THE FUTURE OF NATURAL GAS SUPPLY IN BRAZIL

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A “boutique” consulting group, formed by senior energy specialists with cumulative expertise that spans the whole oil and gas value chain, as well as the intersection of gas and power industries.

Located in Rio de Janeiro, with a keen understanding of the specificities of the Brazilian energy sector, and face-to-face contact with the main players.

But with international experience, in both industry and consulting, that give us a global perspective and reach.
CONTENTS

- Natural gas production in Brazil: Presalt vs. onshore areas, Petrobras vs. new players
- Expected gas demand growth: diversifying the power generation matrix with more gas-to-power?
- The evolving supply-demand balance and the future role of LNG imports
Brazilian natural gas supply at a glance

- **Gas reserves (Dec 2013):**
  - P: 16 tcf
  - PPP: 30 tcf
  - >80% offshore and >2/3 associated with oil

- **Domestic production (aver. 2013):**
  - Gross: 77 mcmd (2.7 bcf/d)
  - Net: 44 mcmd (1.6 bcf/d)

- **Imports (aver. 2013):**
  - Bolivia: 31.8 mcmd (1.1 bcf/d)
  - LNG = 10.5 mcmd (0.4 bcf/d)

- **Main production basins:**
  - Campos (SE)
  - Espírito Santo (SE)
  - Santos (SE)
  - Recôncavo / Camamu (NE)
  - Solimões (Amazon)

- **Pipelines:**
  - Transportation: 9,244 km (Feb 2014)
  - Distribution: 25,263 km (Feb 2014)

- Petrobras dominates all stages of the natural gas chain in Brazil.

*Sources: MME, ANP, Abegas*
Domestic natural gas production has grown rapidly...

... but today nearly 50% of total gas supply is imported

Source: ANP
A large part of production does not reach the market (due to flaring, reinjection and power production on platforms)

Source: ANP
Natural gas reserves are >80% offshore and >70% associated with oil...

...and these characteristics will not change with the development of the Presalt, also offshore and associated gas.
There are also transportation restrictions

Brazil has three gas systems, loosely or not interconnected. And a large part of inland Brazil is not supplied by natural gas.

Source: ANP, own elaboration
Nevertheless Brazil’s natural gas potential is still relatively unexplored – especially onshore

- Over 7.5 million km² of sedimentary area in 29 basins
- Of this 2.8 million km² of effective E&P area (31% offshore, 69% onshore)
- Only 321,000 km² under E&P concessions → ~500 exploratory blocks
- Of these, only ~21,000 km² (~6%) are in the development and production phase → >400 fields
- 77 E&P concessionaires, about half Brazilian and half foreign companies.
Three Bid Rounds in 2013

In 2013, the Brazilian government carried out three E&P Bid Rounds:

- Bid Round 11 - May 2013 – focusing on Oil & Gas New Frontiers and Marginal Accumulation Basins
- Bid Round 12 – Oct. 2013 – focusing on Onshore Areas with Natural Gas Potential (new Frontier and Mature)
- 1st Production Sharing Bid Round for the Presalt – Nov. 2013 – to auction the very large prospect of Libra
Bid Round 11 - Summary


- Objectives: increase the knowledge of frontier or mature sedimentary basins, decentralize the exploratory investment in the country, attract and develop small oil companies, national or foreign, increase demand for local goods and services, job creation and income distribution.

- 71 companies registered, of which 64 were authorized to participate and 30 were successful - 12 Brazilian and 18 foreign.

- 142 blocks awarded in 22 sectors of the 11 sedimentary basins offered, totaling 100,372 km², corresponding to 64% of the area offered (155,813 km²).

- Total signing bonus collected R$ 2.48 bi, in addition to minimum investment commitments of R$ 5.8 bi for the 1st expl. period.

- Average local content: 62% for the expl. phase and 76% for the devel. and production phase.
Bid Round 12 - Summary

- 240 exploratory blocks offered in 13 sectors of 7 sedimentary basins, of which:
  - 110 blocks in the Basins of Acre, Parecis, São Francisco, Paraná and Parnaíba (New Frontier);
  - 130 blocks in the Recôncavo and Sergipe-Alagoas Basins (Mature Basins).

- 21 companies were authorized to participate and 12 made successful offers – 8 Brazilian and 4 foreign.

- Only 72 blocks were awarded in 5 Basins (no offers for Parecis and São Francisco) – corresponding to an area of 47,428 km²

- Of these Petrobras acquired 43 as operator and 6 as non operator

- Total signing bonus collected R$ 165m, in addition to minimum investment commitments of R$ 504m for the 1st expl. period.

- Average local content: 72% for the expl. phase and 84% for the devel. and production phase.
Gas-by-wire could be an options for remote gas resources

- The power transmission grid is much more developed in Brazil than the gas transportation network
- Gas-by-wire seems a good options to monetize remote gas discoveries
- However, some peculiarities of the Brazilian power system have so far hindered this option, and reduced the interested in Round 12 areas.
1st Production Sharing Bid Round for the Presalt

- Area offered - the giant prospect of Libra:
  - ANP estimates that Libra’s production could reach, at its peak 1.4 million bpd of oil and 40 mcmd, requiring up to 12 production platforms

- Criteria for bid selection:
  - highest profit oil offered to the Government (above a minimum level)
  - In addition: signature bonus, local content level, minimum exploration program, 15% royalties, all defined in the Auction Notice

- Petrobras to operate with a minimum 30% participation

- Only one consortia bid in the end, and won:
  - Petrobras (40%), Shell (20%), Total (20%) CNPC (10%), CNOOC (10%)
After 15 years of opening of the E&P, the industry is still very concentrated...

Oil Production by Operator Feb 2014

Gas Production by Operator Feb 2014

Source: ANP
Petrobras controls most of the natural gas value chain

Petrobras >95% (production)
99% (commercialization)

International Pipeline Transmission
51% of Gasbol and 100% of domestic pipelines

Liquefaction
Petrobras 100%

Regasification
Petrobras participates in 21 of 27 LDCs

Storage
National Transmission & Distribution

Power generation capacity
Petrobras >50%

~80% of gas use in power gen.

Source: Own elaboration
But this is set to change gradually, as new players enter the production phase.

Source: Own elaboration with ANP data
# Players in the Presalt (Santos Cluster)

## Blocks the Presalt Santos Cluster with Exploration Concessions

<table>
<thead>
<tr>
<th>Block / Contract</th>
<th>Prospect (Field Name)</th>
<th>Round</th>
<th>Year</th>
<th>Operator (%)</th>
<th>Partners (%)</th>
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<tr>
<td>BM-S-008</td>
<td>Bem-te-vi / Carcará</td>
<td>2</td>
<td>2001</td>
<td>Petrobras 66%</td>
<td>Galp Energia 14%, Barra Energia 10%, Queiroz Galvão E&amp;P 10%</td>
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<td>BM-S-009, Block 1</td>
<td>Guará (Sapinhoá)</td>
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<td>2001</td>
<td>Petrobras 45%</td>
<td>BG 30%, Repsol 25%</td>
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<td>Carioca/ Iguaçu / Abaré Oeste</td>
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<td>Petrobras 45%</td>
<td>BG 30%, Repsol 25%</td>
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<td>BM-S-010, Block 1</td>
<td>Parati / Macunaima</td>
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<td>2001</td>
<td>Petrobras 65%</td>
<td>BG 25%, Partex 10%</td>
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<td>BM-S-011, Block 1</td>
<td>Tupi (Lula)</td>
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<td>Petrobras 65%</td>
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<td>2001</td>
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<td>Petrobras 100%</td>
<td>Galp Energia 20%</td>
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<td>BM-S-021</td>
<td>Caramba</td>
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<td>2002</td>
<td>Petrobras 80%</td>
<td>Exxon 40%, Amerada Hess 40%, Petrobras 20%</td>
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<tr>
<td>BM-S-022</td>
<td>Azulão / Guaraní</td>
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<td>2002</td>
<td>Petrobras 80%</td>
<td>Galp Energia 20%</td>
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<td>BM-S-024</td>
<td>Júpiter</td>
<td>3</td>
<td>2002</td>
<td>Petrobras 80%</td>
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<td>BM-S-052</td>
<td>Corcovado</td>
<td>7</td>
<td>2006</td>
<td>BG 40%</td>
<td>Galp Energia 60%</td>
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</tbody>
</table>

### Transfer of Rights
- Franco
- Tupi NE
- Tupi Sul
- Entorno de Iara
- Florim
- Guará Sul
- Peroba

**Source:** Own elaboration with data from Petrobras & ANP
Looking ahead: bonanza or scarcity?

2014-2018 BMP: Petrobras Oil, NGL and Natural Gas Production Curve in Brazil


GAS
~145 mcmd (5.1 bcfd)

...and from other players?
1 mboe/d ~ 40-60 mcmd?
Expected gas demand growth: what role for gas-to-power?

The Government does not plan for much increase in thermal power capacity...

EPE’s Projections for Power Generation Capacity Growth 2013-2022

Of 62 GW of new capacity, just 5 GW is thermal

Source: EPE (2013), PDE 2022
The Government is putting all its eggs in one (or rather two) baskets – hydro & wind...

EPE’s Projections for New Installed Capacity 2013-2022

New capacity will be mostly large hydro projects in the Amazon region and wind farms

Source: EPE (2013), PDE 2022
...but what happens if the expected new hydro capacity gets delayed?

<table>
<thead>
<tr>
<th>Ano</th>
<th>Mês</th>
<th>Projeto</th>
<th>Rio</th>
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<td>UHE Foz Piquiri</td>
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<td>2020</td>
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<td>UHE Castanhêra</td>
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<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td>19,917</td>
<td></td>
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</tbody>
</table>

Five projects represents about 80% of all hydro capacity being planned for start-up between 2018 and 2022.

This is 15.5 GW!

Source: EPE (2013), PDE 2022
Even if all hydro projects do happen in time, new hydro projects will have very small reservoirs.

The Government is projecting just a 2% growth of the hydro reservoirs capacity (from 288 MW to 295 MW) compared with a 33% growth of the hydro installed capacity (from 89 GW to 119 GW).

This means more volatility of hydropower generation and therefore more need for thermal power generation.

Source: EPE (2013), PDE 2022
If problems arise with hydro and wind, then gas is expected to come in and save the day!

...But will there be gas available for additional gas-fired generation, if need be?

According to Government’s official projections, NO

EPE’s Natural Gas Supply-Demand Projections 2013-2022

Source: EPE (2013), PDE 2022
Will there be gas available for additional gas-fired generation, if need be?

According to Petrobras Strategic Plan, ONLY LNG

Existing and Projected Regasification Terminals in Brazil

- **Regasification Plant Pecém (CE)**
- **Regasification Plant Salvador (BA) - 2013/14**
- **Barra do Riacho LNG Import/Export Project**
- **OGX Regas Project in Açu**
- **Regasification Plant Guanabara Bay (RJ)**
- **Regasification Project in the South**

Source: Gasnet, ANP
In Brazil, LNG is imported for flexibility reasons, to supply peak demand...

- Brazil’s regasification terminals started to operate in 2009:
  - Pecém: January/09 - 7 MMm³/day capacity;
  - Rio de Janeiro: April/09 / 20 MMm³/day capacity;
- Both plants are operated by Petrobras;

Source: MME
...i.e. when thermal power plants are dispatched for lack of water in the hydro reservoirs

Source: ANP, Abegas, MME, ONS
While Bolivian imports provide base-load supply with some flexibility
... but for how much longer?
Main Uncertainties of the Brazilian Supply Scenario

- Lack of investments
- R/P ratio dropping fast (6 years at the end of 2011)
- Supply commitments with Argentina
- Can Bolivia supply both its export markets and its internal market?

- Flexibility has a high price
- High spot LNG prices are incompatible with power sector policy
- Petrobras cannot pass-through this cost to the power consumer
- Are long-term LNG contracts needed?

- Re injection rate?
- GOR?
- Current routes to coast will reach 50 MMm3/d - need to be expanded

- Reserves dimension?
- Exploration technology - repeatability
- Production costs
- Lack of infrastructure
THANK YOU!

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