

# FLNG AS AN OPTION TO MONETIZING THE NATURAL GAS FROM PRE-SALT IN BRAZIL

Rio Pipeline 2019 – EPE Stand

**Claudia Maria Chagas Bonelli**

Natural Gas Analyst

Rio de Janeiro, RJ  
Setembro de 2019

Empresa de Pesquisa Energética  
Ministério de Minas e Energia



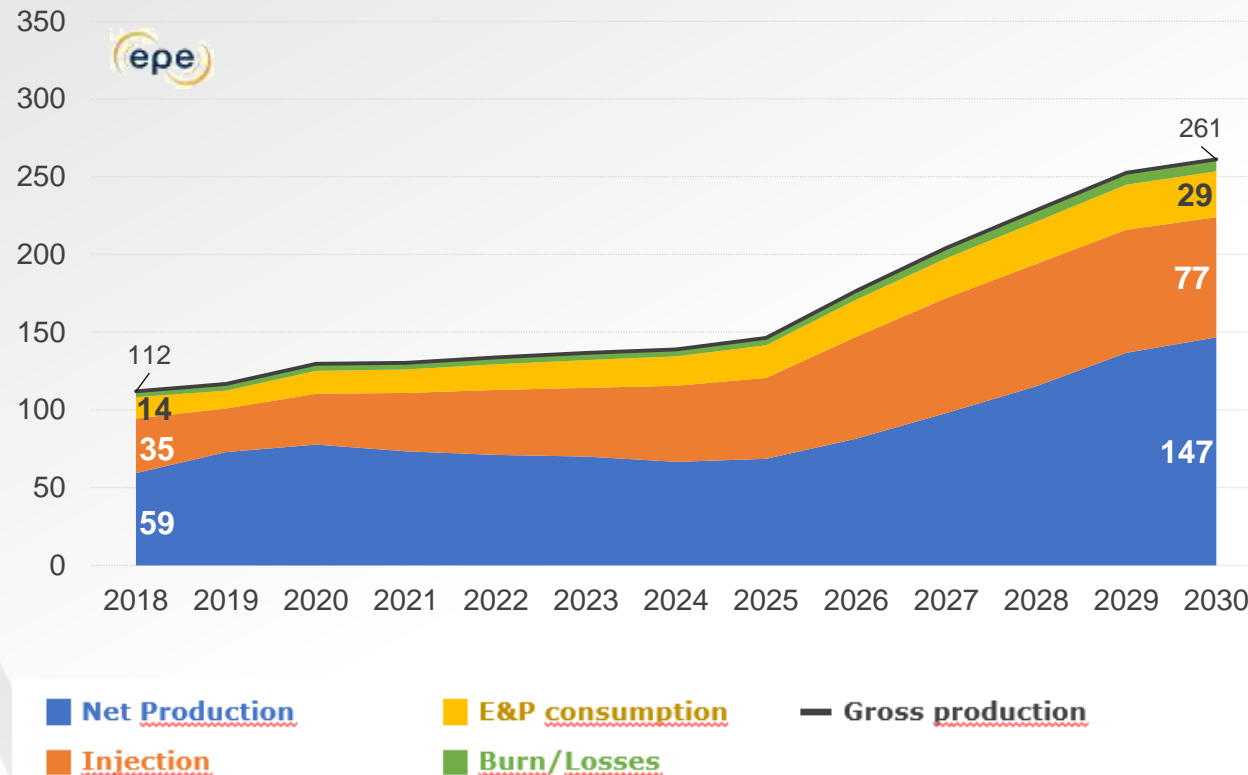
# Topics

- Introduction
- Investment costs of FLNG facilities
- Monetization alternatives via FLNG
- Case study
- Final remarks



# Introduction

## Natural gas gross and net production (MMm<sup>3</sup>/d)



- most of the increase in NG production will come from **pre-salt**
- **high** injection rates

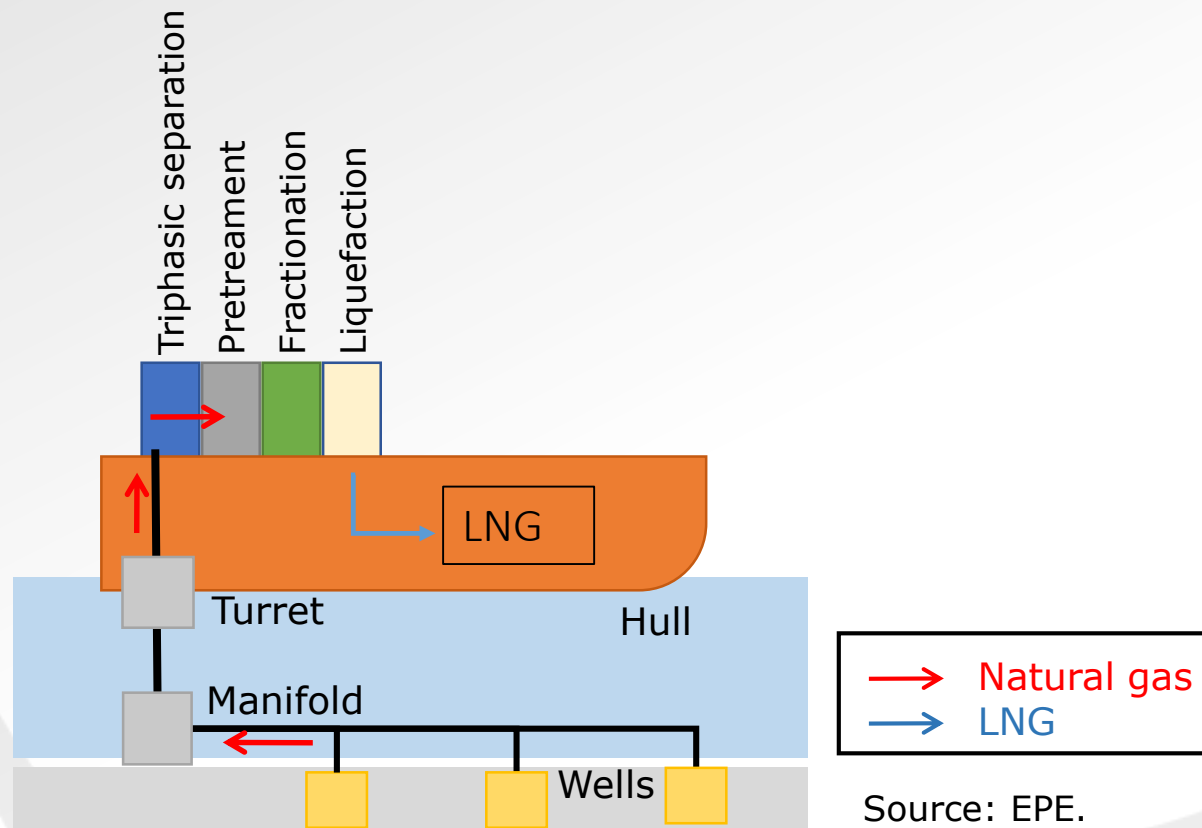


**FLNG**

Source: EPE.

# Introduction

## FLNG technology



Source: Prelude FLNG, Shell, 2019

# Investment costs of FLNG facilities

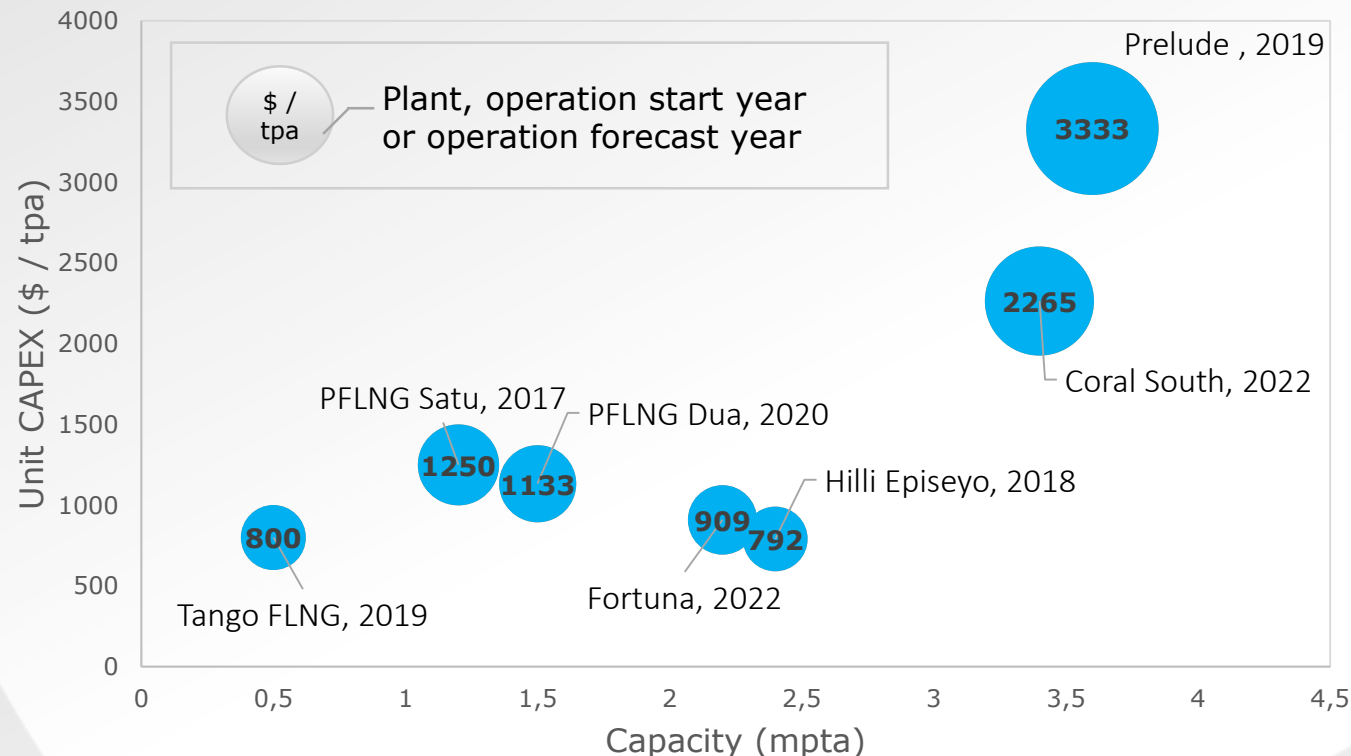
## Characteristics and CAPEX of the main FLNG projects in the world

Project	Localization	Capacity (mtpa)	Liquefaction/ Vessel Capex (US\$bn)	Total Capex (US\$bn)	Status
PFLNG Satu	Malaysia	1.2	1.2	1.5	In operation (2017)
Hilli Episeyo	Cameroon	2.4	1.4	1.9	In operation (2018)
Prelude	Australia	3.6	7.2	12	In operation (2019)
Tango FLNG	Argentina	0.5	0.3	0.4	In operation (2019)
PFLNG Dua	Malaysia	1.5	1.5	1.7	Scheduled to 2020
Fortuna	Equatorial Guinea	2.2	1.5	2.0	Scheduled to 2022
Coral South	Mozambique	3.4	4.3	7.7	Scheduled to 2022

Source: EPE, based on SONGHURST (2018), WORLD MARITIME NEWS (2018), COMPELO ENERGY (2018), OPHIR ENERGY (2017), SCOTT (2018) and SHELL (2019).

# Investment costs of FLNG facilities

## Unit cost of integrated FLNG projects, in US\$ / tpa

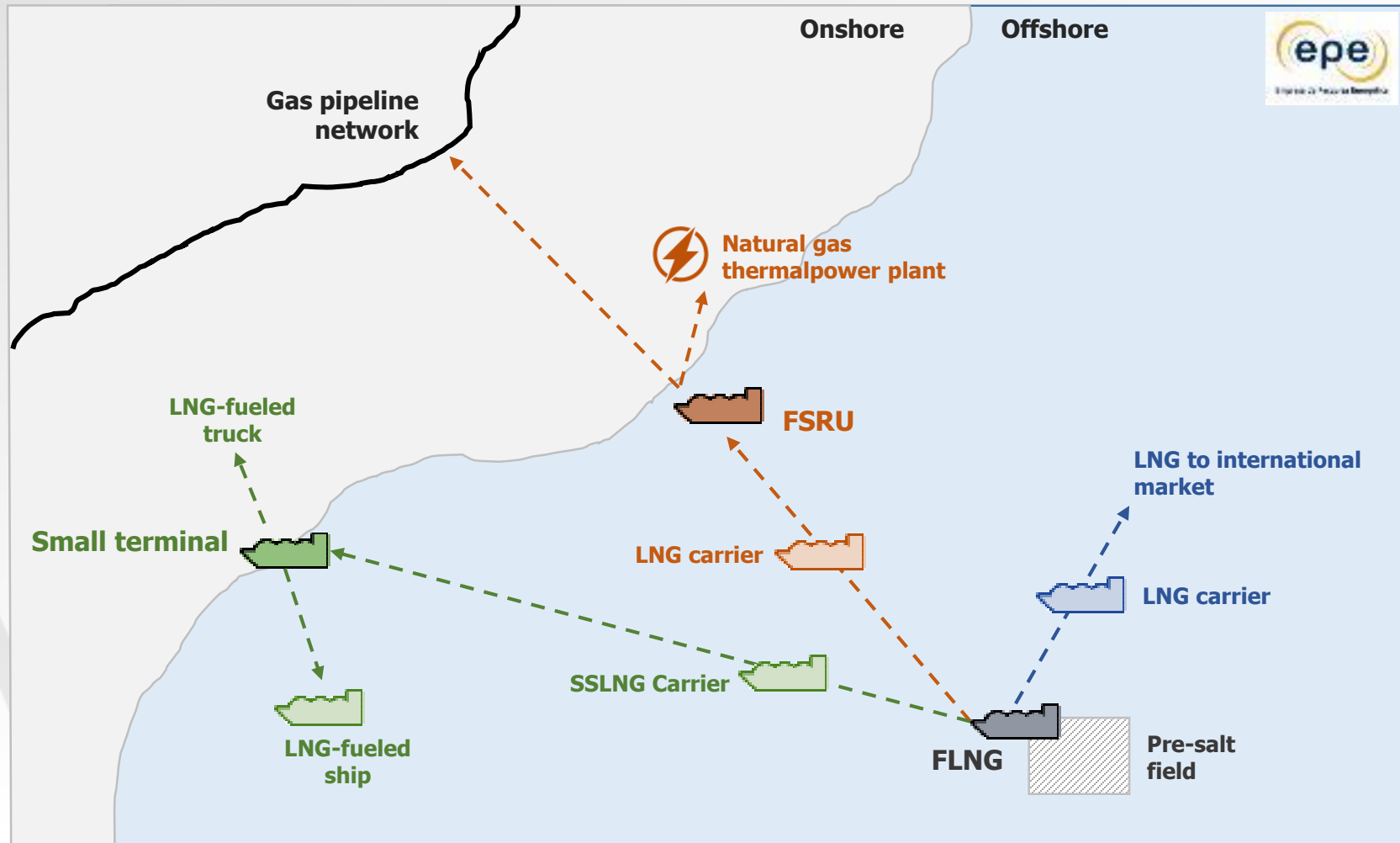


Several variables that affect FLNG costs:

- LNG capacity
- facility location
- external funding

Source: EPE, based on SONGHURST (2018), WORLD MARITIME NEWS (2018), COMPELO ENERGY (2018), OPHIR ENERGY (2017) and SCOTT (2018).

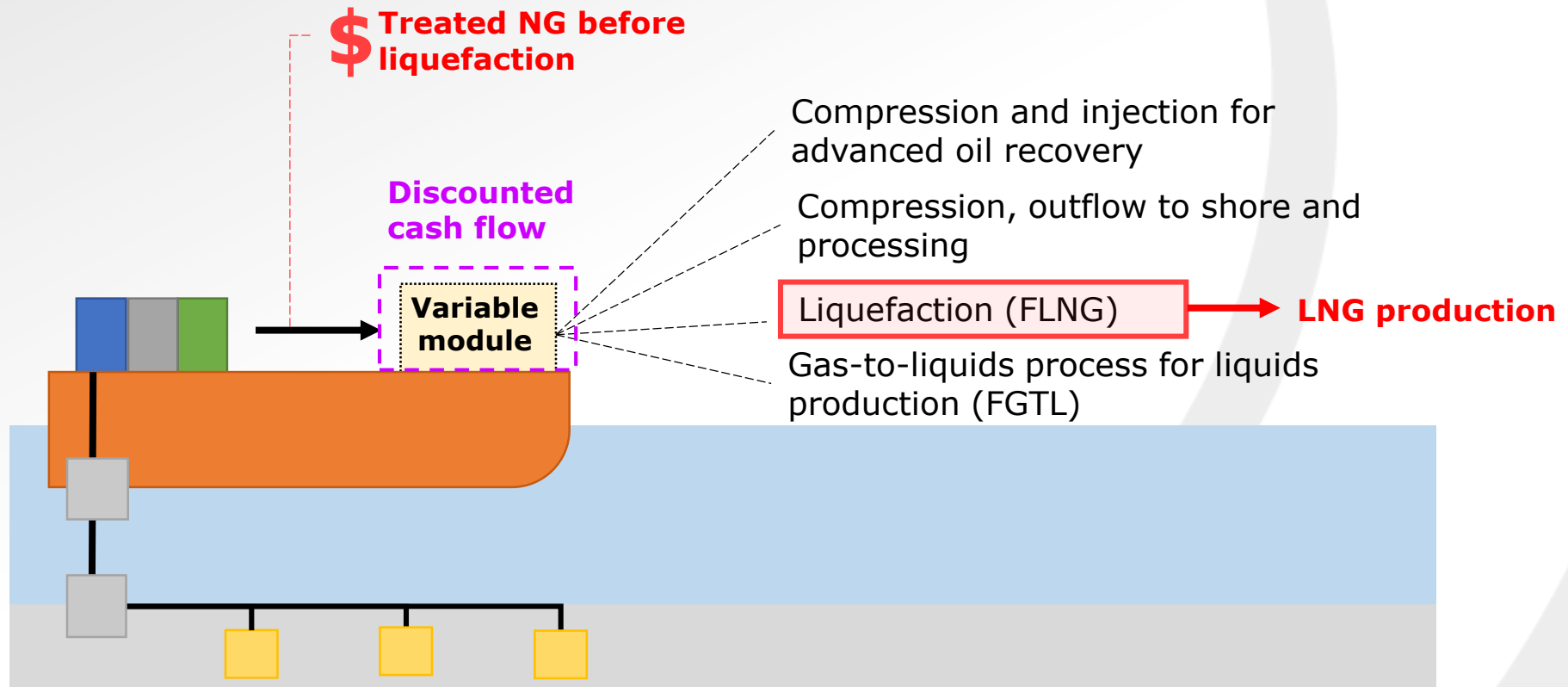
# Monetization alternatives via FLNG



Source: EPE.

# Case study

## Benchmark for price analysis of FLNG project



Source: EPE.



# Case study

## Technical and economic assumptions

Technical assumptions	
Capacity of liquefaction of natural gas*	1.5 mtpa
Construction period	3 years
Operation Period	27 years
Economic assumptions	
CAPEX of liquefaction plant**	US\$ 1.1 bn
OPEX of liquefaction plant	10.6 % CAPEX/year
GNL market sale price***	9.76 US\$/bbl
Taxes and Fees****	
WACC	10 %
Income Tax (IR)	25 %
Social Contribution on Net Income (CSLL)	9 %

\* Corresponding to approximate production of pre-salt fields - 5,6 MMm<sup>3</sup>/d;

\*\* Cost estimate based on liquefaction CAPEX of Coral South Project (1.8 US\$ bn);

\*\*\* Medium price calculated from data provided by MME bulletin dez/18.

\*\*\*\* Results do not include ICMS, PIS/COFINS and ISS

# Case study

## Methodology and results

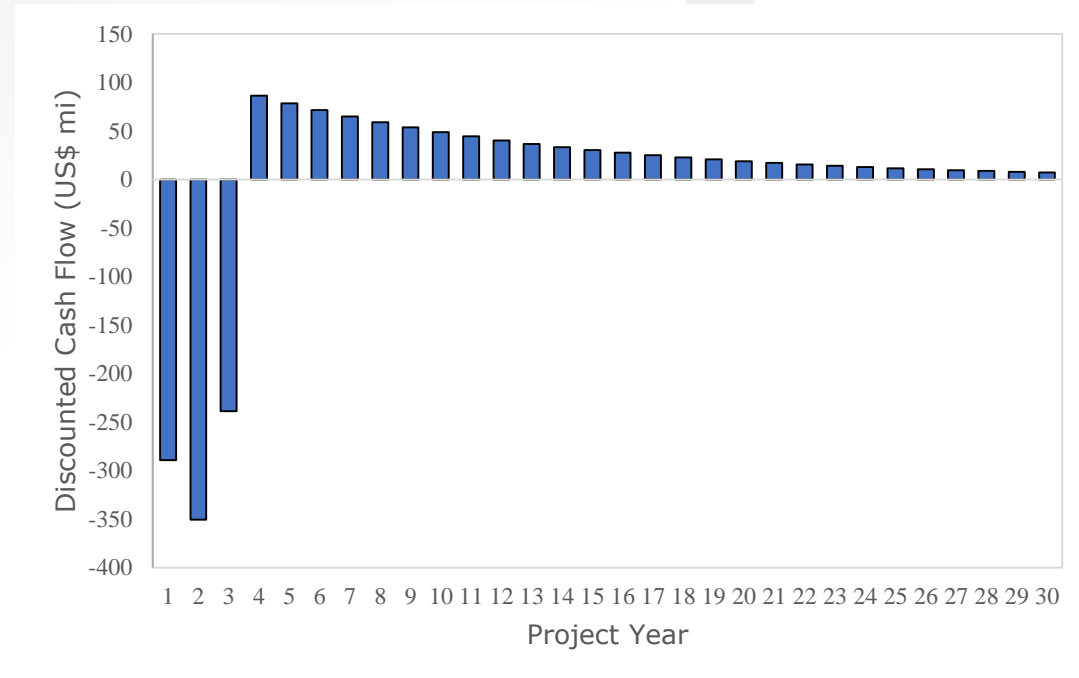
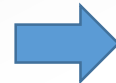
**epe**  
Empresa de Pesquisa Energética

**TERMINAL AND LIQUEFACTION FACILITIES EVALUATION SYSTEM**

**SATIL**

PROJECT DATA  
FILL WHITE-COLORED CELLS

<b>Capacity of liquefaction of natural gas</b> 5,57 MM m3 / day	<b>Products and Price Reference (Select)</b> LNG Price (MME) ▾ LNG 1 - - -	<b>Capacity of liquefaction plant</b> 1,5 mtpa	<b>CAPEX Liquefaction</b> 1055 MMUS\$
<b>Project duration</b> 30 years			<b>CAPEX per unit</b> 705,8 \$/ tpa
<b>CALCULATE BREAK-EVEN OF NATURAL GAS</b>			<b>Results</b> Gas Break-even 6,9 US\$ / MMBtu



Terminal and liquefaction facilities evaluation system - **SATIL**

Discounted cash flow from the FLNG project

# Case study

## Results

**US\$ 6.9 / MMBtu**

Break-even price for treated natural gas (before liquefaction stage)

compatible

**US\$ 2.0 to 7.0 / MMBtu**

Break-even price range for pre-salt natural gas\* (CO<sub>2</sub> content up to 20%)

Several fields whose NG price would be < US\$ 6.9/MMBtu



**FLNG strategy economically feasible, under the conditions studied**

# Case study

## Discussion

### Why FLNG? - Pros



Reduction of pre-salt **natural gas injection**.



FLNG could allow the **monetization of pre-salt NG** in the national market through **different alternatives**.



**Wide range** of LNG production

# Case study

## Discussion

### Why FLNG? - **Challenges**



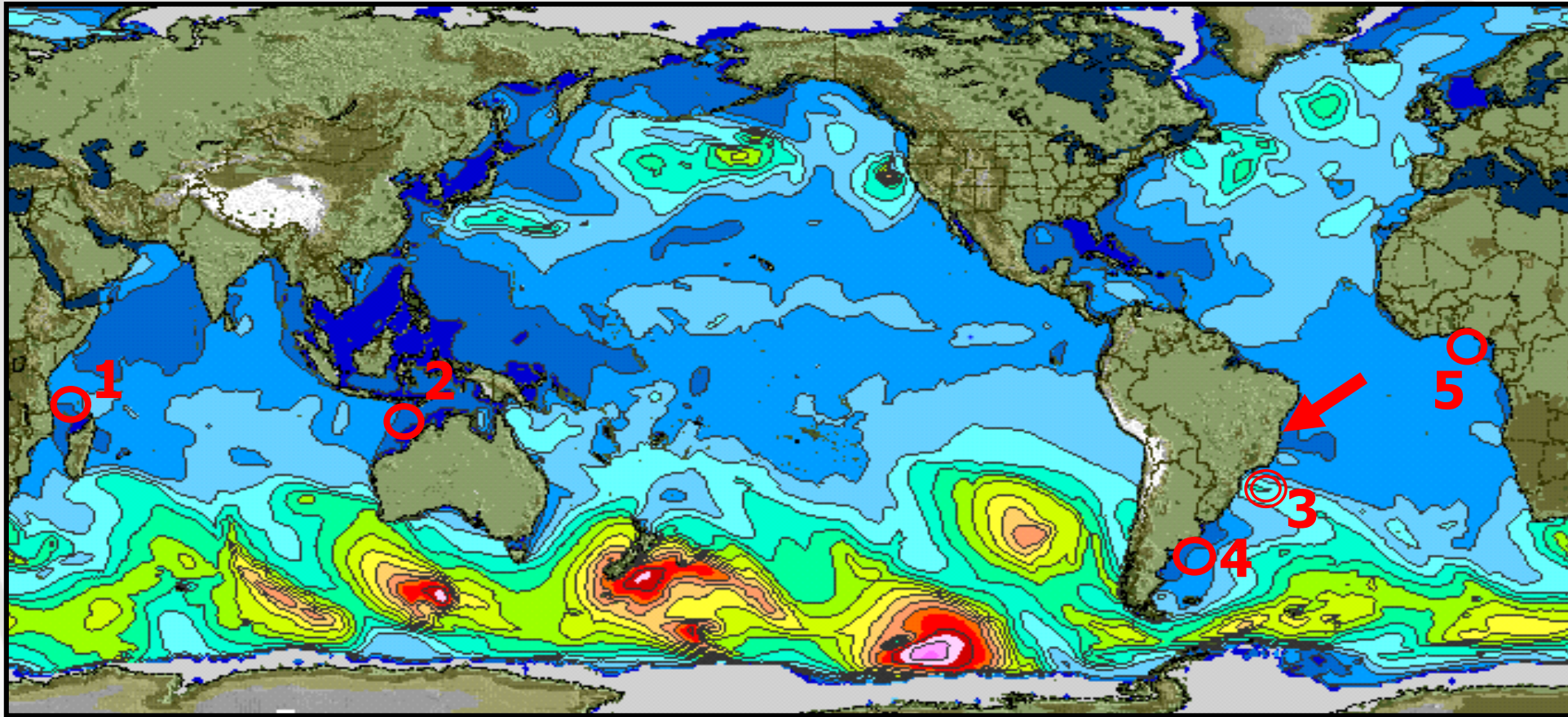
Brazilian pre-salt environment has **adverse meteo-oceanographic conditions**

Product containment and transfer systems need to withstand the effects of winds and ocean waves

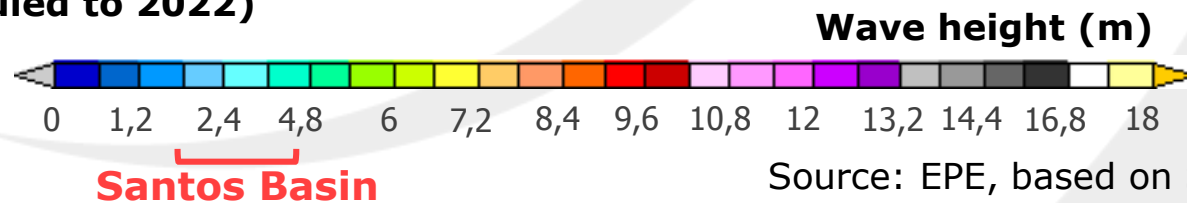


**Technical challenge** to be faced in implementing FLNG technology to the Brazilian pre-salt area

# Wave regime with FLNG project location



- 1 – FLNG Coral South – Moçambique (scheduled to 2022)
- 2 – Prelude FLNG – Australia (in operation)
- 3 – Pre-salt FLNG - Brazil
- 4 – Tango FLNG – Argentina (in operation)
- 5 – Hilli Episeyo - Cameroon (in operation)



Source: EPE, based on STORMSURF (2019)

# Final remarks

- ✓ It was estimated a maximum treated NG price of **US\$ 6.90/MMBtu** so that the FLNG project in the pre-salt environment would be viable, under the conditions studied.
- ✓ However, the application needs to be further studied mostly due to **adverse meteo-oceanographic** conditions.
- ✓ Estimates of CAPEX and OPEX used were based on **literature sources** and **may vary** given the specificities of the projects.

# Claudia Maria Chagas Bonelli

Division of Oil, Gas and Biofuels Studies  
Oil and Gas Department

E-mail: [claudia.bonelli@epe.gov.br](mailto:claudia.bonelli@epe.gov.br)

Telephone: +55 (21) 3512-3299

Avenida Rio Branco, 1 - 11º andar  
20090-003 - Centro - Rio de Janeiro  
[www.epe.gov.br](http://www.epe.gov.br)



/epe.brasil



epe\_brasil



@epe\_brasil



/EPEBrasil

Empresa de Pesquisa Energética  
Ministério de Minas e Energia

