



International Workshop on  
Offshore Geologic CO<sub>2</sub> Storage



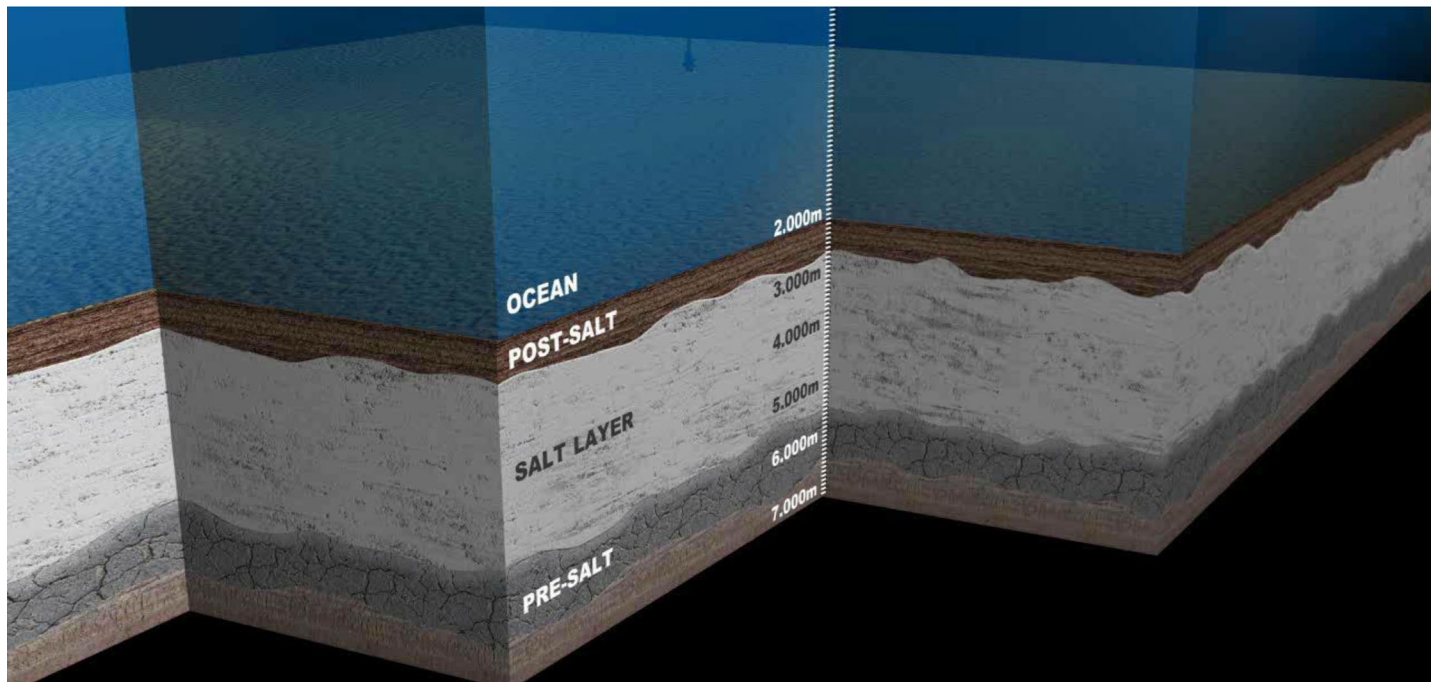
# Lula Oil Field CO<sub>2</sub>-EOR Project Update

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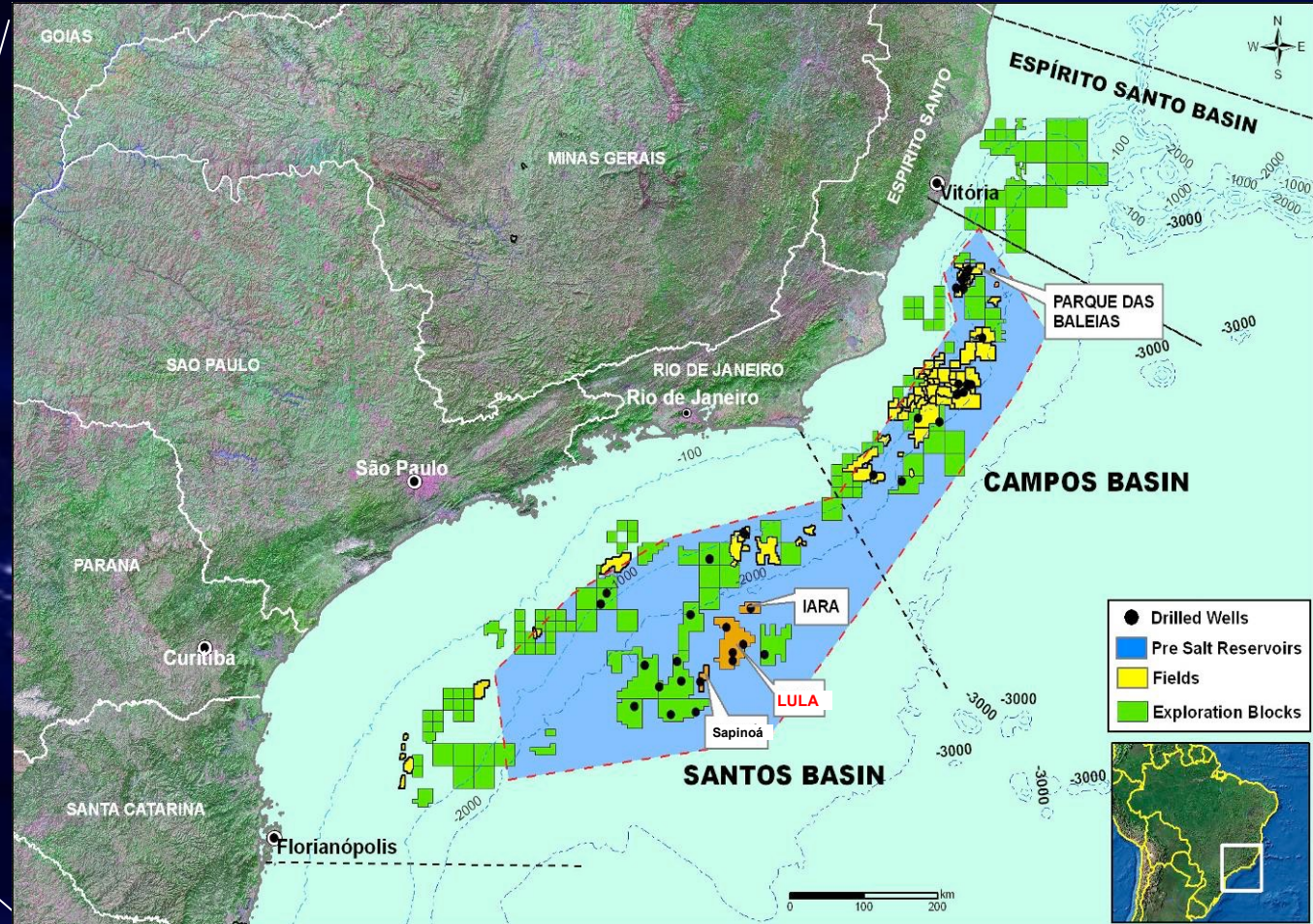
# Pre-Salt Reservoirs [1]



- Huge reservoirs (carbonates) of oil and natural gas (recoverable reserves of 15 billion BOE [2]);
- Between 5,000 and 7,000 m below sea level;
- Water depth ~ 2,000 m;
- ~ 300 km off the coast;
- Salt layer with more than 2,000 m thick, in some areas;
- Light oil (30° API), high GOR (> 200), and variable CO<sub>2</sub> content (between 1 and 80%);
- Accordingly, Petrobras and partners in the pre-salt blocks do not consider to vent the CO<sub>2</sub> associated to the produced gas.



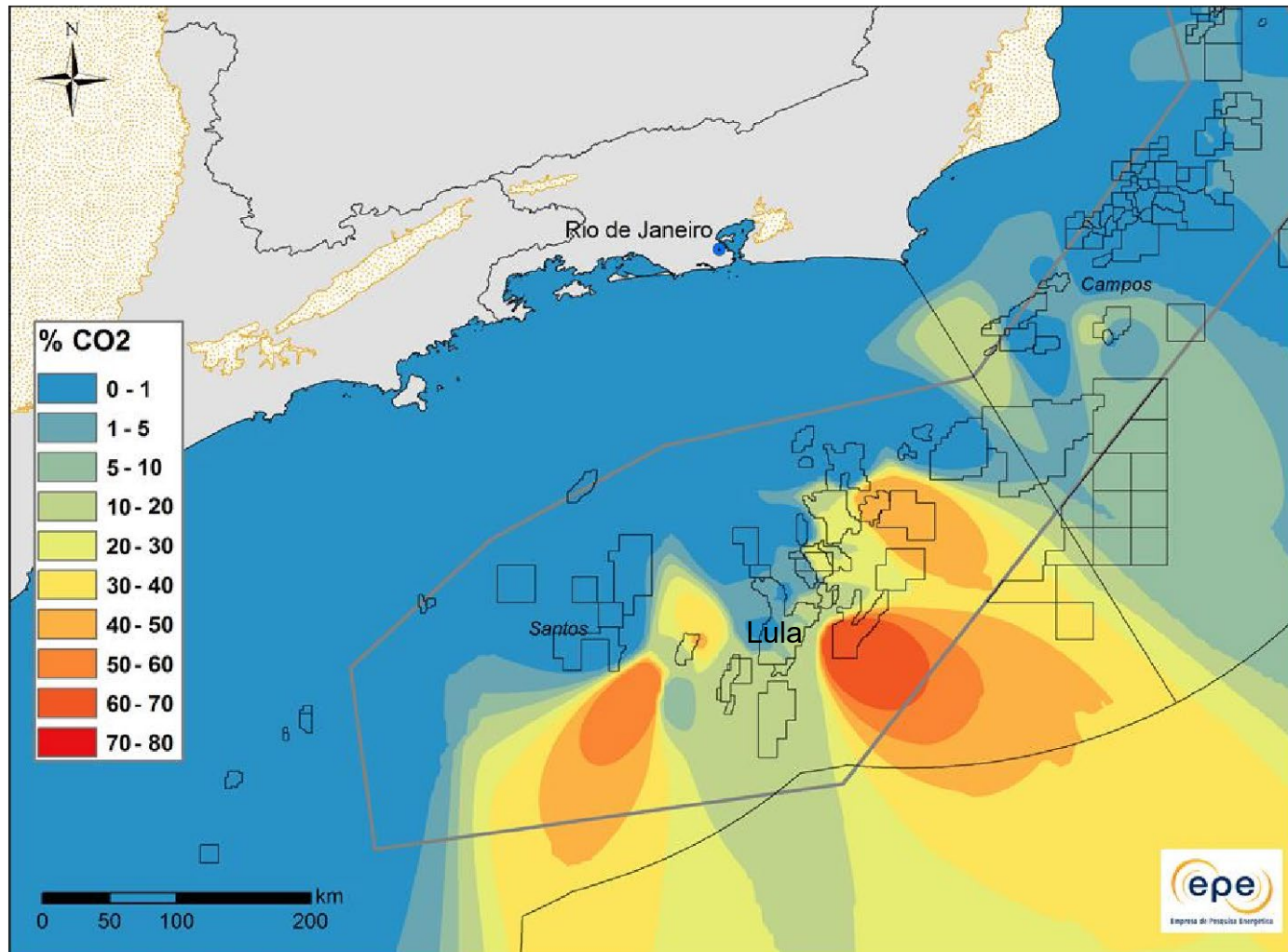
# Pre-Salt Province



Total area = 149,000 km<sup>2</sup>; 14 world oil companies



# CO<sub>2</sub> Concentration in the Eastern Bank of Brazil's Main Exploration Areas





## Evolution of Brazilian Oil Production (November 2019)



# Natural Gas Processing



## CO<sub>2</sub> content in the fluids address challenges:

- Size & Footprint
- Weight
- Efficiency

## Membranes:

- Better for medium or high CO<sub>2</sub> content
- Smaller footprint
- Simple to operate and easy to maintain
- Process a wide range of CO<sub>2</sub> in the inlet stream.

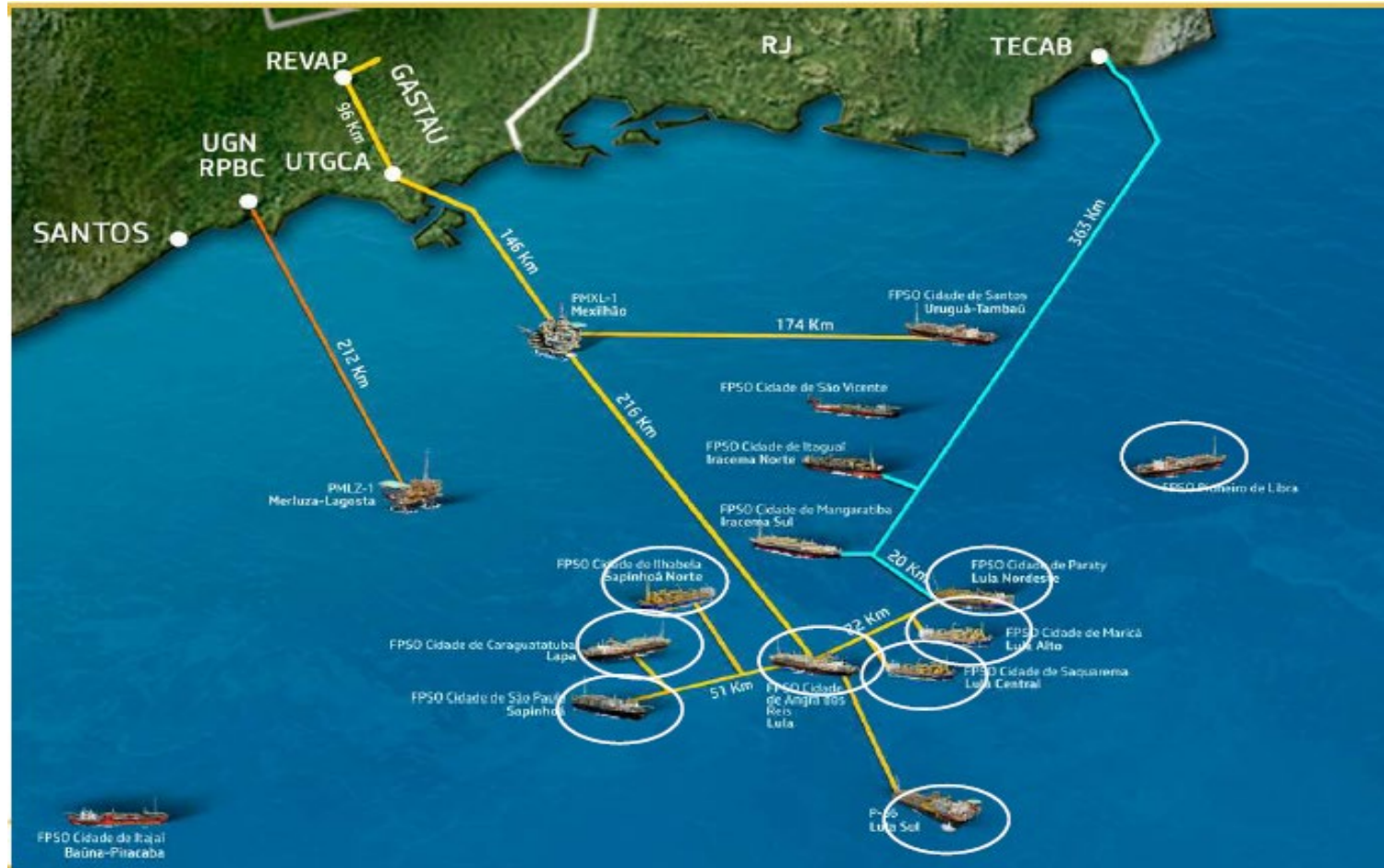


CO<sub>2</sub> unit using the UOP spiral wound membrane.



Cameron CYNARA® CO<sub>2</sub> Separation System

# Floating Production Storage and Offloading (FPSO) Units in Operation



- ✓ Cidade de Angra dos Reis, Cidade de São Paulo, and Cidade de Caraguatatuba (UOP – spiral wound)
- ✓ Cidade de Ilhabela, Cidade de Paraty, Cidade de Maricá, Cidade de Saquarema, and P-66 (Cameron - hollow fiber)



# Remarks

- 9 production systems (FPSOs) at Santos Basin;
- Natural gas pre-treatment and the CO<sub>2</sub> separation using membranes are running with success;
- Around 9.8 million metric tons of CO<sub>2</sub> were injected since 2013 (December 2018) <sup>[1]</sup>.



# Thanks for listening

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