POTENTIAL VOLUMES AND COSTS FOR PRE-SALT AND ONSHORE NATURAL GAS SUPPLY

Brazil Energy Future Summit

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Ministério de Minas e Energia

AGENDA

- Oil and Gas Overview in Brazil
- The Brazilian Pre-salt and its Potential
- The Brazilian Onshore Production and its Potential
- Forecasts for the Oil and Gas in Brazil
- Infrastructure
- Final Remarks

OIL AND GAS OVERVIEW IN BRAZIL

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OIL AND GAS OVERVIEW IN BRAZIL

Discovered Resources
(2018)

Oil reserves (certified)
(Billion barrels of Oil)
13 - 24

Contigent Resources
(Billion barrels of Oil)
5 - 28

Natural Gas reserves (certified)
(Trillion m³ of gas)
0.4 – 0.6

Contingent Resources
(Trillion m³ of gas)
0.1 - 3.3

Source: ANP, EPE

Undiscovered Resources

Estimation of recoverable volumes of oil from contracted and non-contracted areas
(Billion barrels of Oil)
14 - 54

Estimation of recoverable volumes of gas from contracted and non-contracted areas
(Trillion m³ of gas)
1,1 - 7,5

Source: EPE

OIL AND GAS OVERVIEW IN BRAZIL

Sedimentary Basins

68
Sedimentary Basins

- **53** onshore
- **15** offshore

40
basins with oil and gas E&P potential

- **25** onshore
- **15** offshore

(National Zoning of Oil and Gas Resources)

Fields of oil and gas production in Brazil

406
wells

- **28** pre-salt — **7%**

Exploratory oil and gas blocks in Brazil

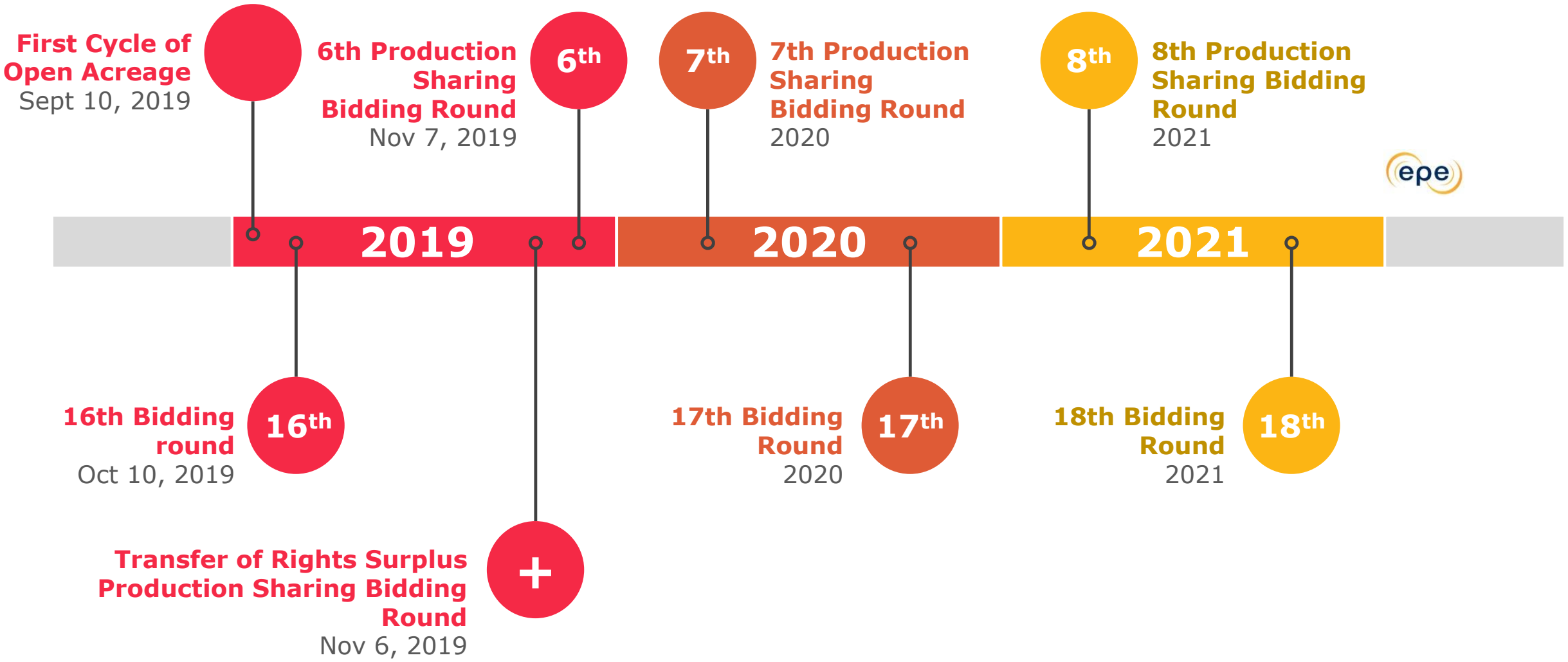
302
exploratory blocks

- **43** pre-salt — **14%**

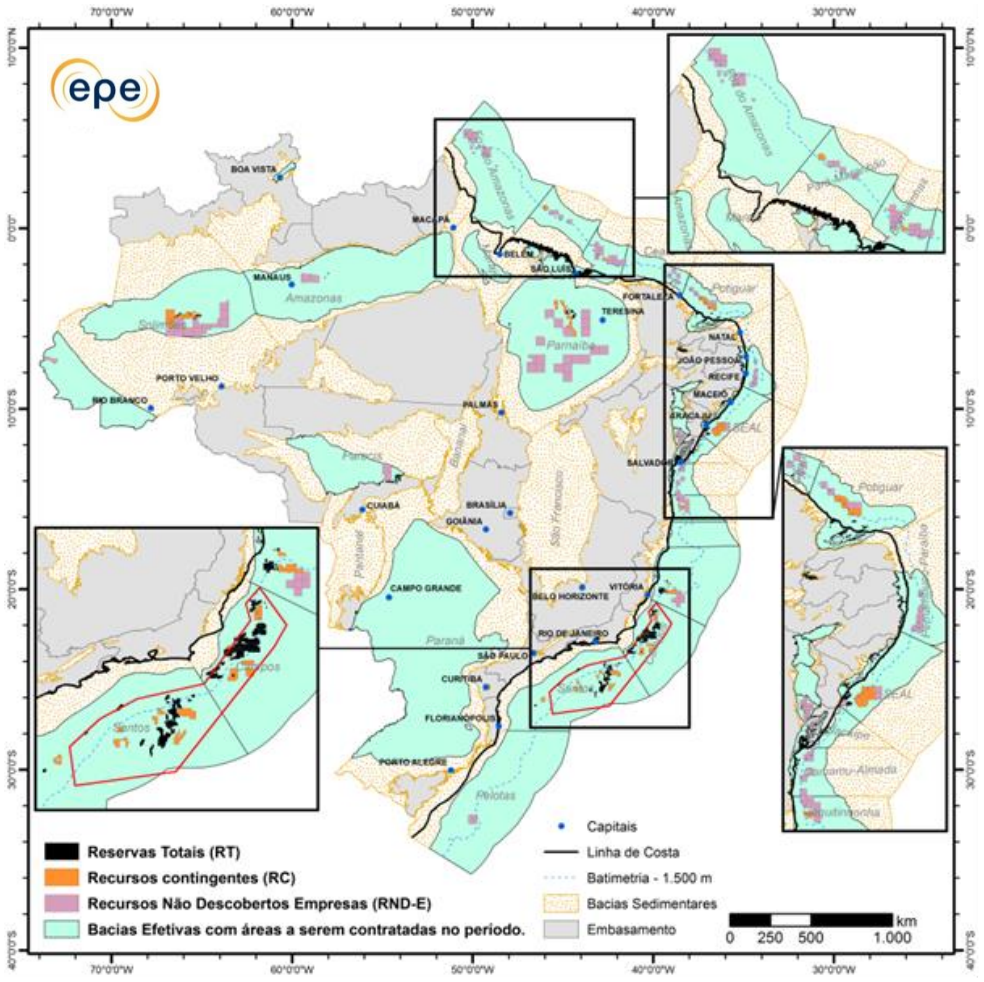
FPSOs in operation in Brazil

45
FPSOs

BIDDING ROUNDS SCHEDULE OF OIL AND GAS EXPLORATORY BLOCKS



INVESTMENTS IN EXPLORATION AND PRODUCTION: 2019-2030



Exploration

Projects: Calendar of bidding rounds, revitalization of mature fields, unconventional exploration

Investments: US$ 60 billion

Production Development

Projects: Development of the fields of Lula, Búzios, Mero, Cernambi, Sapinhoá, Atapu, Berbigão, Sururu, Sépia, among others; revitalization of Marlim; construction of 49 new production units (FPSOs)

Investments: US$ 300 billion

Operative Support

Projects: New technologies for pre-salt, increase of the fleet of supply and support vessels, need for specialized labor

Investments: US$ 60 billion

Estimated investments for E&P in Brazil: 2019-2030

US$ 420 billion

THE BRAZILIAN PRE-SALT AND ITS POTENTIAL

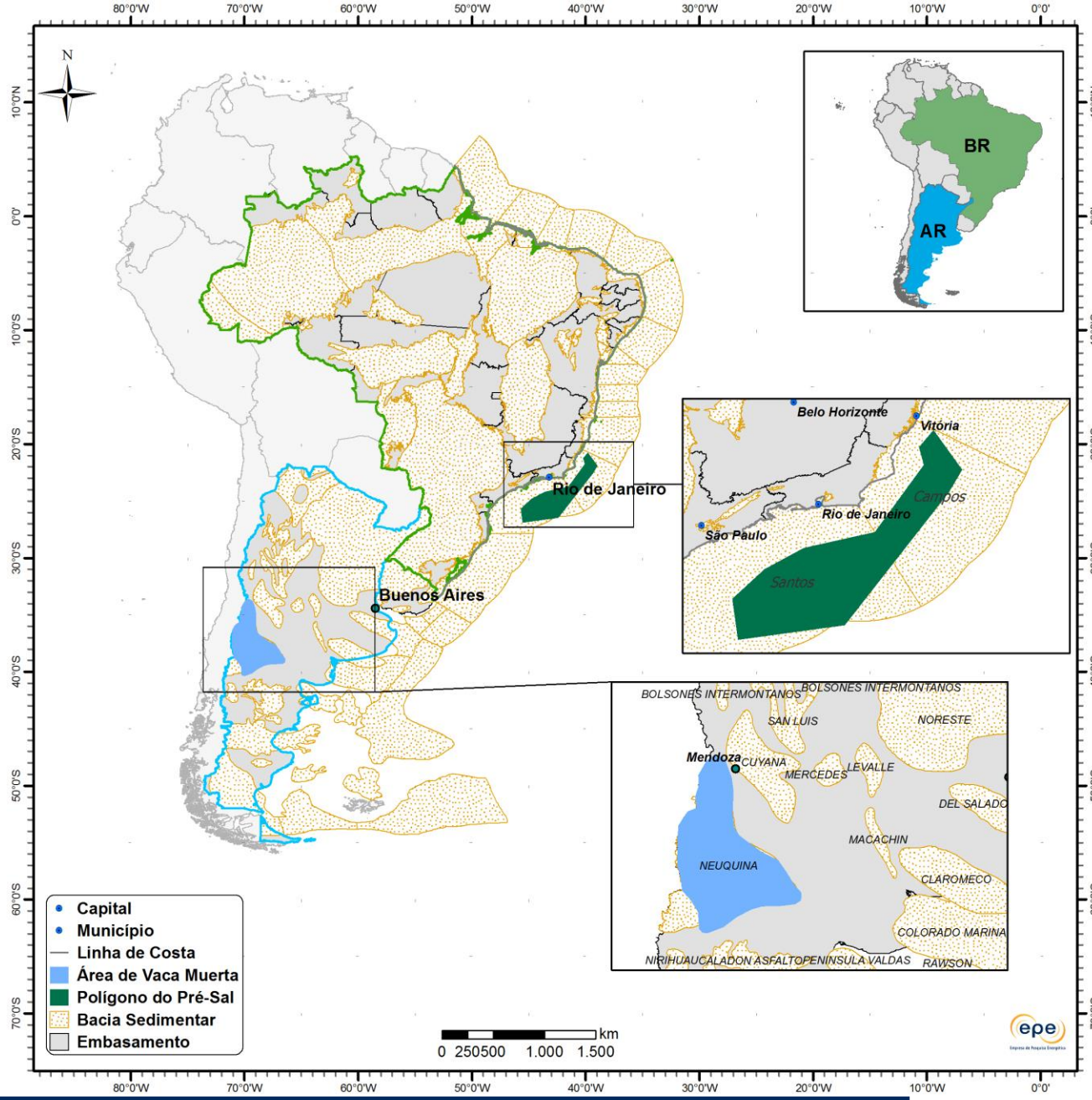
AN OVERVIEW OF THE PRE SALT POLYGON

The Brazilian pre-salt is currently one of the most important oil and gas provinces in the world.

About 70% of the Brazilian oil and gas reserves are in the pre-salt areas.

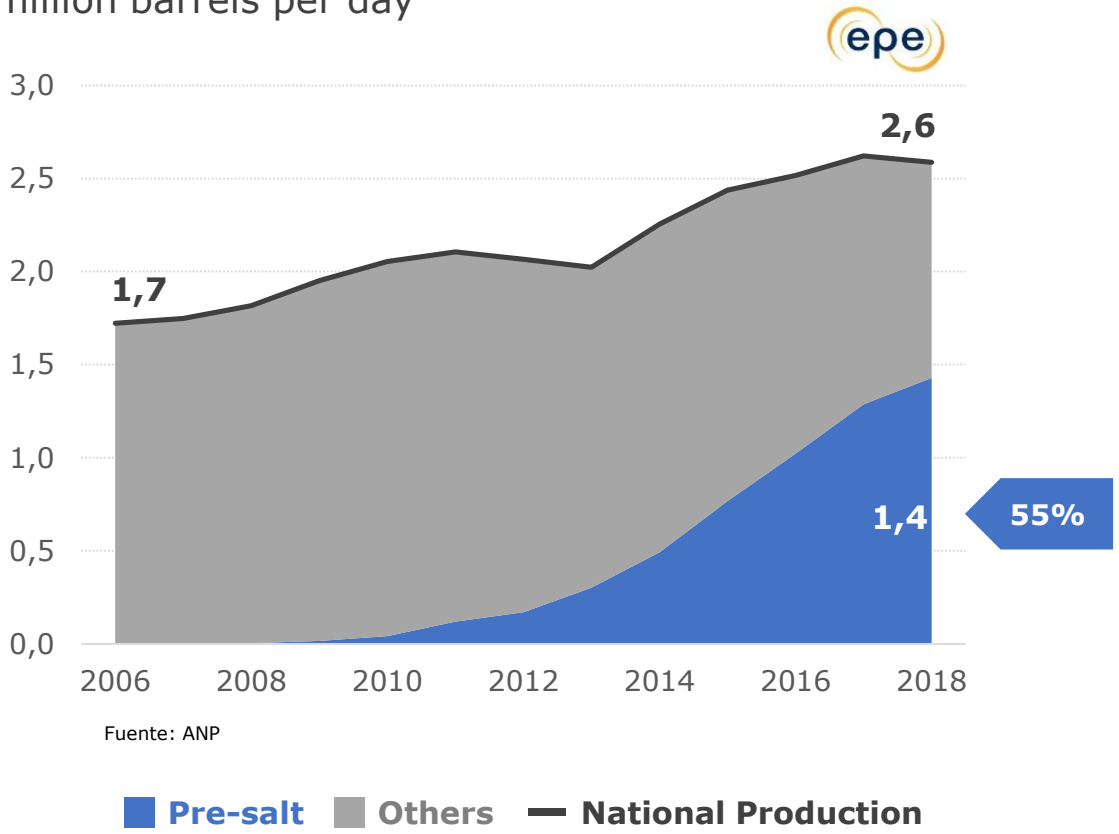
The Brazilian pre-salt is characterized by:

- **high productivity of wells**
- **low exploratory risk**



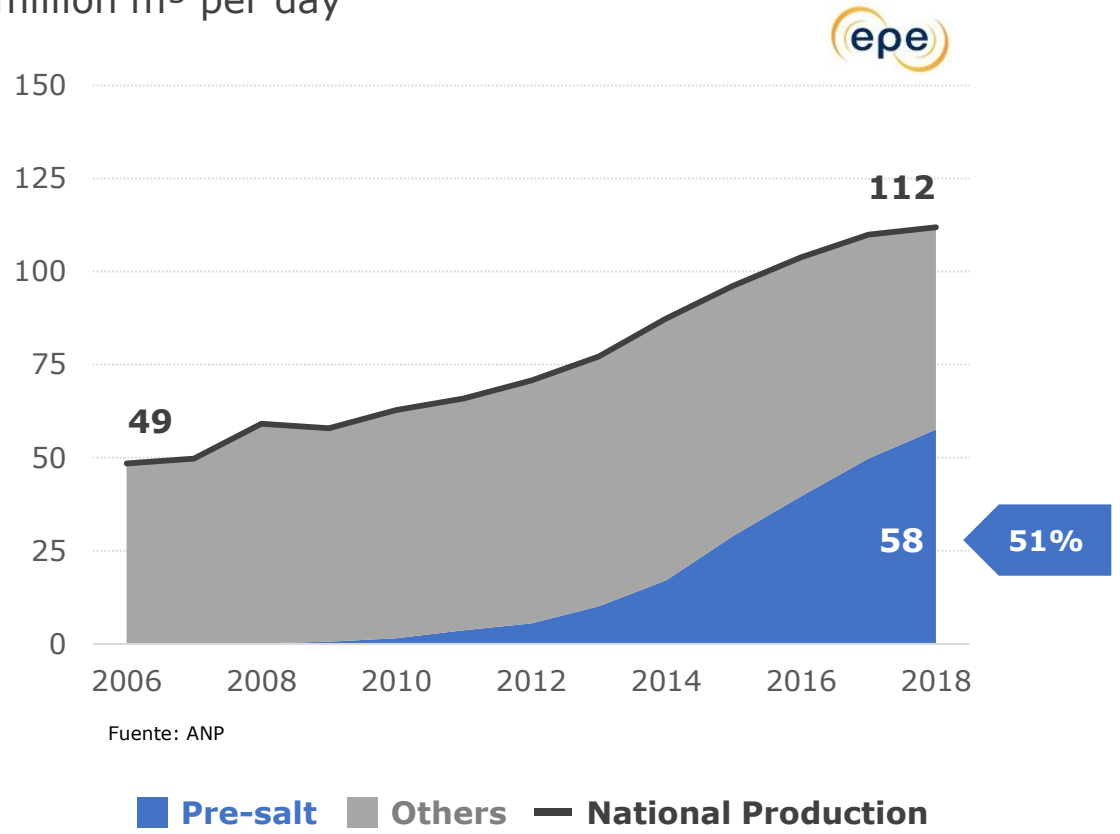
EVOLUTION OF OIL AND NATURAL GAS PRODUCTION OF THE PRE-SALT

Oil Production
million barrels per day

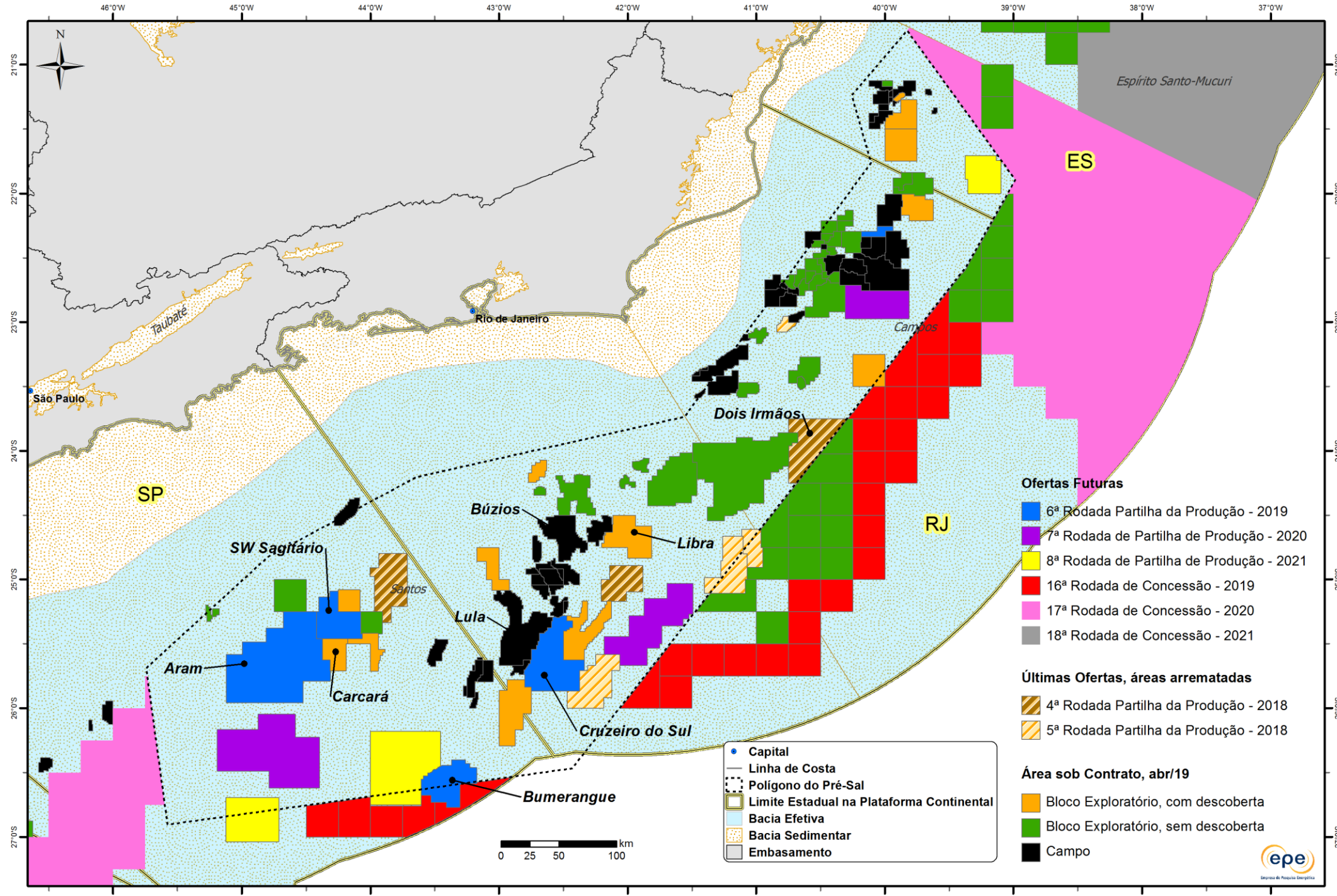


Fuente: ANP

Natural Gas Gross Production
million m³ per day



Fuente: ANP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45°0'W
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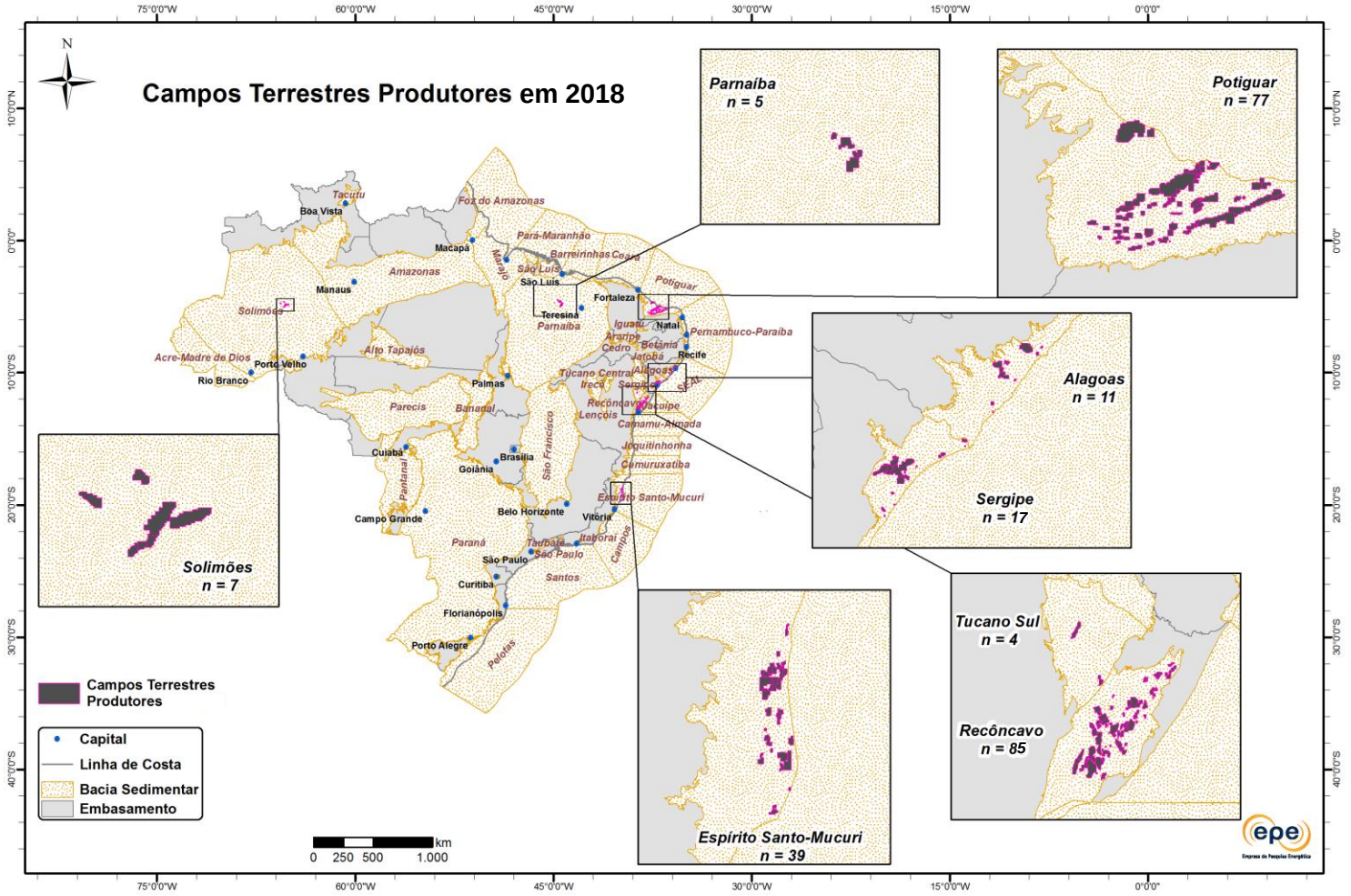
38°0'W
37°0'W
21°0'S
22°0'S
23°0'S
24°0'S
25°0'S
26°0'S
27°0'S
N
Espírito Santo-Mucuri
ES
Taubaté
Rio de Janeiro
São Paulo
Campos
Dois Irmãos
SP
Búzios
Libra
SW Sagitário
Santos
Lula
RJ
Aram
Carcará
Cruzeiro do Sul
Bumerangue
0 25 50 100 km
Capital
Linha de Costa
Polígono do Pré-Sal
Limite Estadual na Plataforma Continental
Bacia Efetiva
Bacia Sedimentar
Embasamento
Ofertas Futuras
6ª Rodada Partilha da Produção - 2019
7ª Rodada de Partilha de Produção - 2020
8ª Rodada de Partilha de Produção - 2021
16ª Rodada de Concessão - 2019
17ª Rodada de Concessão - 2020
18ª Rodada de Concessão - 2021
Últimas Ofertas, áreas arrematadas
4ª Rodada Partilha da Produção - 2018
5ª Rodada Partilha da Produção - 2018
Área sob Contrato, abr/19
Bloco Exploratório, com descoberta
Bloco Exploratório, sem descoberta
Campo
epe
Empresa de Pesquisa Energética

THE BRAZILIAN ONSHORE PRODUCTION AND ITS POTENTIAL

246 PRODUCTION FIELDS IN 9 SEDIMENTARY BASINS



Onshore fields per basin

Recôncavo	85
Potiguar	77
Espírito Santo-Mucuri	39
Sergipe	17
Alagoas	11
Solimões	7
Parnaíba	5
Tucano Sul	4
Camamu-Almada	1

Fonte: ANP, EPE

ESTIMATES OF RECOVERABLE VOLUMES AND RESERVES

Recoverable volumes of oil and natural gas on onshore basins

1.5 – 5.0 billion boe

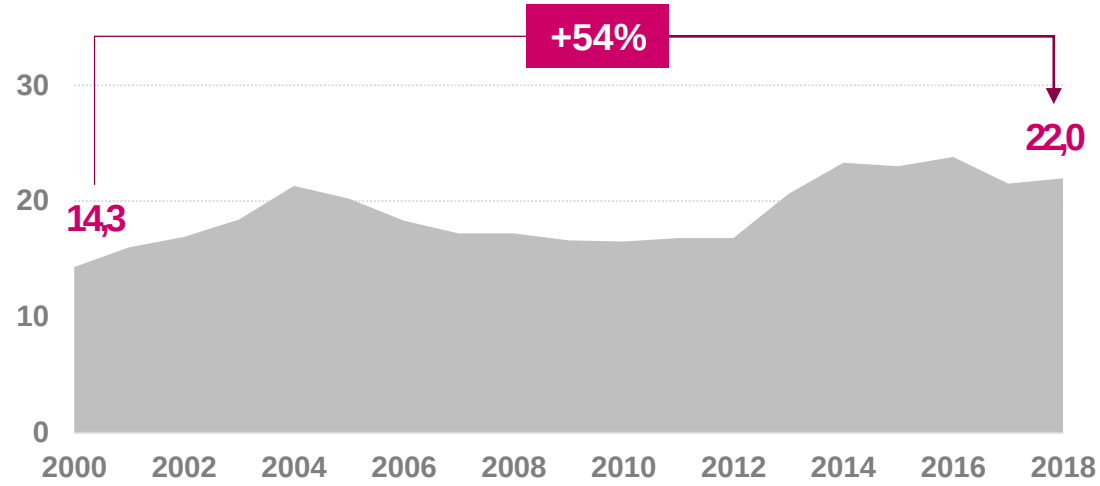
Reserves 1P of natural gas onshore fields 2017

Natural gas

66 billion m³

18%
Brazilian reserves of natural gas

Onshore Production of natural gas: 2000-2018
(million m³/d)



2018

20%
Brazilian production of natural gas

Fonte: ANP, EPE

Revitalization Program of Exploration and Production of Oil and Natural Gas in Onshore Areas - Reate 2020

Main goals

- **reach production of 500,000 barrels per day of boe in 2030**
- **unlock investments**
- **Improve regulatory framework**
- **identify and monetize the onshore gas production potential**
- **increase industry diversity and attract new companies**

FORECASTS FOR OIL AND GAS IN BRAZIL

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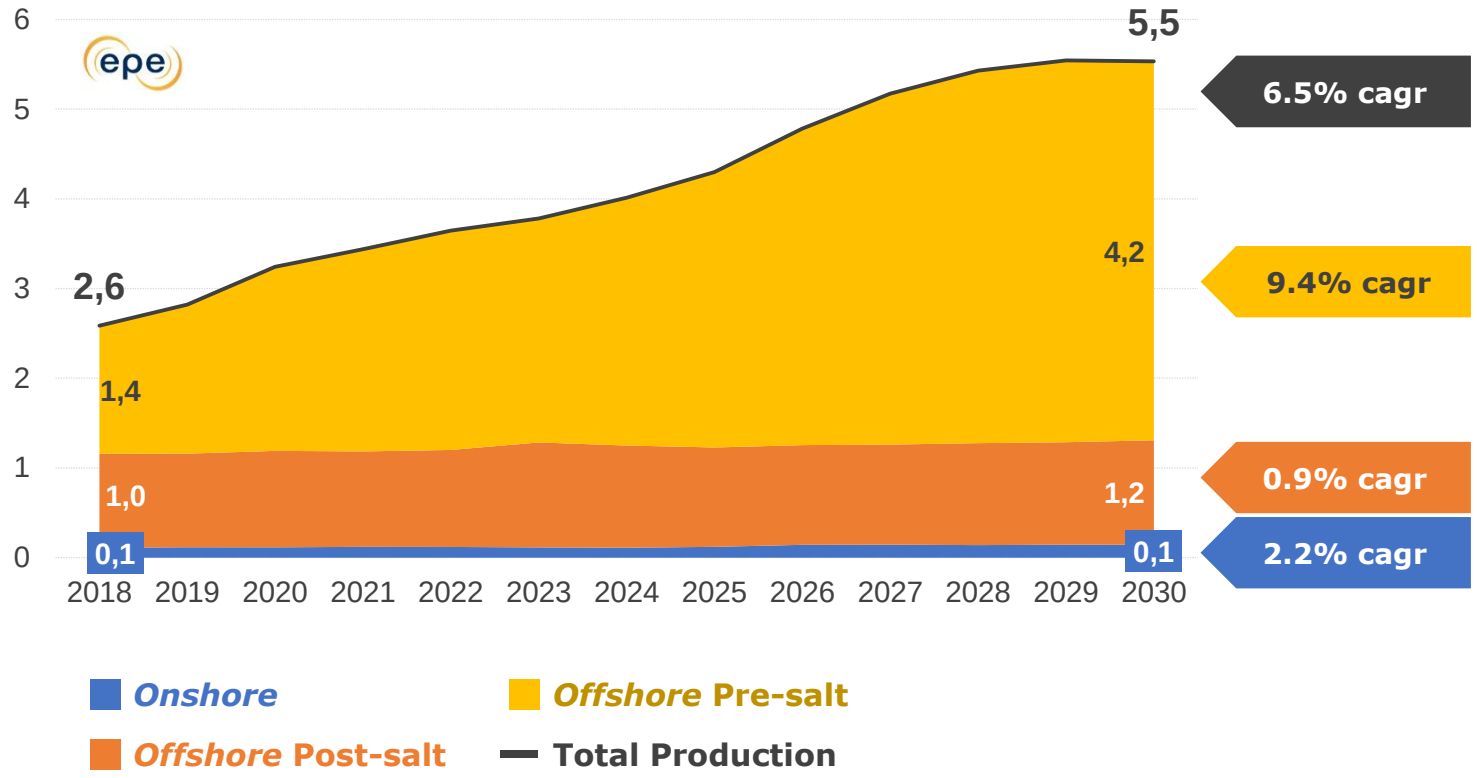
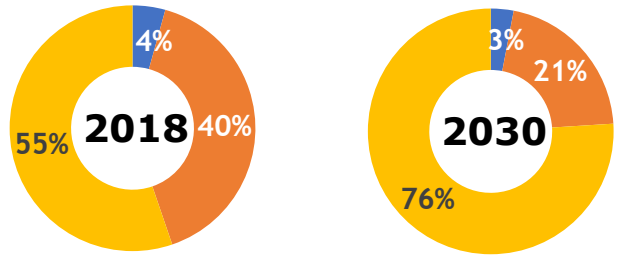
OIL PRODUCTION BY EXPLORATION ENVIRONMENT

Oil Production
Million barrels per day



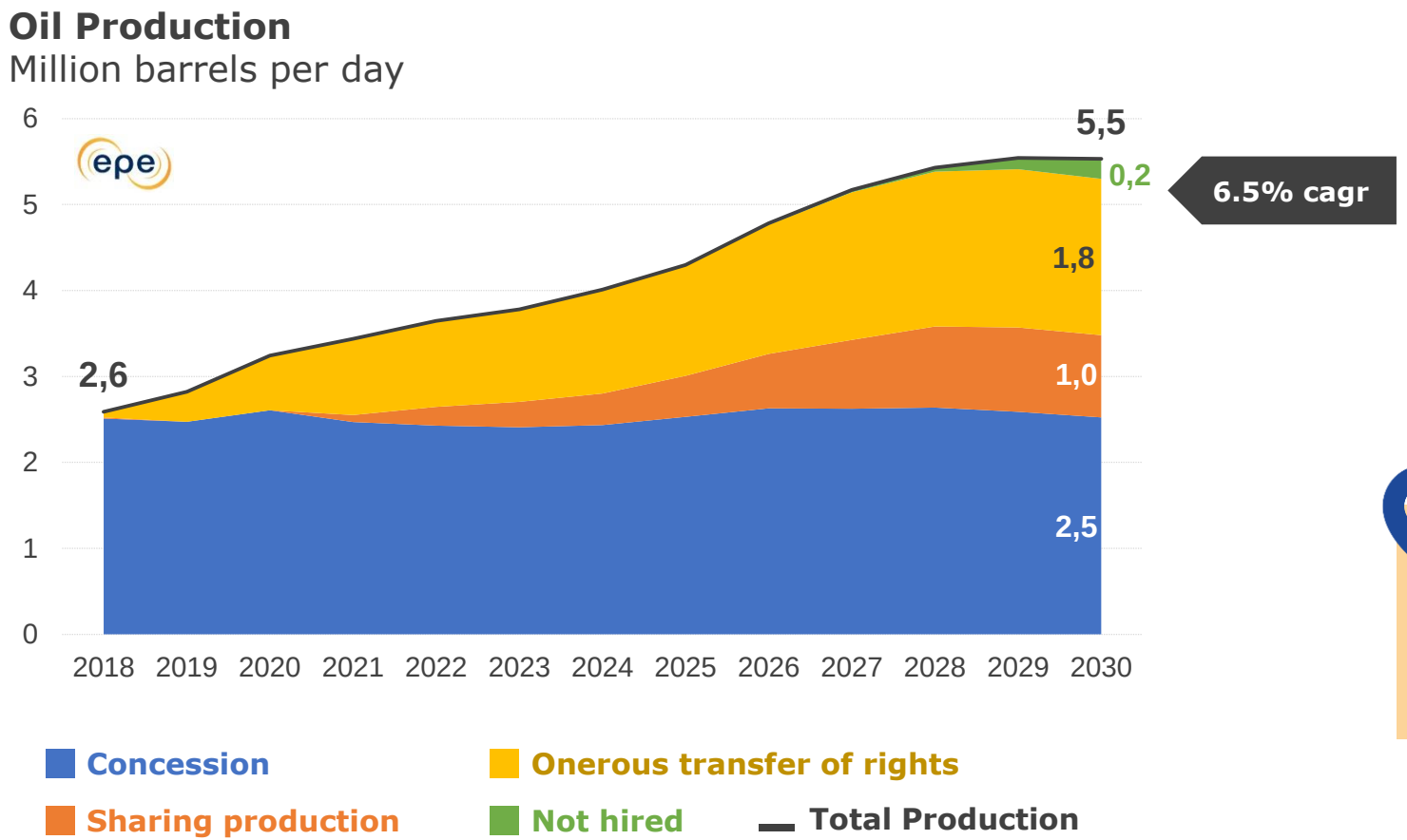


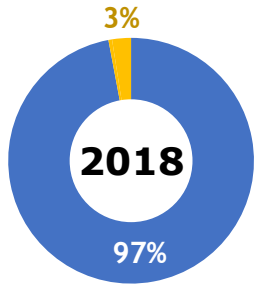
Brazil will be one of the 5 largest producers and exporters of oil in the world.

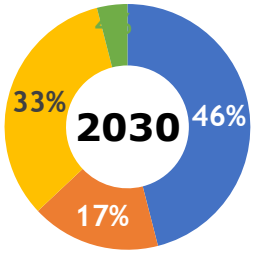
The entry of 49 additional FPSOs is estimated up to 2030, with 6 units already contracted.

Fuente: EPE

OIL PRODUCTION BY CONTRACT



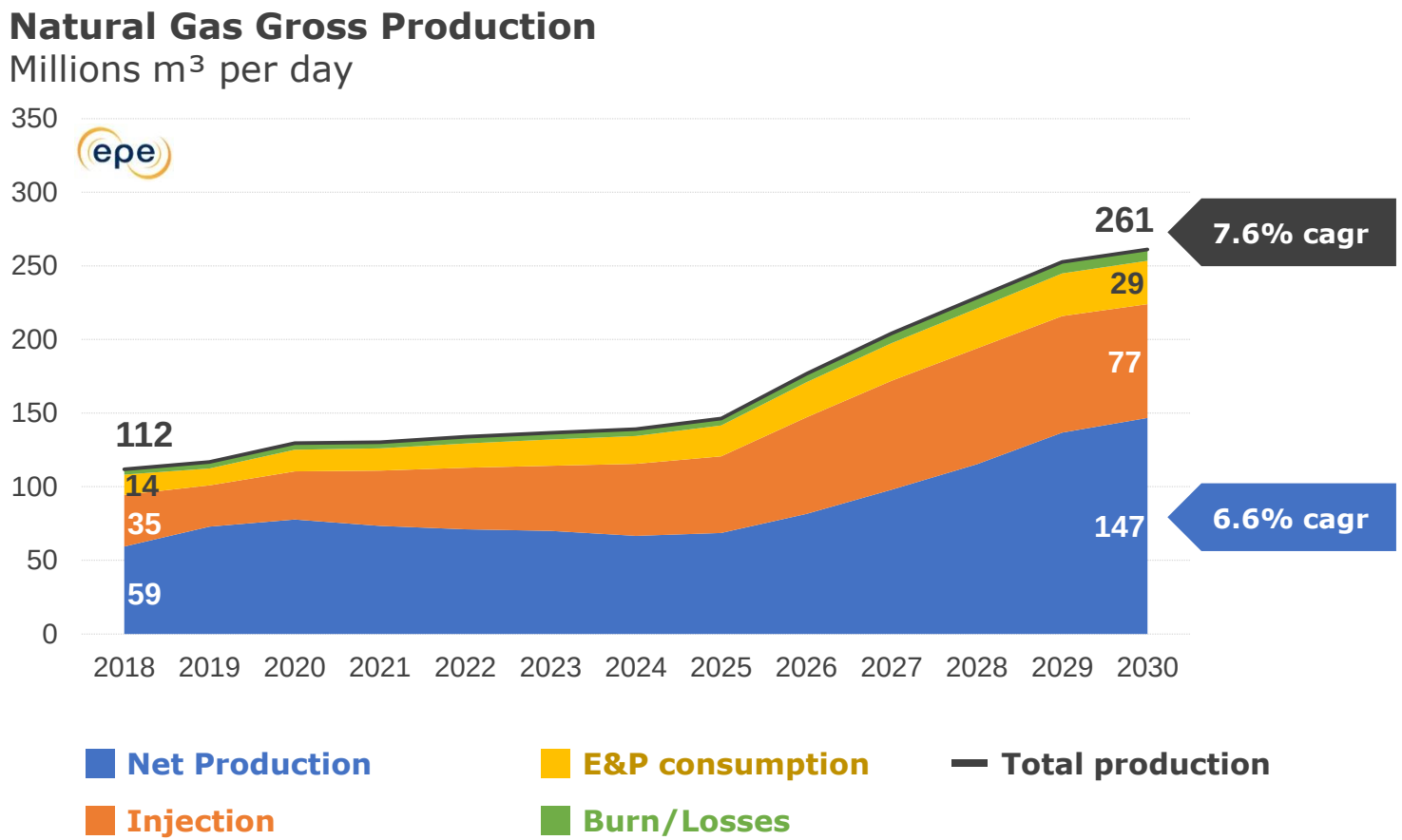


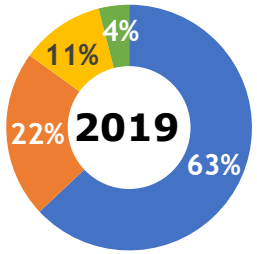


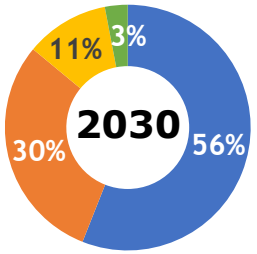
The growth comes mainly from the production sharing contracts and the onerous transfer of rights.

Fuente: EPE

NATURAL GAS PRODUCTION

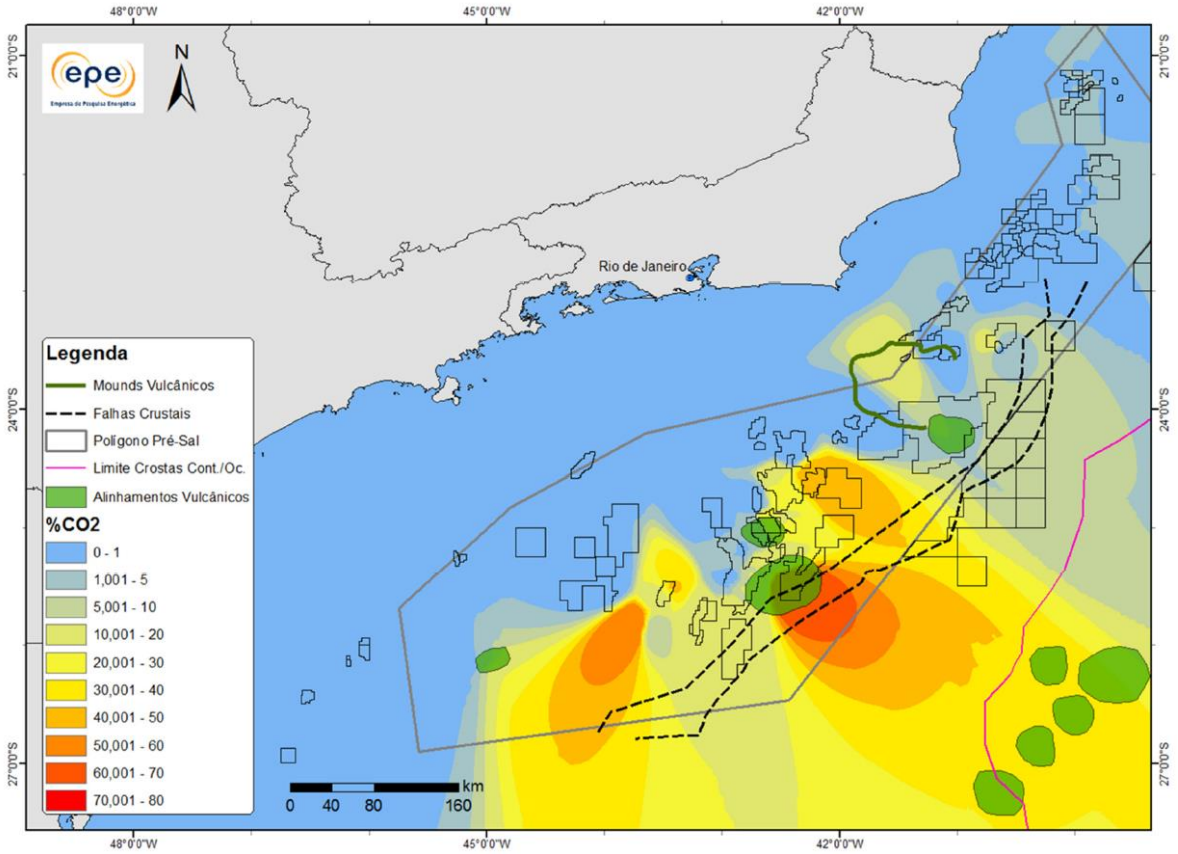






Fuente: EPE

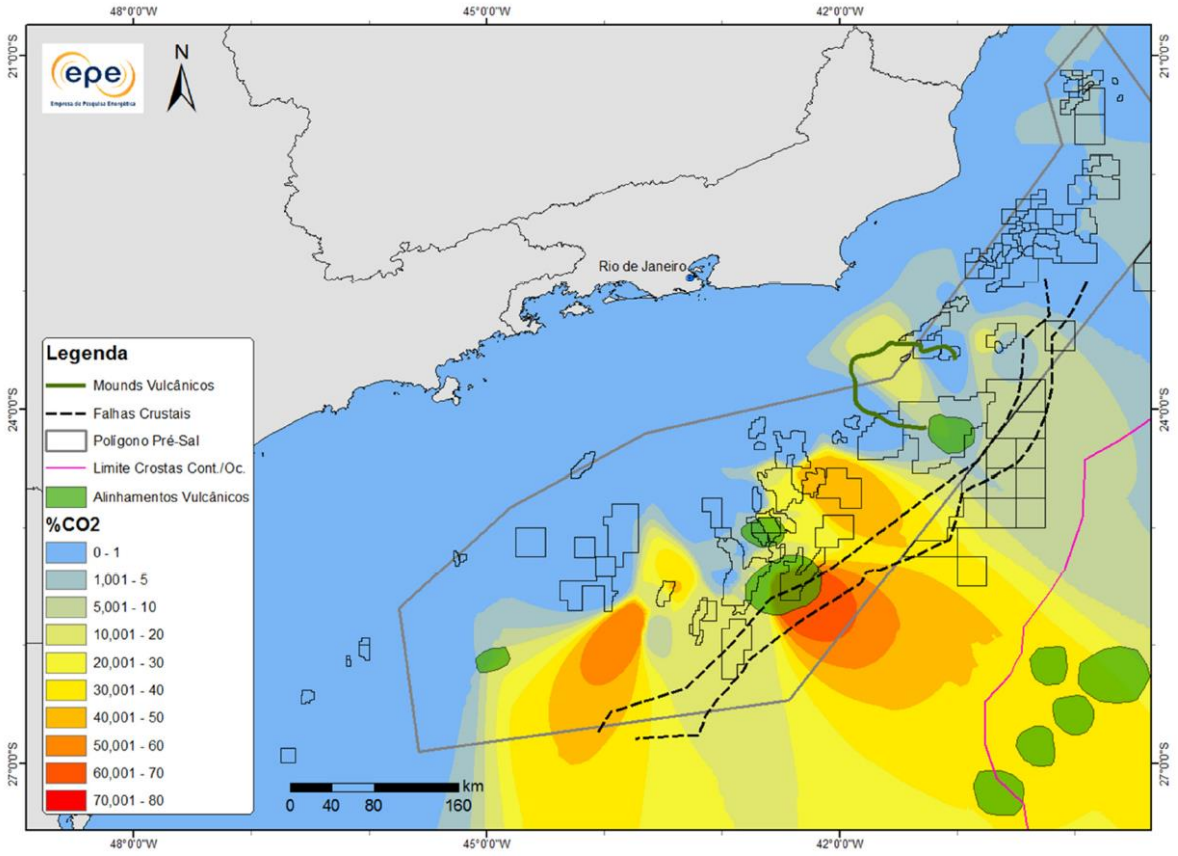
NATURAL GAS PRODUCTION IN PRE-SALT: Challenges regarding CO_2 content



- Estimates of EPE obtained by data interpolation and spatial analysis
- The CO_2 content may vary from 0% to 80% depending on the location of the field
- Southern portion of the Pre-Salt Polygon presents higher levels of CO_2

Fonte: EPE, equipe de E&P

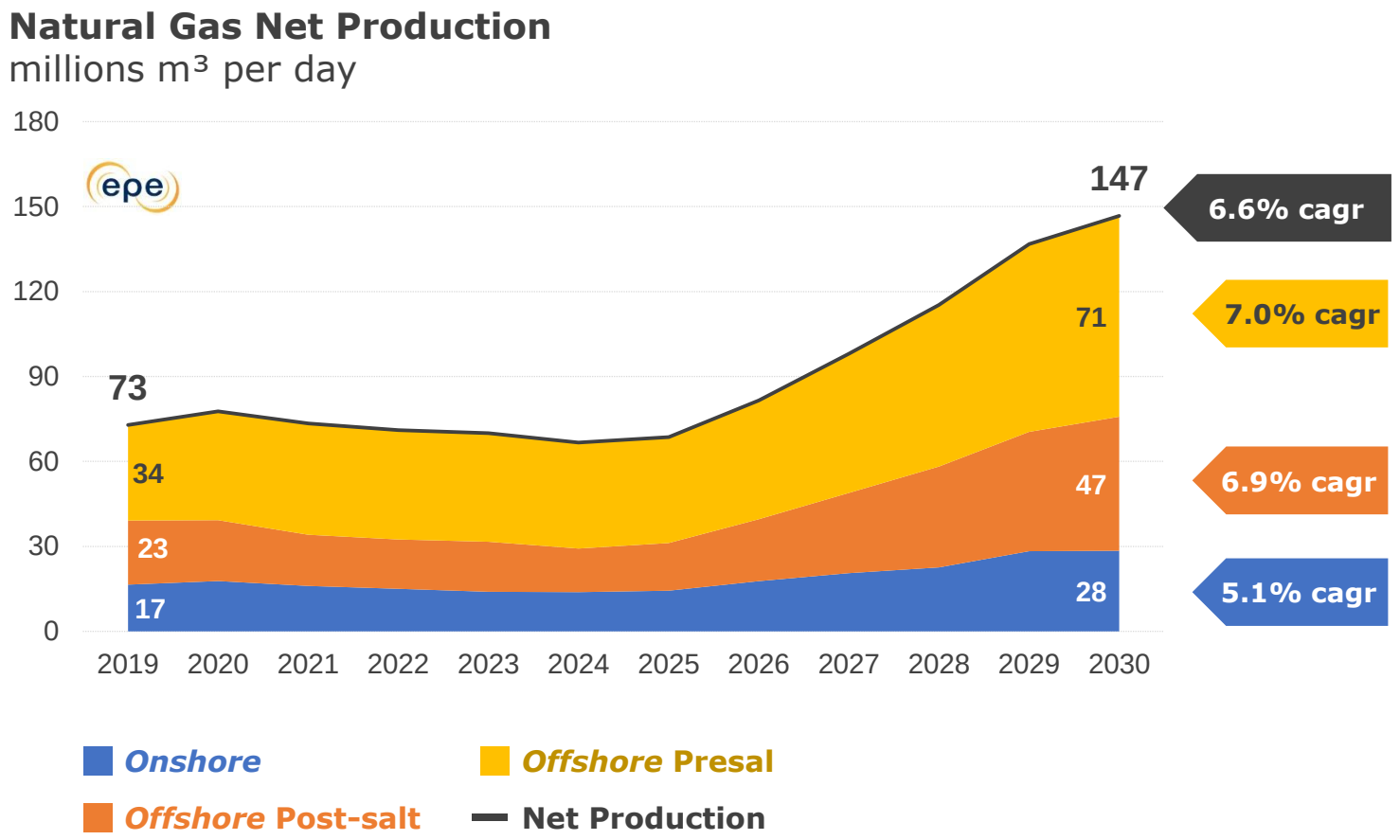
NATURAL GAS PRODUCTION IN PRE-SALT: Challenges Concerning Injection Volume

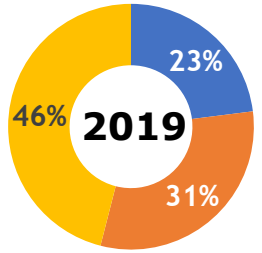


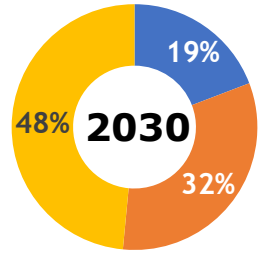
- **Productivity: increased oil recovery**
- **Gas quality: technological barriers to gas recovery with high levels of CO_2**
- **Economy: natural gas competitiveness**

Fonte: EPE, equipe de E&P

NATURAL GAS NET PRODUCTION BY EXPLORATION ENVIRONMENT



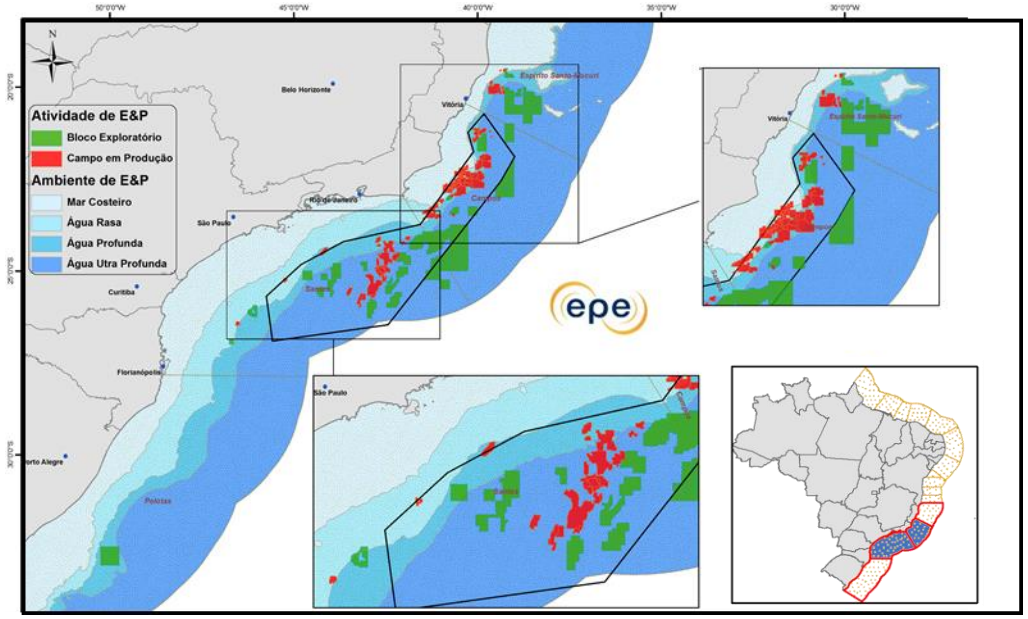




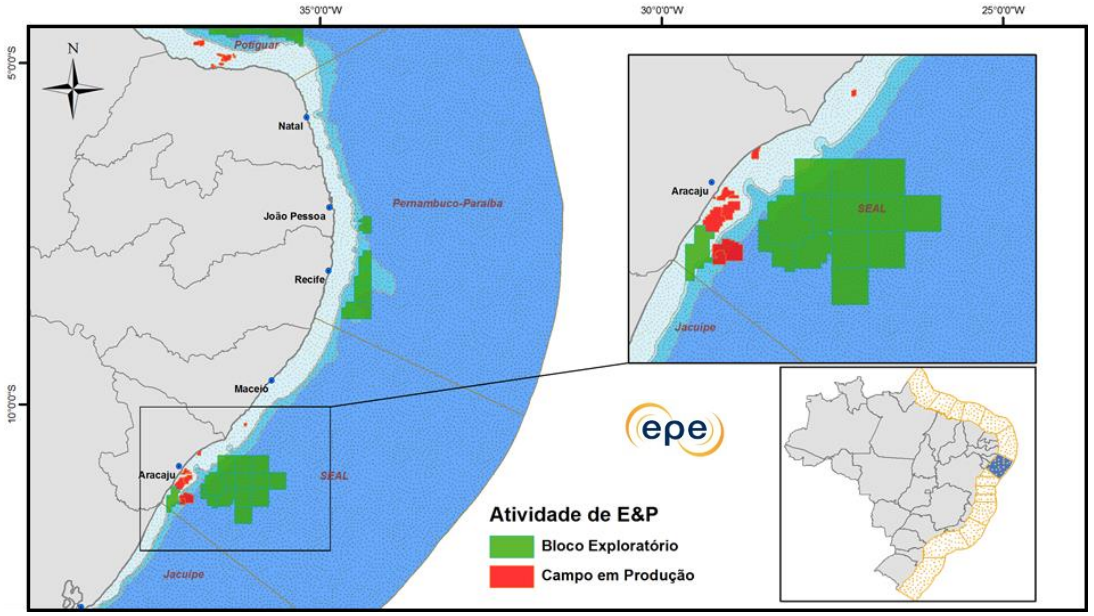
Fuente: EPE

MAIN DRIVERS OF THE GROWTH OF NATURAL GAS PRODUCTION IN BRAZIL

Pre-salt
Campos and Santos Basins

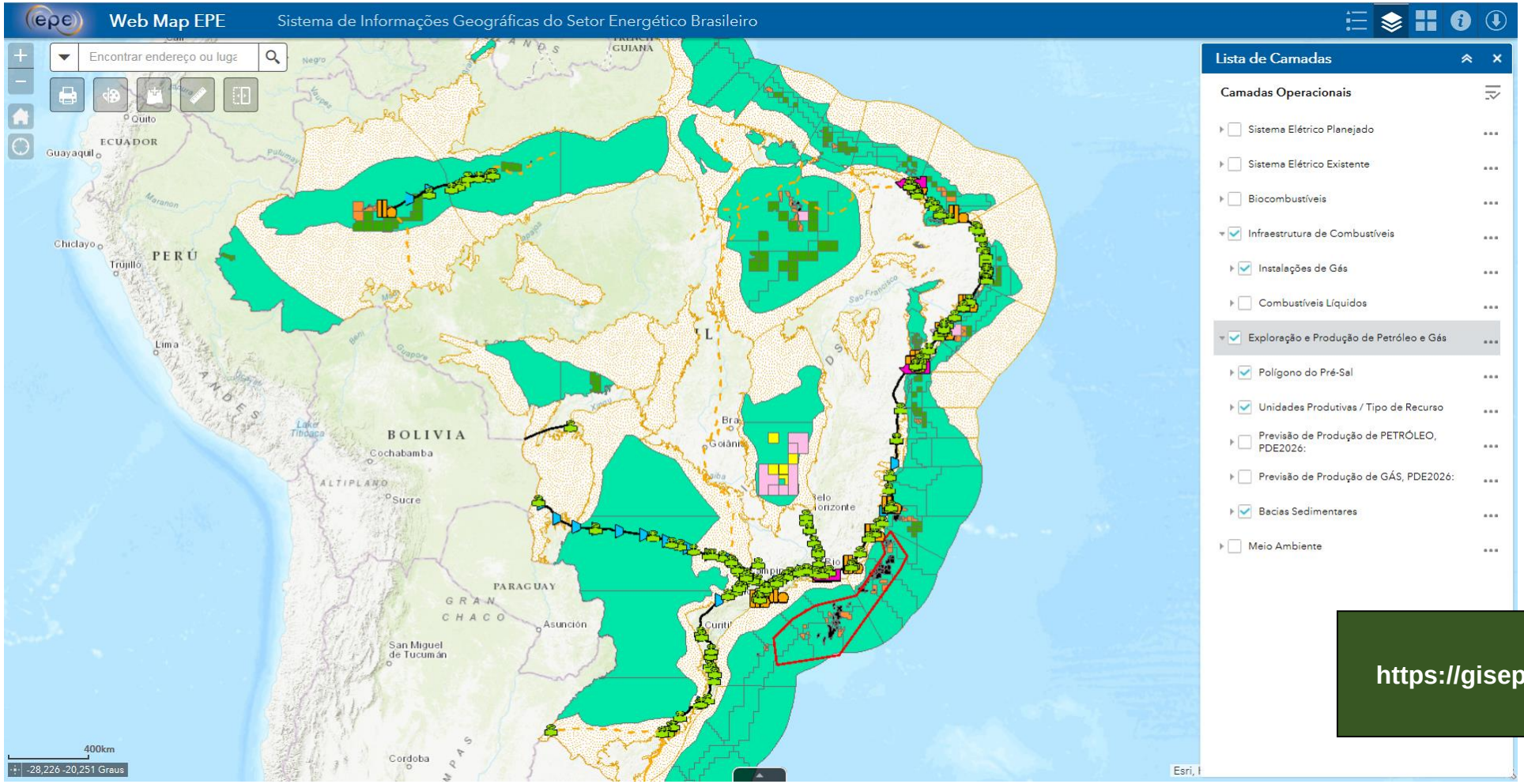


Sergipe-Alagoas Basin
Post-salt



INFRASTRUCTURE

WEBMAP EPE: AN USEFUL TOOL FOR REGIONAL STUDIES & PROJECTS – OIL & GAS LAYERS



WEBMAP epe

https://gisepeprd.epe.gov.br/webmapepe/

NATURAL GAS INFRASTRUCTURE

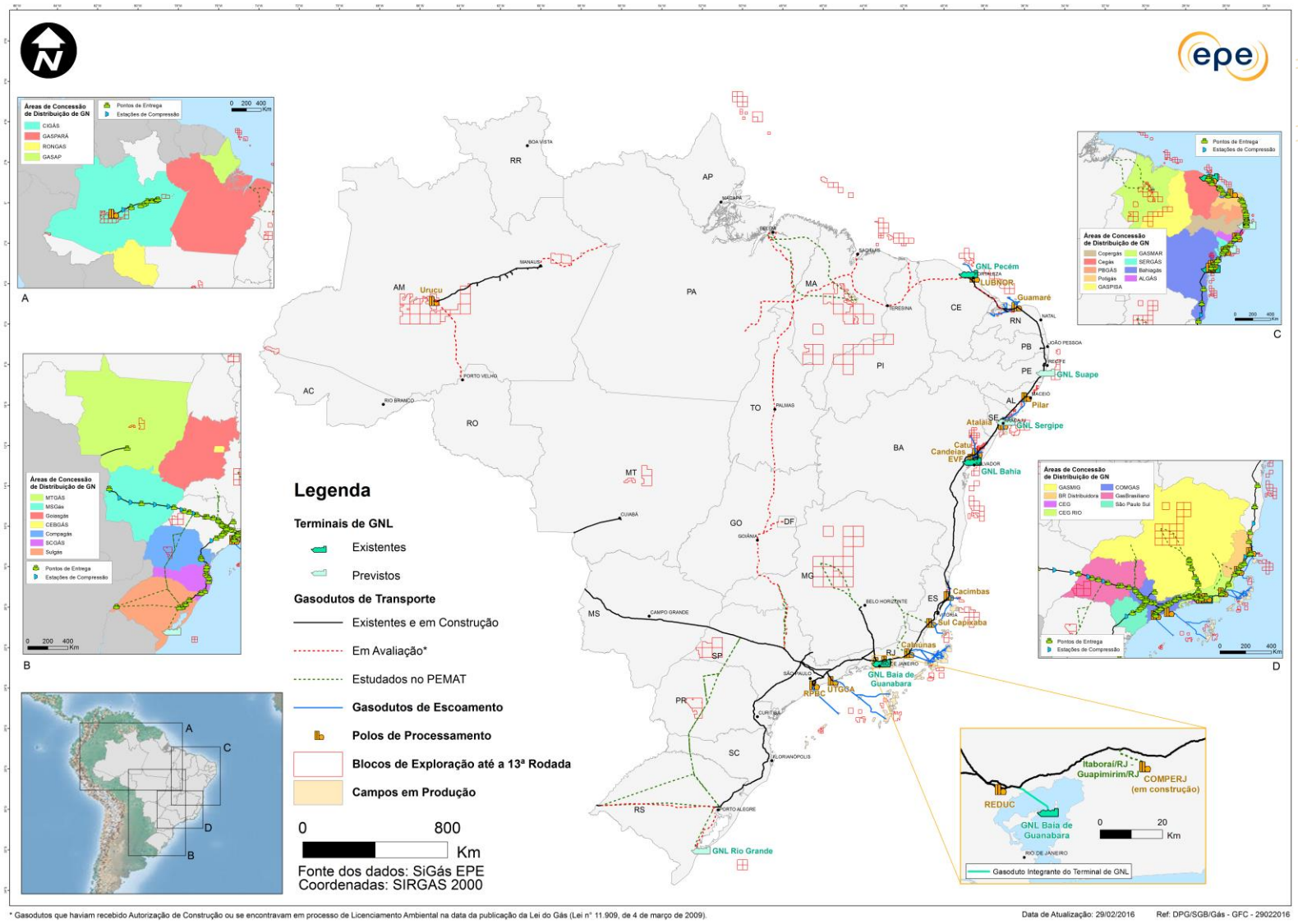
Supply – Demand (Total Brazil, 2018 average)	Million m³/d
Total Supply	**84.12**
National Supply	55.09
Pipelines Imports	22.11
LNG Imports	6.92
Total Demand	**84.12**
Non-thermoelectric	48.32
Thermoelectric	30.53
Pipeline Own Use/Adjusts	5.27

Source: Based on MME

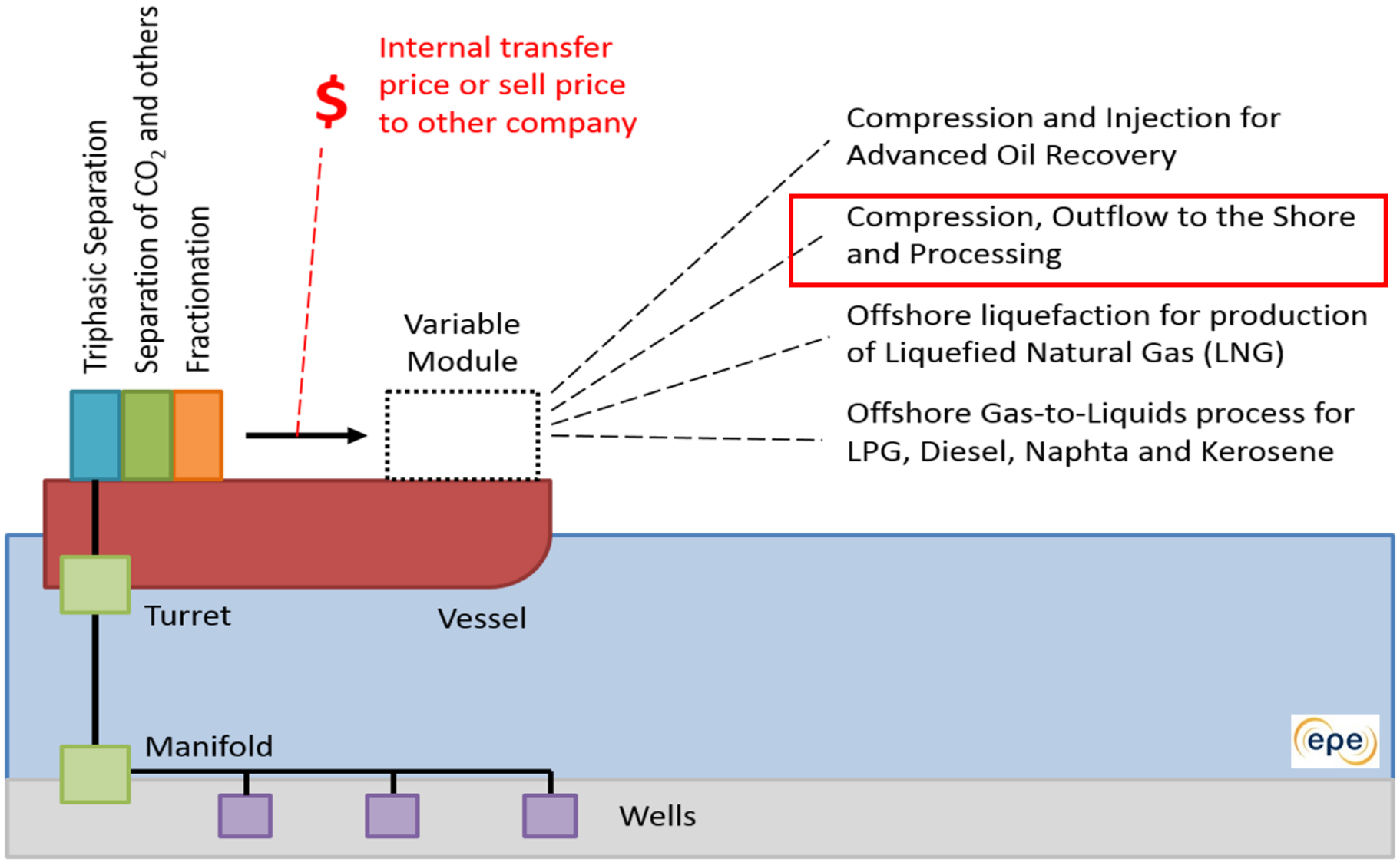
- **15 Processing Zones (95 MMm³/d)**
- **3 Existing LNG terminals (41 MMm³/d)**
- **9.409 km Transmission pipelines**
- **179 Operating citygates**

WEBMAP epe

https://gisepe.epe.gov.br/WebMapEPE/



ALTERNATIVES TO MONETIZING THE NATURAL GAS FROM PRE-SALT IN BRAZIL



OUTLOOK FOR SUPPLY FROM PRE-SALT

In operation:

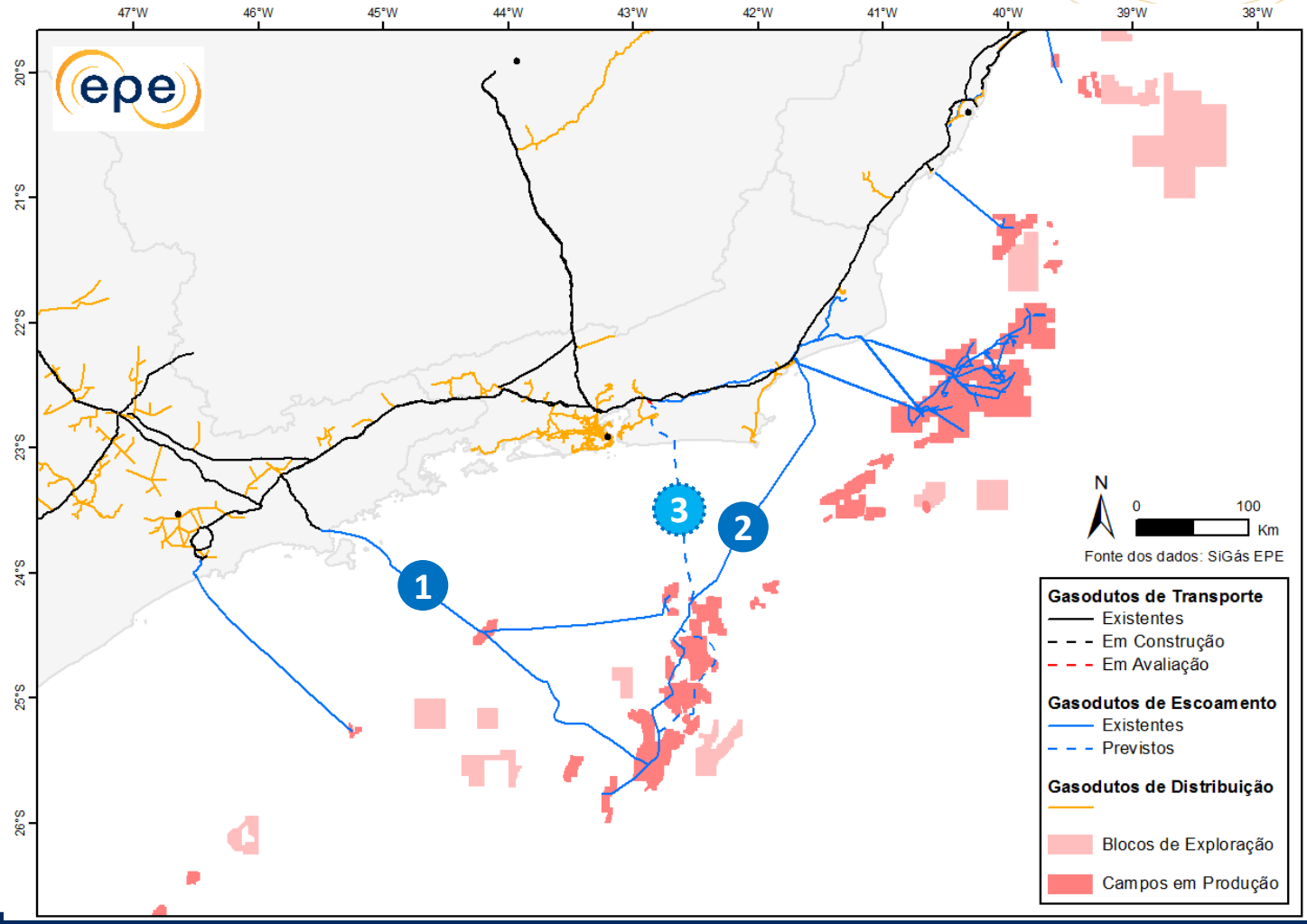
Route 1:
Bacia de Santos – Caraguatatuba/SP
Capacity: 10 MMm³/d

Route 2:
Bacia de Santos – Cabiúnas/RJ
Capacity: 16 MMm³/d

In construction:

Route 3:
Bacia de Santos – Itaboraí/RJ
Capacity: 18 MMm³/d
Scheduled to 2020
Investiment: R$ 6 billion

Total Capacity	**44** MMm³/d



Gathering Pipelines Alternatives in Study

In study (alternatives with capacity 10 to 15 MMm³/d and 20" diameter, each):

Route 4a:
Bacia de Santos – São Vicente/SP

Route 4b:
Bacia de Santos – Itaguaí/RJ

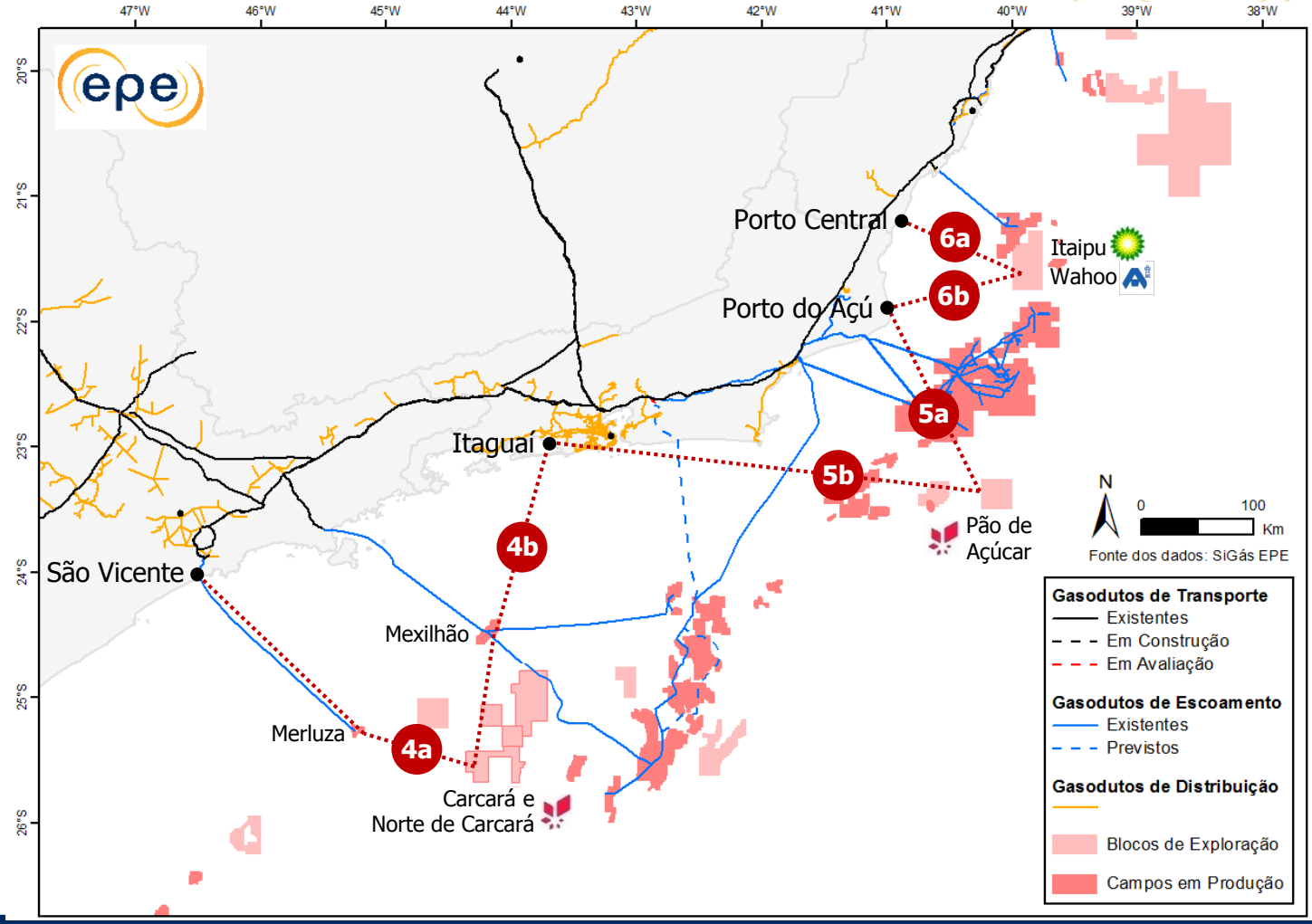
Route 5a:
Bacia de Campos – Porto do Açú/RJ

Route 5b:
Bacia de Campos – Itaguaí/RJ

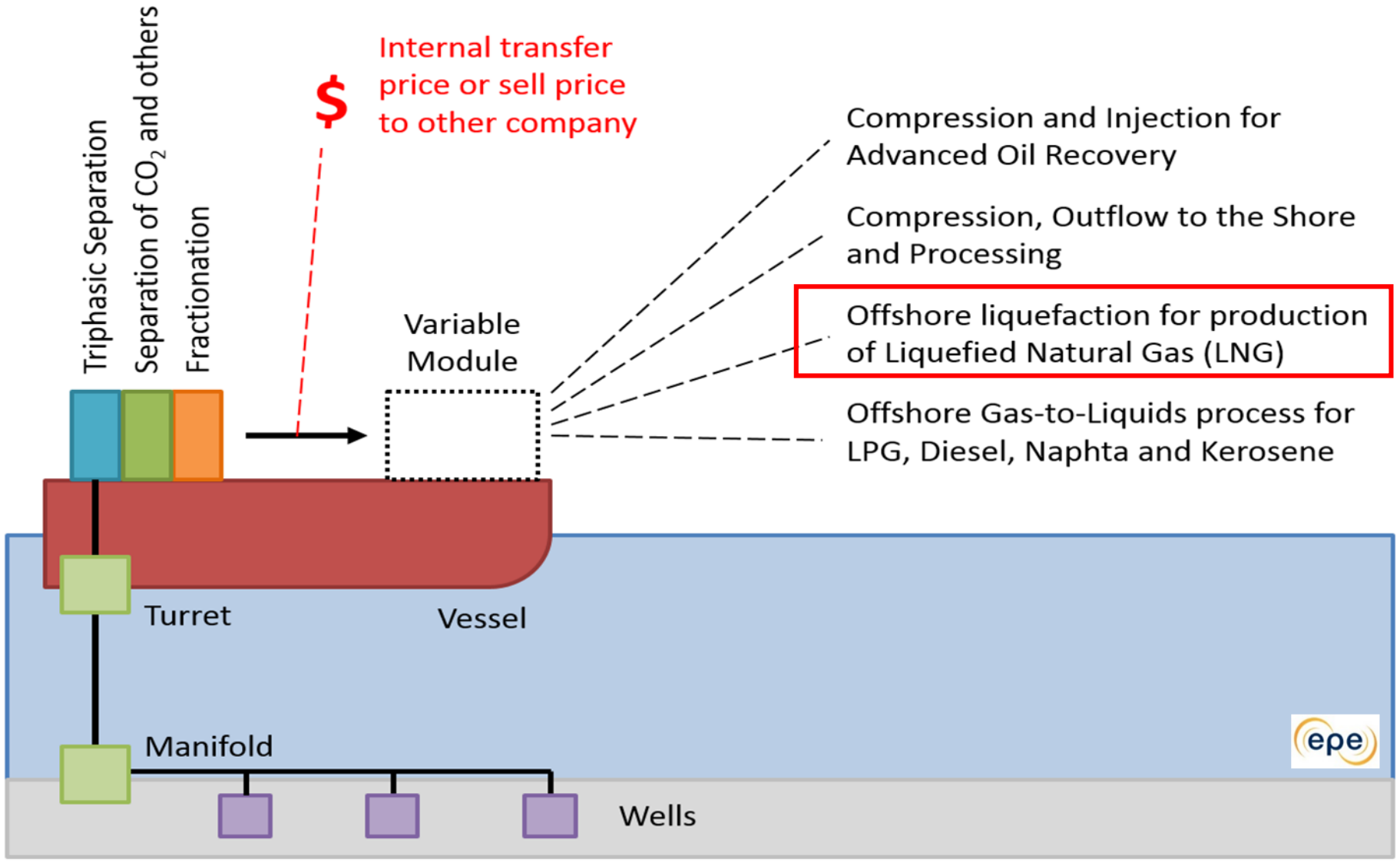
Route 6a:
Bacia de Campos – Porto Central/ES

Route 6b:
Bacia de Campos – Porto do Açú/RJ

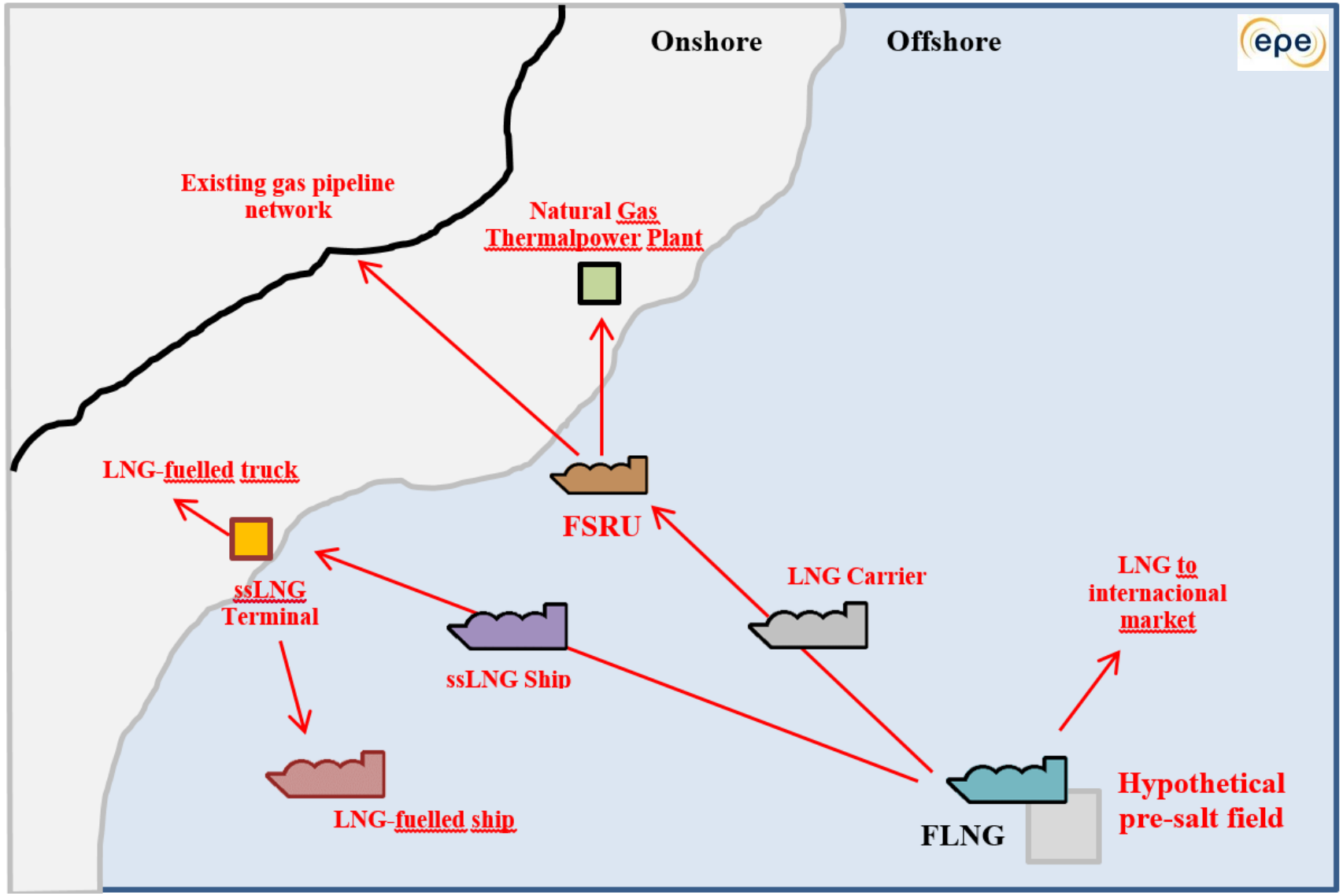
Total Capacity	**30-45** MMm³/d



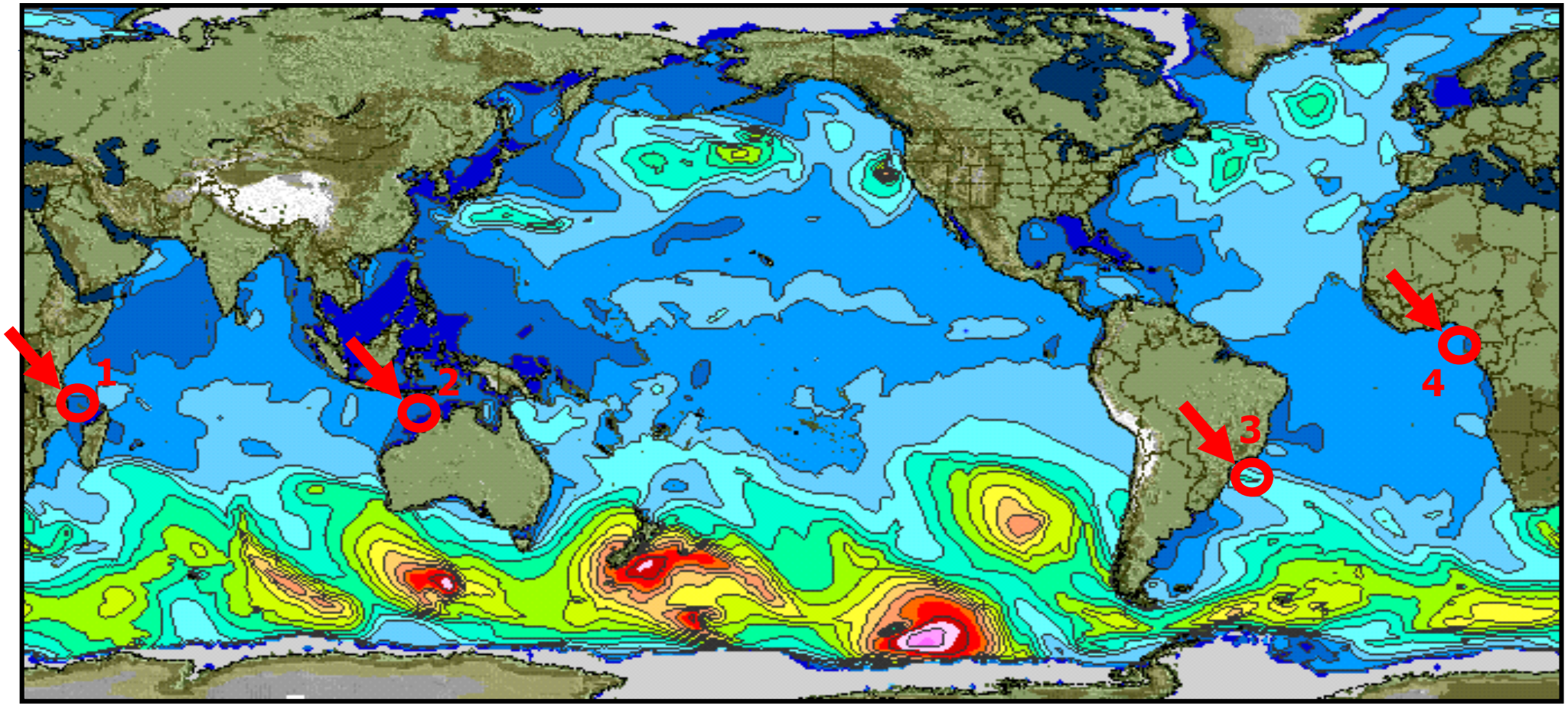
ALTERNATIVES TO MONETIZING THE NATURAL GAS FROM PRE-SALT IN BRAZIL



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

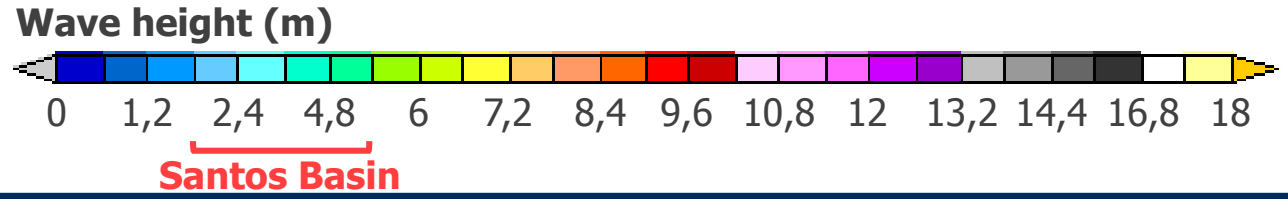


Meteo-oceanographic Conditions in Pre-salt Area



Fonte: STORMSURF (2019)

1 - Moçambique - FLNG Coral South (Scheduled to 2022)
2 - Austrália - Prelude FLNG (in operation)
3 - Brasil - FLNG Pré-Sal
4 - Camarões - FLNG Hilli Episeyo (in operation)



FINAL REMARKS

MARKET SITUATION

Before disinvestment, Petrobras coordinates and supplies the market

Gas production

81% of gas production
~ 100% of gas supply

Gathering pipelines

Gas Processing

LNG Terminals

100% LNG imports

Transmission pipelines (point-to-point)

Imports from Bolivia (pipeline)

100% of imports from Bolivia

LDCs City gate

Share holder in 19 out of 25 LDCs

Source: ANP

100% risks taken by Petrobras

NEW GAS MARKET

Competition vision

Gas production

Several producers

Gathering pipelines

TPA
Third Party Access

Gas Processing

LNG Terminals

Storage

Transmission System (Entry-Exit)

Imports from South Cone (pipeline)

More than one importer and origin

LDCs City gate

Higher diversification

Risks shared by market stakeholders

AGENDA FOR THE COMING YEARS

- TBG's Open season

- New Gas Market Program
  - ✓ Competition promotion
  - ✓ Integration of gas industry to power and industrial sectors
  - ✓ Harmonization of federal and states regulations
  - ✓ Removing tax barriers

- Challenges to monetizing pre-salt discoveries

- REATE 2020 Program

- New market access and development

- To promote investments on gas infrastructure

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