The market structure for small hydro electricity in Brazil

DECEMBER 2012
Brazilian Interconnected System (2012)

Source: ONS (National Electricity System Operator)
It is estimated that the total installed small hydro power (SHP) capacity will increase from 5 to 7 GW up to 2021. According to EPE (Brazilian Energy Research Company) the renewable sources (SHP, biomass and wind power plants) share of the total installed capacity will increase from 13% in 2011 to 20% in 2021.
Brazilian classification of Hydro Power Project by its generating capacity

<table>
<thead>
<tr>
<th>Installed capacity (MW)</th>
<th>Reservoir area (km²)</th>
<th>Others Requirements</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 1</td>
<td>-</td>
<td>CGH</td>
<td>Hydroelectric Generating Station</td>
</tr>
<tr>
<td>&gt;1 and ≤ 30</td>
<td>&lt; 3</td>
<td>Independent Power Producers or Self-Producers</td>
<td>PCH* Small Hydroelectric Power Plant (SHP)</td>
</tr>
<tr>
<td>&gt;30</td>
<td>-</td>
<td>UHE</td>
<td>Hydroelectric Power Plant</td>
</tr>
</tbody>
</table>

Source: ANEEL (National Electric Energy Agency)

*According to ANEEL (National Electric Energy Agency): Small Hydroelectric Power Plant (SHP) are hydro power plants with installed capacity greater than 1 MW and less or equal to 30 MW with reservoir area of less than 3 km². (Independent Power Production or Self-Production)
Important Brazilian Incentive Small Hydro Power Plants Programs:

**PCH-COM**

**PCH-COM**
Small Hydro Power Development and Commercialization Program

Launched in 2001 by Eletrobras in partnership with BNDES.

**Objective**: stimulating the installation and reactivation of grid-connected small Hydropower plants (SHP) by private entities.

**Goal**: 1200 MW of capacity installed during 2001-2003, in blocks of 400 MW / year.

- The purchase of the power generated - guaranteed by Eletrobras
- The project financing – by BNDES (National Bank of Economic and Social Development)
### Incentive Programs for Small Hydro Power Plants

**PROINFA** Incentive Program for Alternatives Sources of Energy

Launched in 2004 by the Brazilian government.

**Objective:** increasing in 3,300 MW the participation of wind, small hydropower (SHP) and biomass plants in the national interconnected system.

The energy purchase is ensured through a 20-year contract by the Eletrobras.

**Goal:** Implementation of 144 selected plants corresponding to 3,299.40 MW capacity.

**Results in 31/12/2011:** 119 new plants representing 2.649,87 MW of installed capacity and a generation of 10,690 GWh of an annual clean energy.

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The total SHP capacity installed by PROINFA up the year of 2011 correspond to 25% of the total SHP capacity installed in Brazil.

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#### PROINFA - Installed capacity and total of plants in 31-12-2011

<table>
<thead>
<tr>
<th></th>
<th>MW</th>
<th>SHP</th>
<th>Wind Plant</th>
<th>Biomass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planned</td>
<td></td>
<td>1.191,24</td>
<td>1.422,92</td>
<td>685,24</td>
</tr>
<tr>
<td>Installed</td>
<td></td>
<td>1.152,54</td>
<td>963,99</td>
<td>533,34</td>
</tr>
</tbody>
</table>

- **SHP**: 63 \( \times \) 1.191,24 = 72,334 MW, 59 \( \times \) 1.152,54 = 67,844 MW
- **Wind Plant**: 54 \( \times \) 1.422,92 = 77,610 MW, 41 \( \times \) 963,99 = 39,536 MW
- **Biomass**: 27 \( \times \) 685,24 = 18,406 MW, 19 \( \times \) 533,34 = 9,643 MW
Power Sector Players

Government Policies

State Policies

ELECTRIC INDUSTRY

Operation

ONS

CCEE

Comercialization Chambre

Agents
G, T, D, C
IMP/EXP, Free Consumers

ISOLATED SYSTEMS

ANEEL

CNPE

MME

EPE
Trading Environments

ACR
Regulated Contracting Environment
- Distribution Utilities
  (Captive Consumers)

ACL
Free Contracting Environment
- Free Consumers
- Energy Traders
- Selfproducers

MWh
Auction
$ Spot Market
Competition
PGU & IPP
$ MWh
Free Negotiations
Contracting Environments

Regulated Contracting Environment (ACR)

- Generator
- Generator
- Generator

Prices defined by Government auctions

Distributor

Regulated Tariffs

Captive customer

Free Contracting Environment (ACL)

- Generator
- Generator

Prices freely negotiated

Traders

Prices freely negotiated

Free customer

Free customer

Free customer
Alternatives of Trading for SHP

- **Regulated Auction - ACR**
  - **Renewable Energy**
  - **New Energy**
  - **Reserve Energy**

- **Free and Special Customer - ACL**
  - **Free Customer**
  - **Special Customer**

- **Distributed Generation - ACR**

  Not included in this classification:
  I – Hydropower plant with a installed capacity > 30 MW;
  II – Thermal power plant / cogeneration - with energy efficiency <75%

contracted demand ≥ than 3 MW.
contracted demand > 500 kW from incentivized energy source (solar, wind, biomass, hydro and cogeneration with installed capacity ≤ 30 MW).
promotion of renewable energy sources by exclusive auctions.
amount of energy declared by the distribution utilities in order to meet demand growth in the regulated market.
supplementary energy to increase the system’s reserve margin.
Alternatives of Trading for SHP

- Free and Special Customer - ACL
- Distributed Generation - ACR
- Regulated Auction - ACR

Financiability
Flexibility
Price
Consumers demand ≥ 500 kW

Generators with a 50% discount on their grid usage fee (TUSD/T)

- Special Customer
  - SHP, CGH (≤ 1MW), Solar, Wind or Biomass Plants up to 30 MW

Generators without a discount on their grid usage fee (TUSD/T)

- Hydro* (>1 and ≤ 50 MW), Solar, Wind or Biomass Plants with a
  installed capacity >30 and ≤50 MW

* Hydroelectric Plant that doesn’t comply with SHP classifications requirements
Incentivized Energy

- **CGH**
  - installed capacity ≤ 1MW

- **SHP Small Power Plants**
  - installed capacity >1 and ≤ 30 MW reservoir area < 3 km²

- **Biomass, Wind, Solar Plants**
  - installed capacity ≤ 30 MW

- **Qualified Cogeneration**

  - Special Incentivized Energy Purchasing Contract (CEIE)
    - Special Customer

  - Special Incentivized Energy Purchasing Contract for Qualified Cogeneration (CCEICQ)
    - Free Customer

ANEEL Resolution nº 376/2009
Sellers Agents:
• Generators (PIE);  
• Self producers;  
• Traders.

Buyers Agents:
• Free Customers;  
• Special Customers (demand ≥ 500 kW)

Agents that apply the discount on the grid usage fee (TUSD/T):
• Distribution companies;  
• Transmission company (ONS).

Agents that calculate the discount on the grid usage fee:
• CCEE

1 PIE - Independent Power Production
Distributed Generation

It is defined as the connection of small power generation equipment to the buyer utility distribution system. According to ANEEL resolution qualifying small distributed generators include:

- Any energy-generating facility with a installed capacity ≤100 kW that utilizes an incentivized energy source and is interconnected at the concessionaire’s distribution network through consumer-installed systems.

- Any generating-facility with a installed capacity >100 kW and <1 MW that utilizes an incentivized energy source and is interconnected at the concessionaire’s distribution network through consumer-installed systems.

According to ANEEL, qualifying small distributed generators do not include:

I – Hydropower plant with a installed capacity > 30 MW; and

II – Thermal power plant / cogeneration - with energy efficiency <75% (exception for biomass plants)
Auctions of “A-5” and “A-3” (15 to 35 years)

“A-3” Amount of contracted energy to be delivered 3 years ahead the auction year

“A-3” purchase limited to 2% of “A-5” load

“A-5” Amount of contracted energy to be delivered 5 years ahead the auction year

“A-5” Amount of contracted energy to be delivered 5 years ahead the auction year

Auction year

Auction year
**New Energy and Reserve Energy Auctions**

- **NEW energy auctions** - contract an amount of energy declared by the distribution companies in order to meet demand growth in the regulated market (ACR),

- **RESERVE energy auctions** - contract supplementary energy to increase the system’s reserve margin (ACR).
Since 2005, the 22 New energy auctions have contracted 503 new projects corresponding to 64,472 MW of new capacity (include Nuclear Power Plant Angra 3):

- Hydropower plants 33,620 MW
- Small Hydro plants 523 MW
- Conventional thermal 18,663 MW
- Biomass 4,908 MW
- Wind power plants 6,758 MW

Source: EPE (M. Tolmasquim – Seminário Internacional – 17-04-2012)
Energy Auctions Average Prices (R$ / MWh)

Auction Average Prices by source (R$ / MWh)

Source: CCEE
**Energy Relocation Mechanism (MRE)** is a financial mechanism based on the transfer of exceeding energy generated by all MRE members to those members who do not reach their corresponding assured energy.

**Objectives of this mechanism:**
- sharing the hydrological risk among the MRE participants;
- optimizing energy supply of the National Interconnected System.

**The Assured Energy** of a hydroelectric plant is issued for each plant by Ministry of Mines and Energy, and serves essentially to:
- establish an upper limit for energy supply contracts;
- define the share of each generating plant on the total amount of energy generated in the system by hydro plants.
CCEE accounting is based on differences between the amount of contracted energy and the amount of verified energy.
### Alternatives of Trading for Small Hydropower Plants (SHP)

<table>
<thead>
<tr>
<th>Contracting Environment</th>
<th>Financiability</th>
<th>Flexibility</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distributed Generation - ACR</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Regulated Auction - ACR</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Free and Special Customer - ACL</td>
<td>Medium</td>
<td>High</td>
<td>Medium</td>
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