- Estimating the Difference Settlement Price (PLD) for each submarket;
- Estimating all collateral for financial settlements and being their custodian;
- Holding public auctions for trading power, as delegated by Aneel.

Key Processes

source: http://www.ccee.org.br

Accounting and Settling Differences

Besides registering all purchase and sale agreements at CCEE, every month the agents (generators, distributors and marketers, representing the free consumers) are obliged to report the volume of power that was generated and consumed during that period.

Based on this information, at the end of each month CCEE will perform an hourly check of the consumption, generation, purchases, and sales of power and will produce a power balance for each agent

The remaining power is financially settled at a later stage, based on the difference between effective and contracted consumption. Each agent may have a positive balance (consumption greater than contracted volume) or a negative one (consumption lower than contracted volume).

In the first case, the consuming party (distributor or customer) must purchase the additional power used at the “spot market“ price that is determined weekly by the CCEE. This price is called PLD (Difference Settlement Price). In the second case, the consuming party also sells its surplus power at the PLD price. If the sum of the last twelve months is a negative balance, besides paying the PLD for the power, the agent is subject to a penalty that is estimated as the average exposure during the twelve months multiplied by the highest value between the PLD and the reference value (VR).

Composition of the spot price (or PLD)

[4] http://www.deltaenergia.com.br/index.php?texto=15

The Difference Settlement Price (PLD) is estimated every week by the CCEE based on a series of mathematical models called Newave.

Newave simulates power supply and demand for the next 5 years, based on a scenario with existing demand and expanding supply of power as well as 2000 hydrological scenarios (considering that most of the power in Brazil is produced by hydro plants.)

These prices are estimated for all four regions (or submarkets) into which the country is divided: North, South, Northeast, and Southeast/Midwest.

The price that is published weekly for each of these submarkets is the average of the 2000 scenarios, as long as it is within the minimum and maximum limits.

These limits are estimated yearly by ANEEL, with the purpose of covering incremental costs incurred in the operation and maintenance of the hydro plants and the payment of the financial compensation for usage of water resources that refers to the power traded in the MAE, that is, to remunerate the hydro plants for the incremental costs incurred in the production of power.

The PLD (Difference Settlement Price) is limited by minimum and maximum amounts according to ANEEL legislation, and is effective between the first and last weeks of the year in which the prices are practiced.

PLD limits (2010)	R$/mWh
Minimum	12.80
Maximum	622.21

The PLD level for each region depends on a series of factors. The main ones are:

- Hydrology
- Reservoir level
- Projected power consumption (5 years)
- System expansion schedule (5 years)
- Transmission restrictions
- Deficit cost

Commercialization Rules

The Commercialization Rules are a set of mathematical formulas and basic concepts that supplement and integrate the Commercialization Convention of Electrical Energy created by ANEEL Regulation 109 from October 26, 2004, which, together with their respective Commercialization Procedures, define the necessary basis for the commercial operation of the CCEE and the accounting and settlement process.

- Module 1 – Difference Settlement Price
- Module 2 – Definition of Power Generation and Consumption
- Module 3 – Contracts
- Module 4 – Collateral and Warranties
- Module 5 – Financial Surplus
- Module 6 – System Service Charges
- Module 7 – Consolidation of Results
- Module 8 – Accounting and Re-accounting Adjustment
- Contracting of Surplus Power

- Definitions and Interpretations
- Governance
- Settlement
- Penalties

Metering

As defined in the Commercialization Convention, established by ANEEL Regulation 109 from October 26, 2004, the CCEE is responsible for specifying, governing, and defining all aspects concerning adjustment of the Invoicing Metering System (SMF) and the implementation, operation, and maintenance of the SCDE – Power Data Collection System, in order to enable the collection of electrical energy data to be used in the Accounting and Settlement System – SCL and to ensure precision of the estimated magnitudes and compliance with the schedules required.

1.5. Specific Regulation for Commercialization of Alternative Sources (Including Photovoltaic Power)

- Law no. 9427 from December 26, 1996 – Creates the National Electricity Agency (ANEEL), regulates the concession system of the public electricity services, and other provisions.

- Law no. 10848 from March 15, 2004 – Defines rules for the commercialization of electricity.

- Decree no. 5163 from July 30, 2004 – Regulates the commercialization of electricity, the process for granting concessions and authorizations for power generation, and other provisions.

- Decree no. 5177 from August 12, 2004 – Regulates articles 4 and 5 of Law 10848 from March 15, 2004 and defines the organization, attributions, and functioning of the CCEE.

- ANEEL Regulation no. 109 from October 26, 2004 – Creates the Electricity Commercialization Convention.

- ANEEL Regulation no. 247 from December 21, 2006 – Defines the conditions for commercializing power produced in generation projects using alternative sources of energy for consumers or group of consumers whose load is equal to or greater than 500kw, and other provisions.

- ANEEL Regulation no. 286 from November 6, 2007 – Approves the applicable Electricity Commercialization Rules for alternative sources and special consumers defined in Regulation 247 from December 21, 2006.

- ANEEL Regulation no. 77 from August 18, 2004 – Defines the procedures for reducing transmission and distribution system usage tariffs for hydro plants and for solar, wind, biomass, or qualified cogeneration projects with installed capacity equal to or below 30,000 kW.

- ANEEL Regulation no. 376 from August 25, 2009 – Defines the conditions for contracting power within the National Interconnected System – SIN by Free Consumers and other provisions.

Instruments for Approval of Commercialization Rules

- Regulation no. 385 from December 17, 2009
- Technical Note no. 128/2009 (Regulation no. 385)
- Order no. 942 from April 8, 2010
- Technical Note no. 69/2010
- Technical Note no. 31/2010
- Order no. 1065 from April 16, 2010
- Technical Note no. 32/2010
- Order no. 2037 from July 15, 2010
- Technical Note no. 69/2010

2. The Regulated Contracting Environment (ACR)

2.1. Brief overview of different end-user tariffs in the Brazilian regulated market

Decree no. 41019 from February 26, 1957, Article 119, established tariffs for remunerating electricity services, and in Article 173 it defined that they should be estimated uniquely as a function of the cost of service, thus rendering a highly inefficient model, for any costs were accepted within the tariff composition.

Decree no. 86463 from October 13, 1981, introduced enhancements for new methodologies, including marginal costs based on load types which led to fairer rates. This effort, during the 1980´s, involved the participation of engineers from the electricity industry in a partnership with French professionals from EDF and for the first time employed IT equipment and a survey of the load profile characteristics in different regions of Brazil.

Application of marginalistic economics associated to new tools and principles that encourage usage during off-peak hours gave rise to a new set of tariffs:

1. Blue time-of-use tariff – includes a demand price (kW) during peak hours (P) and a demand price outside peak hours (FP); four prices for power (kWh), differing according to the time of year (dry – May to November and wet – December to April), with two daily peak (PS and PU) and off-peak (FPS and FPU) periods. The peak period comprises 3 consecutive hours from 5 p.m. to 10 p.m. and the off-peak period comprises the remaining 21 hours of the day.
   This required the introduction of different metering elements to record the different magnitudes.

2. Green time-of-use tariff – includes a demand price (kW) for all 24 hours of the day; four prices for power (kWh), varying according to the time of year (dry – May to November and wet – December to April), with two daily peak (PS and PU) and off-peak (FPS and FPU) periods; peak hours being the three consecutive hours between 5 p.m. and 10 p.m. and off-peak hours being the remaining 21 hours of the day.

3. Yellow tariff – monomial tariff measuring only power (kWh), dedicated to residential and rural consumers and IPs. At the time, there were supposed to be three options: (a) basic – a single price throughout the day, (b) two prices for different periods, and (c) access to green tariffs if more favorable.
   In practice, the single price was kept for residential consumers in the different ranges, and the two-price option is still undefined.

In a simplified way, the load consumed by clients of a power utility and the cost of operating, maintaining, and expanding the networks make up the reference rates, to which economic and financial components (federal taxes and industrial charges) are added, resulting in the application rates (final tariffs, which we pay.)

These rates are adjusted annually to correct inflation losses, and every 4 or 5 years (according to each concession agreement) the components of the rate structure are reviewed, based on the remuneration of assets (new networks, maintenance, and personnel), and on the

depreciation of assets (wear and tear of the different components), as well as fluctuations in power purchasing costs that are directly transferred to the consumers. This comprehends the rate revision process.

These concepts are stated in Ordinance no. 222 from December 22, 1987, later in Ordinance no. 466 from November 12, 1997, Resolution 456 from November 29, 2000, and more recently in ANEEL Regulation no. 414 from September 10, 2010, which include the more relevant aspects below:

Article 2º :

XV – Rate structure: the set of rates applied to metered usage and/or contracted demand according to the mode of supply.

XVI – Conventional rate structure: defined as the application of electricity tariffs for usage and/or contracted demand irrespective of daily or yearly time of use.

XVII – Time-of-use rate structure: application of different tariffs for power usage and contracted demand according to daily or yearly time of use, defined as:

a) Blue Rate: different electricity usage rates according to daily and yearly time of use and different rates for contracted demand according to daily time of use.

b) Green Rate: different rates for electricity usage according to daily and yearly time of use and a single rate for contracted demand.

c) Peak Hours (P): period defined by the utility company, comprising 3 (three) daily consecutive hours, except for Saturdays, Sundays, Carnival Tuesday, Good Friday, Corpus Christi, All Saints´ Day, and other holidays included in the federal legislation, considering the characteristics of the electricity system.

(Wording as per ANEEL Resolution no. 090 from March 27, 2001)

d) Off-peak Hours (F): period comprising the number of consecutive daily hours outside those defined as peak hours.

e) Wet Period (U): period comprising 5 (five) consecutive months, including the power supply measured from December of one year to April of the next year.

f) Dry Period (S): period comprising 7 (seven) consecutive months, including the power supply measured from May to November.

XXXIV – group A: group of consumers with supply voltage equal to or greater than 2.3 kV, or those with supply of secondary voltage provided by underground distribution, charged by the binomial tariff and further divided into the following subgroups:

a) subgroup A1 – supply voltage equal to or greater than 230 kV;
b) subgroup A2 – supply voltage from 88 kV to 138 kV;
c) subgroup A3 – supply voltage of 69 kV;
d) subgroup A3a – supply voltage from 30 kV to 44 kV;
e) subgroup A4 - supply voltage from 2.3 kV to 25 kV;
f) subgroup AS - supply voltage lower than 2.3 kV, provided by underground distribution system.

XXXV – group B: composed of consumers with power supply voltage below 2.3 kV, charged by the monomial tariff and further divided into the following subgroups:

a) subgroup B1 – residential;
b) subgroup B2 – rural;
c) subgroup B3 – other classes; and
d) subgroup B4 – public lighting.

XLVII – tariff mode: set of rates applied to usage of power and to contracted demand:

a) conventional tariff: charged for metered usage and for contracted demand, irrespective of daily and yearly time of use; and

b) time-of-use tariff: different rates for usage and contracted demand of power according to daily and yearly time of usage, observing the following:

1. peak hour: period comprising of 3 (three) daily consecutive hours defined by the distributor considering the load on its electrical system, approved by ANEEL for the entire concession area, except for Saturdays, Sundays, Carnival Tuesday, Good Friday, Corpus Christi, and the holidays below, ***Month and Day****:*	***National Holidays***	***Federal Laws***
January 01	*Universal Confraternization*	*10.607 from Dec. 19, 2002*
April 21	*Tiradentes*	*10.607 from Dec. 19, 2002*
May 01	*Labor Day*	*10.607 from Dec. 19, 2002*
September 07	*Independence Day*	*10.607 from Dec. 19, 2002*
October 12	*Our Lady of Aparecida*	*6.802 from June 30, 1980*
November 02	*All Saints´ Day*	*10.607 from Dec. 19, 2002*
November 15	*Proclamation of the Republic*	*10.607 from Dec. 19, 2002*
December 25	*Christmas*	*10.607 from Dec. 19, 2002*

LXX – metering system – set of equipment, conductors, accessories, and switches that effectively used to perform metering for invoicing;

LXXI – centralized metering system – SMC: system composed of electronic modules for individual metering of electricity, concentrating, processing, and indicating usage data in a centralized manner;

LXXII – encapsulated metering system: external electricity metering system with metering transformers coupled to the secondary or primary network and conventional or remote

meter-reading; control, protection, transformation, and all other equipment, conductors and accessories employed in civil construction and erection projects;

LXXV – tariff: monetary value defined by ANEEL in BRL (reais) per metered usage or contracted power, including:

a) binomial power supply tariff: charges for metered power consumption and for contracted power;

b) electricity tariff: for payment of electricity consumption according to regulated conditions;

c) distribution system usage tariff – TUSD: for payment of usage of the distribution system, represented in BRL per megawatt-hour (R$/mWh) and in BRL per kilowatt (R$/kW); and

d) monomial power supply tariff: flat rate tariff exclusively for metered usage, the sum of contracted power and actual usage that make up the binomial tariff.

Section V

Power Supply Voltage

The distributor is responsible for providing supply voltage data to any consumers requesting them, according to the following rules:

I – secondary voltage in overhead network: when the consumers´ installed load is equal to or lower than 75 kW;
II – secondary voltage in underground system: up to the limit of the installed load according to distributor´s service standards;
III – primary distribution voltage lower than 69 kV: when the consumer´s installed load is greater than 75 kW and the demand to be contracted by the interested party is equal to or greater than 2500 kW; and
IV – primary distribution voltage equal to or greater than 69 kV: when demand to be contracted by the interested party is greater than 2500 kW.
§1 For consumers of group A, the data mentioned in the heading above must be provided in print.
§2 For time-of-use tariffs, the greatest contracted demand must be considered for stipulating the supply voltage.

The distributor may define the power supply voltage without complying with the rules stated in Article 12 if:

I –the consumer unit contains any equipment whose running or output may hinder supply quality to other consumers.

II – it is technically and economically convenient for the distributor´s subsystem, upon agreement with the consumer.

§1 The consumer may choose voltages greater than those mentioned in Article 12, as long as they is technically feasible in the electrical subsystem, and he shall pay for any additional investments required for the service.

§2 If the parties are included in any of the paragraphs referred to in the heading of this article, they are bound to include a provision in the Supply Agreement explaining the reasons for its application.

§3 The consumer with secondary voltage service, except when such secondary voltage is provided by underground systems, may choose the primary distribution voltage, provided he pays for any additional investments required and the electrical subsystem is technically feasible.

CHAPTER IV
TARIFF MODES
Section I
Conventional Tariff

The conventional tariff is applied considering:

I – for group A:
a) flat rate tariff for demand (kW); and
b) flat rate tariff for consumption (kWh).
II – for group B, flat rate tariff for consumption (kWh).

Section II
Time-of-Use Tariff

The blue tariff is applied considering:

I – for power demand (kW):
a) one tariff for peak hours (P); and
b) one tariff for off-peak hours (F).
II – for consumption (kWh):
a) one tariff for peak hours during wet periods (PU);
b) one tariff for off-peak hours during wet periods (FU);
c) one tariff for peak hours during dry periods (PS); and
d) one tariff for off-peak hours during dry periods (FS).

The green tariff is applied considering:

I – for contracted demand (kW), one flat rate tariff; and
II – for consumption (kWh):
a) one tariff for peak hours during wet periods (PU);
b) one tariff for off-peak hours during wet periods (FU);
c) one tariff for peak hours during dry periods (PS); and
d) one tariff for off-peak hours during dry periods (FS).

Section III
Classification

Consumer units serviced by the National Interconnected System – SIN, must be classified according to the following criteria:

I – in the blue time-of-use tariff, those units with supply voltage equal to or greater than 69 kV;

II – in the blue or green time-of-use tariff, as chosen by the consumer, those units with supply voltage lower than 69 kV and contracted demand equal to or greater than 300 kW; and

III – in the conventional tariff, or blue or green time-of-use tariff, as chosen by the consumer, those units with supply voltage lower than 69 kV and contracted demand below 300 kW.

§1 Consumer units in group A not covered by the SIN must be classified in the conventional tariff or time-of-use tariff, according to specific authorization given by ANEEL.

§2 Specifically for consumers in the cooperative class of rural electricity, inclusion in the time-of-use tariff must be chosen by the consumer.

§3 Changes in the tariff mode, when requested by the consumer, must be made in the following cases:

I – provided that the latest change is prior to the last 12 (twelve) billing cycles; or

II – provided that the request is submitted up to 3 (three) complete billing cycles after the latest tariff revision made by the distributor.

For consumers in group A, upon request for connection, change of tariff group, or whenever requested, the distributor shall inform, in writing and in a maximum of 15 (fifteen) days, all tariff modes available, and the consumer shall inform the mode of choice in writing.

Section IV
Peak Hours

The definition of peak and off-peak hours must be submitted by the distributor for ANEEL´s approval up to 150 (one hundred fifty) days prior to the date of periodical tariff revision.

§1 Approval of peak and off-peak hours proposed by the distributor occurs upon approval of its periodical tariff revision.

§2 ANEEL may authorize different peak and off-peak hours for a single distributor, resulting from different operational characteristics of each subsystem or from the need to foster changes in the load profile of its consumers, observing the following conditions:

I – definition of a different peak period for each electrical subsystem, with compulsory compliance of all consumers with time-of-use tariffs; and

II – definition of a specific peak period for specific consumers, upon their agreement.

2.2. Table with Tariffs Practiced in Different Regions of Brazil

The table below records green and blue time-of-use tariffs for the Brazilian regions, displaying final costs in R$/mWh for the different tariffs and aggregating all final costs for captive consumers.

Group A tariff, pursuant to Regulation no. 414 from September 9, 2010, is described as consumers connected to voltage ranges equal to or greater than 2.3 kV to 230 kV. Free or potentially free consumers, who can buy renewable energy (specially photovoltaic) and with a minimum installed load of 500 kw, mainly industrial customers and commercial customers such as shopping malls and condominiums (whether formally established or not), are connected at the 13.8kV voltage level, that is, in tariff subgroup A4.

This subgroup includes the Blue and Green time-of-use tariffs which, as described in the above topic of this report, is classified in the following manner:

The blue tariff is applied considering:

I – for power demand (kW):
a) one tariff for peak hours (P); and
b) one tariff for off-peak hours (F).
II – for usage (kWh):
a) one tariff for peak hours during wet periods (PU);
b) one tariff for off-peak hours during wet periods (FU);
c) one tariff for peak hours during dry periods (PS); and
d) one tariff for off-peak hours during dry periods (FS).

The green tariff is applied considering:

I – for contracted demand (kW), one flat rate tariff; and
II – for usage (kWh):
a) one tariff for peak hours during wet periods (PU);
b) one tariff for off-peak hours during wet periods (FU);
c) one tariff for peak hours during dry periods (PS); and
d) one tariff for off-peak hours during dry periods (FS).

Therefore, after examining the latest regulations for tariff approval of pre-selected distributors in Brazil, we have prepared a summary in the table below:

Table: Group A Tariffs

A4		TUSD (R$/KW)		TE (R$/MWH)			
		P	FP	P		FP	
				PS	PU	FPS	FPU
AES Eletropaulo	BLUE time-of-use	44.83	11.06	344.69	313.09	220.24	201.90
	GREEN time-of-use		11.06	1385.55	1353.95	220.24	201.90
CEMIG	BLUE time-of-use	63.64	17.23	315.45	28.,59	201.76	185.02
	GREEN time-of-use		17.23	1793.48	1764.62	201.76	185.02
LIGHT	BLUE time-of-use	68,8	18.66	402.02	365.26	257.21	235.87
	GREEN time-of-use	5	18.66	2000.55	1963.78	257.21	235.87
ESCELSA	BLUE time-of-use	69.92	19.52	385.98	349.67	242.97	221.90
	GREEN time-of-use		19.52	2009.33	1973.03	242.97	221.90
COPEL	BLUE time-of-use	56.08	13.93	351.32	319,64	226,55	208.16
	GREEN time-of-use		13.93	1595.53	1563,84	226,55	208.16
RGE	BLUE time-of-use	56.33	14.29	406.35	368,35	256,74	234,70
	GREEN time-of-use		14.29	1714.18	1676,19	256,74	234,70
CELTINS	BLUE time-of-use	90,6	27.48	390.01	352,25	241,32	219,42
	GREEN time-of-use	7	27.48	2495.39	2457,62	241,32	219,42
CEMAT	BLUE time-of-use	61,4	20.03	46.07	423,42	295,17	269,83
	GREEN time-of-use	3	20.03	1893.71	1850,06	295,17	269,83
CELPA	BLUE time-of-use	76,9	21.66	346.91	310,05	215,31	196,60
	GREEN time-of-use	5	21.66	2129.04	2096,78	215,31	196,60
AMAZONAS EM	BLUE time-of-use	50,4	16.83	407.28	366,59	247,03	223,42
	GREEN time-of-use	7	16.83	1579.08	1538,39	247,03	223,42
COELCE	BLUE time-of-use	63,7	18.09	380.14	343,56	236,05	214,80
	GREEN time-of-use	0	18.09	1859.26	1822,67	236,05	214,80
CEPISA	BLUE time-of-use	67,2	15.62	294.84	265,87	180,80	164,00
	GREEN time-of-use	3	15.62	1856.15	1827,19	180,80	164,00

Next, we present a table containing the final costs for captive residential consumers of all distributors in Brazil, including taxes such as ICMS, PIS, and COFINS, based on information from ANEEL´s website. ICMS rates were obtained in ABRADEE´s website for residential consumers with monthly usage greater than 500 kWh/month which are assumed to have access to credit and to information to decide upon how they would purchase a PV generation system for their household, considering the savings gained for their level of consumption.

	State	Abrev.	Name	ANEEL Rate	ICMS Tax	PIS+COFINS Taxes	Final Tariff (R$/kWh)	R$/mWh
1	MG	energisa	Energisa Minas Gerais – Distribuidora de Energia S.A.	0.430	25%	9.75%	R$ 0.659	R$ 659.00
2	RS	UHENPAL	Usina Hidroelétrica Nova Palma Ltda.	0.420	25%	9.75%	R$ 0.644	R$ 643.68
3	TO	CELTINS	Companhia de Energia Elétrica do Estado do Tocantins	0.41807	25%	9.75%	R$ 0.641	R$ 640.72
4	MA	CEMAR	Companhia Energética do Maranhão (Interconnected)	0.414	30%	9.75%	R$ 0.687	R$ 687.00
5	CE	COELCE	Companhia Energética do Ceará	0.40199	27%	9.75%	R$ 0.636	R$ 635.56
6	SP	CLFM	Companhia Luz e Força Mococa	0.38851	25%	9.75%	R$ 0.595	R$ 595.42
7	SC	EFLJC	Empresa Força e Luz João Cesa Ltda.	0.38626	25%	9.75%	R$ 0.592	R$ 591.97
8	RS	RGE	Rio Grande Energia S/A	0.38429	25%	9.75%	R$ 0.589	R$ 588.95
9	GO	CHESP	Companhia Hidroelétrica São Patrício	0.38426	29%	9.75%	R$ 0.627	R$ 627.36
10	MG	CEMIG	CEMIG Distribuição S/A	0.37624	30%	9.75%	R$ 0.624	R$ 624.46
11	MG	ELFSM	Empresa Luz e Força Santa Maria S/A	0.37753	30%	9.75%	R$ 0.627	R$ 626.61
12	RJ	AMPLA	Ampla Energia e Serviços S/A	0.37394	30%	9.75%	R$ 0.621	R$ 620.65
13	PI	CEPISA	Companhia Energética do Piauí	0.37317	25%	9.75%	R$ 0.572	R$ 571.91
14	SC	IENERGIA	Iguaçu Distribuidora de Energia Elétrica Ltda.	0.37183	25%	9.75%	R$ 0.570	R$ 569.85
15	PA	CELPA	Centrais Elétricas do Pará S/A (Interconnected)	0.3699	25%	9.75%	R$ 0.567	R$ 566.90
16	RS	ELETROCAR	Centrais Elétricas de Carazinho S/A	0.392	25%	9.75%	R$ 0.601	R$ 600.77
17	RS	DEMEI	Departamento Municipal de Energia de Ijuí	0.36764	25%	9.75%	R$ 0.563	R$ 563.43
18	SP	ELEKTRO	Elektro Eletricidade e Serviços S/A	0.36604	25%	9.75%	R$ 0.561	R$ 560.98
19	MT	CEMAT	Centrais Elétricas Matogrossenses S/A (Interconnected)	0.36483	30%	9.75%	R$ 0.606	R$ 605.53
20	PR	FORCEL	Força e Luz Coronel Vívida Ltda.	0.36405	27%	9.75%	R$ 0.576	R$ 575.57
21	SE	SULGIPE	Companhia Sul Sergipana de Eletricidade	0.3387	27%	9.75%	R$ 0.535	R$ 535.49

22	MS	ENERSUL	Empresa Energética de Mato Grosso do Sul S/A (Interconnected)	0.36343	25%	9.75%	R$ 0.557	R$ 556.98
23	SP	CSPE	Companhia Sul Paulista de Energia	0.36183	25%	9.75%	R$ 0.555	R$ 554.53
24	RS	HIDROPAN	Hidroelétrica Panambi S/A	0.36026	25%	9.75%	R$ 0.552	R$ 552.12
25	SC	COOPER-ALIANÇA	Cooperativa Aliança	0.35786	25%	9.75%	R$ 0.548	R$ 548.44
26	SP	CLFSC	Companhia Luz e Força Santa Cruz	0.3541	25%	9.75%	R$ 0.543	R$ 542.68
27	AC	ELETROACRE	Companhia de Eletricidade do Acre	0.34952	25%	9.75%	R$ 0.536	R$ 535.66
28	PB	EPB	Energisa Paraíba – Distribuidora de Energia	0.34886	27%	9.75%	R$ 0.552	R$ 551.56
29	SP	CPEE	Companhia Paulista de Energia Elétrica	0.34867	25%	9.75%	R$ 0.534	R$ 534.36
30	BA	COELBA	Companhia de Eletricidade do Estado da Bahia	0.34858	27%	9.75%	R$ 0.551	R$ 551.11
31	SP	EEB	Empresa Elétrica Bragantina S/A	0.34503	25%	9.75%	R$ 0.529	R$ 528.78
32	AL	CEAL	Companhia Energética de Alagoas	0.33363	25%	9.75%	R$ 0.511	R$ 511.31
33	RJ	ENF	Energisa Nova Friburgo – Distribuidora de Energia S/A	0.33311	30%	9.75%	R$ 0.553	R$ 552.88
34	PR	COCEL	Companhia Campolarguense de Energia	0.33214	27%	9.75%	R$ 0.525	R$ 525.12
35	ES	ESCELSA	Espírito Santo Centrais Elétricas S/A	0.32889	25%	9.75%	R$ 0.504	R$ 504.05
36	RR	CERR	Companhia Energética de Roraima	0.32728	17%	9.75%	R$ 0.447	R$ 446.80
37	RS	MUX-Energia	Muxfeldt Marin & Cia. Ltda.	0.32609	25%	9.75%	R$ 0.500	R$ 499.75
38	SP	BANDEIRANTE	Bandeirante Energia S/A	0.32537	25%	9.75%	R$ 0.499	R$ 498.65
39	SC	CELESC-DIS	Celesc Distribuição S/A	0.32499	25%	9.75%	R$ 0.498	R$ 498.07
40	RN	COSERN	Companhia Energética do Rio Grande do Norte	0.32365	25%	9.75%	R$ 0.496	R$ 496.02
41	PE	CELPE	Companhia Energética de Pernambuco	0.31929	25%	9.75%	R$ 0.489	R$ 489.33
42	RO	CERON	Centrais Elétricas de Rondônia S/A	0.31806	17%	9.75%	R$ 0.434	R$ 434.21
43	RJ	LIGHT	Light Serviços de Eletricidade S/A	0.31769	30%	9.75%	R$ 0.527	R$ 527.29
44	SC	EFLUL	Empresa Força e Luz Urussanga Ltda	0.31736	25%	9.75%	R$ 0.486	R$ 486.38
45	RS	CEEE-D	Companhia Estadual de Distribuição de Energia Elétrica	0.31642	25%	9.75%	R$ 0.485	R$ 484.93

46	SP	CPFL-Piratininga	Companhia Piratininga de Força e Luz	0.31421	25%	9.75%	R$ 0.482	R$ 481.55
47	SP	CNEE	Companhia Nacional de Energia Elétrica	0.31201	25%	9.75%	R$ 0.478	R$ 478.18
48	SP	CPFL-Paulista	Companhia Paulista de Força e Luz	0.3077	25%	9.75%	R$ 0.472	R$ 471.57
49	MG	DMEPC	Departamento Municipal de Eletricidade de Poços de Caldas	0.30642	30%	9.75%	R$ 0.509	R$ 508.58
50	SE	ESE	Energisa Sergipe – Distribuidora de Energia S/A	0.30495	27%	9.75%	R$ 0.482	R$ 482.13
51	AM	AmE	Amazonas Distribuidora de Energia S/A	0.30425	25%	9.75%	R$ 0.466	R$ 466.28
52	PR	CFLO	Companhia Força e Luz do Oeste	0.3041	27%	9.75%	R$ 0.481	R$ 480.79
53	PR	COPEL-DIS	Copel Distribuição S/A	0.3	27%	9.75%	R$ 0.474	R$ 474.31
54	SP	EDEVP	Empresa de Distribuição de Energia Vale Paranapanema S/A	0.29901	25%	9.75%	R$ 0.458	R$ 458.25
55	SP	ELETROPAULO	Eletropaulo Metropolitana Eletricidade de São Paulo S/A	0.29651	25%	9.75%	R$ 0.454	R$ 454.42
56	RS	AES-SUL	AES SUL Distribuidora Gaúcha de Energia S/A	0.29637	25%	9.75%	R$ 0.454	R$ 454.21
57	GO	CELG-D	Celg Distribuição S/A	0.29353	29%	9.75%	R$ 0.479	R$ 479.23
58	SP	CJE	Companhia Jaguari de Energia	0.28636	25%	9.75%	R$ 0.439	R$ 438.87
59	SP	CAIUÁ-D	Caiuá Distribuição de Energia S/A	0.28195	25%	9.75%	R$ 0.432	R$ 432.11
60	DF	CEB-DIS	CEB Distribuição S/A	0.27952	25%	9.75%	R$ 0.428	R$ 428.38
61	RR	Boa Vista	Boa Vista Energia S/A	0.26876	17%	9.75%	R$ 0.367	R$ 366.91

2.3 Conclusions

Which Group of Final Consumers will be the First to Reach Grid Parity?

Tariff parity is defined as the amount paid for generating one´s own power, in this case solar photovoltaic power, being equal to the regulated tariffs paid by the consumer to the distributor. That is, the cost of generation must include the cost of purchasing, installing, and operating one´s own generation plant, and it shall be paid up along the plant´s life cycle and according to the capital remuneration rates.

The price of the kWp in Germany is being considered to build the example of PV generation in Brazil, to which importing costs are added such as taxes (II, ICMS, PIS, and COFINS) and customs costs, travel insurance, transportation, engineering, assembly, commissioning, etc.; 25 years life cycle, capital costs of 6% a year, resulting approximately in 600 R$/mWh.

By assessing residential tariffs charged by Brazilian distributors obtained in ANEEL´s website and adding the ICMS tax rate of each different state as well as PIS and COFINS (federal taxes), we estimated the final tariffs for the residential subgroup.

From the amounts estimated, we may conclude that customers of ENERGISA, UHENPAL, CELTINS, CEMAR, COELCE, CHESP, CEMIG, AMPLA, ELETROCAR, and CEMAT distributors already pay more than 600 R$/mWh, that is, they have already reached tariff parity to justify the two alternatives below:

1. Installation of solar photovoltaic power generation systems by residential consumers for internal consumption (after the meter), which would imply in a lower consumption of electricity for the distributor[5], that is, providing energy efficiency with a return (energy savings);
2. Installation of photovoltaic power generation systems by residential consumers in the net-metering mode, which can be regulated by ANEEL, that is, the consumer would receive credits in kWh or in BRL for feeding power into the grid.

Besides the eleven distributors mentioned above, five others are very close to tariff parity: ELFM, CFLJC, RGE, CEPISA, IENERGIA. A total of at least 6 million residential consumers would qualify.

It is worthwhile mentioning that many of these states have extremely high solar radiation compared to the national average; they are Ceará, Tocantins, Minas Gerais, Maranhão, Goiás, and Piauí.

In these states and in the special case of Rio de Janeiro, the residential and commercial load for air conditioning coincides with the levels of solar radiation, benefitting the system with a considerable reduction in peak consumption during the warmest periods of the day. Rio de Janeiro is highlighted because in the last 10 years, the local distributor (LIGHT) has implemented emergency programs during summer to ensure supply to its population,

[5] It is important to record the project at ANEEL and to submit a copy to the local distributor in order to avoid the distributor´s interpretation of the sudden drop in consumption as fraud.
One particular situation may anticipate tariff parity in the regions described, which is the green time-of-use tariff. The cost of power during peak hours in this case is approximately 1800R$/mWh, that is, three times above the tariff parity value.

considering the growing use of air-conditioning resulting from easier access to financial credit and to the extremely high temperatures in the capital city; the same occurring in the other states mentioned in the previous paragraph.

Consumers in subgroup A4 with captive contracts for the blue time-of-use tariff pay in average 250 R$/mWh during off-peak hours and approximately 400 R$/mWh during peak hours. One may conclude that this group would reach tariff parity in approximately 3 or 4 years, considering the dropping curve for international manufacturing prices and the growing trend for tariffs in Brazil.

Although this situation may occur for three daily consecutive hours during peak periods, and given the changes defined in ANEEL Regulation 414, each distributor may stipulate the peak hours of the system for any daily period, that is, the distributors suffering stronger influence of daily peaks due to commercial activities that affect temperature, due to air-conditioning use, may stipulate higher prices for these periods.

Thus, for example, as is the case with AES Eletropaulo, Light, CEMIG, and other distributors, dry and wet peak hours may be stipulated from 11a.m. to 1p.m.; from 12a.m. to 3p.m., from 2p.m. to 5p.m.; periods defined as high demand for their distribution systems, leading to load restrictions during summer. These consumers would benefit from savings of approximately R$1200 for every MWh not consumed by their photovoltaic systems during these hours.

It is therefore not even a matter of tariff parity for the entire period; these three daily periods alone could produce sufficient revenues to pay for investing in one´s own power generation system. For the distributor, it would enable a more efficient grid management and lower tariffs for the other captive consumers, given the reduced need for investment in the expansion of the grid, besides providing improved network reliability and quality due to the lower loads.