ESTIMATION OF OFFSHORE BRAZILIAN NATURAL GAS BREAK-EVEN PRICES

Rio Pipeline 2019 – Estande da EPE

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Setembro de 2019

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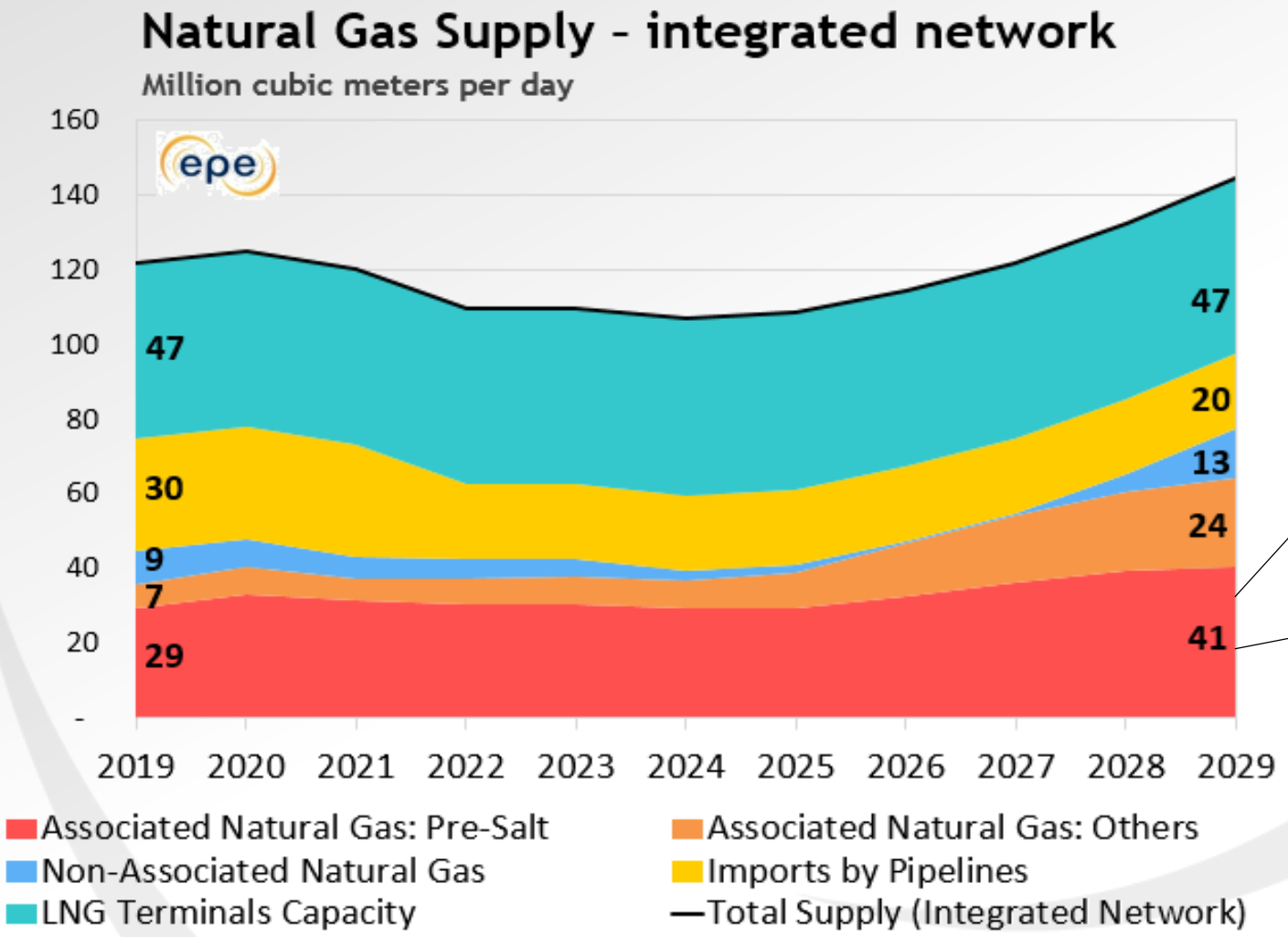
Topics

- Pre-Salt Potential
- Main Clusters in Pre-Salt
- CO_2 Content
- CO_2 Removal
- Production Curves
- Cost Analyses
- Conclusions

Pre-Salt Potential

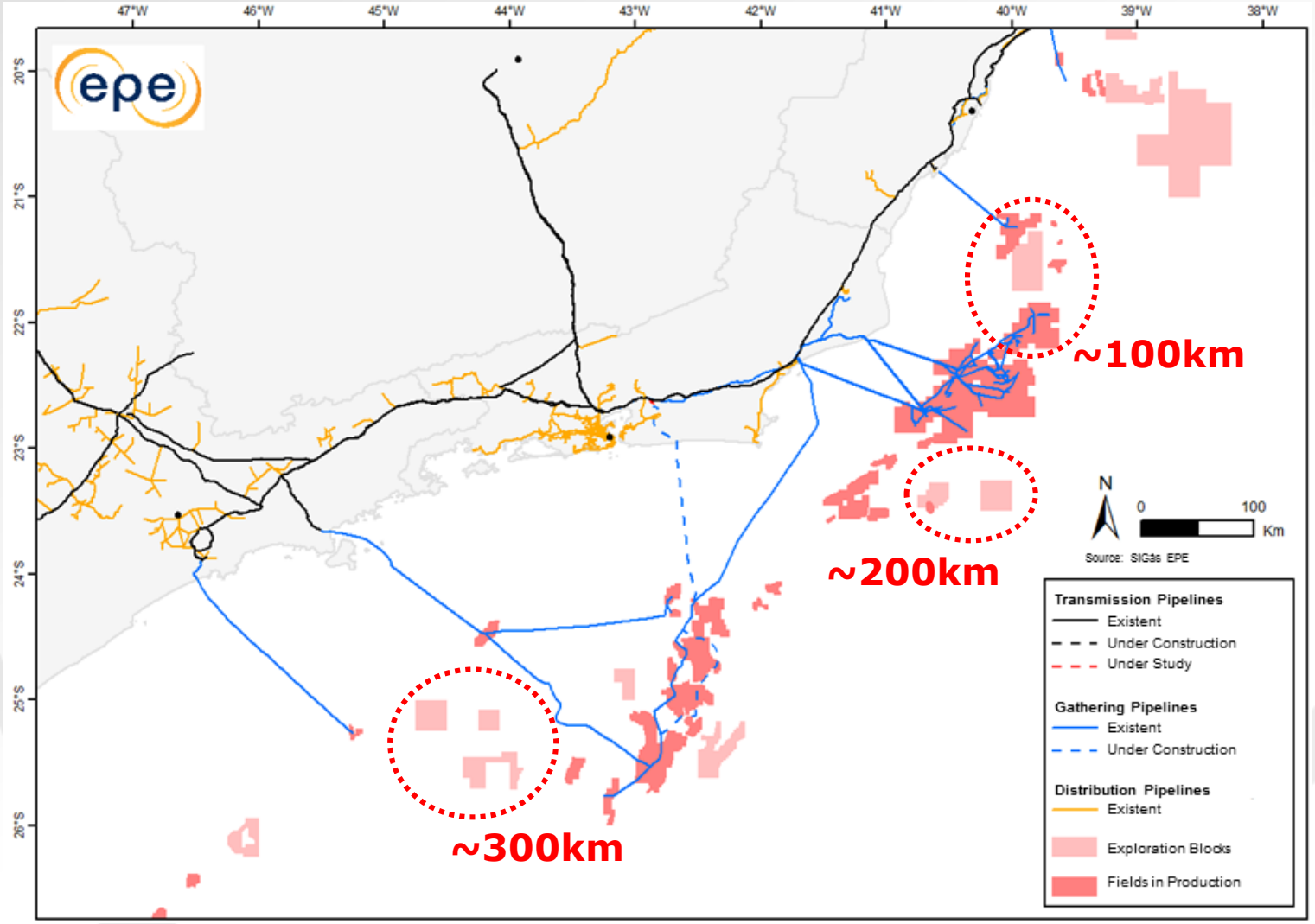


Pre-Salt will reach 47% of Brazilian gas production by 2029

+41% Pre-Salt Production in the next 10 years

Source: EPE.

Main Clusters in Pre-Salt



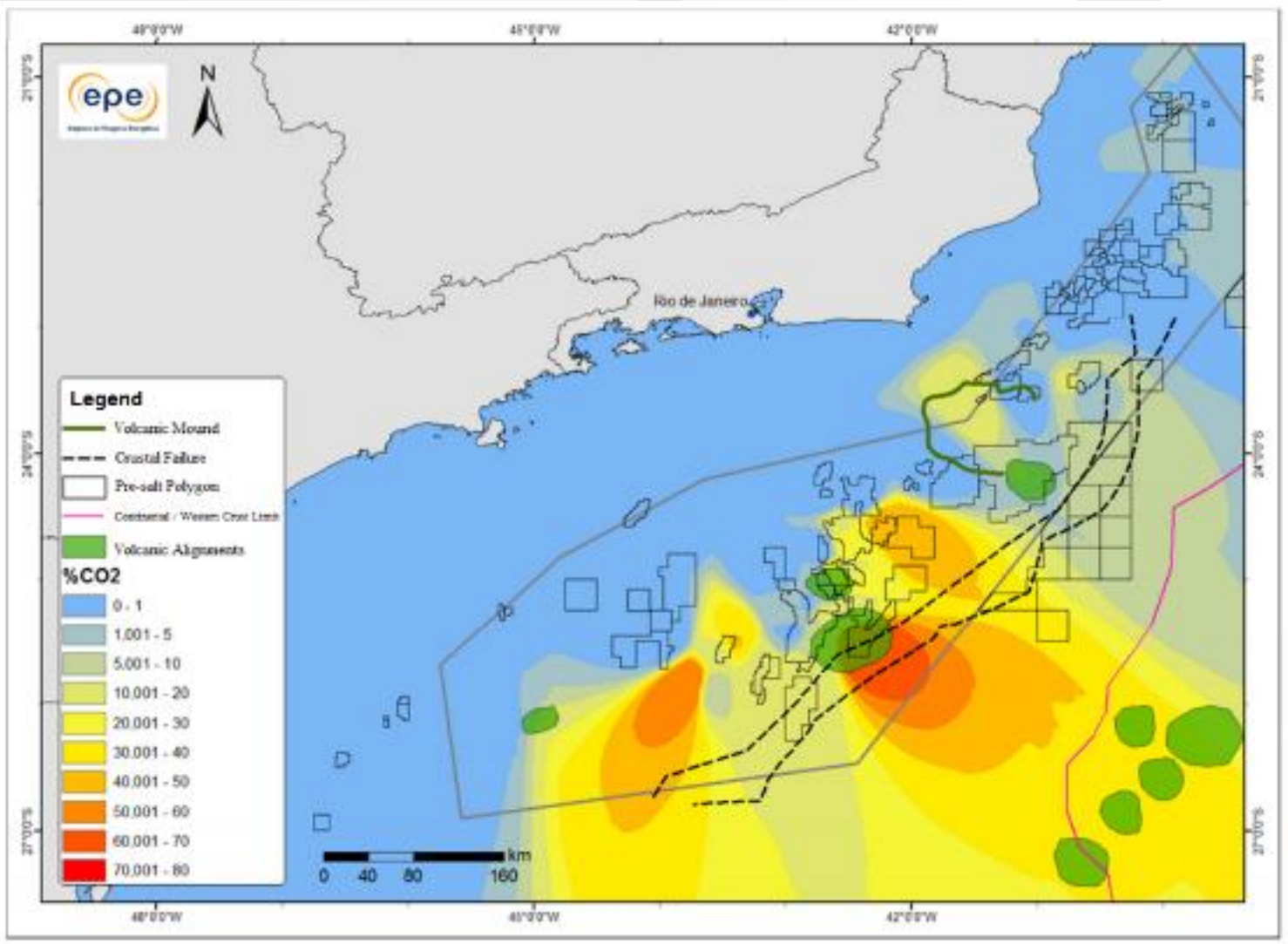
Most of the fields present distance to the shore of 100 to 300 km

Source: EPE.

CO_2 Content

- 0-3% CO_2
- 10% CO_2
- 20% CO_2
- 30% CO_2
- 40% CO_2

Can be limited to Technology Constraints



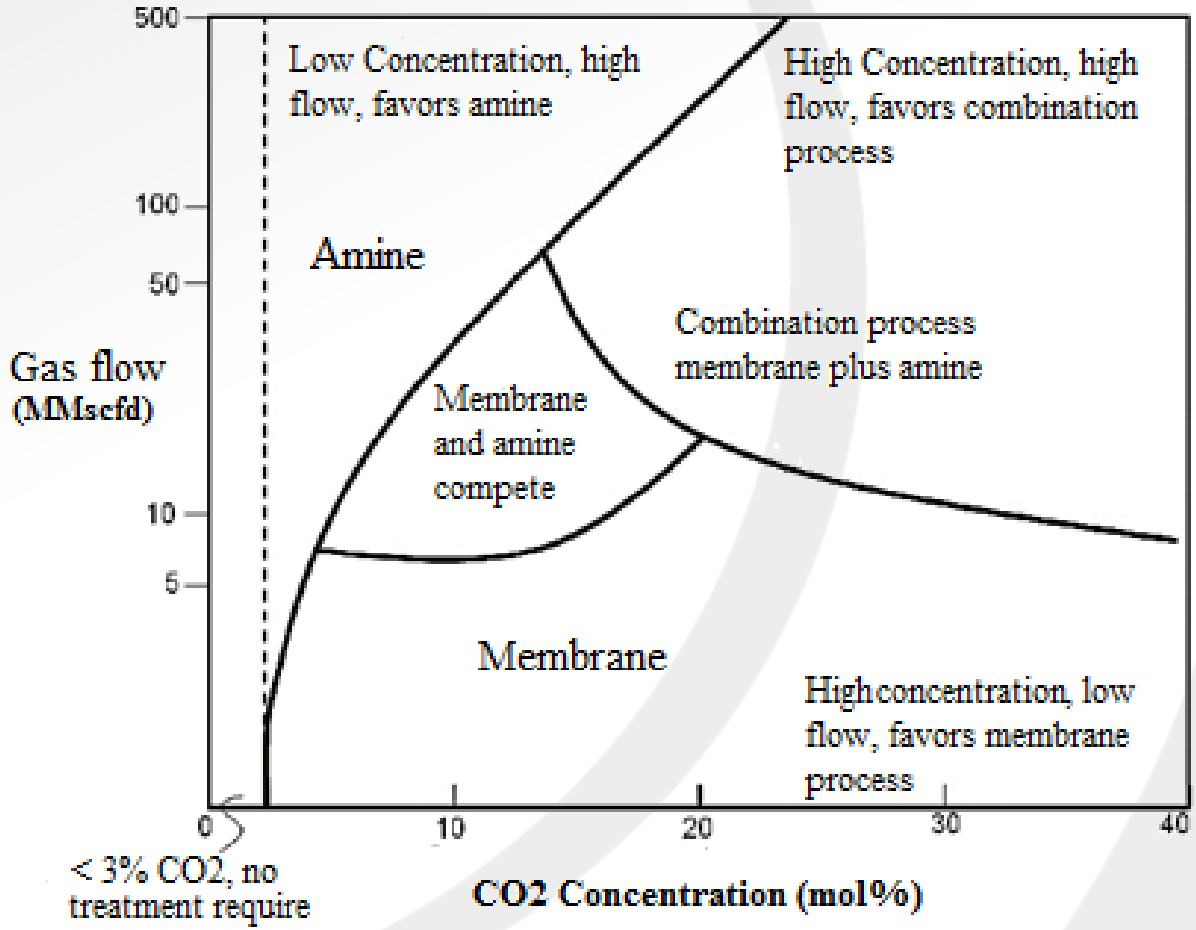
Source: EPE, Almeida *et al* (2018).

CO_2 Removal

- Membrane and Amine combination can be preferred

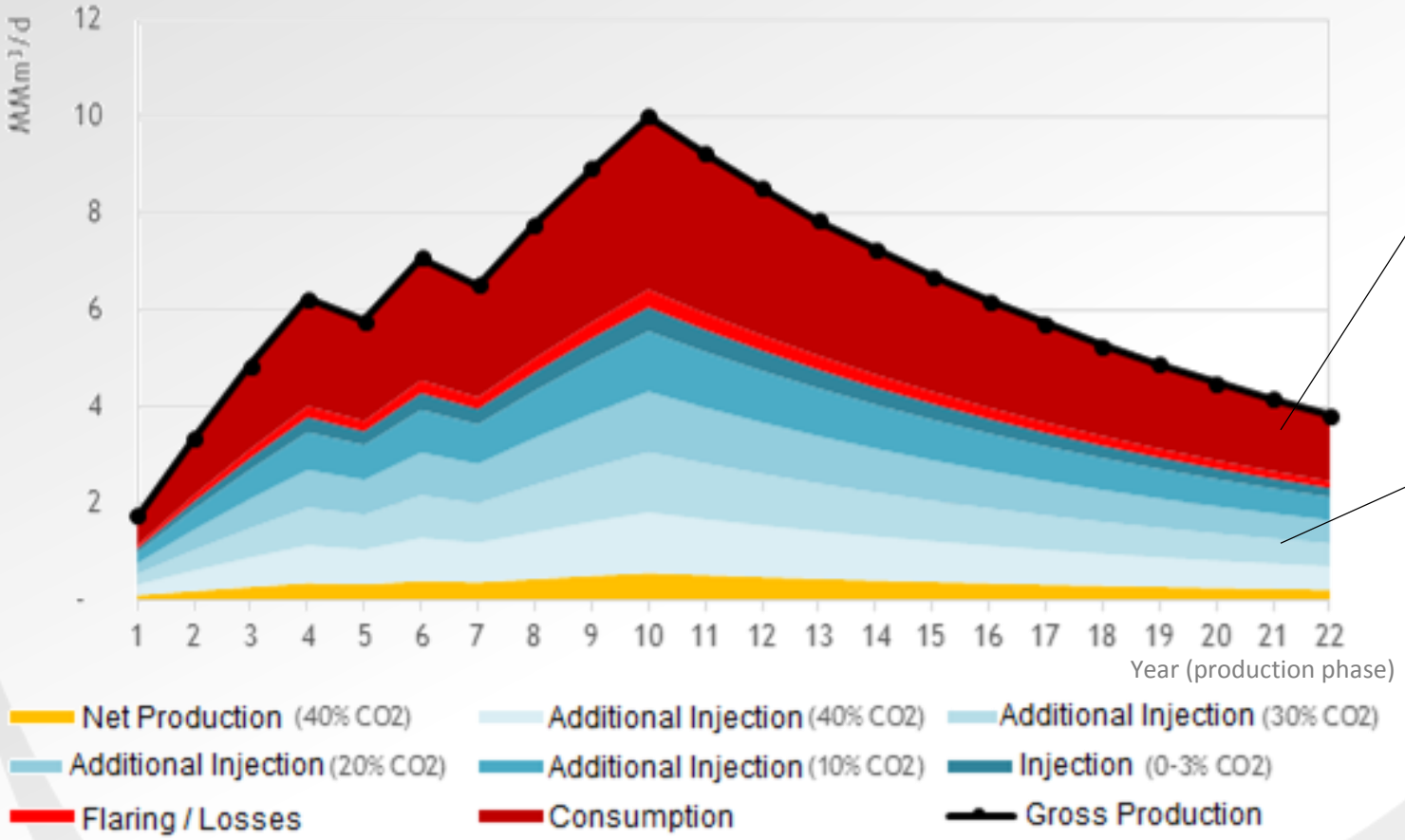
versus

- Limitations of space and weight on the offshore platforms



Source: Baker and Lokhandwala (2008), apud Nakao (2010).

Production Curves



Consumption for gas compression is high in Pre-Salt projects

CO_2 can be injected for advanced oil recovery

Note: Net Production presented to the lower case (higher CO2 content); in the cases with lower CO_2 percentual, the shares correspondent to the additional injection must be summed up to the Net Production; consumption in the platforms is mainly associated to the operation of compressors.

Source: EPE.

Cost Analyses

Natural Gas Exploration and Production

CO_2 Content	Break-Even Price (US$/MMBtu)
0-3%	2.06
10%	3.06
20%	3.95

CO_2 contents of 30% and 40% (not presented) resulted in high Break-Even values

Can require other strategies for monetization (e.g. FLNG, FGTL, more injection)

Note: estimates based on concept screening level analyses, with -20% to -50% and +30% to +100% precision.

Source: EPE.

Cost Analyses

Outflow of Natural Gas to the Shore

CO_2 Content	Costs of Transportation to Shore (US$/MMBtu)				
	100 km	150 km	200 km	250 km	300 km
0-3%	0.99	1.49	1.99	2.48	2.98
10%	1.28	1.92	2.56	3.20	3.85
20%	1.81	2.71	3.61	4.51	5.42

Higher CO_2 contents, less natural gas to pay for the pipelines

Note: estimates based on concept screening level analyses, with -20% to -50% and +30% to +100% precision.

Source: EPE.

Cost Analyses

Natural Gas Processing Cost (considers NGL sales)

CO_2 Content	Processing Cost (US$/MMBtu)
0-3%	- 1.48
10%	- 1.13
20%	- 0.60

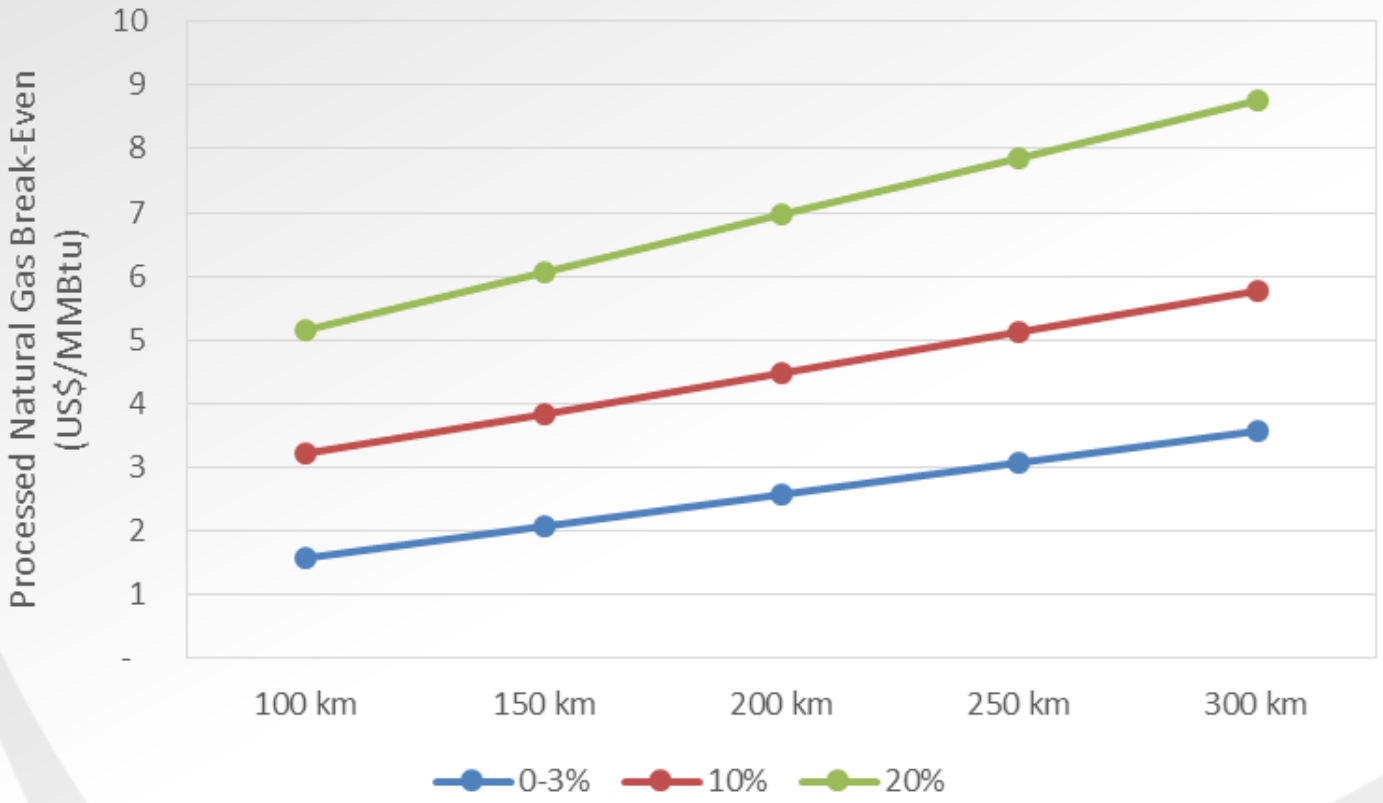
Higher CO_2 contents, less natural gas to pay for the processing plants, less liquids to sell

Note: estimates based on concept screening level analyses, with -20% to -50% and +30% to +100% precision.

Source: EPE.

Cost Analyses

Total Exploration & Production, Outflow and Processing costs



CO_2 contents of 30% and 40% presented a Break-Even higher than US$ 10 /MMBtu

Can require other strategies for monetization

Note: estimates based on concept screening level analyses, with -20% to -50% and +30% to +100% precision.

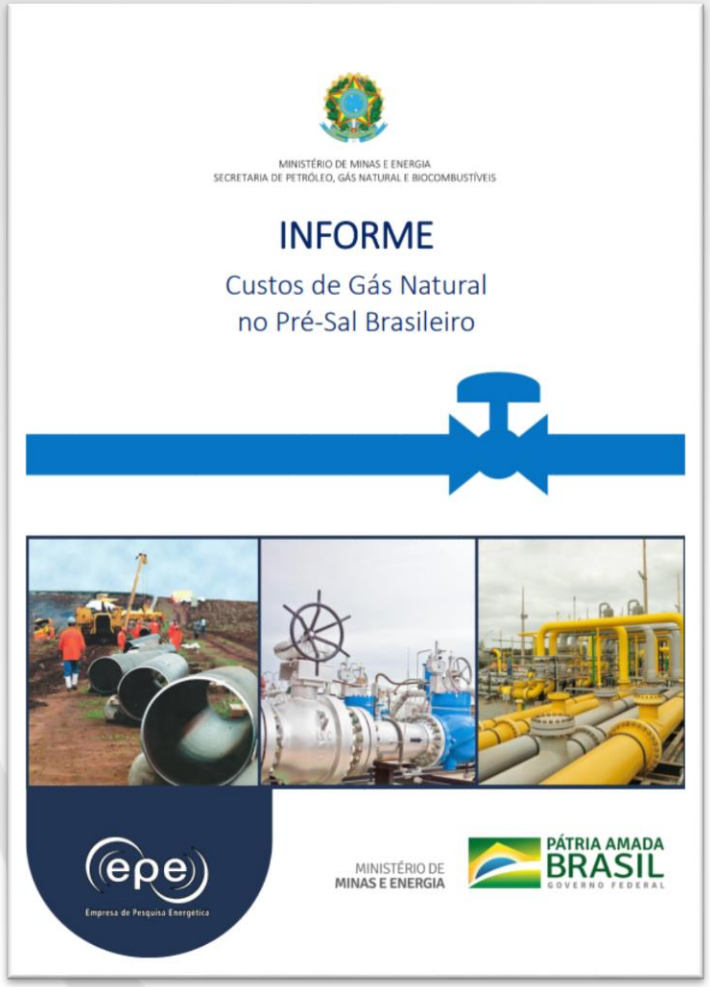
Source: EPE.

Conclusions

Final Considerations and Limitations of the Study

- Pre-Salt will be important for Brazilian Gas Supply
- Pre-Salt Break-Even Prices can vary a lot
- CO_2 content and distance to shore are important parameters
- Producers can sell their gas based on field/cluster/portifolio
- CAPEX, OPEX and ABEX in this study do not consider field-specific parameters and project specificities

Complete Study



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