



RystadEnergy

Assessment of Brazil's Updated Production Tax Scheme

New royalty regime unfairly penalizes independent
operators in the post-salt environment

Rystad Energy Advisory

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The new royalty regime unfairly penalizes independent operators in the non-pre salt environment

ANP's new royalty regime disproportionately impacts post-salt assets, often classified as marginal or mature, and will impede a diverse and growing operator landscape in Brazil

Why?

I

The post salt fields are different from Brazil's wider oil and gas industry – independent operators face more marginal economics and higher Sulfur crudes

- Post salt, including most marginal and mature fields, represent much of the diversity seen in Brazil's operator landscape, often extending the life of tail-end assets
- Operating these tail-end assets requires more maintenance and investment for lower production volumes – economic margin gained per barrel is far lower than in the pre salt
- Additionally, the crude oil produced is often heavier and with higher Sulfur content than in the pre salt – Crudes produced by independent operators in post salt environments is not the same as the general crude produced by Petrobras or in Brazil

II

...these crudes are traded at a discount following IMO2020, and the ANP's suggested reference price will overvalue them

- The IMO2020 regulation has fundamentally changed global crude markets. The change is observable in differences between VLSFO and HSFO* prices
- Shipping companies are only to a limited degree installing scrubbers and prefer VLSFO – IMO2020 effects are long-lasting
- Only certain refineries can remove Sulfur from crude, and at extra cost. The cost is compounded in heavy crudes, which has leads to an increased difference in prices between lighter and/or sweeter crudes compared to their heavy sour counterparts
- ANP's Sulfur de-escalator does not compensate for this and ~1%wt S crudes will be overvalued

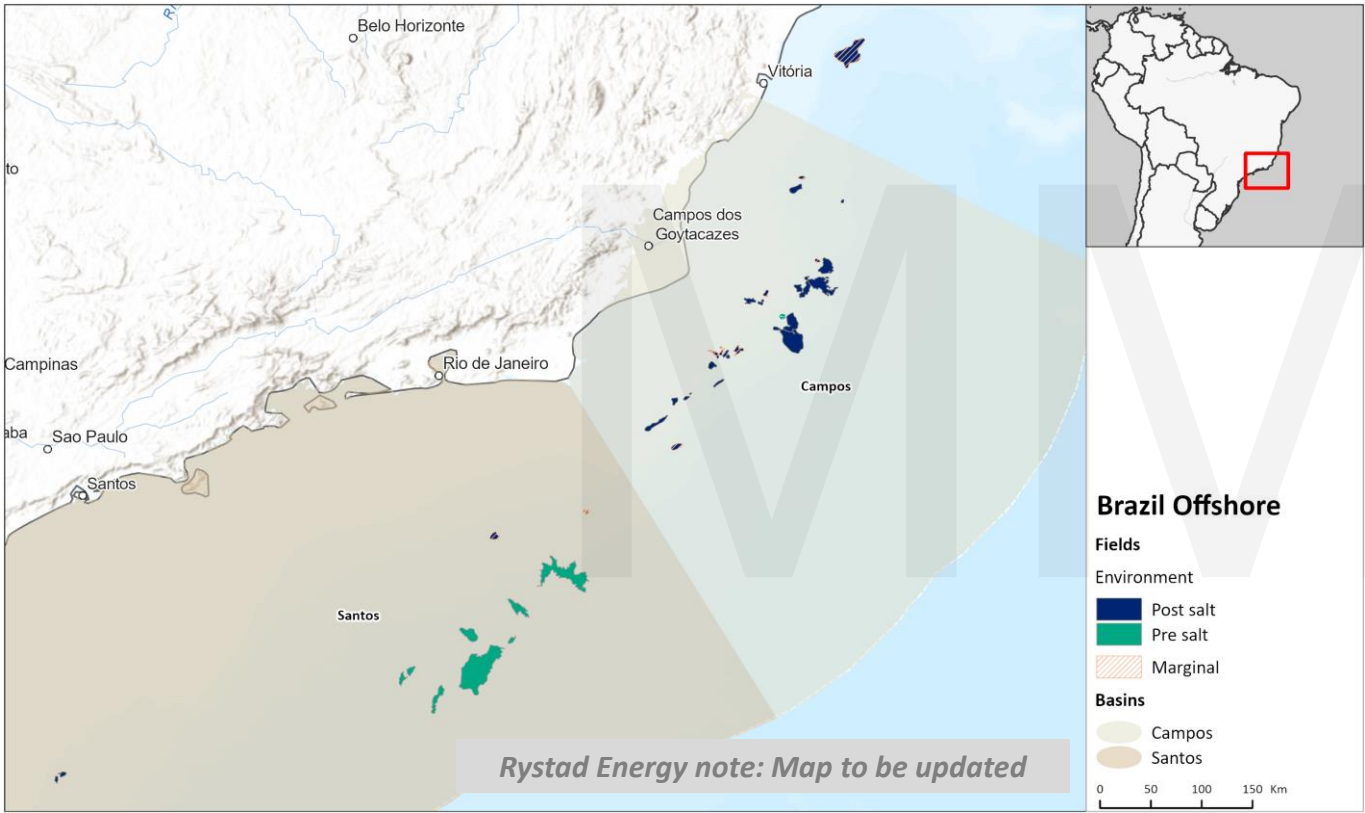
III

Still, independent operators are taxed as if they sold low sulfur crude. Similar tax revenue can be gained by Brazil's gov't without discouraging operator diversity

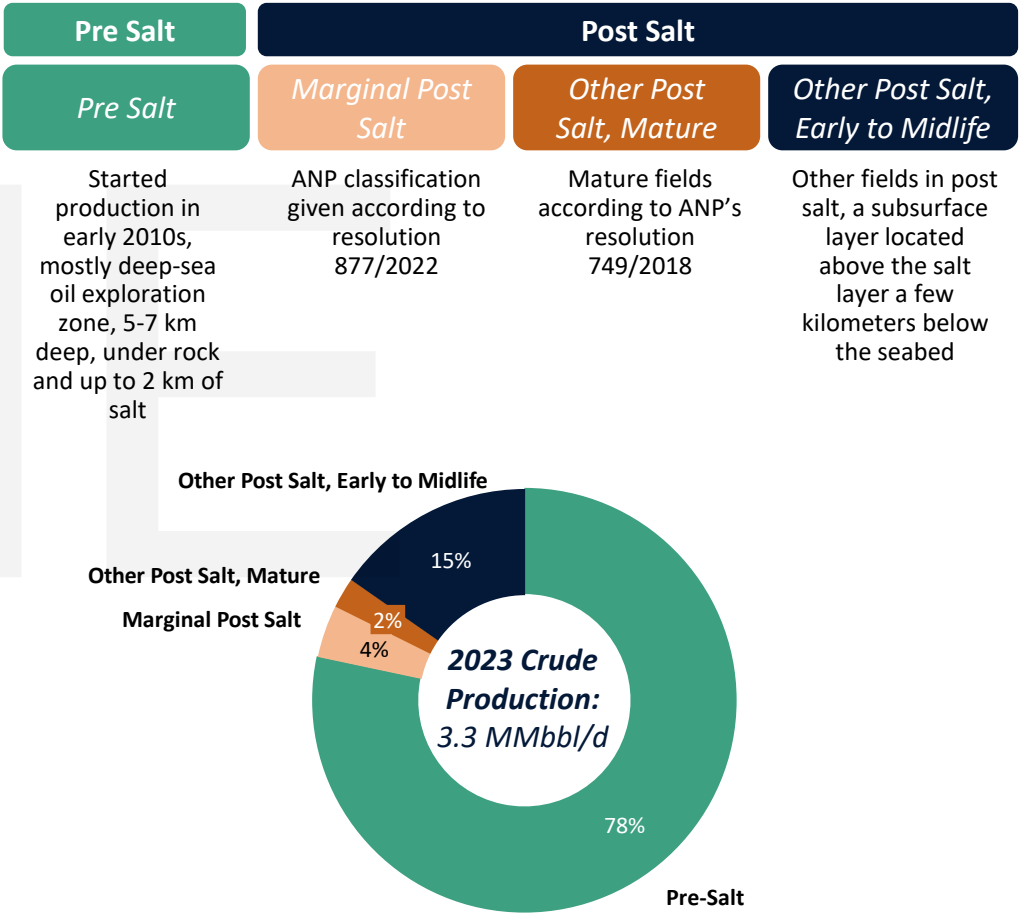
- A post salt operator is already facing more challenging margins per barrel than e.g. Petrobras, due to e.g. high share of marginal & mature fields
- The updated royalty regime will lead to a disproportionate increase in royalties for these operators, adding further downside risks to an already challenging post salt environment
- Rystad Energy has calculated that retaining the old pricing bucket for marginal and mature post salt assets will have minimal effect on overall Brazilian tax revenue but will be encouraging for the value of investing in late-life assets
- Similar effect is observed if a formula more representative of market prices is applied for Sulphur quality differentials in the Ref price calculation

*Very Low Sulfur Fuel Oil (0.5%) and High Sulfur Fuel Oil (3.5%)

Four types of fields/crudes considered in report – Marginal/Other post salt mostly seen in Campos



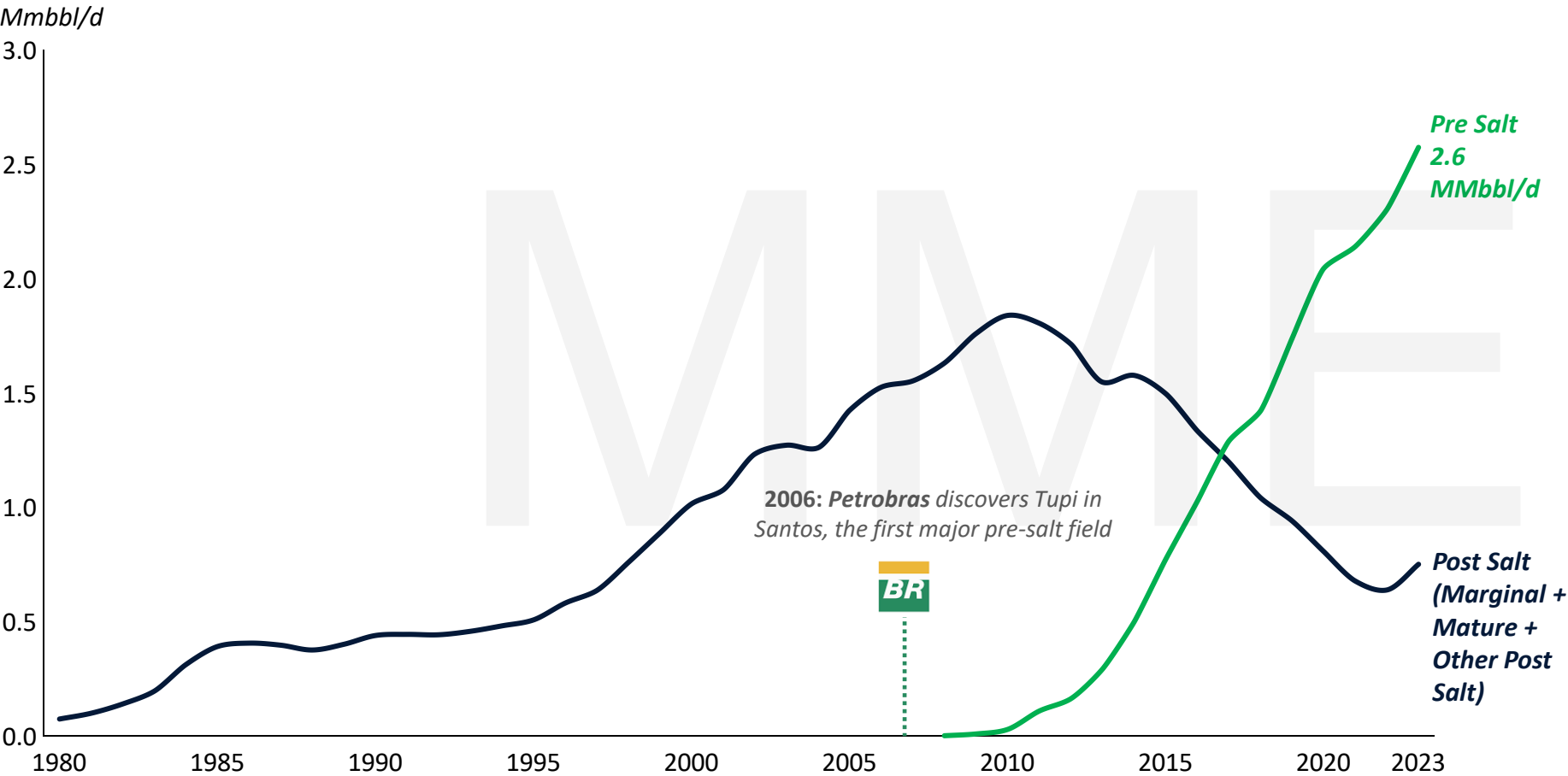
Crudes from four types of offshore field considered:



Source: Rystad Energy research and analysis; Rystad energy GIS solution; ANP

Pre salt main driver of Brazilian crude production since 2010, post salt meanwhile fighting decline

Offshore crude oil production in Brazil, 1980 to 2023

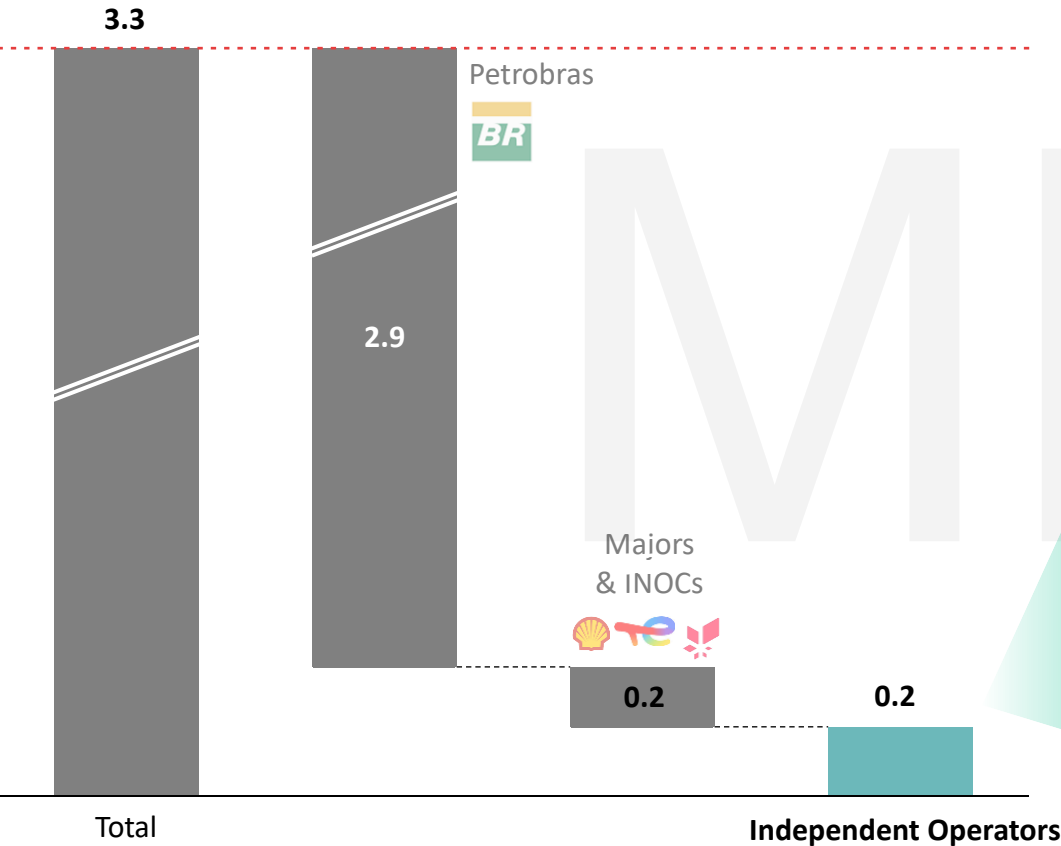


- Pre-salt fields contribute 78% of Brazil's total oil production. Despite bouncing back in 2023 with 14% YoY increase, post-salt still represents a smaller and more mature share of Brazilian offshore oil production.
- Pre-salt is expected to have a larger share of production until early 2030s; geo-economic studies for four pre-salt blocks (Rodocrosita, Cerussita, Aragonita, and Malaquita) were approved recently, with three additional studies to be concluded in 2024 (Hematita, Opala, and Calcita)

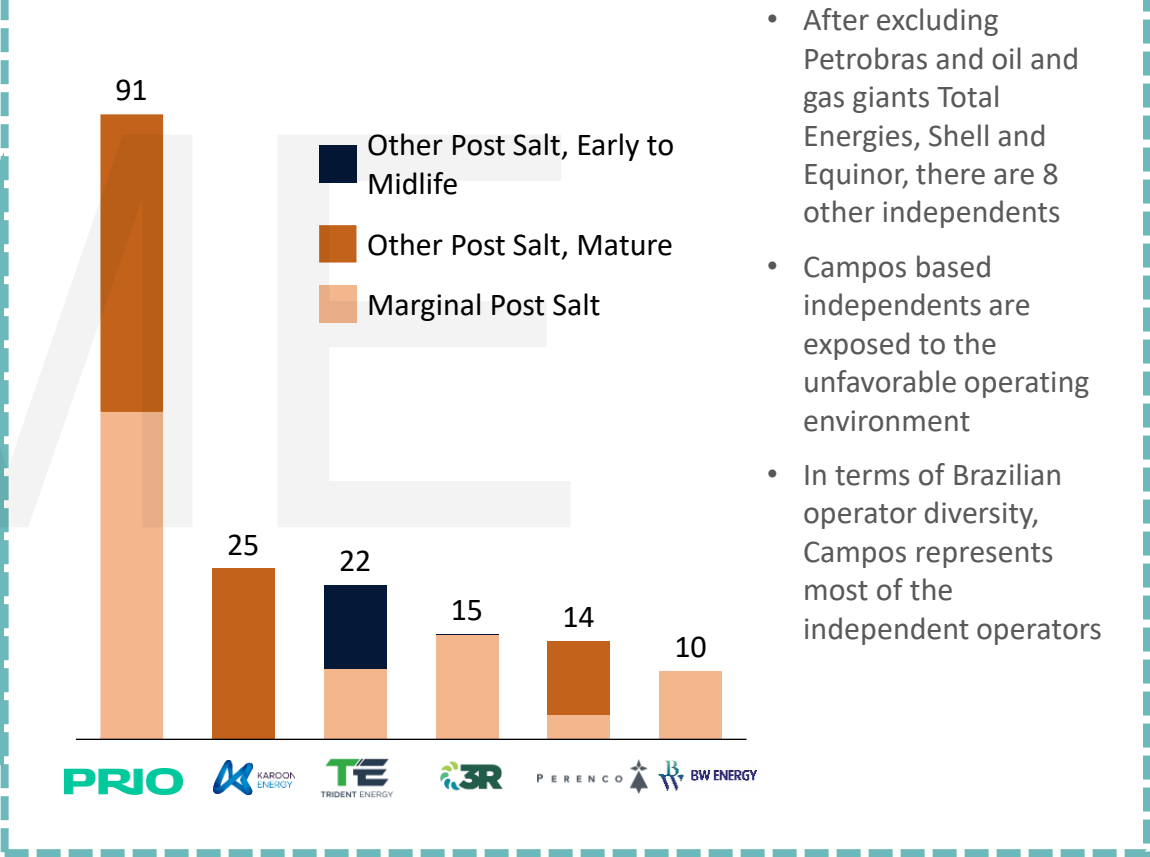
Source: Rystad Energy research and analysis; Rystad Energy UCube; ANP

Aside from Petrobras and Majors, Brazilian operator diversity largely represented in post-salt fields

Offshore production in Brazil split by operators, 2023
MMbbl/d



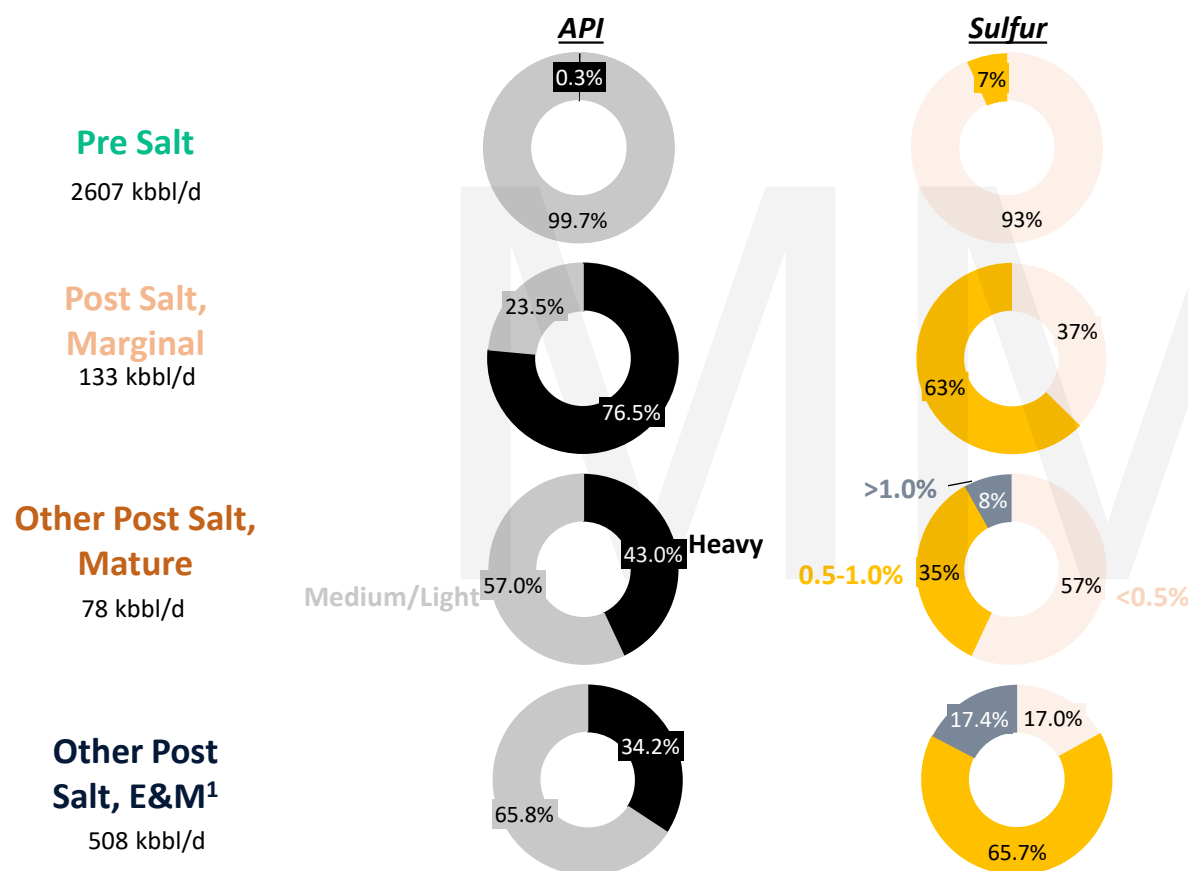
Production breakdown for independent operators, 2023
Kbbl/d



Note: Karoon Energy and Perenco are the only IOCs operating in Santos and/or Campos
Source: Rystad Energy research and analysis; Rystad Energy UCube

>60% of Marginal field's volumes over 0.5% sulfur and ~75% heavy, Pre Salt much lighter & sweeter

Brazil offshore crude distribution by API and Sulfur Content, 2023

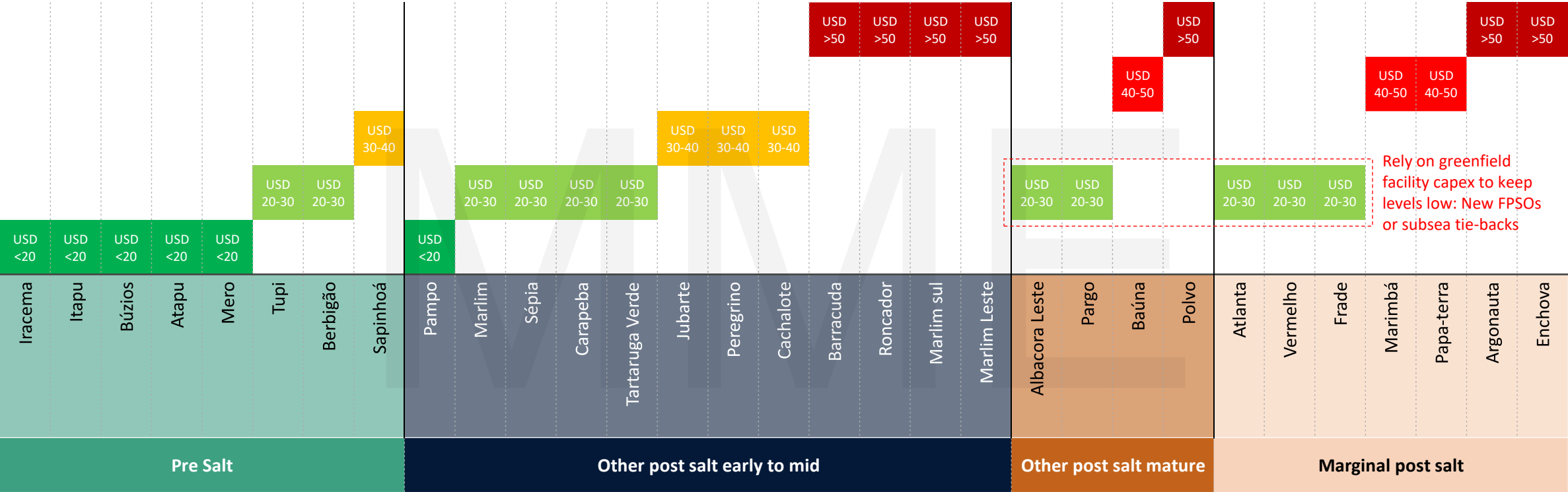


- Pre salt fields mostly produce refinery favored crudes such as Tupi, Mero, Sapinhoa, and Atapu with <0.5% sulfur content and API in the range of above 25
- Marginal fields like Frade, Papa-Terra, and Espadarte produce crudes ranging from 13 to 27 API and minimum 0.7% sulfur content
- Prominent post salt fields such as Albacora Leste, Polvo and Pampo produce heavy crudes ranging from 14 to 20 API and average sulfur content of 1.4%
- Early to midlife post salt fields such as Peregrino produce heavy sour crudes with APIs between 14 and 19 and an average sulfur content above 2%

Heavy crudes defined as having API under 22; 1: Early to Midlife
Source: Rystad Energy research and analysis; Rystad Energy UCube

Several Marginal and Mature Post Salt fields see challenging pre-tax well breakevens of >40 USD/bbl

Average pre-tax well breakeven for Brazilian offshore production hubs
USD/bbl



- Pre Salt production hubs don't see pre-tax well breakevens below 40 USD/bbl
- Larger fields like Mero, Buzios and Tupi have even more favorable figures at <30 USD/bbl
- A majority of volumes are highly sensitive to increased cost base or lowered commodity prices
- Large share of Mature Post Salt production hubs see pre-tax breakevens of 40 USD/bbl or more, making the operators' investment decision very sensitive to incremental cuts in margin.
- Large commodity price downside risk is another contributor to this uncertainty

Pre-tax well breakeven calculate average unit costs for volumes from new wells; Production hubs include central fields and all wellhead platforms, subsea tiebacks or other crude streams flowing to the same central field for offshore processing. Marginal and Mature fields defined by central processing field being marginal or otherwise a majority of production being from marginal or mature fields; Source: Rystad Energy research and analysis

We present 4 indicators that heavy sour crudes will be disproportionately impacted by ANP's update

4 Indicators:

Heavy sour crudes likely traded at a discount following IMO2020

So what?

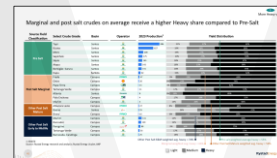
ANP's updated reference price calculation will disproportionately impact heavy sour crudes

Indicates that heavy sour is hit harder

1

Marginal and Other Post Salt crudes yields are heavier:

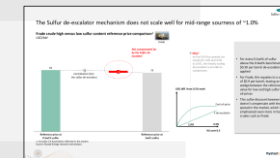
Change in the fuel oil portion of the price bucket will impact harder



2

S% de-escalator is disproportional to current product prices:

The de-escalator scales linearly, spreads to 0.5% fuel oil do not



Examples used to represent crude types:

Marginal: Frade



API: 21
S%: 0.9

Pre Salt: Tupi



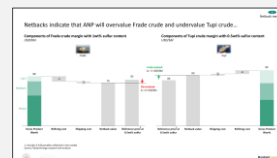
API: 31
S%: 0.3

Indicates that ref. price calculation is over-valued

3

Netbacks indicate overvalued reference price:

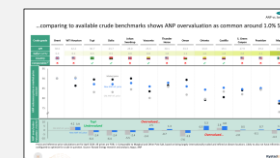
Accounting for a realistic product mix, shipping and refining costs shows large discount to reference price calc.



4

Market benchmarks indicate overvalued reference price:

Mapping ref. price calculation to available benchmarks shows overvaluation centered around 1.0% Sulfur crudes



Marginal and Other Post Salt fields to be taxed as if low sulfur, receive crude price as if not – significant loss of margin

Summarizing effects of changed Royalty on the individual field:

Inherent disadvantages for Post Salt fields¹:

I

II-a

II-b

III

Higher cost base for incremental decision to continue production through well breakevens

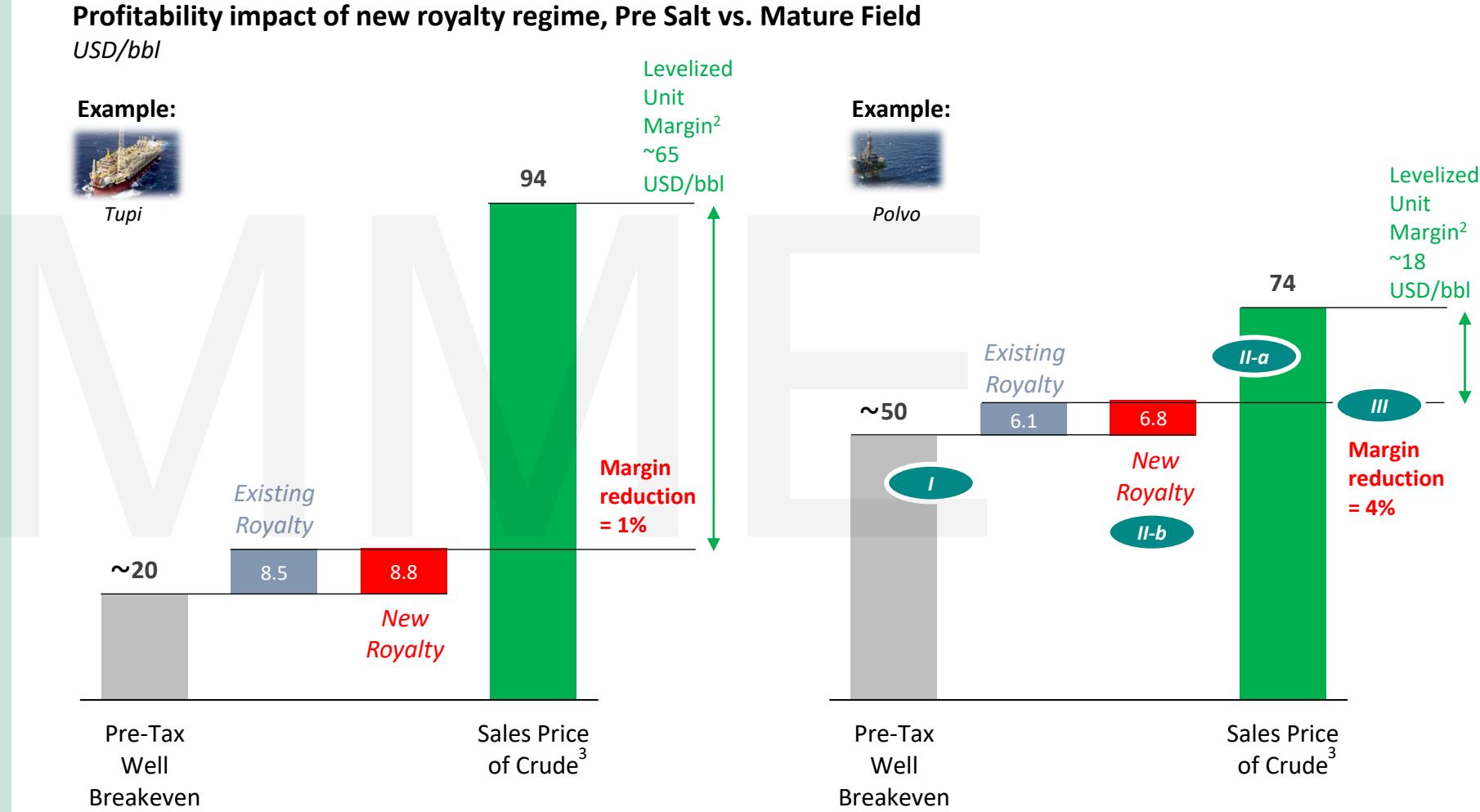
Discounted sales price received from heavy sour crude vs Pre Salt's light sweet

Harder relative impact of proposed royalty change

Leads to: Larger effect on already small margin

➤ Already facing more challenging economics through higher cost base and discounted crude sales prices, the royalty change will have a higher impact on Marginal and Other Post Salt fields' profitability

➤ The change chips away a profitability that is already fragile in the face of uncertain commodity prices – likely decreasing operators' willingness to keep investing in new wells



1: Includes Marginal, Other Post Salt Mature and Other Post Salt Early to Midlife; 2: Before Corporate tax; 3: Based on netback exercise using April 2024 numbers, Polvo price assumes 1% Fuel Oil as Heavy yield, Tupi assumes 0.5% Fuel Oil as Heavy yield; Source: Rystad Energy research and analysis

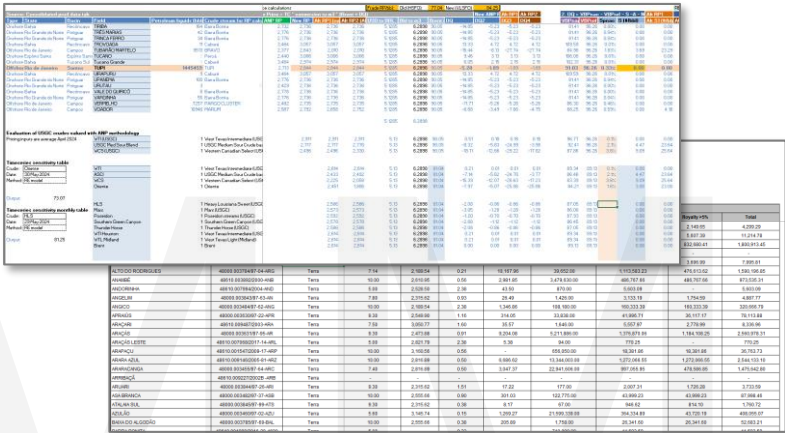
Rystad Energy has modeled Brazil's full production, reference pricing mechanisms, and royalty rates to simulate gov't revenue under various alternative regimes

Assessing impact of the Royalty change

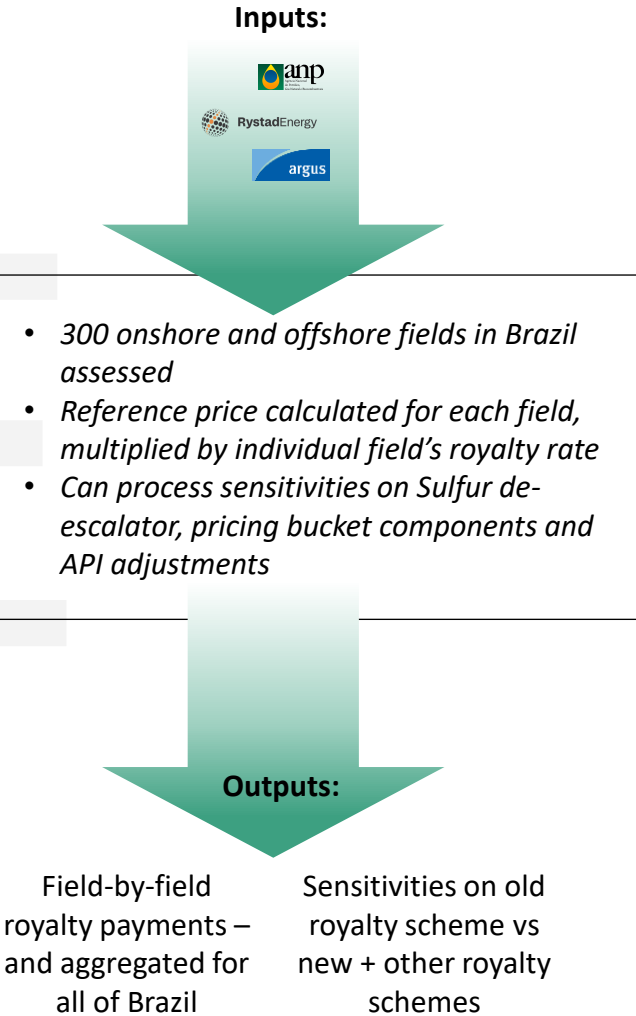


Rystad Energy royalty revenue model:

- Uses Rystad Energy proprietary data, 3rd party pricing data and ANP published data as inputs
- Able to assess royalty payments on field level using published L/M/H yield, Sulfur, nitrogen and TAN data.
- All producing Brazilian fields covered.
- Modeled with the most recent published monthly data (April 2024)
- Able to calculate sensitivities in royalty calculation scheme and adjustments to reference price calculation
- **Accurate within 0.9% of aggregated ANP published reference price figures**



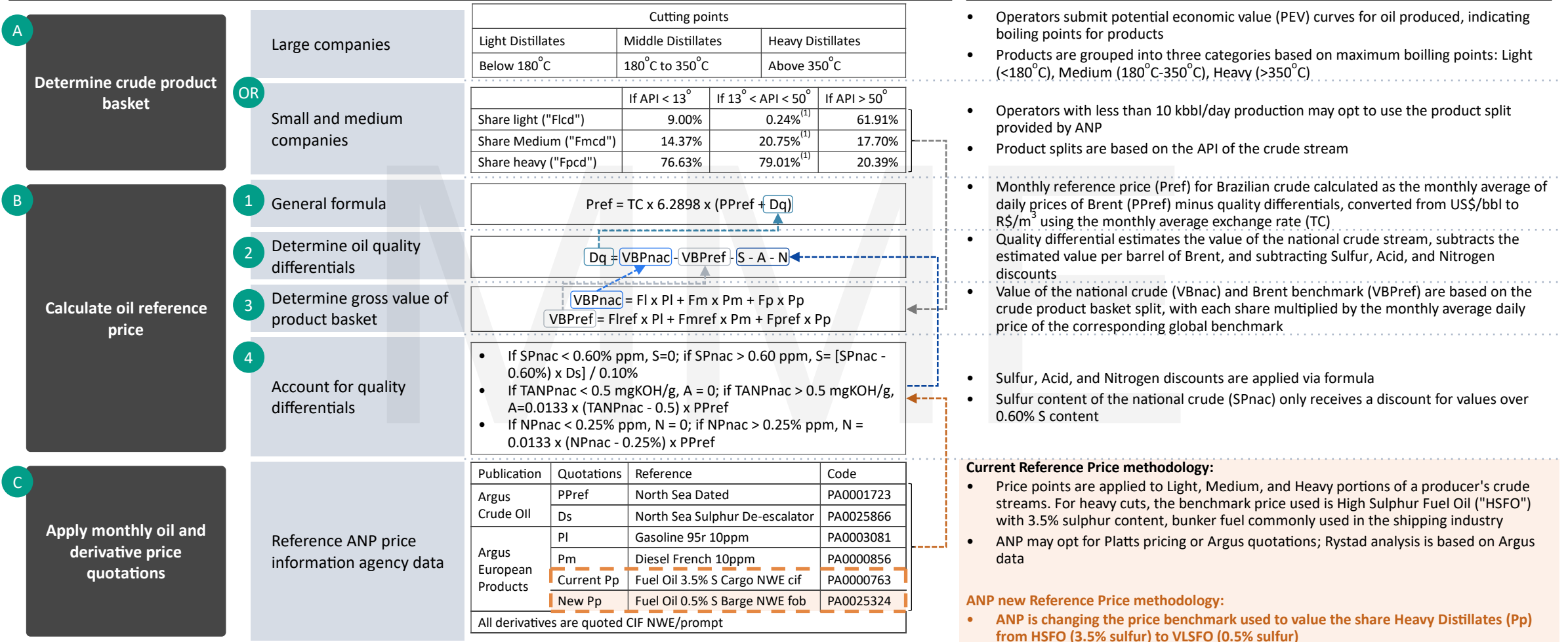
Functionality



Source: Rystad Energy research and analysis

Rystad's model incorporates the full ANP reference price calculation

Reference price calculation steps

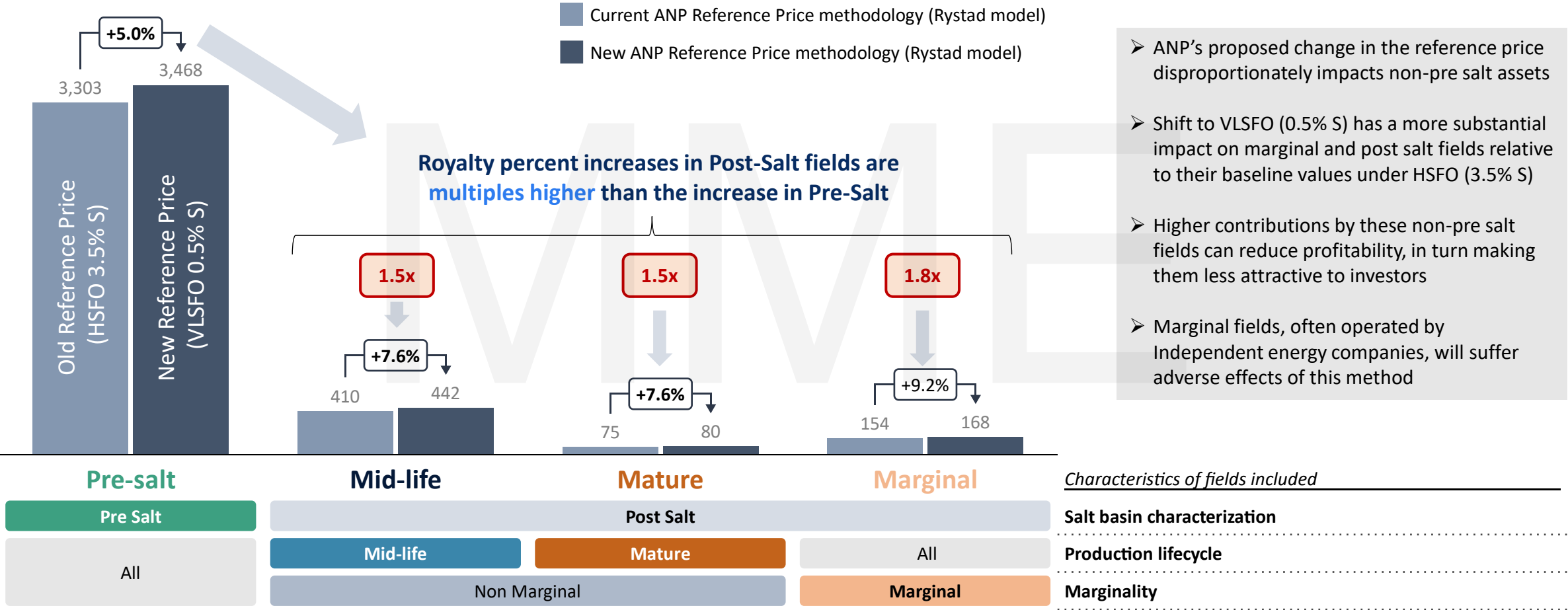


Note: Medium grade product baskets for small companies are determined using a formula. Values provided are estimates.

Source: Rystad Energy research and analysis; Rystad Energy UCube; ANP website: [Resolution 874 2022](#); [Draft Resolution](#)

The ANP's new reference price methodology impacts environments in a disproportionate manner

Royalty for Offshore Oil Production, April 2024
R\$ million



Source: Rystad energy research and analysis; ANP

Rystad Energy recommends a reference price calculation method that more accurately values the sulfur content in Brazilian crudes

Recommended Alternative Reference Price Methodology

To price the sulfur discount for Mature and Marginal post-salt, apply a method that accounts for the difference in benchmark prices for Fuel Oils with different sulfur contents

Calculation specifics

Change “S” component of “Dq” quality discount in ANP’s current reference price methodology.

New methodology:

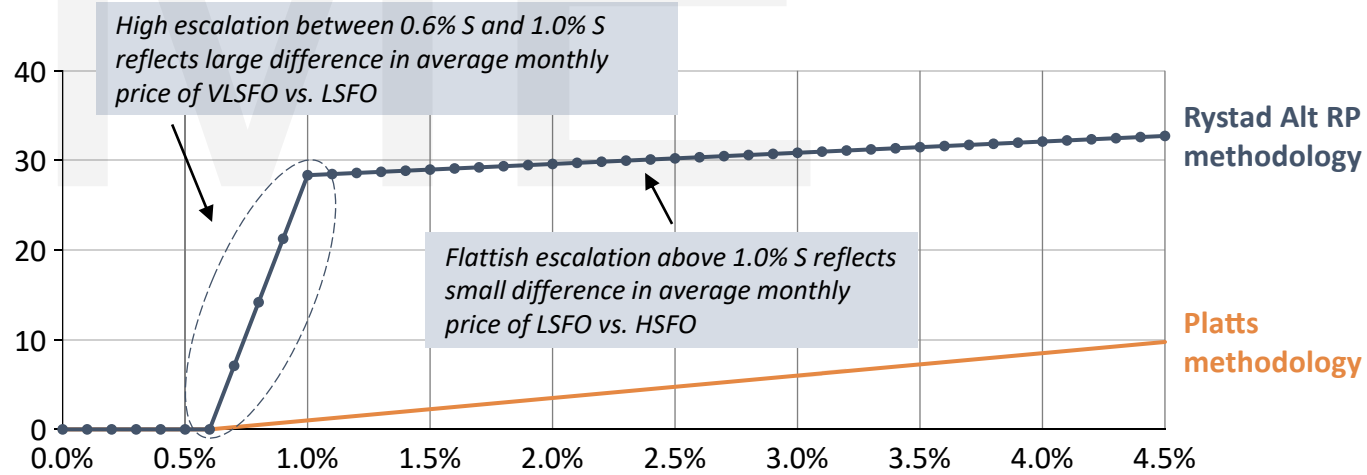
- If $SP_{nac} < 0.60\%$ ppm, $S_0 = 0$
- If $0.60\% < SP_{nac} < 1.0\%$ ppm, $S_1 = (SP_{nac} - 0.60\%) / (LS\% - VLS\%) \times (\$VLSFO - \$LSFO)$
- If $SP_{nac} > 1.0\%$ ppm, $S_2 = (SP_{nac} - 1.0\%) / (HS\% - LS\%) \times (\$LSFO - \$HSFO) + (\$VSLFO - \$LSFO)$

Note: Rystad evaluation of different alternative methodologies is provided in the Appendix.
Source: Rystad Energy research and analysis

Rationale

- Platts and Argus sulfur de-escalation are applied in a linear fashion
- Observed sulfur differentials in the fuel oil market do not conform to a linear formula
- Tracking observable sulfur discounts in fuel oil markets more accurately represents a market-based sulfur discount

Sulfur discount by methodology, April 2024



Rystad's recommended RP calculation change focuses on the sulfur quality differential and minimizes overall changes to the existing methodology

Reference price calculation steps

A

Determine crude product basket

Large companies

OR

Small and medium companies

B

Calculate oil reference price

1 General formula

2 Determine oil quality differentials

3 Determine gross value of product basket

4 Account for quality differentials

C

Apply monthly oil and derivative price quotations

Reference ANP price information agency data

Current and New RP calculation

Cutting points		
Light Distillates	Middle Distillates	Heavy Distillates
Below 180°C	180°C to 350°C	Above 350°C

	If API < 13°	If 13° < API < 50°	If API > 50°
Share light ("Flcd")	9.00%	0.24% ⁽¹⁾	61.91%
Share Medium ("Fmcd")	14.37%	20.75% ⁽¹⁾	17.70%
Share heavy ("Fpcd")	76.63%	79.01% ⁽¹⁾	20.39%

$$\text{Pref} = \text{TC} \times 6.2898 \times (\text{PPref} + \text{Dq})$$

$$\text{Dq} = \text{VBPnac} - \text{VBPref} - \text{S} - \text{A} - \text{N}$$

$$\text{VBPnac} = \text{Fl} \times \text{Pl} + \text{Fm} \times \text{Pm} + \text{Fp} \times \text{Pp}$$

$$\text{VBPref} = \text{Flref} \times \text{Pl} + \text{Fmref} \times \text{Pm} + \text{Fpref} \times \text{Pp}$$

- If SPnac < 0.60% ppm, S=0; if SPnac > 0.60 ppm, S= [SPnac - 0.60%] x Ds / 0.10%
- If TANPnac < 0.5 mgKOH/g, A = 0; if TANPnac > 0.5 mgKOH/g, A=0.0133 x (TANPnac - 0.5) x PPref
- If NPnac < 0.25% ppm, N = 0; if NPnac > 0.25% ppm, N = 0.0133 x (NPnac - 0.25%) x PPref

Publication	Quotations	Reference	Code
Argus Crude Oil	PPref	North Sea Dated	PA0001723
	Ds	North Sea Sulphur De-escalator	PA0025866
Argus European Products	Pl	Gasoline 95r 10ppm	PA0003081
	Pm	Diesel French 10ppm	PA0000856
	Current Pp	Fuel Oil 3.5% S Cargo NWE cif	PA0000763
	New Pp	Fuel Oil 0.5% S Barge NWE fob	PA0025324
All derivatives are quoted CIF NWE/prompt			

Change?

✗

✗

✗

✗

✗

!

✗

Rystad recommended RP calculation changes

Change applies to "S" component of "Dq" quality differential modifier of the RP calculation

If SPnac < 0.60% ppm S

- S₀ = 0

If 0.60% ppm S < SPnac < 1.0% ppm S

- S₁ = (SPnac - 0.60%) / (LS% - VLS%) x (\$VLSFO - \$LSFO)

If SPnac > 1.0% ppm S

- S₂ = (SPnac - 1.0%) / (HS% - LS%) x (\$LSFO - \$HSFO) + (\$VLSFO - \$LSFO)

Acronym	Definition
SPnac	Sulfur content of national crude oil being evaluated in % ppm S by weight.
HS%	Percent sulfur content in High Sulfur Fuel Oil (HSFO) per global price benchmark definitions. Equal to 3.5% ppm S wt.
LS%	Percent sulfur content in Low Sulfur Fuel Oil (LSFO) per global price benchmark definitions. Equal to 1.0% ppm S wt.
VLS\$	Percent sulfur content in Very Low Sulfur Fuel Oil (VLSFO) per global price benchmark definitions. Equal to 0.5% ppm S wt.
\$HSFO	Average monthly reported price of HSFO global benchmark. Argus code PA0000763 (Fuel oil 3.5%S 380cst cargo NWE cif, USD/t).
\$LSFO	Average monthly reported price of LSFO global benchmark. Argus code PA0000748 (Fuel oil 1.0%S 380cst cargo NWE fob, USD/t).
\$VLSFO	Average monthly reported price of VLSFO global benchmark. Argus code PA0025324 (Fuel oil 0.5%S barge NWE fob, USD/t).

Note: Medium grade product baskets for small companies are determined using a formula. Values provided are estimates. See Appendix "ANP reference price methodology and definitions" for full list of ANP definitions.

Source: Rystad Energy research and analysis; Rystad Energy UCube; ANP website: [Resolution 874 2022](#); [Draft Resolution](#)

The alternative reference price methodology effectively mitigates the impact of the ANP's change on Mature and Marginal fields while retaining most of the royalty increase

Royalty per barrel of crude oil production and difference vs. ANP current reference price methodology, April 2024
USD/bbl

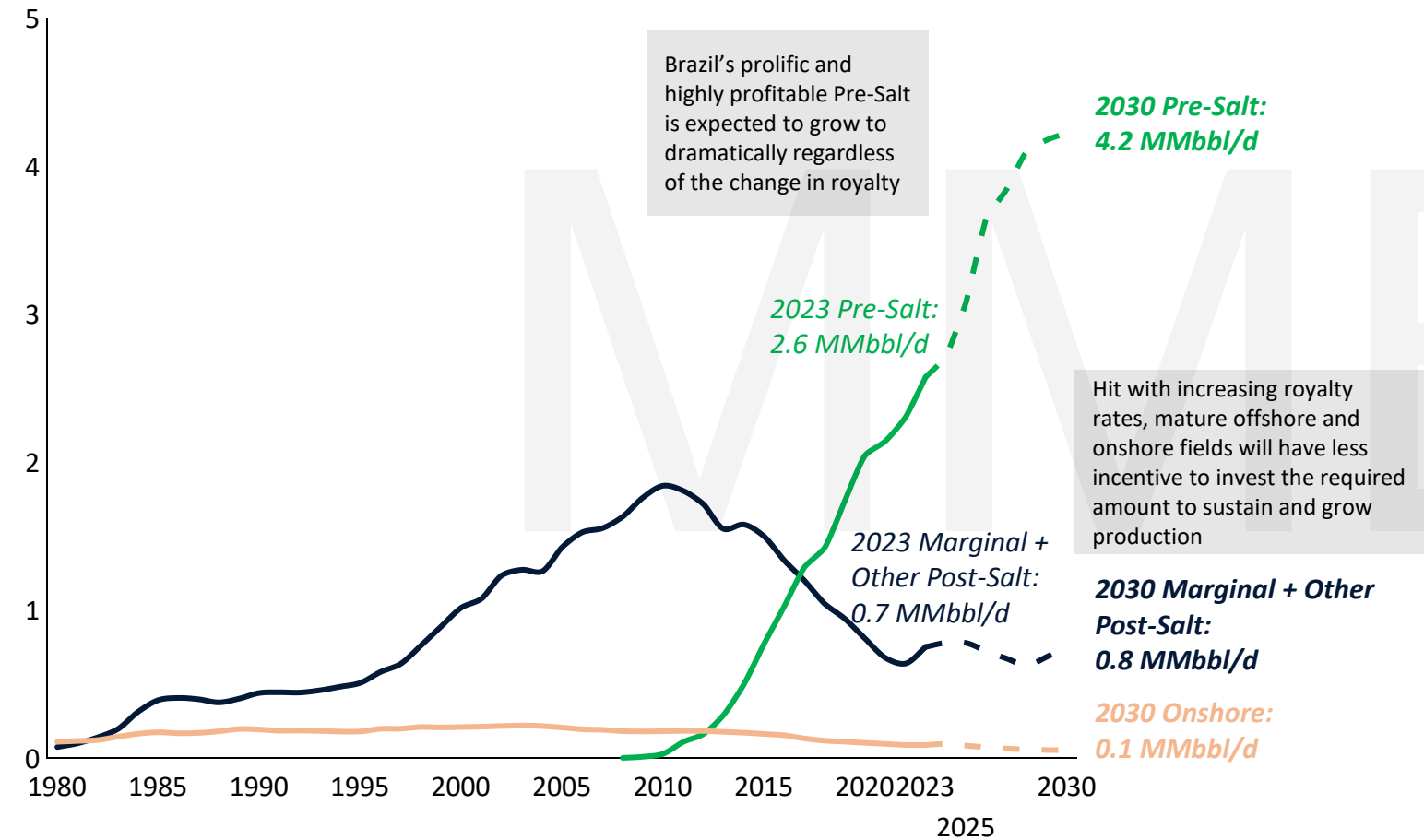


1: Int is defined as the interim solution recommended to accommodate the needs of projects in non-pre salt basins for independent operators.
Source: Rystad Energy research and analysis

By modifying the sulfur discounting mechanism, the ANP can support its dual objectives of better alignment with IMO 2020 and promote continued development of Mature and Marginal fields

Historical and forecast crude oil production in Brazil, 1980 to 2030

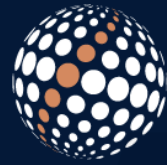
Mmbbl/d



Modifying the new reference price methodology enables ANP to achieve multiple strategic objectives

- 1 Continue to align with fuel oil markets post-IMO 2020 by valuing heavy product share of crude oil reference price with VLSFO (0.5% S)
- 2 Raise government revenues generated from crude oil royalties by increasing the reference price of under-valued light and medium crudes
- 3 Support continued development of post-salt and marginal oil fields by decreasing the reference price valuation on over-valued heavy sour crudes
- 4 Promote growth of Independent E&P companies and diversification of the domestic energy industry outside of Petrobras

Source: Rystad Energy research and analysis



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Navigating the future of **energy**

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