

Brazilian natural gas markets

Wood Mackenzie's Southern Cone Gas and Power Service

Pedro Camarota, Belo Horizonte, April 2019

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Wood Mackenzie

Who we are

For the past 45 years, we have established our reputation as a trusted source of knowledge and forward-looking insight for the world's most innovative organisations.

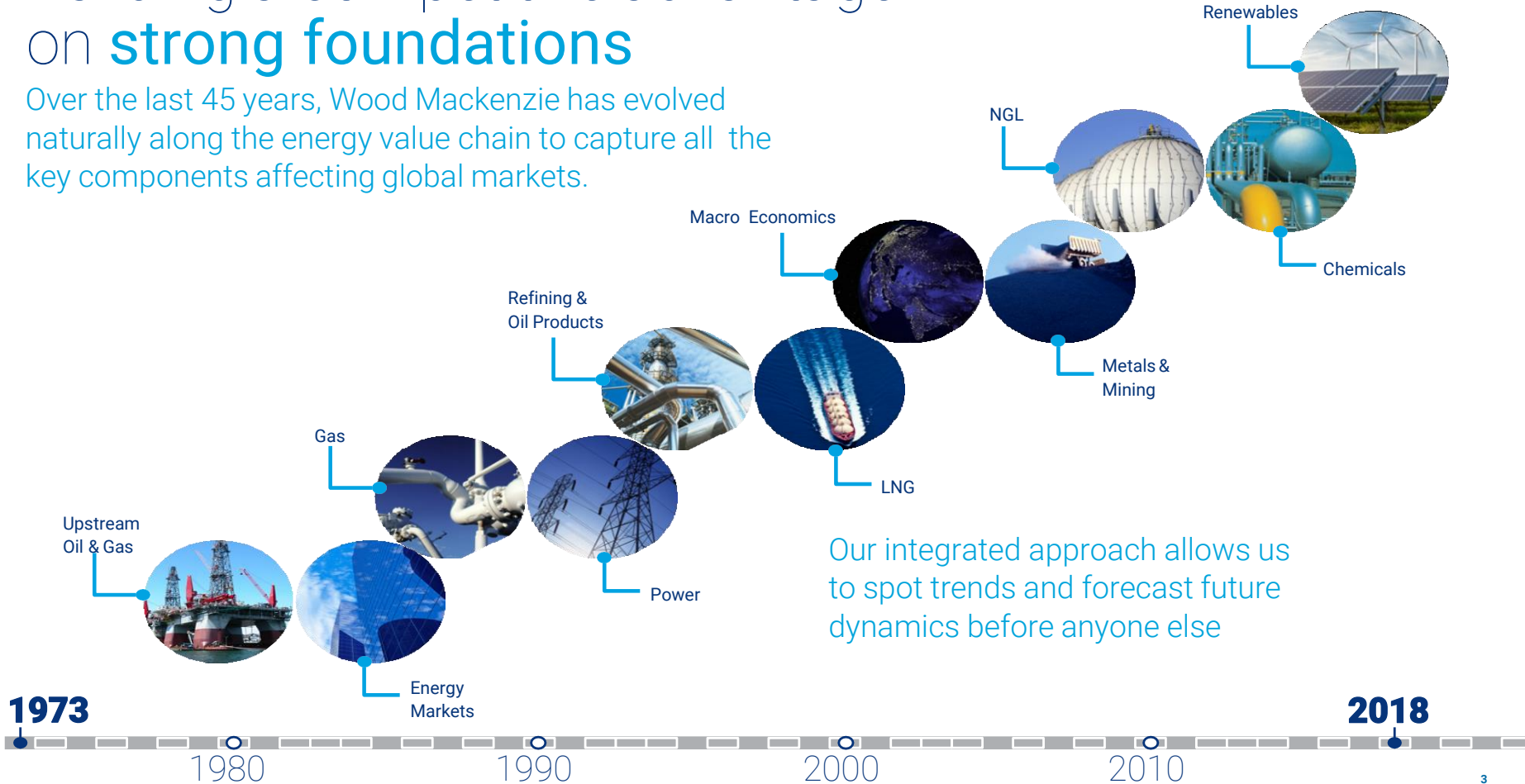
We are a global leader in commercial intelligence for the natural resources sector, empowering clients to make better strategic decisions, by arming them with objective analysis and advice on assets, companies and markets.

Our dedicated oil, gas, power, chemicals, metals and mining sector teams are located around the world, and deliver research and consulting projects based on our assessment and valuation of thousands of individual assets, companies and economic indicators such as market supply, demand and price trends.

At every stage, we apply a unique and rigorous analytical approach to provide objective analysis and advice that is valued by industries across the world. As a result, we can count the world's key energy institutions and governments among our most loyal clients.

Building a competitive advantage on **strong foundations**

Over the last 45 years, Wood Mackenzie has evolved naturally along the energy value chain to capture all the key components affecting global markets.



Our integrated approach allows us to spot trends and forecast future dynamics before anyone else

1973

1980

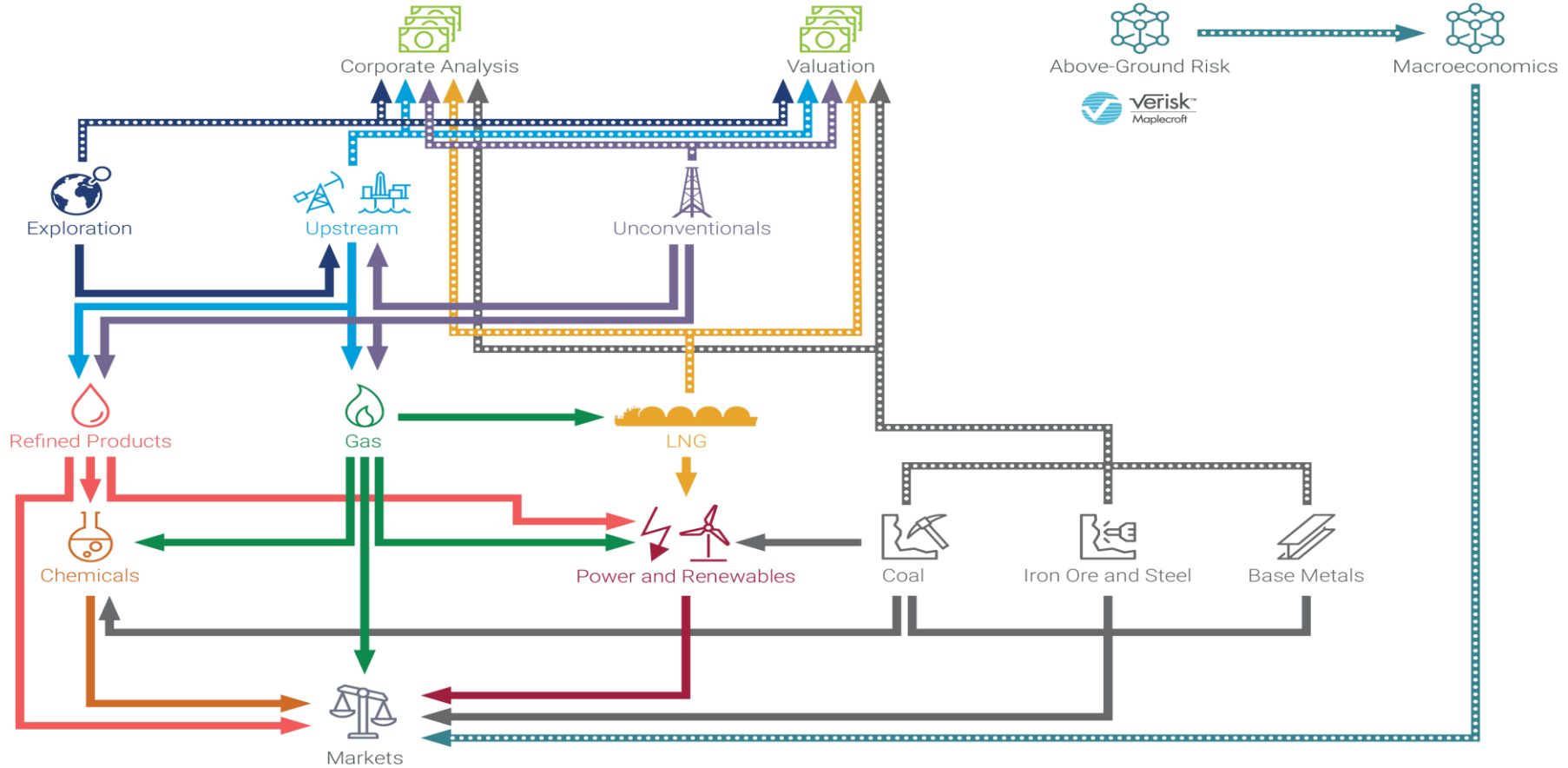
1990

2000

2010

2018

Your industry is our business

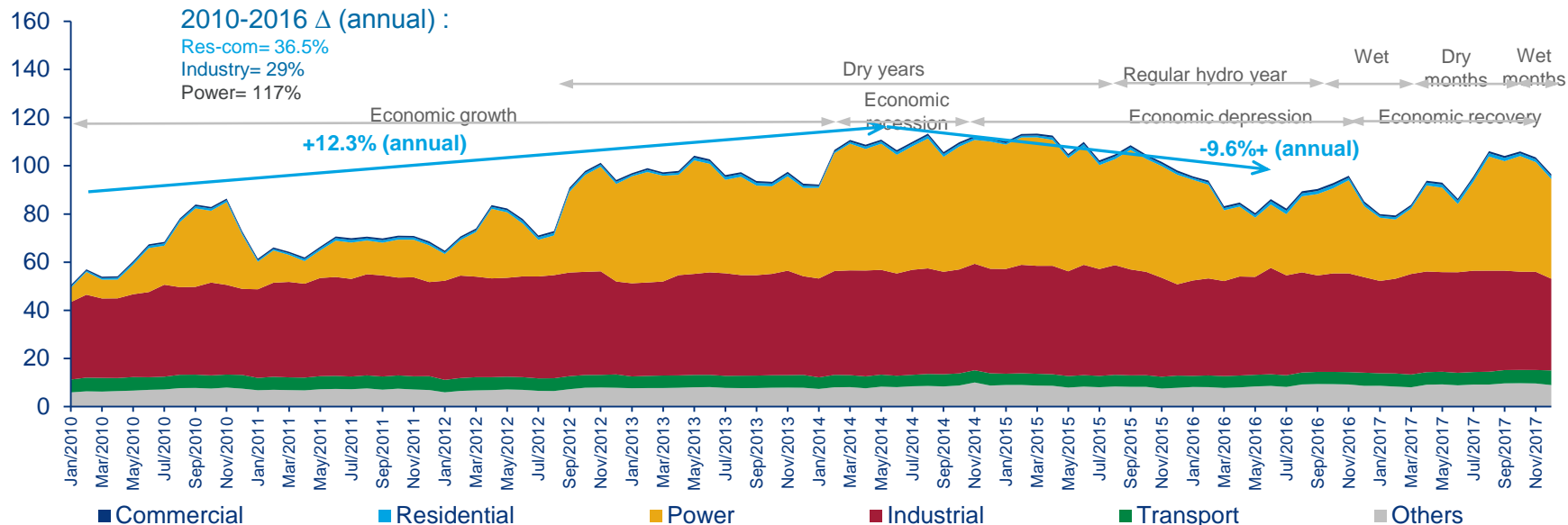




Demand variations depend strongly on power generation, which is sensitive to the uncertainty of hydrological regimes

Industrial and res-com consumption have expanded significantly. Over 2017, they continued recovering from the 2016 economic recession.

mcmd



Source: Wood Mackenzie

Economic depression (-3.6% GDP) and low oil-product prices in 2016 reduced industrial and transport gas demand, as well as electricity demand. This last factor, along with average rainfall totals for the year, dramatically impacted the demand for gas-based power generation.

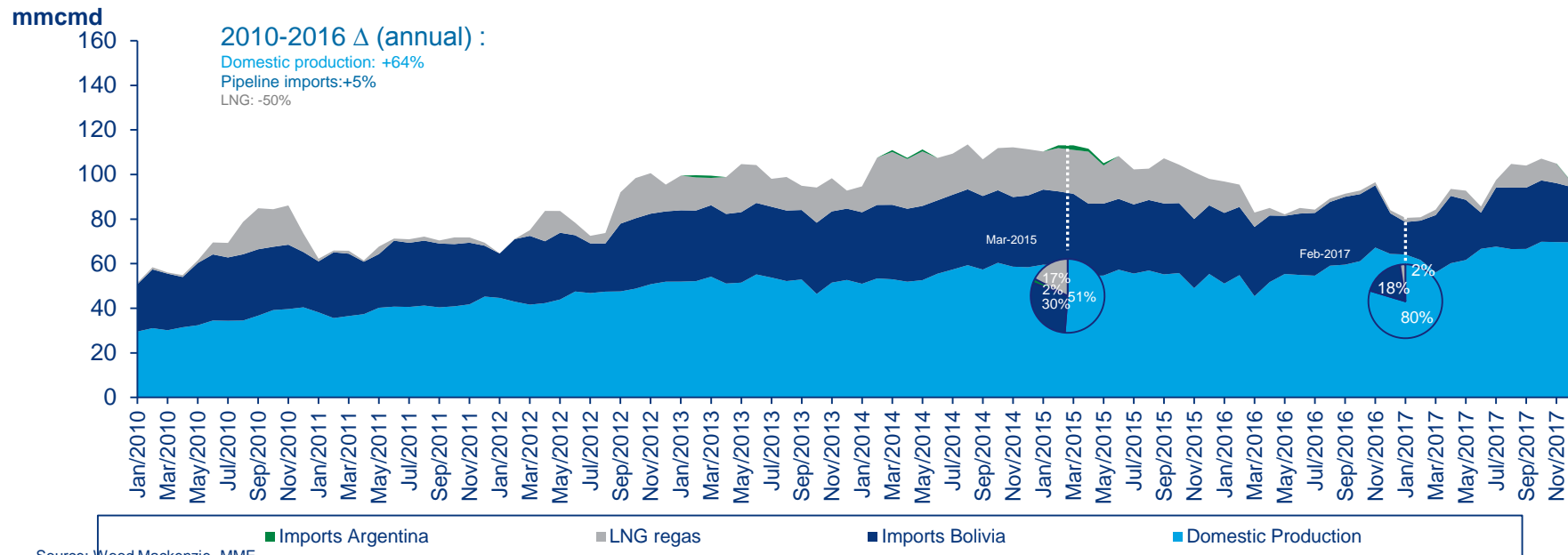
'Others' category includes the energy equivalent of NGLs extracted and gas consumed in natural gas processing plants, plus the gas consumed and losses in domestic transport (pipelines)

Source: Wood Mackenzie



Bolivian gas plays a pivotal role in terms of volume and flexibility to address Brazil's intermittent gas demand

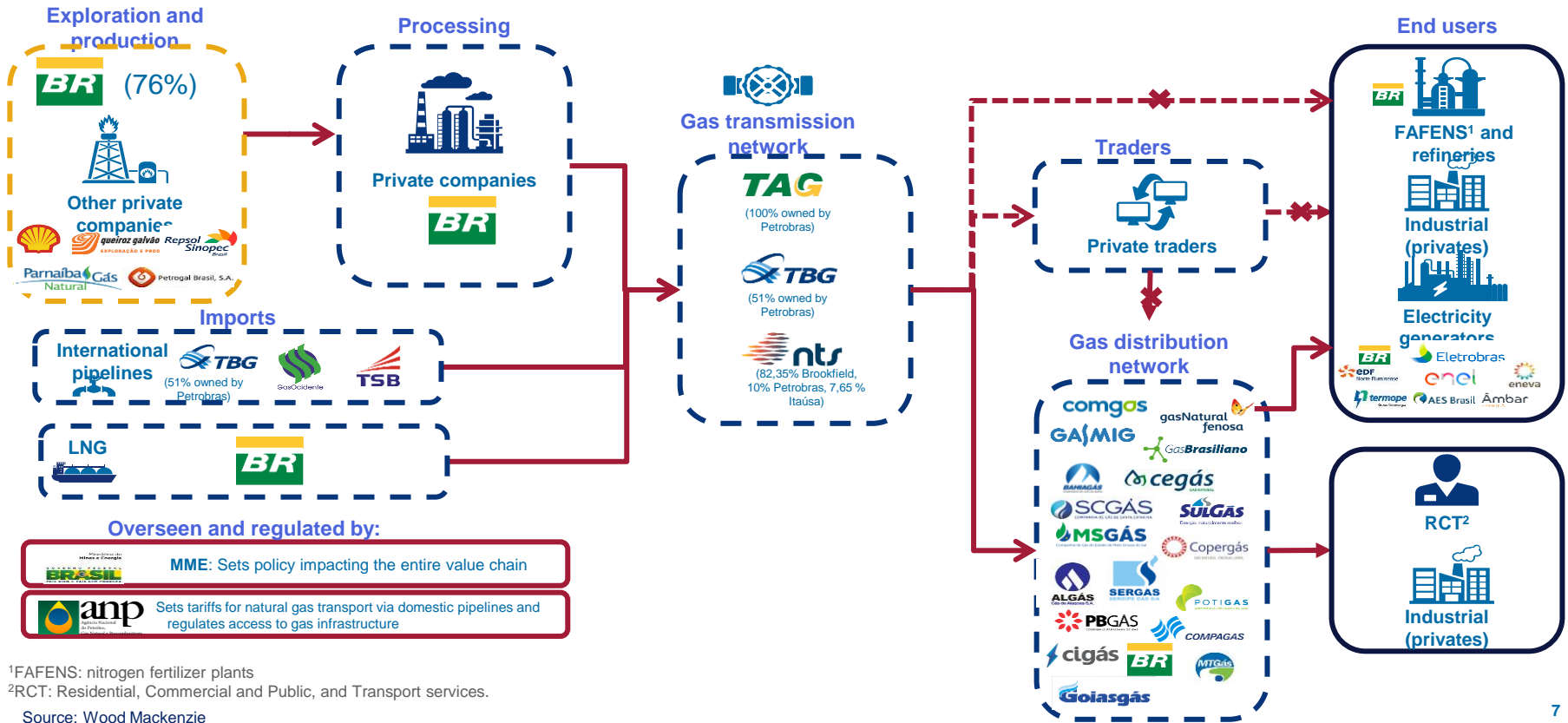
LNG has helped the country cope with dry hydrology and has served as a backup when Bolivian gas supply is interrupted



In January 2017, Bolivian gas and LNG imports hit a low of 14.5 mmcmd and 1.9 mmcmd, respectively. This was due to an increase of domestic supply and based on predictions of a typical year for hydro.

Despite Gas Law objectives, the Brazilian gas market is largely dominated by Petrobras's participation in all segments of the value chain, with monopoly status in processing, LNG regasification and gas commercialization

Brazil gas market structure



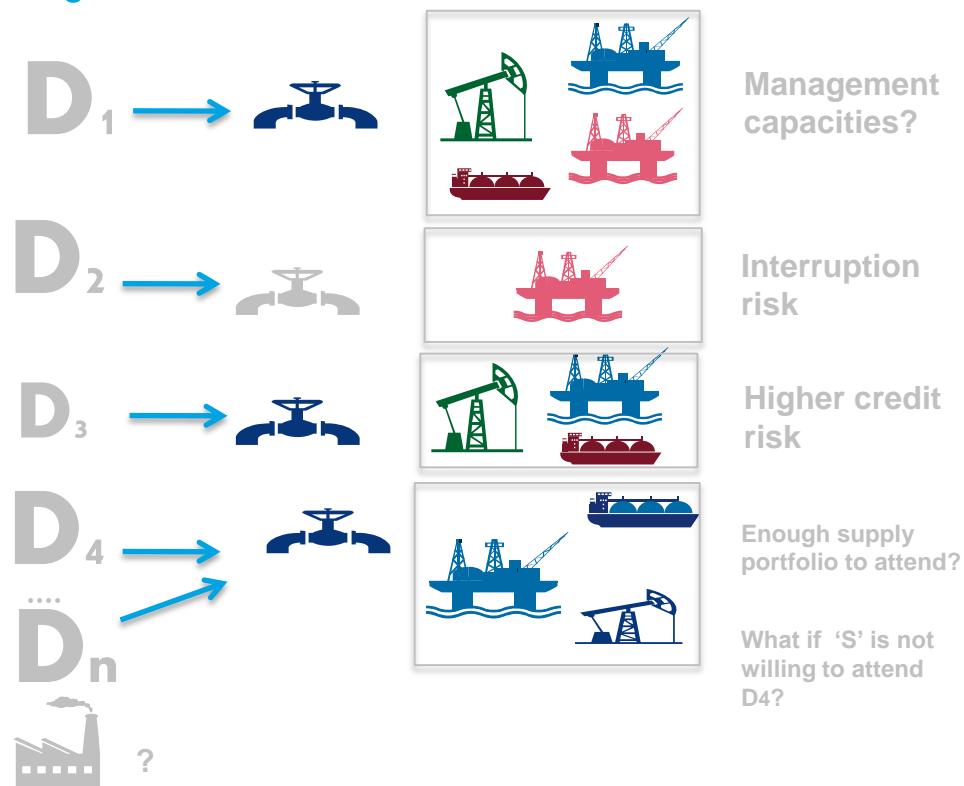
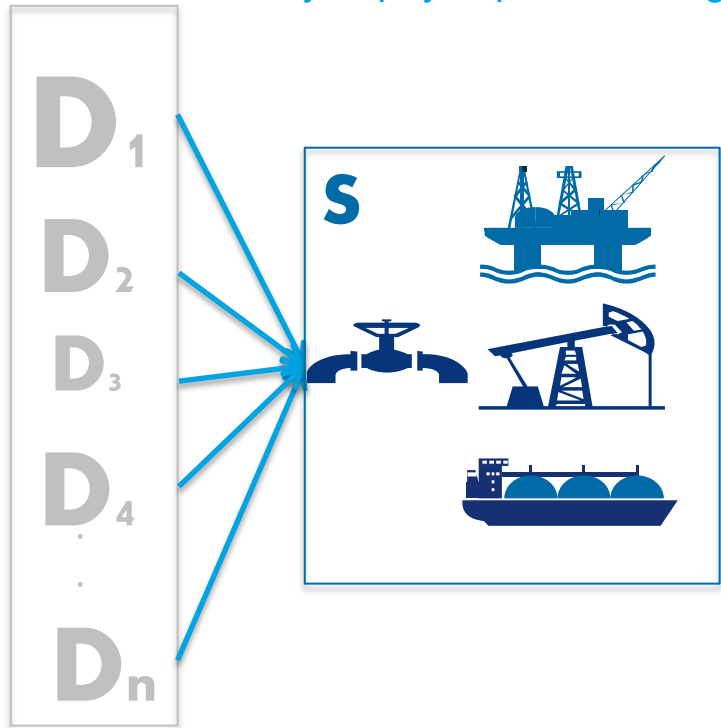
¹FAFENS: nitrogen fertilizer plants

²RCT: Residential, Commercial and Public, and Transport services.

Source: Wood Mackenzie

The new regulation framework would offer more options for gas procurement strategies

However, risk and portfolio management capabilities will be required. Small and high-risk credit offtaker are likely to pay a 'premium', aggregation might be a solution.





Southern Cone Gas, Power & Renewables Service

Anticipate trends and make informed **investment decisions** with access to data and unrivalled analysis covering short term and long term outlooks into the economics for Southern Cone (Argentina, Bolivia, Brazil and Chile) gas, power & renewables markets.

20 years horizon
Semi-annual base case
long-term outlooks

Historical
commercial
data

Timely
market
insights

Quarterly
market update
and short-
term outlooks

Access to
analysts

Modelling

37

**sub- regions for gas
in Argentina, Brasil,
Bolivia and Chile**

Use it to:



Understand the regional gas & power market dynamics, evolution and the interplays



Analyse regulatory, economic and technological uncertainties on market fundamentals



Benchmarking internal forecasts against a "second opinion" or third party view



Use the data provided as inputs for your own models



Identify investment opportunities for infrastructure expansion

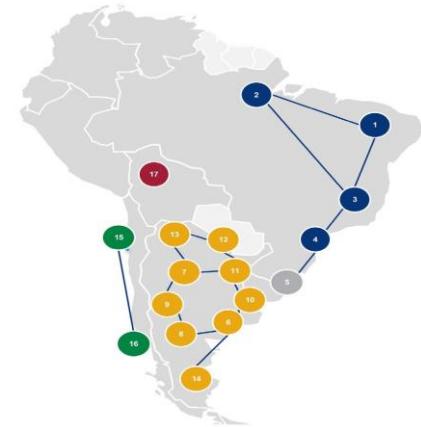
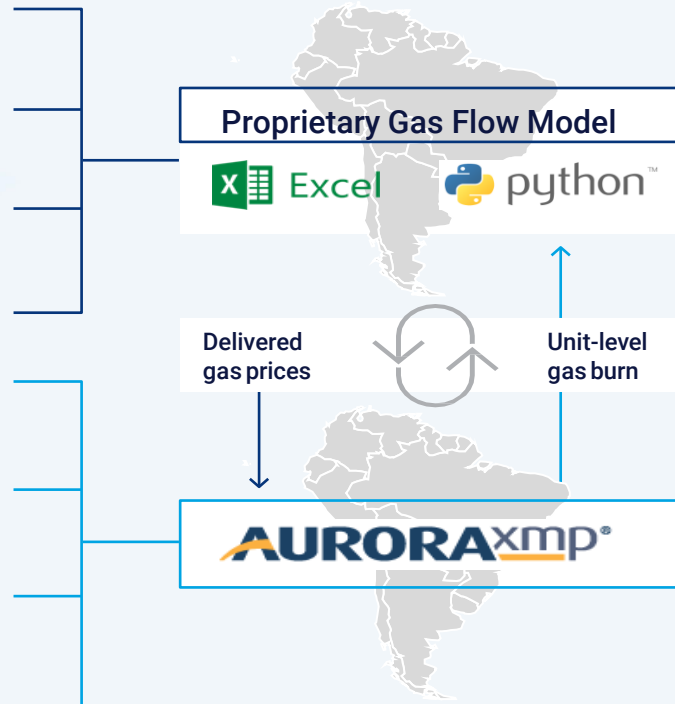


Test, contrast and refine internal views on market fundamentals

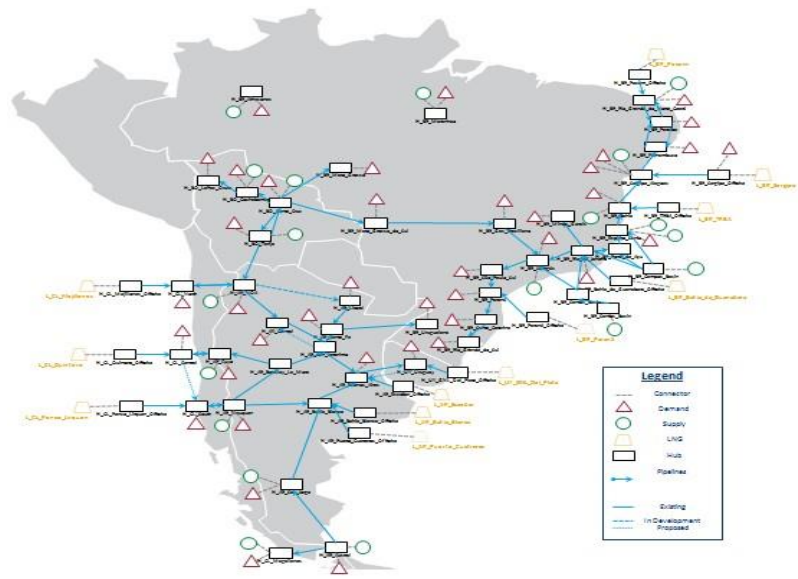


Our approach employs an **integrated** solution

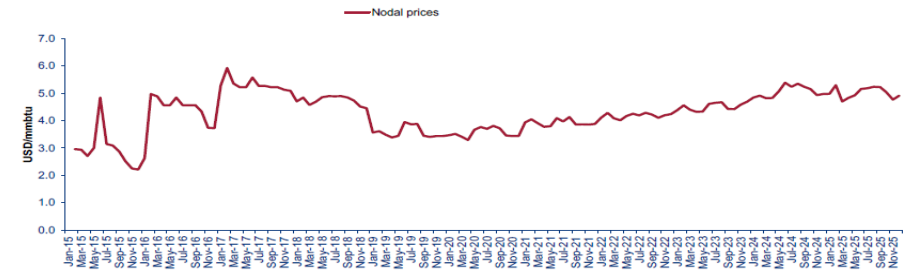
-  Non-power and power gas demand
-  Field-by-field domestic production
-  LNG Import price
-  Pipeline capacities and tariffs
-  Renewable profiles, goals
-  Unit-level supply stack and resource shapes
-  Regional power demand
-  Reserve margin targets



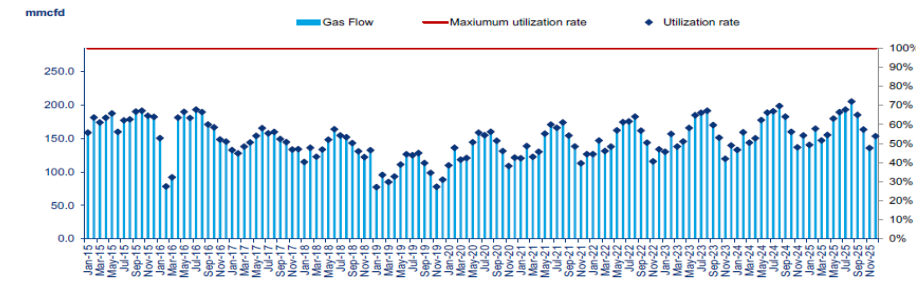
Proprietary gas flow and pricing model replicates Southern Cone's gas market infrastructure and hubs



Prices at 37 different nodes



Monthly detailed flow & utilization data for 50+ pipe segments





Power modelling employs detailed unit-by-unit optimized dispatch across 17 transmission zones in the National Interconnected Systems

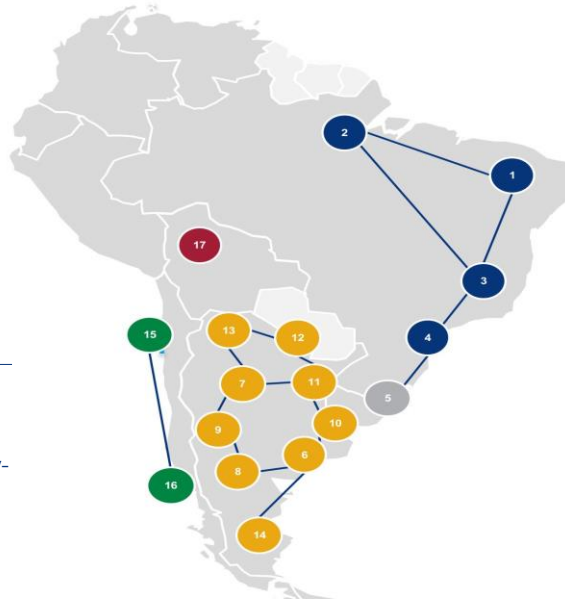
A plant by plant dispatch on:

+6,000 generating units

including detailed adding and retirement analysis

Zonal topology

- Full 8,760 hourly chronological unit-by-unit dispatch
- LP optimization subject to plant operational constraints and transmission limits



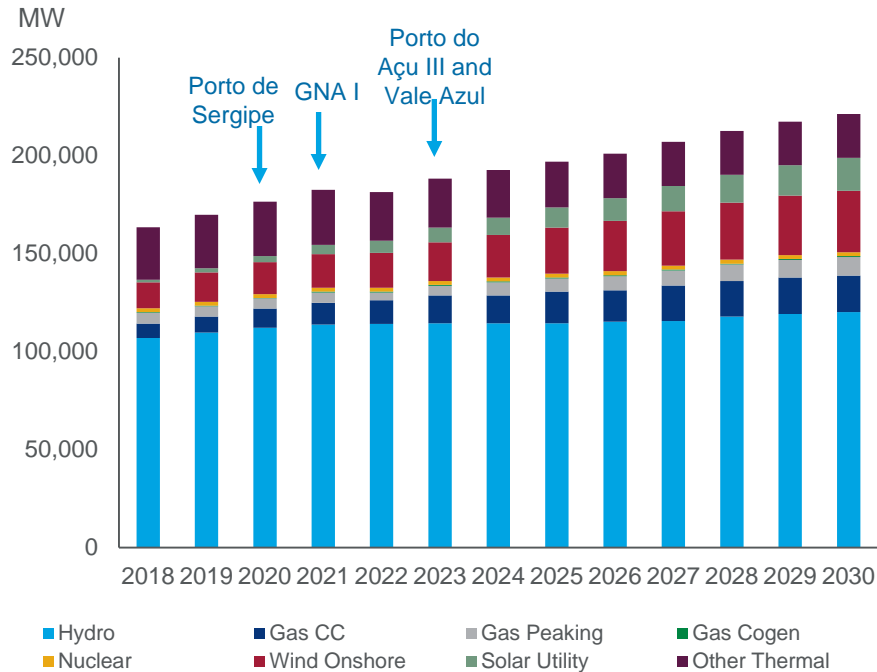
AURORAxmp®

1	Northeast
2	North
3	SE-CO
4	South
5	Uruguay
6	GBA
7	Centro
8	Comahue
9	Cuyo
10	Buenos Aires

11	Litoral
12	Noreste
13	Noroeste
14	Patagonia
15	SING
16	SIC
17	Bolivia

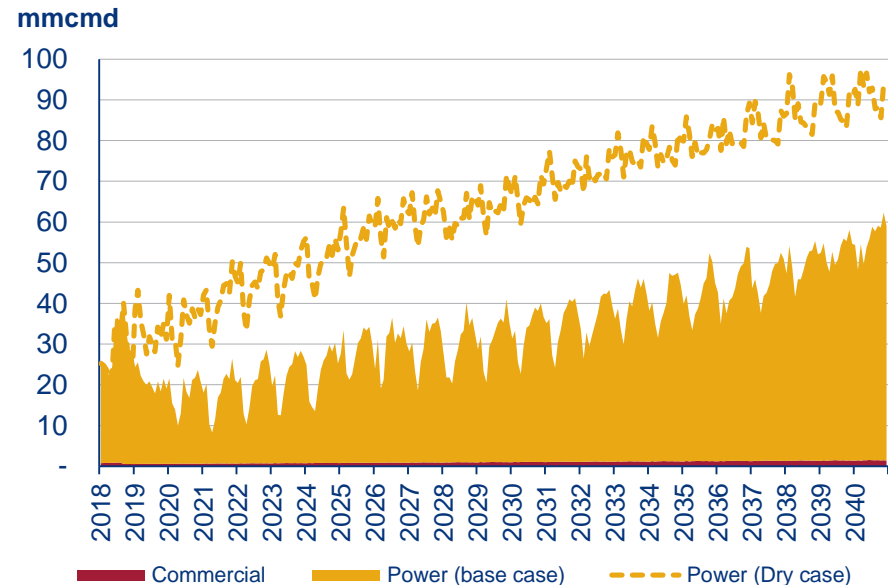
Generation: Gas fired power plants will increase utilization over the time according to the pace of renewables penetration

Installed capacity by technology



Source: Wood Mackenzie

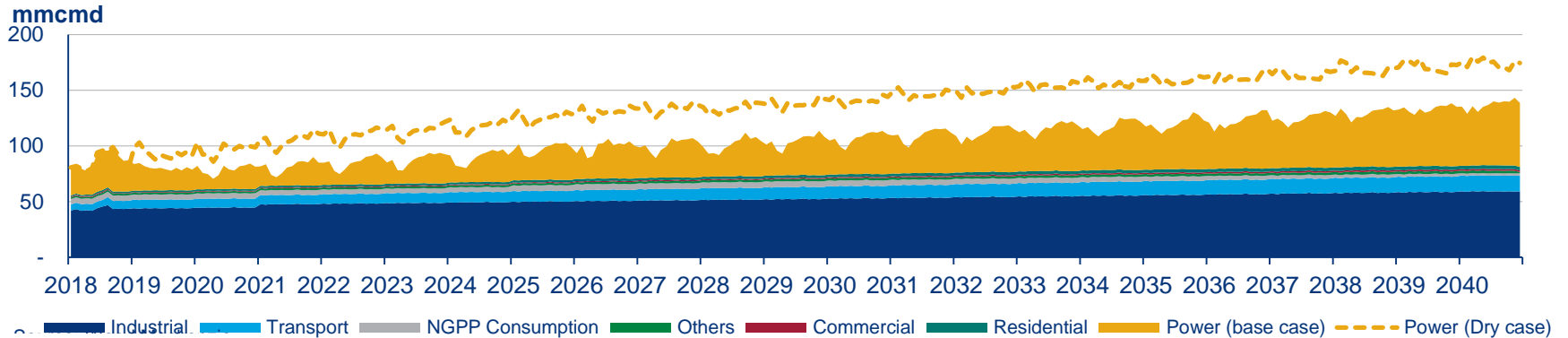
Gas to power consumption



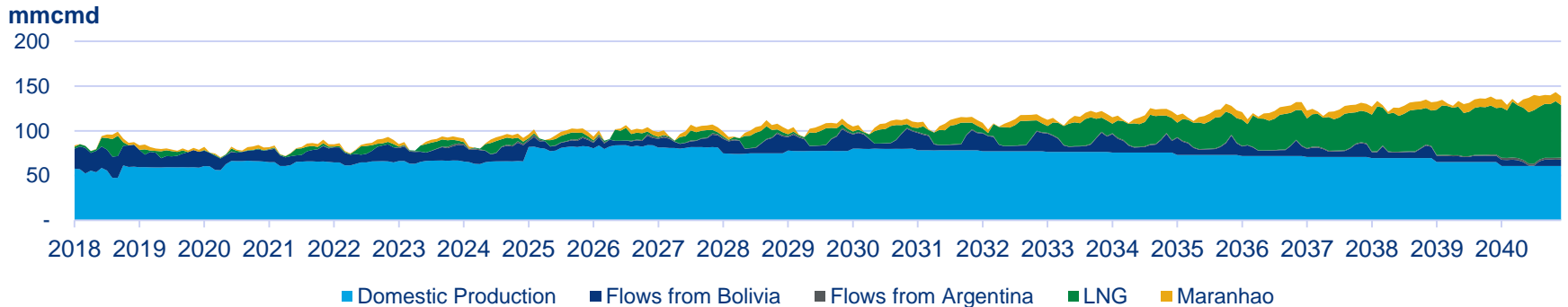
Source: Wood Mackenzie

Gas balance: Average hydro

Brazil gas demand and exports (average case)



Brazil gas supply and imports (average case)



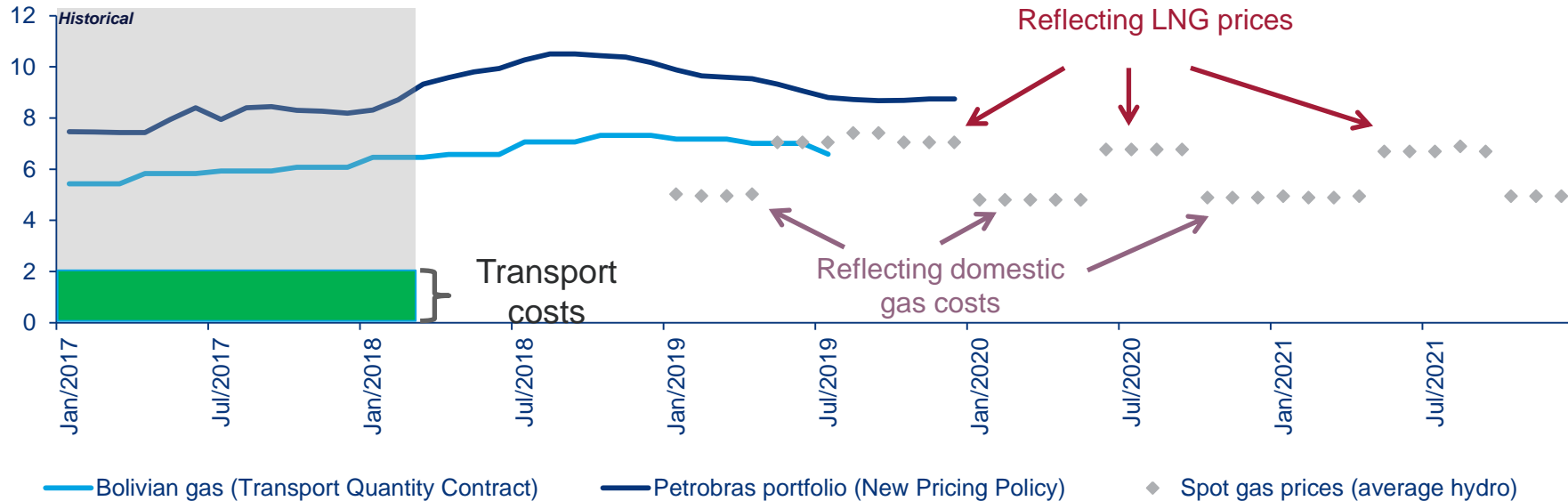


Will regulatory reforms to open gas markets in Brazil result in lower prices?

Robust supply portfolios are required to manage “contingencies” in a decentralized procurement system

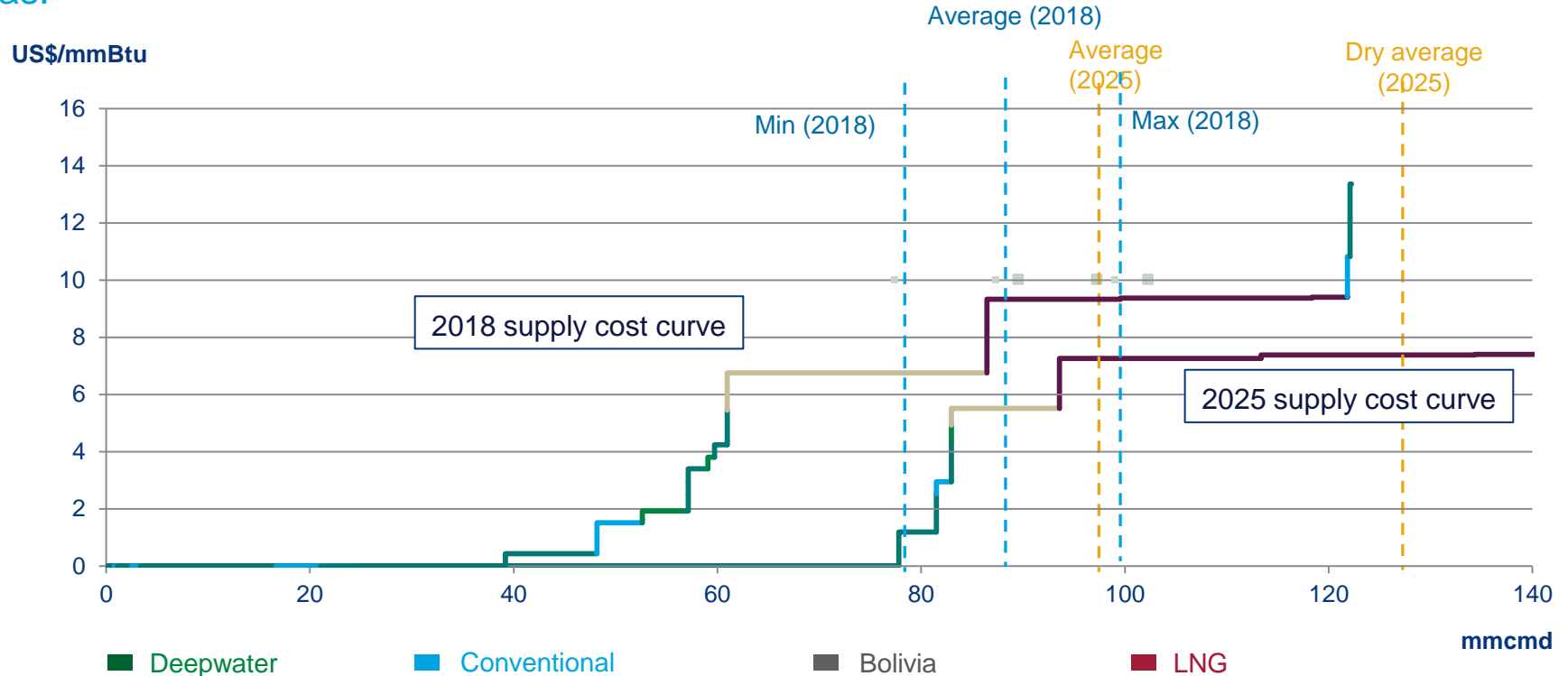
Gas prices at Sao Paulo city gate

US\$/mmbtu



Supply Cost Curve: 2018 vs 2025

Brazil's associated presalt gas will result in cheaper but inflexible gas. Early infrastructure that incorporates flexibility and monetization solutions will secure a stake of the logistics of presalt gas.

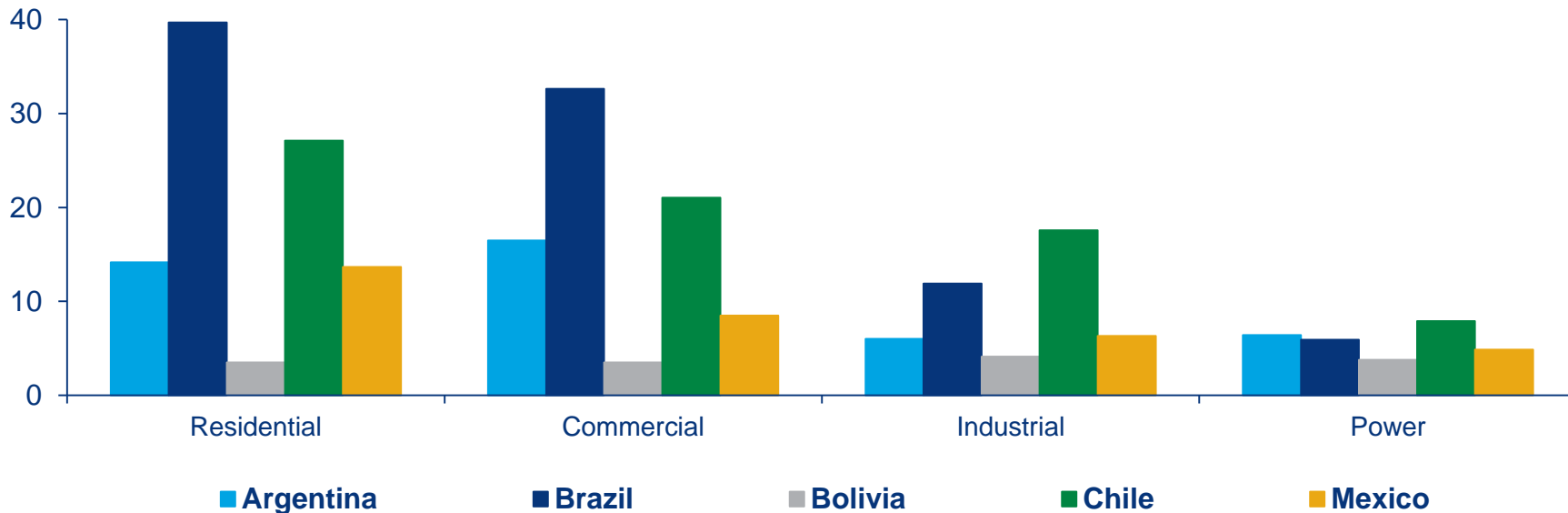




Brazil is second to Chile in terms of expensive gas prices for end-users

Current average gas prices for final consumers including taxes

US\$/mmbtu



Source: Wood Mackenzie



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