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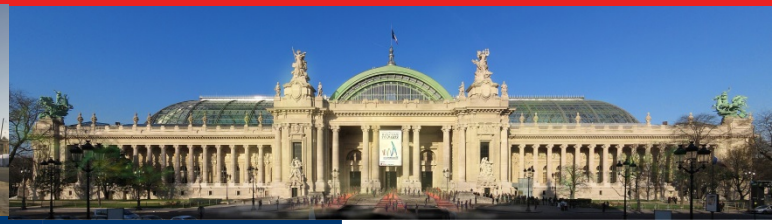

THE FUTURE FOR UGS IN BRAZIL

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IGU
WGCPARIS2015
WORLD GAS CONFERENCE

Agenda

Background:

- Domestic Balance of NG
- Case of Study: NG Storage vs. LNG Imports

Aims:

- Potential Market

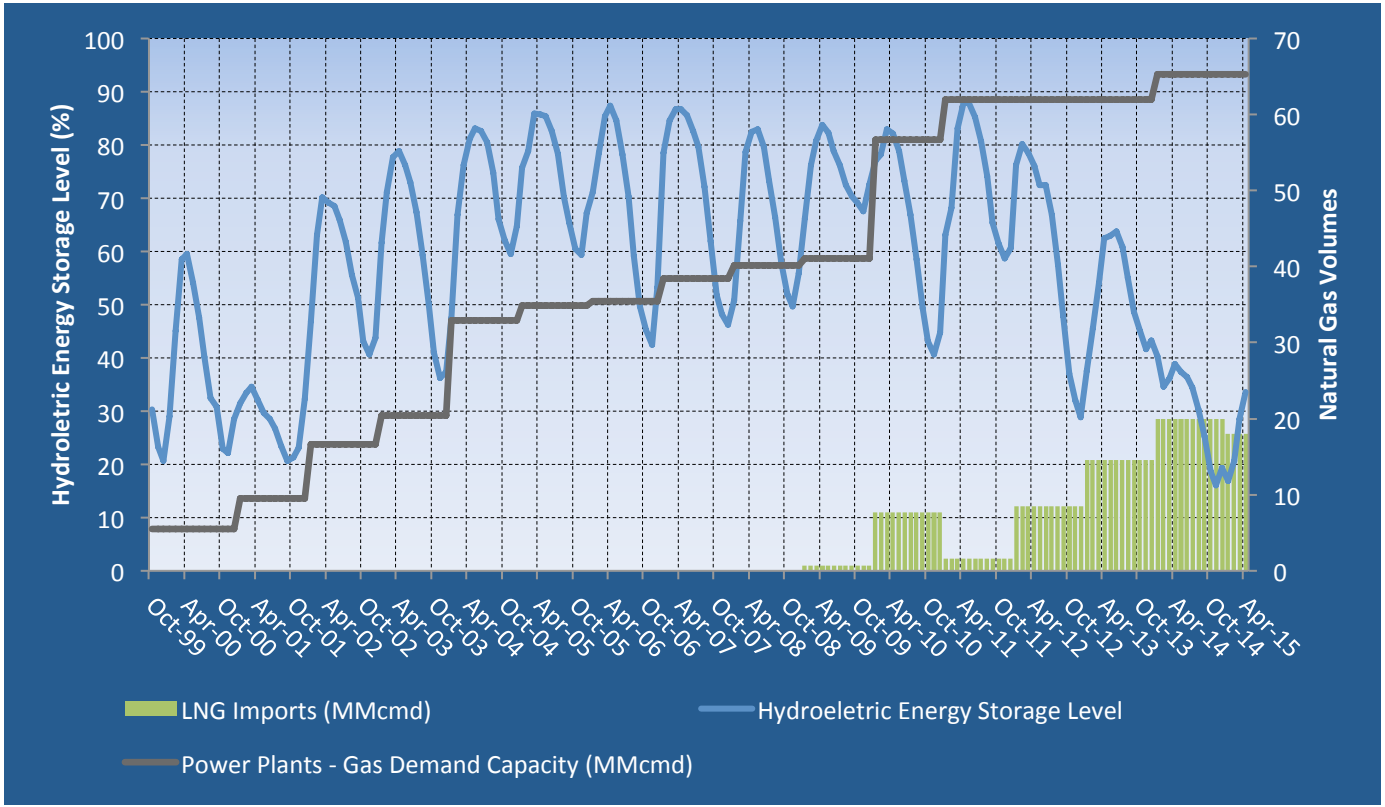
Methods & Results:

- Potential locations for a UGS in Brazil
- Current alternatives to UGS

Summary / Conclusions:

- Key Takeaways

Domestic Balance (or imbalance) of Natural Gas

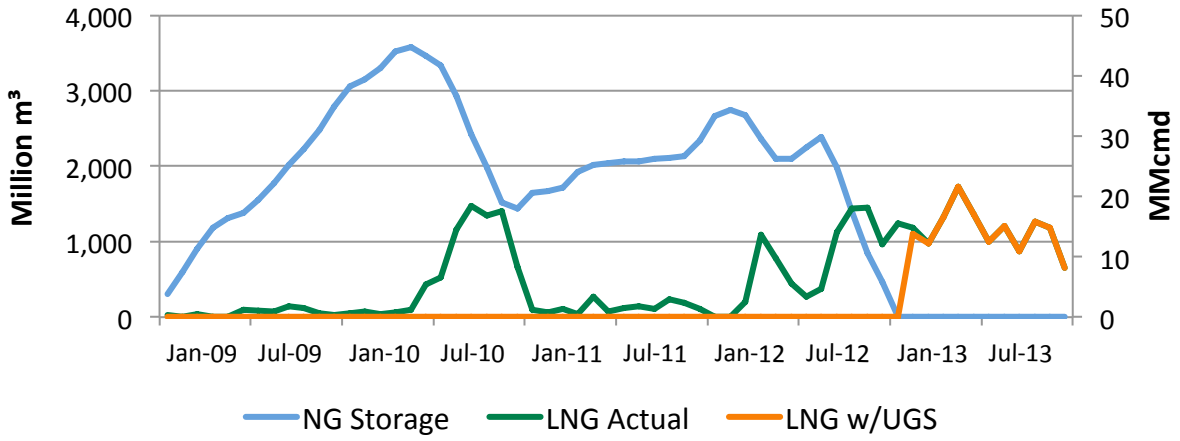


Extensive LNG imports due to: high energy demand, lack of new hydro plants with large reservoirs, unusual raining season 2013/14/15, new power plants

Case of study: NG Storage vs. LNG Imports

Assumptions

- Bolivian imports locked in 30 MMcmd
- Total Offer: Net Domestic Production + Bolivia Imports
- Storage:
- Total Offer > Total Demand → Injection
- Total Demand > Total Offer → Withdraw
- Bolivian gas price: 13 US$/MMBtu
- LNG price range ('14):
  - Commodity: 16.0 US$/MMBtu
  - Regas: 1.0 US$/MMBtu

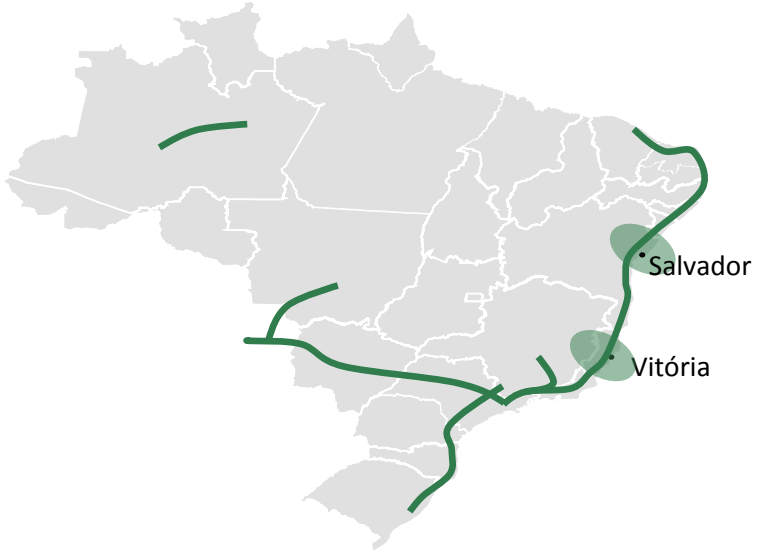


Conclusions

- LNG Imports Real: **12.1 bi m³**
- LNG Imports w/ UGS: **4.9 bi m³**
- Potential LNG non imports: **7.2 bi m³**
  - LNG overal costs: **R$ 4.4 bi**
  - Bolivian Gas Cost: **R$ 2.7 bi**

  Total Savings : R$ 1.7 bi

Potential Market



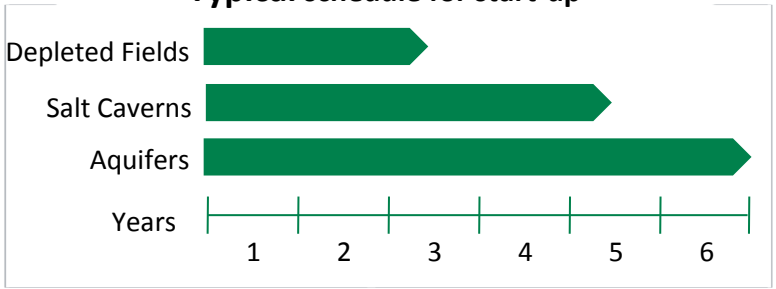
Rationale

- Quick response for the volatility of energy demand
- Need for a working gas storage volume of 30 to 90 days: **0,6 - 2 billion m³**
- Assuming the need of UGS is equivalent to a withdrawal rate similar to the local regasefication capacity : **20 - 25 M m³/d**
- States with idle capacity in the existing pipelines
  - **Bahia and Espírito Santo**

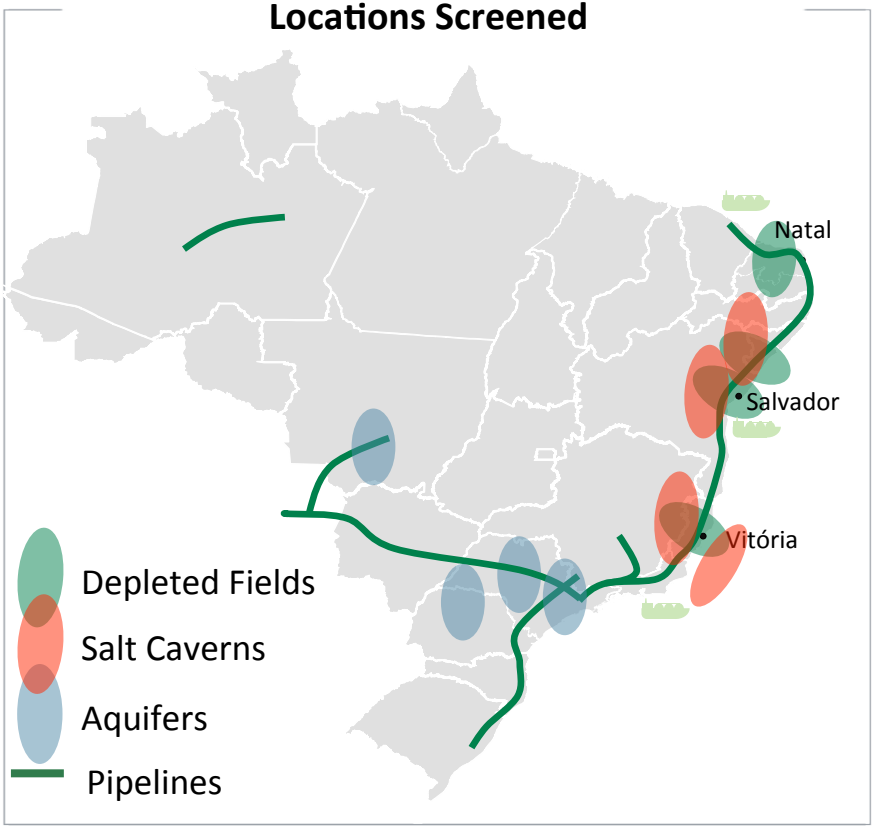
Withdraw Rate (Mcmd field) | # fields

Working Gas M m³ \ Withdraw / Working Gas	1%	2%	3%	4%	5%
200	2 | 10	4 | 5	6 | 3	8 | 3	10 | 2
300	3 | 6	6 | 3	9 | 2	12 | 2	15 | 2
400	4 | 5	8 | 3	12 | 2	16 | 2	20 | 1
500	5 | 4	10 | 2	15 | 2	20 | 1	25 | 1

Typical schedule for start-up



Possible Locations for a UGS Facility in Brazil



Milestones Achieved:

- Negotiate with client an MOU;
- Based on internal analysis and consultants opinions, 30 onshore fields from independent producers were identified;
- A second round of analysis were carried out and 7 (out of the 30) mature fields were prioritized;
- Geotechnical consultancy was hired in order to evaluate these 7 prospects
- Three depleted fields proved some viable conditions to implement a UGS facility

Cost Comparison Alternatives to UGS

	Today		Near Future
	FSRU Storage	**Storage in LNG Carriers**	**UGS**
Current budget costs (MM US$)	Vessel chartering **43.3**[1] Regas **6.8** Others: Depreciation **30.3** Total **80.4**	Vessel chartering **18,1**[1] Regas **6.8** Others: Depreciation **30.3** Total **55.2**	**+ 50**
Storage Capacity (MM m³)	**104.04**	**96.00**	**100.00**
Comparison:			
US$ / m³	**0.77**	**0.57**	**Up to 0.50**

1. Daily rate: US$ 118.6 k
2. Daily rate: US$ 50.0 k

Key Takeaways

I. As the country becomes more dependent on Gas Fired Power Plants for energy supply, UGS becomes more necessary to handle supply x demand fluctuations;

II. Currently the alternatives to gas storage are not enough and nor the most efficient way to meet the expected demand for gas fired plants;

III. The “de facto” monopoly of gas infrastructure allied to the regulatory landscape poses relevant challenges to anyone trying to venture in this field, but there are some signs of change coming from regulatory agency;

IV. However, there are still some room for entrepreneurs trying to seize, now, local and specific opportunities either by offering a reliable source of energy for IPPs due to upcoming energy auctions or by creating a security of energy supply for the Brazil

Thank you.

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