GAS MASTER PLAN

INDUSTRY STAKEHOLDER CONSULTATION WORKSHOP

Mining, Minerals and Energy Policy Development Branch

7 June 2023

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Gas Master Plan 2023: Scene Setting

- Global shift towards cleaner forms of energy conversion
  - Conversion of coal power generation to gas power generation, *(USA accounted for 61% carbon emission reduction)*
  - Commercialization of Carbon Capture Utilization and Storage,
  - Commercialization of Small Modular Reactors,
  - Acceleration Solar and Wind based power generation, and
  - Introduction of Cleaner Fuels for transport sector.

- Natural Gas Recent Global Developments
  - **Russia-Ukrain** – *impact on global natural gas supply*
  - **United States** - *Biden administration approval of exports of Liquefied Natural Gas (LNG) - compete with Russia LNG* ($ 39 billion Capex by 2030)*
  - **Regional** – Increased natural gas commercialization activities (**Mozambique, Tanzania and Namibia**)
  - **South Africa** – Increased interest from International Oil Companies (IOC's) to explore and develop gas fields within our shores (next slide)

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* Reuters (https://www.reuters.com) April 2023. (accessed 01- May 2023)

Natural Gas Southern Africa: Scene Setting*

*Source: WoodMackenzie, Eskom, Standard Bank, Company reports.

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Gas Master Plan 2023: Scene Setting

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iGas

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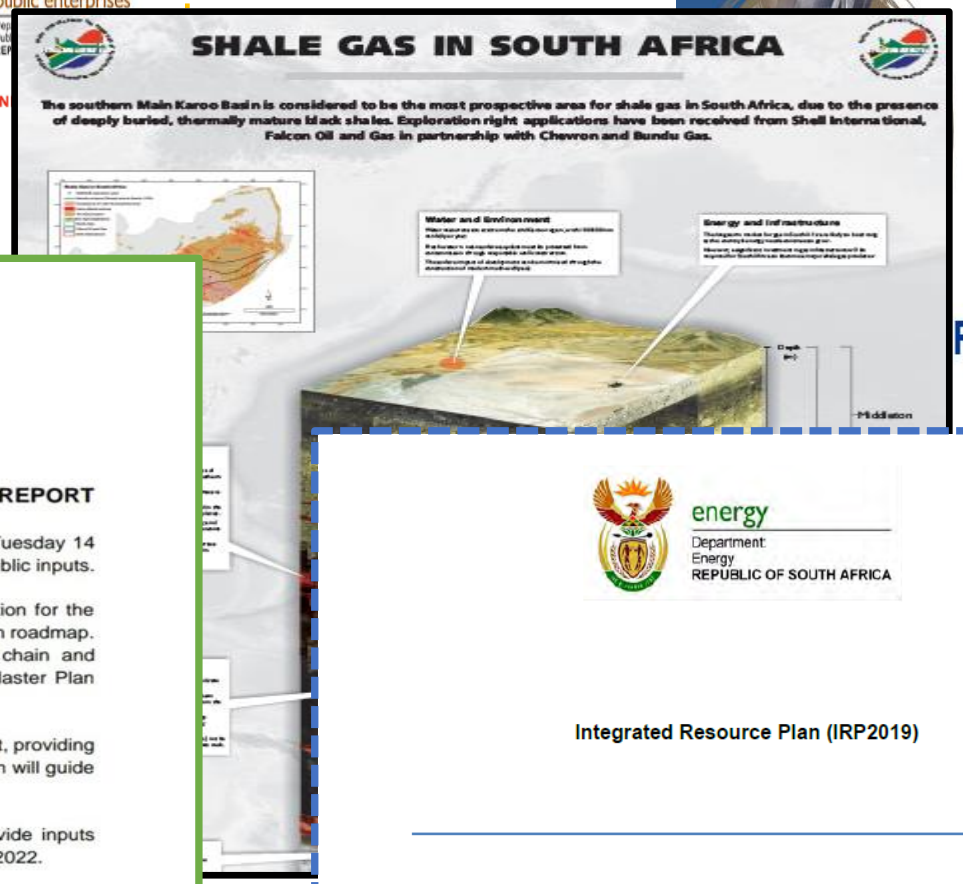

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Media statement
To: All media
Date: 14 December 2021

DMRE RELEASES THE GAS MASTER PLAN BASECASE REPORT

The Department of Mineral Resources and Energy (DMRE) has on Tuesday 14 December 2021, released the Gas Master Plan Basecase report for public inputs.

The purpose of the basecase report is to establish baseline information for the natural gas sector in South Africa as well as outline the Gas Master Plan roadmap. Such baseline information includes an overview of the gas value chain and regulatory framework. The report also sets the scene for the Gas Master Plan development process.

The Gas Master Plan, once developed, will serve as a policy instrument, providing a roadmap for taking strategic, political and institutional decisions which will guide industry investment planning and coordinated implementation.

Members of the public and affected stakeholders are invited to provide inputs and/or comments on the basecase report by no later than 31 January 2022.

The Gas Master Plan basecase report is available on http://www.energy.gov.za/files/media/explained/Gas_Master_Plan_Basecase_Report.pdf.

Written inputs may be submitted to zita.harber@dmre.gov.za and thilivhali.mulangaphuma@dmre.gov.za.

For media enquiries contact: Mediadesk@energy.gov.za | Media@dmre.gov.za

End

Issued by the Department of Mineral Resources and Energy

Eskom

Richards Bay - 3000 MW Gas-to-Power

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Integrated Resource Plan (IRP2019)

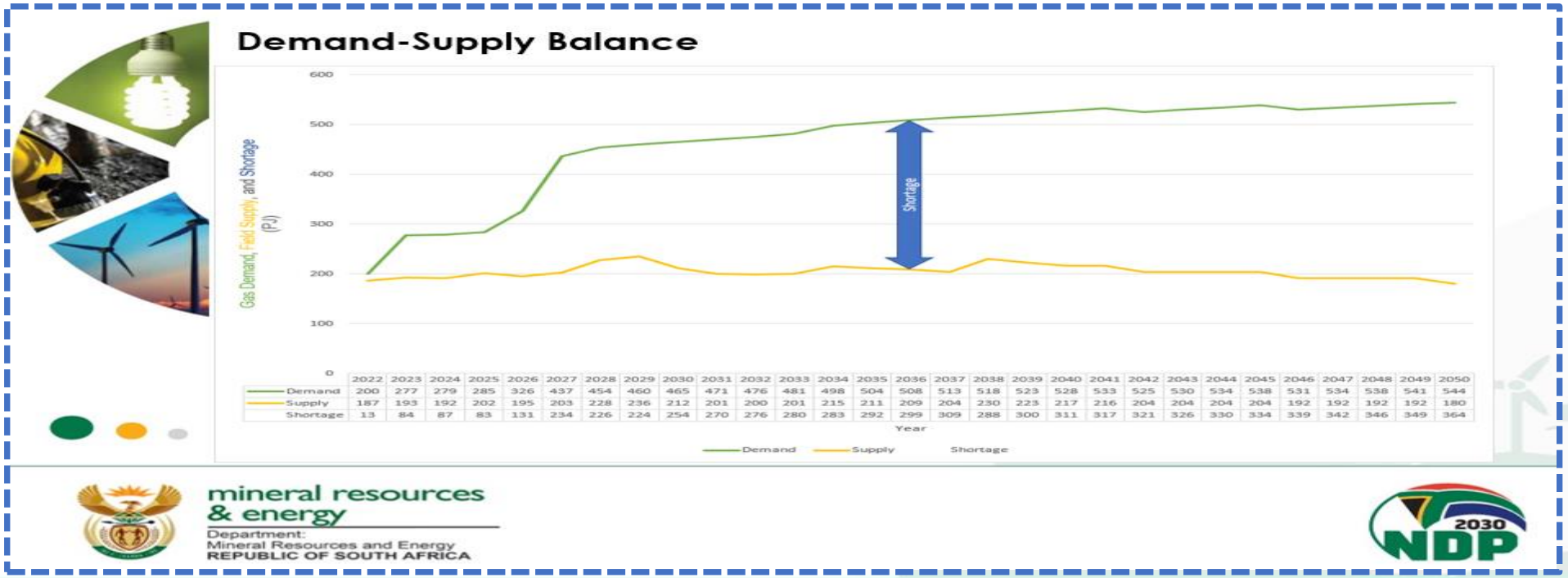
OCTOBER 2019

2030 NDP

Gas Master Plan 2023: Objective

❖ Overall Objective:

- To study the **balancing of <u>natural gas</u> Demand-Supply** for period up to 2050.
- *Propose optimized natural gas infrastructure development.*



	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Demand	200	277	279	285	326	437	454	460	465	471	476	481	498	504	508	513	518	523	528	533	525	530	534	538	531	534	538	541	544
Supply	187	193	192	202	195	203	228	236	212	201	200	201	215	211	209	204	230	223	217	216	204	204	204	204	192	192	192	192	180
Shortage	13	84	87	83	131	234	226	224	254	270	276	280	283	292	299	309	288	300	311	317	321	326	330	334	339	342	346	349	364

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* Reuters (https://www.reuters.com) April 2023. (accessed 01- May 2023)

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Stakeholder Consultation Objective

DMRE Presents

- Input assumptions
  - Natural Gas Demand and Supply,
  - Transportation (including Compressor Stations))
- Modelling results

Stakeholders:

- Provide initial inputs to assumptions and modelling results.

* Draft Report to be released for Public Comments

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Presentation Outline

1 GMP Document Structure and Implementation Plan

2 Demand Side Drivers and Scenarios

3 Supply Side Inputs and Assumptions

4 Modelling Approach and Output Results

5 Next Steps and Way Forward

6 Questions and Answers

TABLE OF CONTENTS

Gas Master Plan (GMP) consist:

- **Thirteen (13)** chapters categorized into **six (6)** non-technical chapters and **seven (7)** technical chapters form part of the policy document. **Ninety-five percent (95%)** of the GMP have been completed to date
- Non-technical chapters compiled through in-depth desktop research, literature review, benchmarking exercises with other countries including preliminary research conducted as per GMP Basecase Report
- Technical chapters cover gas demand and supply analysis, gas infrastructure, key input parameter assumptions, basecase scenario and alternative scenarios, modelling and modelling results analysis
- ***Currently in progress:*** Consultations on the basecase results, conducting inter and outside government stakeholder consultations as well as conducting the socio-economic impact assessment systems etc
- The work in progress subjected to reviews and changes based on consultations with key stakeholder, new critical information emerges, proof-reading and peer-review

Chapter 1: Executive Summary

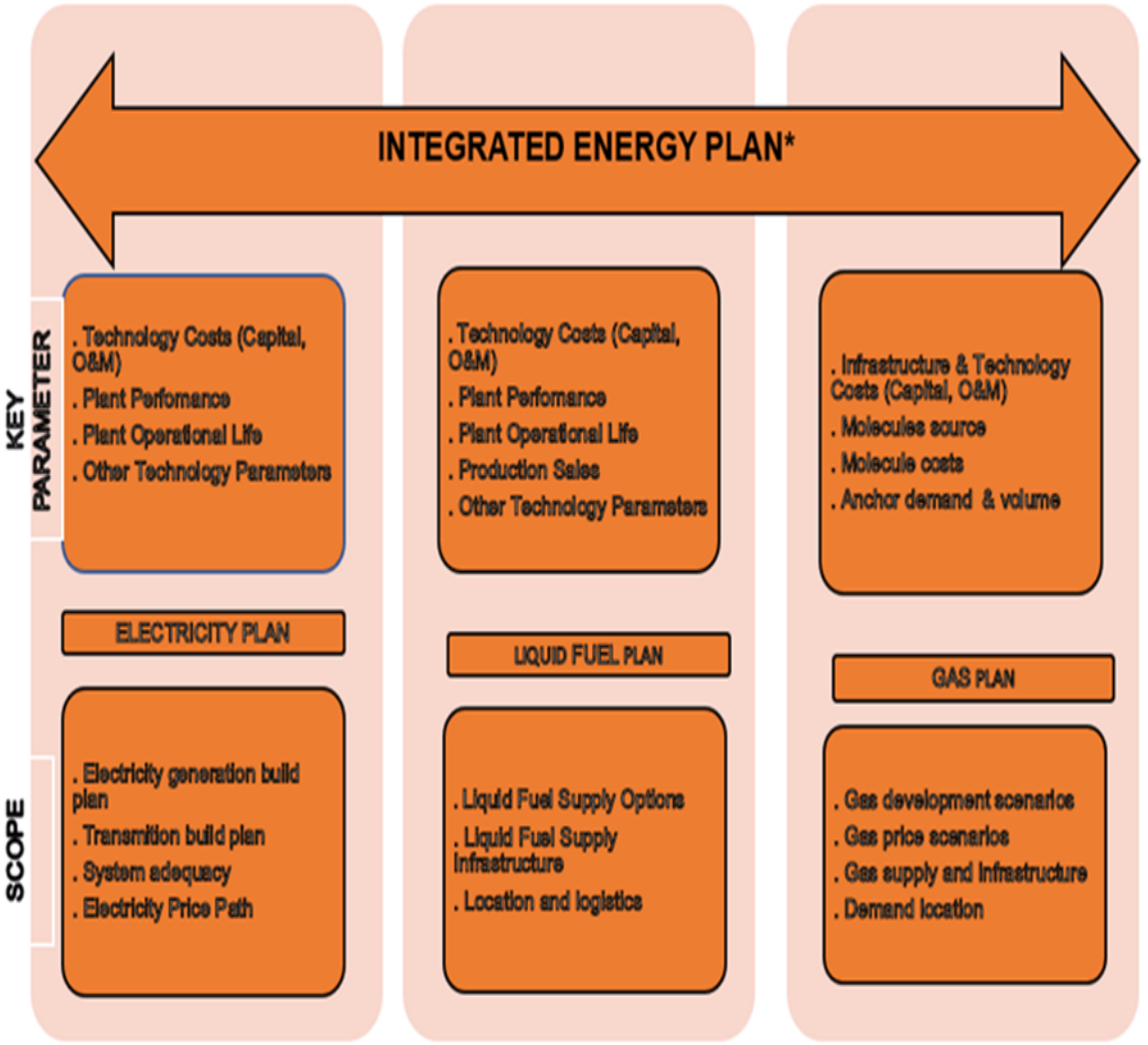
Context for the development of the Gas Master Plan:

"Energy is the backbone of the country's sustainable and economic development"

"Gas plays a central role in the socio-economic development of our country"

Gas Master Plan linkage with Integrated Energy Plan and Integrated Resource Plan:

- ❖ the maturity of the integrated energy planning
- ❖ focus on the bottom-up approach and how GMP links with other energy plans



Chapter 2 & 3

Chapter 2 : Introduction and background

- Legislative prescripts mandating the department to pursue GMP
- Ensuring security of energy supply through diversification at the core
- The abundance of energy sources and successful tapping into all possible energy carriers is vital

Chapter 3: Gas Master Plan In context

- Objective of the Gas Master plan
- Scope of the Gas Master Plan
- The role of gas

Chapter 4: Gas Master Plan Process Flow

Chapter 5: Overview of Legislative Prescripts

Key policies within the energy sector:

- White Paper on Energy Policy of 1998
- National Energy Act (No. 34 of 2008)
- Integrated Energy Plan
- Gas Act (No. 48 of 2001)*
- Gas Regulator Levies Act (No 75 of 2002)
- Mineral and Petroleum Resources Development Act (No 28 of 2002)

*Gas Amendment Bill to be resubmitted to Cabinet

Chapter 5: Overview of Current Legislature

Key legislation within other sectors

- National Environmental Management Act (NEMA)
- National Environmental Management: Biodiversity Act (NEMBA)
- National Water Act (No 36 of 1998)
- International Trade Administration Act (No 71 of 2002)
- Carbon Tax Act (No 15 of 2019)

Chapter 6: Overview of the SA Gas Sector

"natural gas market contributes 3% of the total South African energy mix"*

"90% of country's existing natural gas demand is supplied by a single entity, Sasol"

"physical workflow architecture for the natural gas business is built around a capital-intensive asset base"

Natural Gas value chain

- ❖ Upstream Gas Sector
- ❖ Midstream Gas Sector
- ❖ Downstream Gas Sector
- ❖ Gas Storage

Upstream
PetroSA's FA platform
(off-shore at Mossel Bay)
Sasol's Pande and Temane gas field
(Mozambique)
Tetra4 CNG Production
(onshore in Virginia)

Midstream
Large-scale gas transmission pipelines
(ROMPCO, Lilly pipeline, Sasol Gas)
PetroSA subsea gas transmission pipeline
(FA platform to GTL refinery in Mossel Bay)
Above ground natural gasholder facilities
(Egoli Gas in Gauteng – Cottesloe & Langlaagte)

Downstream
Distribution pipeline
(MP, FS, GP, KZN)
CNG dispensing
(GP, KZN)
GTL plant
(Mossel Bay)
CTL (converted)
(Sasolburg)

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*DMRE (2021) The South African Energy Sector Report
* BP Statistical Review of World Energy 2022

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GMP Demand Modelling

- Demand Modelling Approaches
- Gas Demand Drivers and Demand Nodes
- Gas Demand Scenarios
- Gas Demand Projections

Demand Modelling Approaches

❖ Bottom-up approach (Power Sector):

✓ Ratio of output energy to installed capacity:

$$\boldsymbol{Capacity\ Factor\ = \frac{Actual\ Energy\ Output(MWh)}{Capacity\ (MW) \times Hours}}$$

✓ Ratio of output energy to input energy:

$$\boldsymbol{Efficiency\ Rate = \frac{Capacity\ (MW) \times Capacity\ Factor\ \times Hours}{Input\ Energy(MWh)}}$$

✓ Using ratio defined in 2. above:

$$\boldsymbol{Input\ Energy(MWh) = \frac{Capacity\ (MW) \times Capacity\ Factor\ \times Hours}{Efficincy\ Rate}}$$

✓ Converting MWh to PJ:

$$\boldsymbol{Energy\ Demand(PJ) = Input\ Energy(MWh) \times Conversion\ Factor}$$

Demand Modelling Approaches

❖ Bottom-up approach:

✓ Transport sector

1. Vehicle Sales Forecast = Gompertz Distribution Model
2. Vehicle Stock = Vehicle Sales Forecast **x** Scrapping Model
3. Vehicle Kilometres = New Vehicle Mileage **x** Decay Model
4. Fuel Economy = Initial Fuel Economy **x** Fuel Standard Model
5. Fuel Consumption (m^3) = Vehicle Stock **x** Vehicle Kilometres x Fuel Economy
6. Energy Demand(PJ) = Fuel Consumption **x** Conversion Factor

Demand Modelling Approaches

❖ Top-Down approach:

✓Power (private power generation), Industrial, commercial and agricultural sectors.

1. $\boldsymbol{Energy = Activity \times \beta + \alpha}$

2. $\boldsymbol{Energy = (Activity \times Intensity)/Efficiency}$

- Notes:

✓ ***Activity*** – *refers to the size of the stock, e.g., GDP, air-conditioned area of commercial buildings*

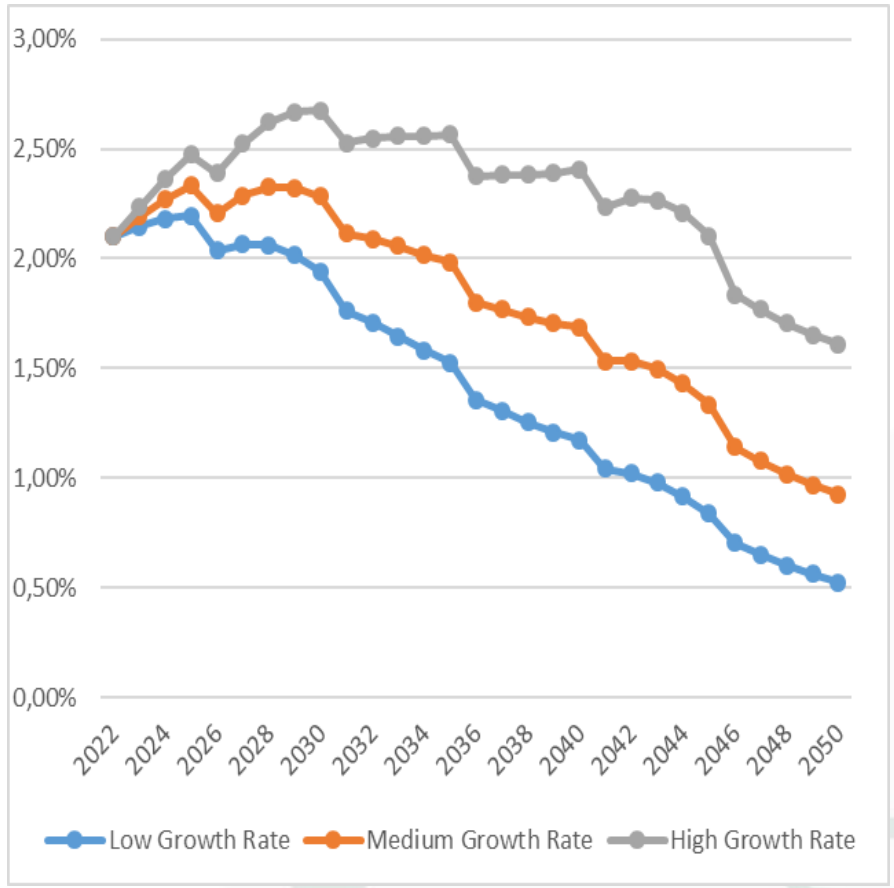
✓ ***Intensity*** – *usage and capacity of each unit*

✓ ***Efficiency*** – *is the technological performance of the equipment*

✓ β, α – *parameters*

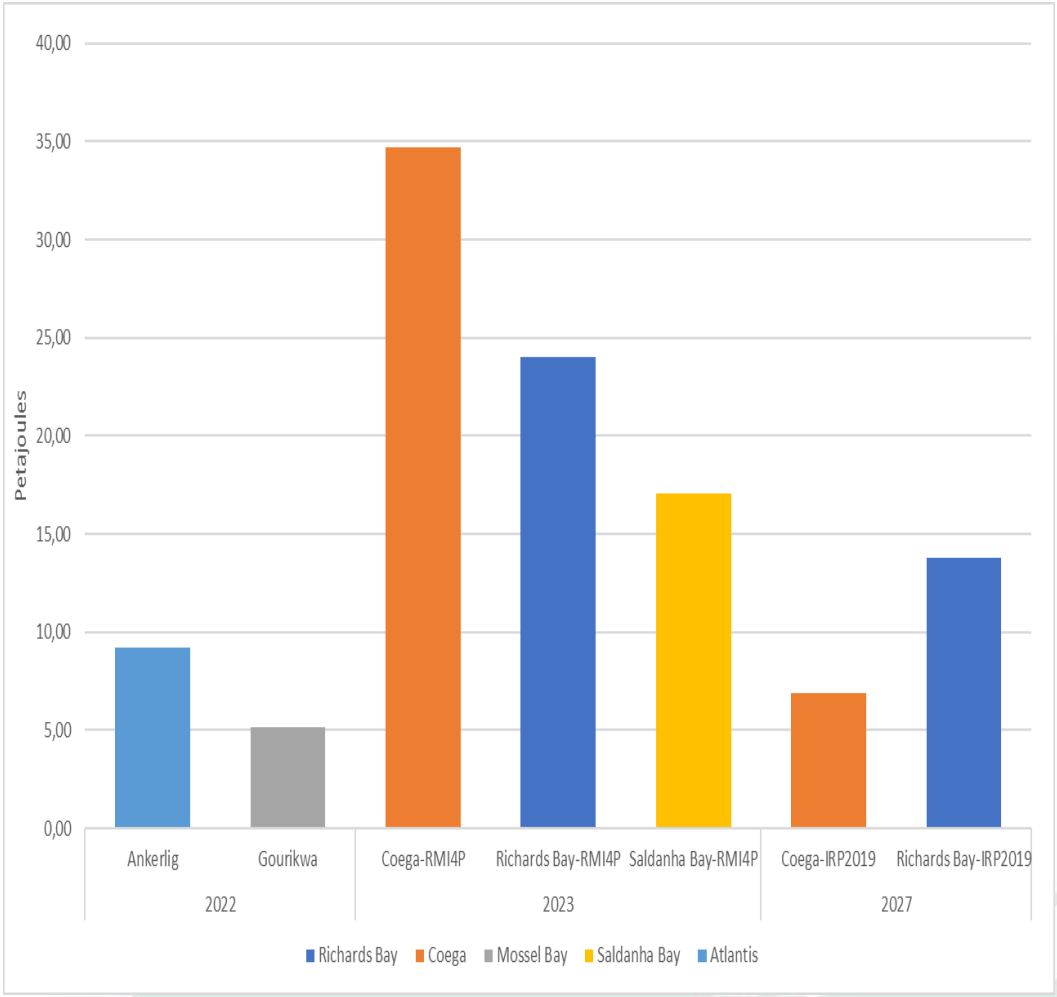
GDP Growth Rates (Gas Demand Driver)

- The Long-Term Growth Model (LTGM) is publicly available:
  - ✓ Developed by World Bank.
  - ✓ Spreadsheet-based toolkit.
  - ✓ Applied in more than 40 countries including South Africa.
  - ✓ Based on the neoclassical Solow-Swan growth model, where Savings & investment are key.
  - ✓ Designed for simplicity, transparency, ease-of-use and low data requirements.
- Simulated three long-term growth scenarios:
  - ✓ Low, Medium and High GDP growth rates.
  - ✓ Calibrated to the National Treasury growth rates.



Existing and New-builds GTP Plants (Gas Demand Driver)

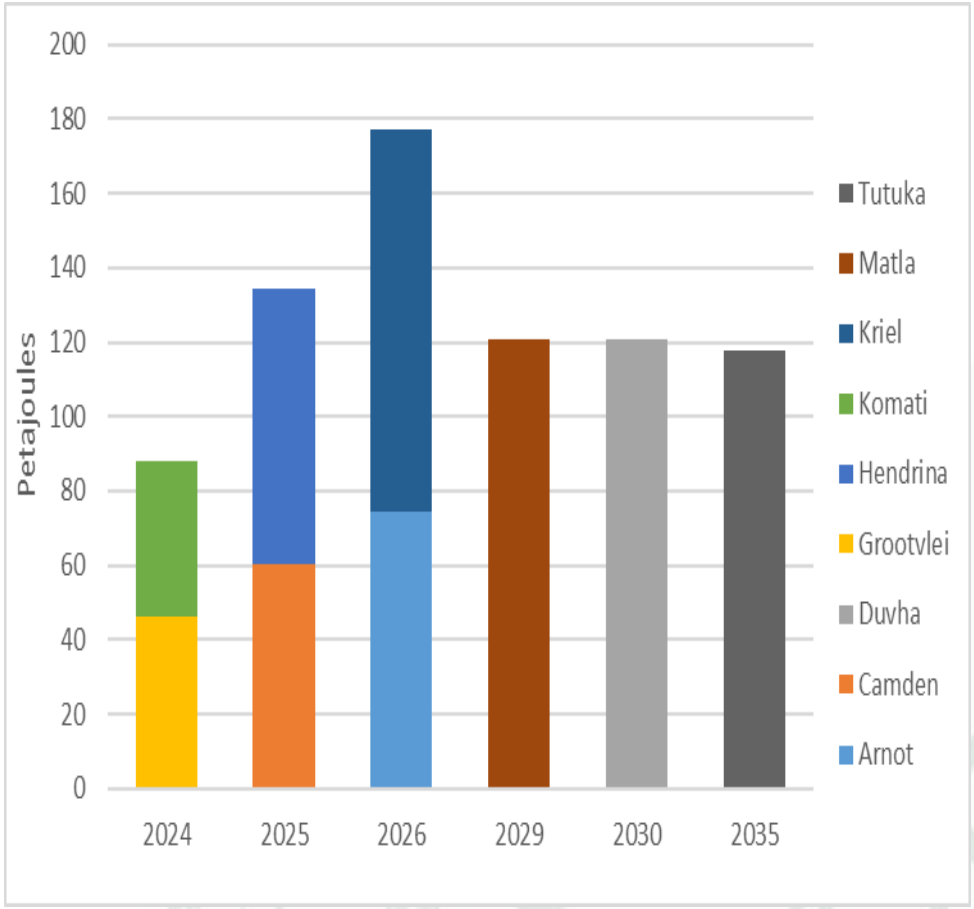
- Existing OCGTs to CCGTs:
  - ✓ Ankerlig (capacity = 1338MW, capacity factor = 12% and efficiency rate = 50%)
  - ✓ Gourikwa (capacity = 746MW, capacity factor = 12% and efficiency rate = 50%)
- New-build through RMI4P:
  - ✓ Capacity = 1420MW, capacity factor = 66% and efficiency rate = 39%
- New-build through IRP2019:
  - ✓ Capacity = 3000MW, capacity factor = 12% and efficiency rate = 55%



Conversions of Coal Power Plants (Gas Demand Driver)

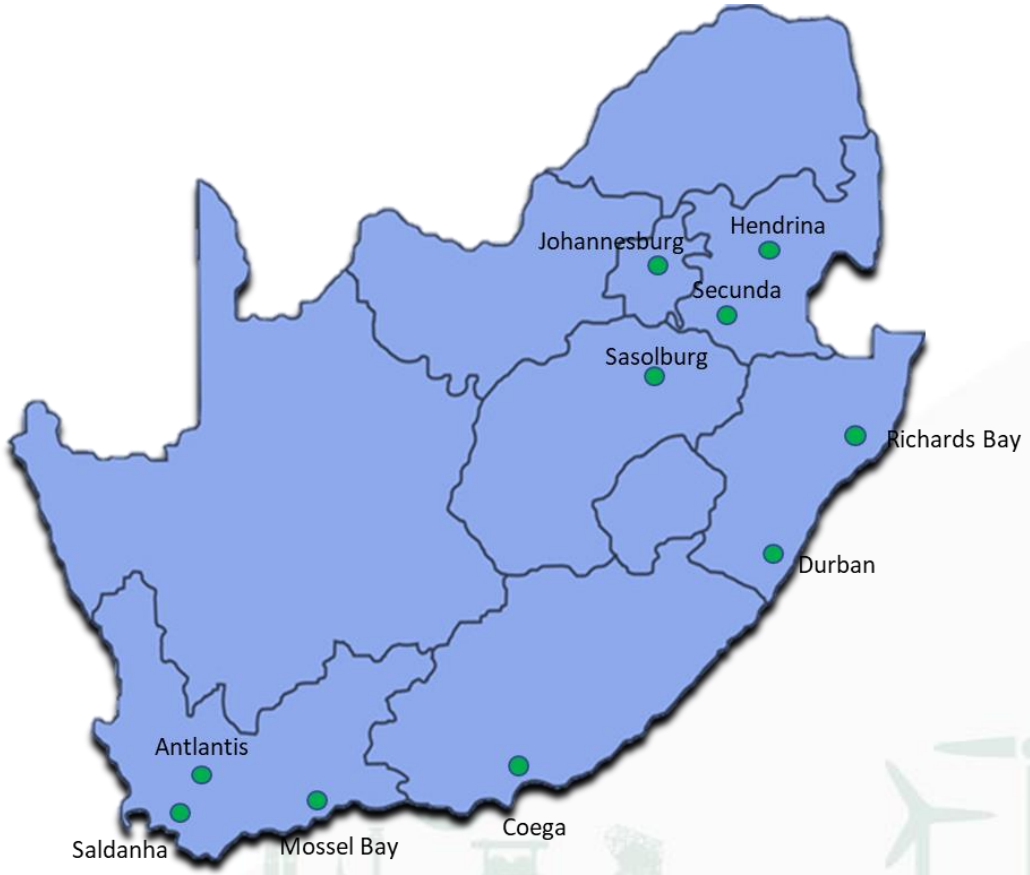
- 50-year Life Decommissioning

Province	Power Station	Installed Capacity (MW)	Efficiency Rate (%)
Mpumalanga	Duvha	3600	37,6
Mpumalanga	Matla	3600	37,6
Mpumalanga	Kriel	2850	34,99
Mpumalanga	Arnot	2100	35,6
Mpumalanga	Hendrina	2000	34,2
Mpumalanga	Camden	1600	33,4
Mpumalanga	Grootvlei	1200	32,9
Mpumalanga	Komati	1000	30



Gas Demand Nodes

- Ten potential gas demand nodes
- Criteria:
  - ✓Existing gas consumption and growth
  - ✓Envisaged Government programs
  - ✓Corporate plans



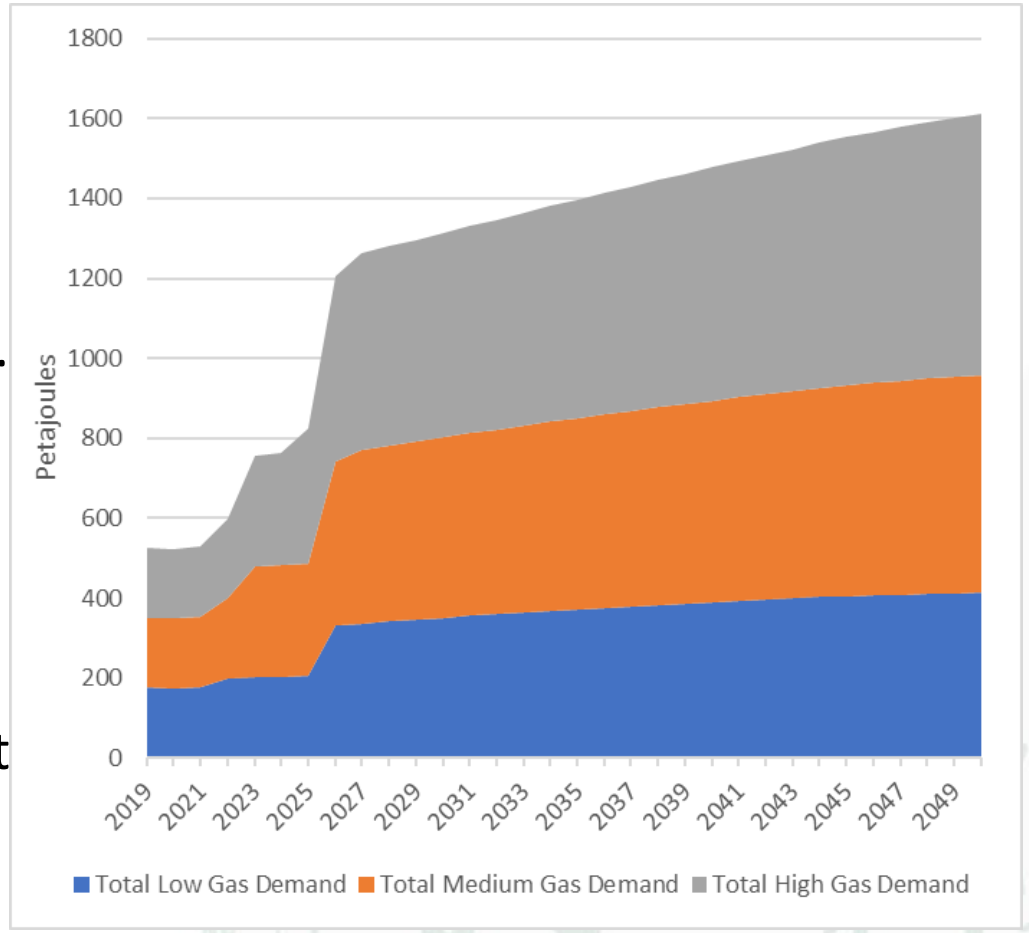
Gas Demand Scenarios

- Three gas demand scenarios:
  1. Low gas demand
  2. Medium (Base case) gas demand
  3. High gas demand
- Six economic sectors are considered
- Four main gas demand drivers:
  1. Existing CCGT power plants
  2. New-builds of CCGT power plants
  3. Conversion of coal power plants to gas power plants
  4. GDP growth rates
- Potential ten demand nodes identified

Sector	Driver	Low	Medium	High
Power	Conversion of OCGT plants	√	√	√
	Conversion of coal power plants			√
	New-builds of CCGT plants		√	√
	Private gas-to-power (GTP) plants	√	√	√
	Embedded and co-generation	√	√	√
Industry	Increase as per corporate plans		√	√
	Increase as per GDP growth rates	√	√	√
Other	CNG and LNG conversion rates			√
Demand Nodes		Atlantis	Atlantis	Atlantis
			Coega	Coega
		Durban	Durban	Durban
		Johannesburg	Johannesburg	Johannesburg
				Hendrina
		Mossel Bay	Mossel Bay	Mossel Bay
			Richards Bay	Richards Bay
			Saldanha Bay	Saldanha Bay
		Sassolburg	Sassolburg	Sassolburg
		Secunda	Secunda	Secunda

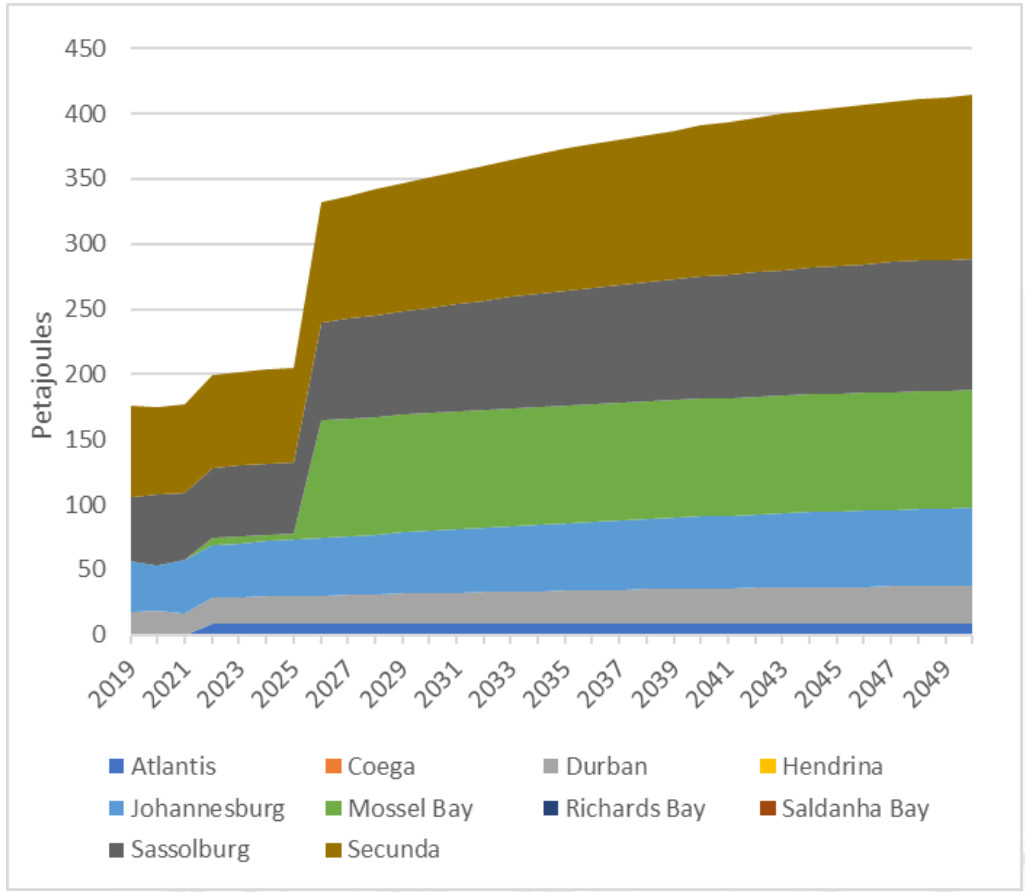
Total Gas Demand Projections

- In the medium term (2035), the demand could grow considerably – more than 500 PJ.
- The Low Gas Demand Scenario assumes Government programmes do not materialize.
- The Medium Gas Demand Scenario assumes that all GTP related Government programmes materialize.
- The High Gas Demand Scenario assumes that all GTP Government programmes and some coal power plant are converted to CCGT plants. sectors.



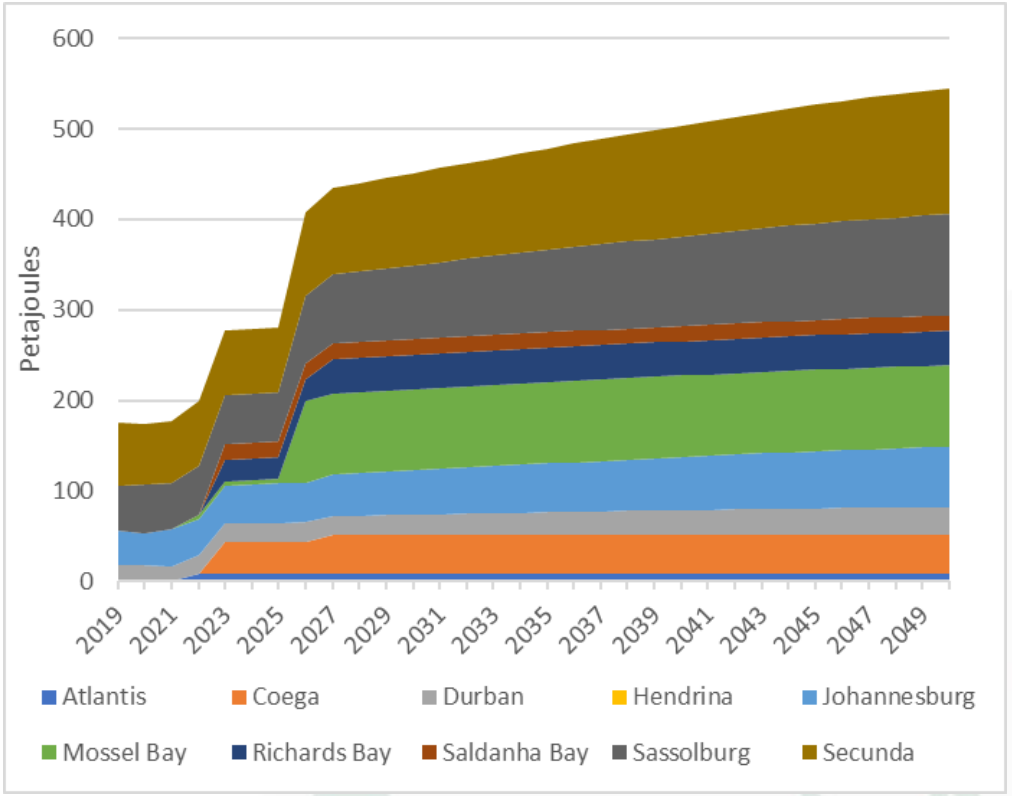
Low Gas Demand Projections

- The Low Gas Demand Scenario has six Demand Nodes.
- Secunda, Sassolburg and Mossel Bay are the highest consuming nodes due to the industrial sector.
- Johannesburg and Durban are moderate consuming demand nodes.
- Atlantis is the least consuming demand node.
- Gas Supply is through ROMCO pipeline from Mozambique.



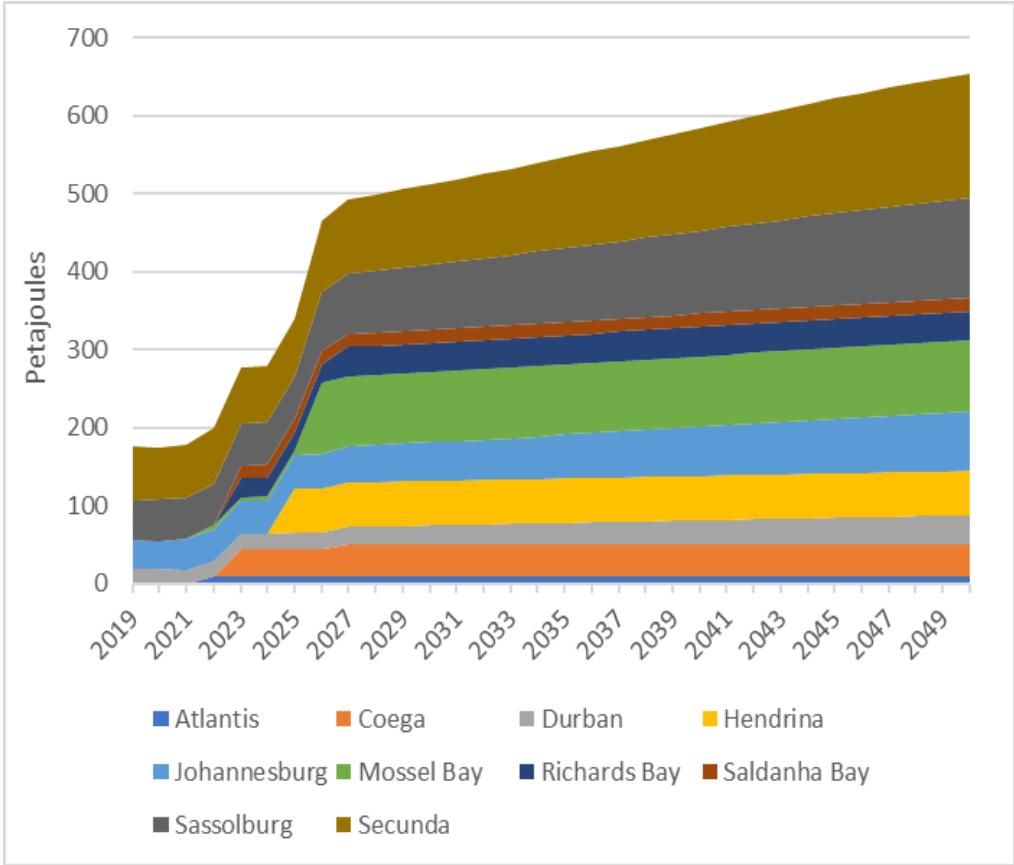
Base Case (Medium) Gas Demand Projections

- The Medium Gas Demand Scenario consists of nine demand nodes.
- Secunda, Sassolburg and Mossel Bay are the highest consuming demand nodes.
- Richards Bay, Coega and Saldanha Bay are the second highest consuming demand nodes due new-build projects through RMI4P and IRP2019.
- Atlantis demand node is mainly based on an existing CCGT power plant.
- Johannesburg and Durban demand nodes are based on expected increase of gas consumption in the industrial and commercial sectors.

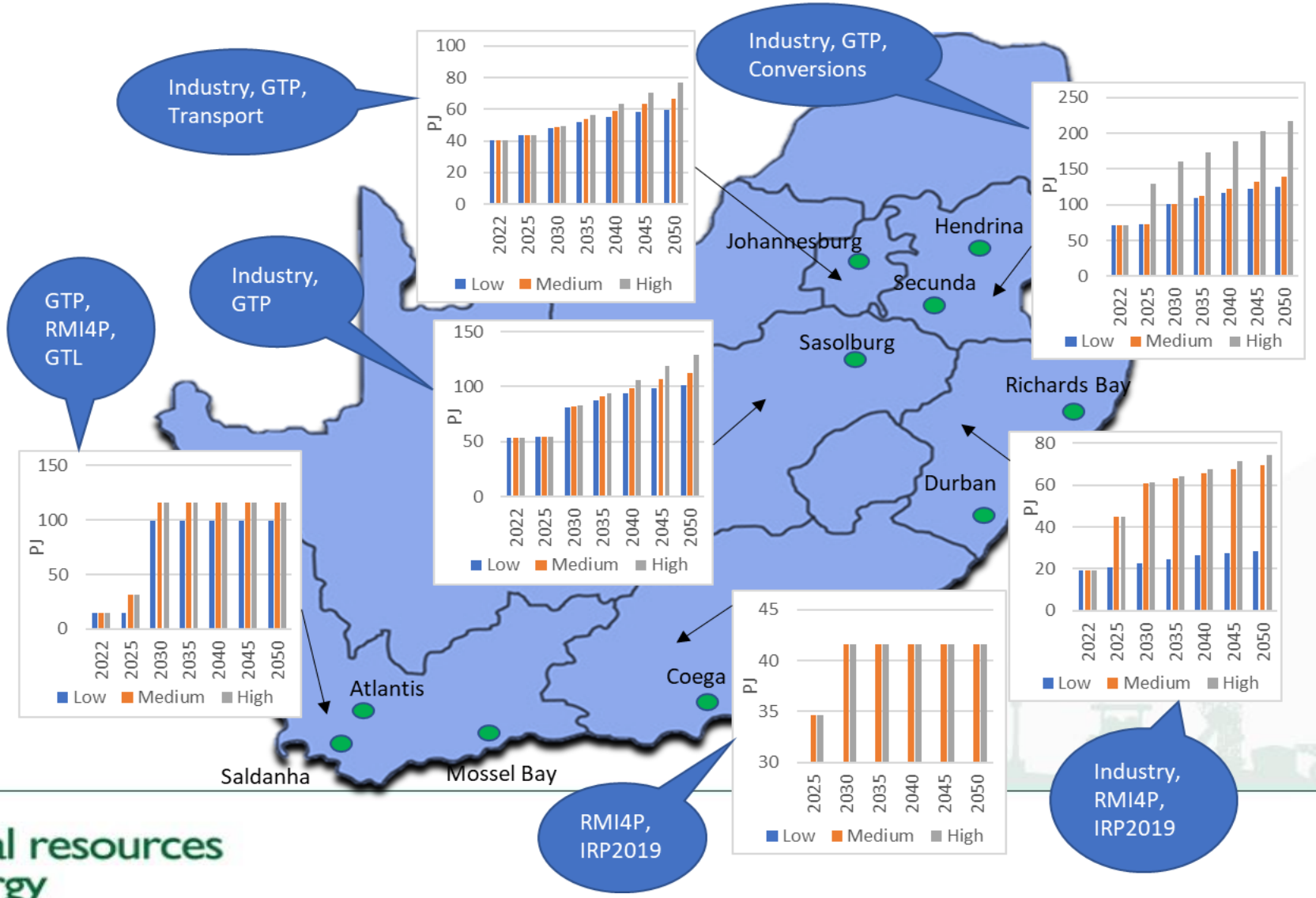


High Gas Demand Projections

- The High Gas Demand Scenario consists of ten demand nodes.
- Secunda, Sassolburg and Mossel Bay are the highest consuming demand nodes.
- Richards Bay, Coega and Saldanha Bay are the second highest consuming demand nodes due new-build projects through RMI4P and IRP2019.
- Atlantis demand node is mainly based on an existing CCGT power plant.
- Johannesburg and Durban demand nodes are based on expected increase of gas consumption in the industrial and commercial sectors.
- Hendrina demand node is introduced as a result of conversion of Hendrina, Komati and Arnot coal power stations.



Provincial Gas Demand Projections



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Natural Gas Supply Input Assumptions Components

- Natural gas fields
- Transportations: Pipelines
- Terminals:
  - Conventional Onshore Terminal
  - Offshore Port Terminals (FSRU)

Economic and Financial Parameters

Parameter	Value used in the model	Source
WACC (real, pre-taxed)	10%	National Treasury (EOCK Approach)
Exchange Rate	R/$15.87 (3 January 2022)	South African Reserve Bank
CPI SA	Historical - 2021	Stats SA
CPI USA	Historical - 2021	U.S. Bureau of labor statistics
Base year	2022	DMRE Planning
Study horizon	2022-2050	DMRE Planning Horizon

Natural Gas Fields

Fields Classifications

1. **Existing** - Field that are already producing
2. **Committed field -** Fields which have successfully passed a Financial Investment Decision (FID) stage or are expected to obtain the FID in the next three years. These fields should be on the 1P,2P,3P reserve categories
3. **Prospective gas fields-** Gas supply from undeveloped gas reserves that could provide domestic gas in the future. Currently have a lot of uncertainty, falling under the resource classifications (Contingencies)

*For **Base Case** – Existing and Committed Fields (1P,2P,3P) [Domestic]*

- with LNG [Imports] were considers.

Fields Properties Input Assumption

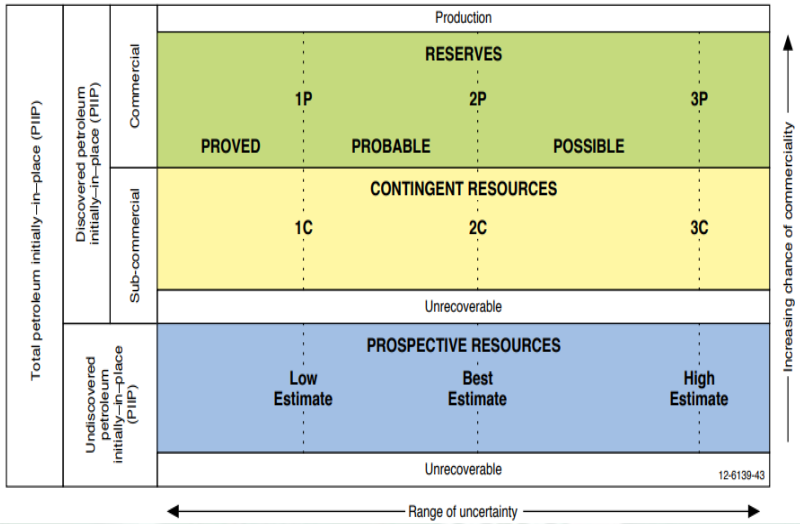
	Reserves Type	Initial Reserves (tcf)	Initial Reserves (PJ)	Production volume (PJ/yr)	Project start date	Sources
Pande-Temane	2P	Producing	Producing	Producing	Producing	Field Owners
Sasol MRG (Plant)	2P	Producing	Producing	Producing	Producing	
Tetra Field	1P	0.28	295	1.0	2022	
Tetra Field	2P	0.4	420	12.0	2028	
Tetra Field	3P	0.6	630	12.0	2034	
Block 11B/12B (Phase 1)	2P	3.0	3150	200	2027	
Block 2A	1P	0.2	210	17.6	2026	
Block 2A	2P	0.54	567	47.6	2032	
Block 2A	3P	0.92	961	80.7	2038	
Lephalale CBM	2C	1	1,050	68.4	To monetise first	
Lephalale CBM	3C	2.4	2,520	164.3	To monetise first	
Amersfoort CBM	2C	4.6	4,830		To monetise first	
Shale	2C	13	13,650	889.7	To monetise first	
Graaf	2P	5.5	5,775	376.4	2027	
Venus	2P	1.5	1575	102.7	2028	
Kudu	1P	1.4	1,470	95.8	2024	
Kudu	2P	3	3,150	205.3	To monetise first	
Kudu	3P	9	9,450	615.9	To monetise first	
Rovuma piped	3P	3	9,450	134	2027	

Reserves - quantities of petroleum anticipated to be commercially recoverable by application of development projects to known accumulations from a given date forward under defined conditions.

Contingent resources - quantities of petroleum estimated to be potentially recoverable from known accumulations, but the applied project(s) are not yet considered mature enough for commercial development due to one or more contingencies.

Prospectives- less certain than contingent. Potentially recoverable based on indirect evidence but which have not yet been drilled;

Reserves and contingent resources are categorized in accordance with the level of certainty associated with the estimates. Low best, and high estimates are denoted as 1P/2P/3P, and 1C/2C/3C

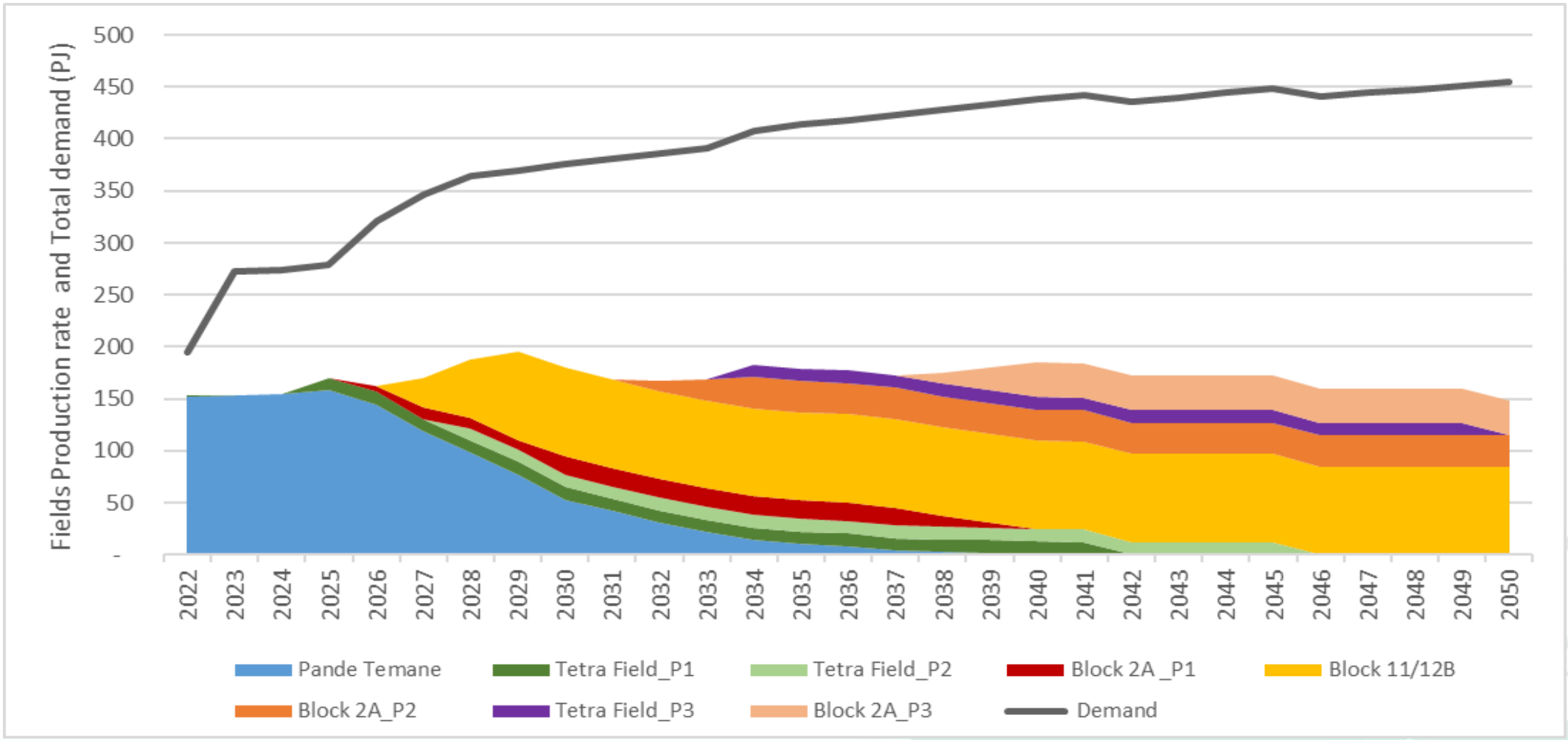


Domestic Fields Categorisation (Base Case)

Fields name	Classification	Reason
Pande- Temane	Existing	Currently on production
Tetra	Existing	Currently on production
Block 2A	Committed / (Prospective)*	Process of acquiring FID
Block 11B/12B	Committed	Production right approved. In the process of acquiring the FID
Amersfoort CBM	Prospective	Gas currently classified as "Contingent
Lephalale CBM	Prospective	Gas currently classified as "Contingent
Shale Gas	Prospective	Gas currently classified as "Contingent

*FID conditional on confirmation of off-take

Projected Reserve Decline And Total Demand



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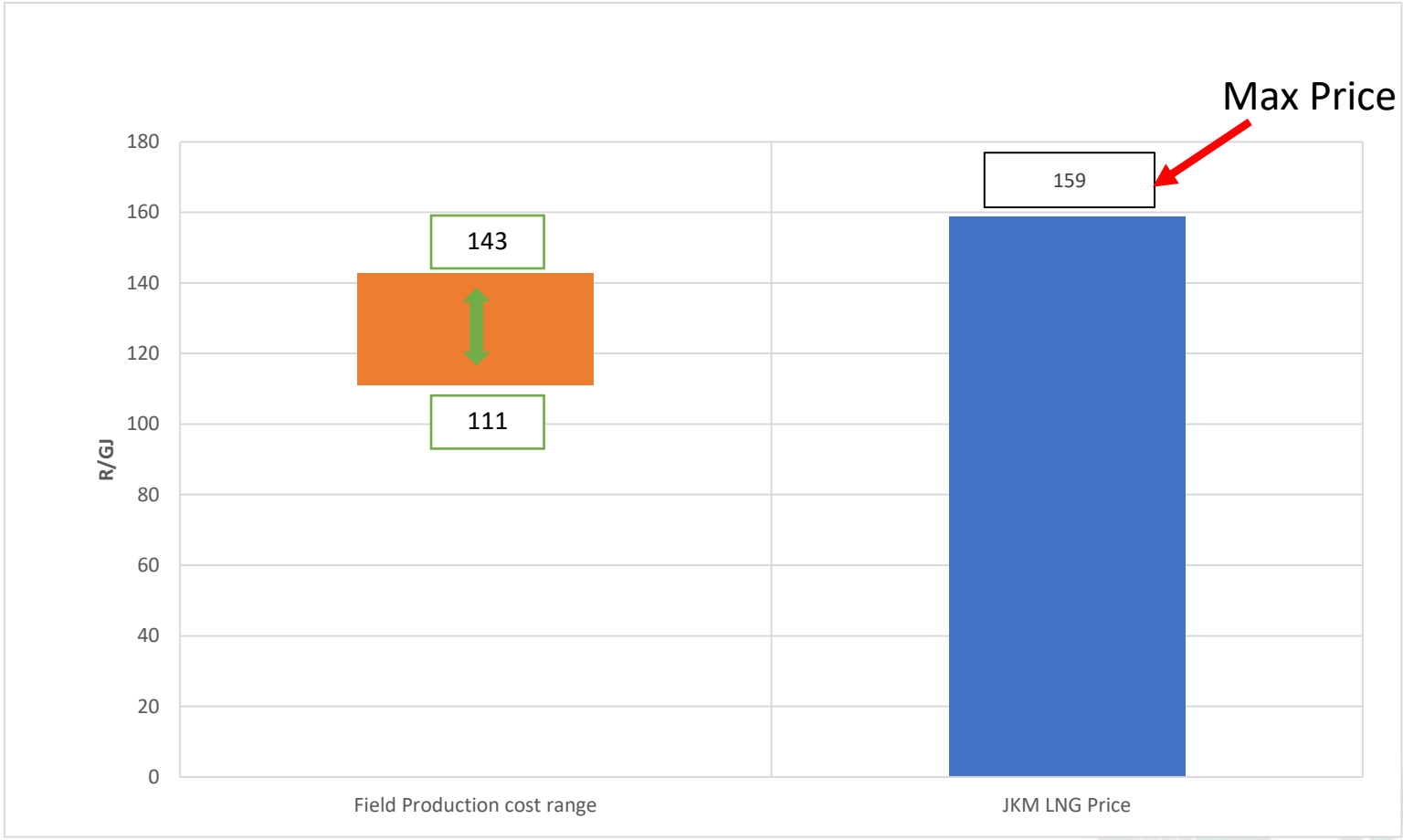
Field Production cost and JKM LNG Price (2019)*



- Indicative field production costs were provided by field owners.
- NERSA proposed the use of a benchmark, being the Japan Korea Marker (JKM) Platts price.
- JKM is a price assessment set by the marginal transaction into North Asia and therefore is driven by Asia Pacific supply and demand fundamentals.
- JKM is used as a landed LNG Price and includes the shipping cost, Delivery Ex-ship (DES)

Source: The Methodology to Approve Maximum Prices of Piped-Gas in South Africa
***Exchange Rate of R/$ = 15.87**

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Pipelines

Existing Pipelines

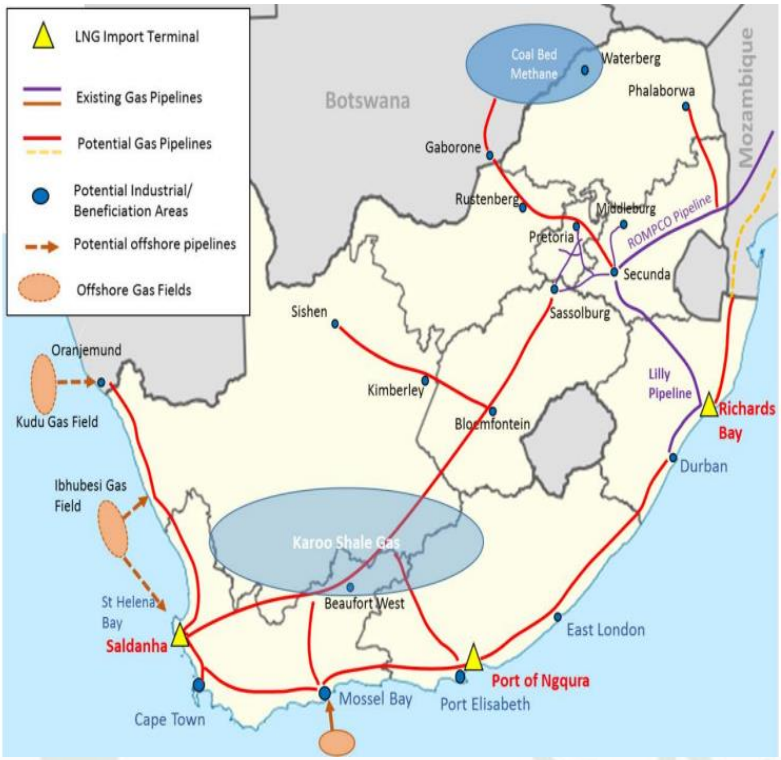
Existing Pipelines	Owner	Transport capacity (MGJ/y)	Average max flow (MGJ/y)	Utilisation rate (%)
Pande-Secunda (ROMPCO)	Sasol/CEF	212	195.8	92%
Secunda – Sasolburg	Sasol	51	40.5	79%
Secunda - Gauteng	Sasol	92	51.7	56%
Secunda - Middelburg	Sasol	11	4.97	45%
Secunda – KZN (Lily)	Transnet	23	18.23	79%

Tariffs	Sasol Gas - Zone 1 (Gauteng)	Sasol Gas - Zone 2 (Mpumalanga)	Sasol Gas - Zone 3 (KZN)
Sasol Transmission tariff (zone 1, 2 or 3)	R7.61	R20.34	R7.82
ROMPCO total tariff (zone 1 only)	R18.94	R0.00	R0.00
Transnet transmission tariff (Zone 3 only)	R0.00	R0.00	R7.71

Source: Nersa and Sasol inputs

Potential Pipelines Assumptions

	Onshore pipeline						Offshore pipeline				
Pipelines sizes	12"	16"	20"	24"	30"	36"	12"	16"	20"	24"	30"
Transport Capacity (mmscfd)	78	138	216	310	485	700	78	138	216	310	485
Transport Capacity (TJ/d)	81.9	144.9	226.8	325.5	509.3	735	81.9	144.9	226.8	325.5	509.3
Transport Capacity (mtpa)	0.6	1.1	1.7	2.4	3.7	5.4	0.6	1.1	1.7	2.4	3.7
Construction Cost (2014 $ mil/km)	1	1.3	1.5	1.9	2.2	2.6	1.4	1.8	2.1	2.7	3.1
Construction cost per km distance ($ 2022 mil)	1.16	1.50	1.73	2.20	2.54	3.01	1.62	2.10	2.43	3.08	3.56
Opex cost (% of Capex per size)	3	2.8	2.6	2.4	2.2	2	3	2.8	2.6	2.4	2.2
Economic life	25	25	25	25	25	25	25	25	25	25	25
Technical life	25	25	25	25	25	25	25	25	25	25	25
Planning years (FS/Design)	2	2	2	2	2	2	2	2	2	2	2
Construction time per km											
100 km	1	1	1	1	1	1	2	2	2	2	2
300 km	2	2	2	2	2	2	3	3	3	3	3
500 km	2	2	2	2	2	2	3	3	3	3	3
>500 km	3	3	3	3	3	3	4	4	4	4	4



Source: Yellow- JICA(2017): Republic of South Africa Study on Natural Gas Utilisation, Green – BUSA consultation

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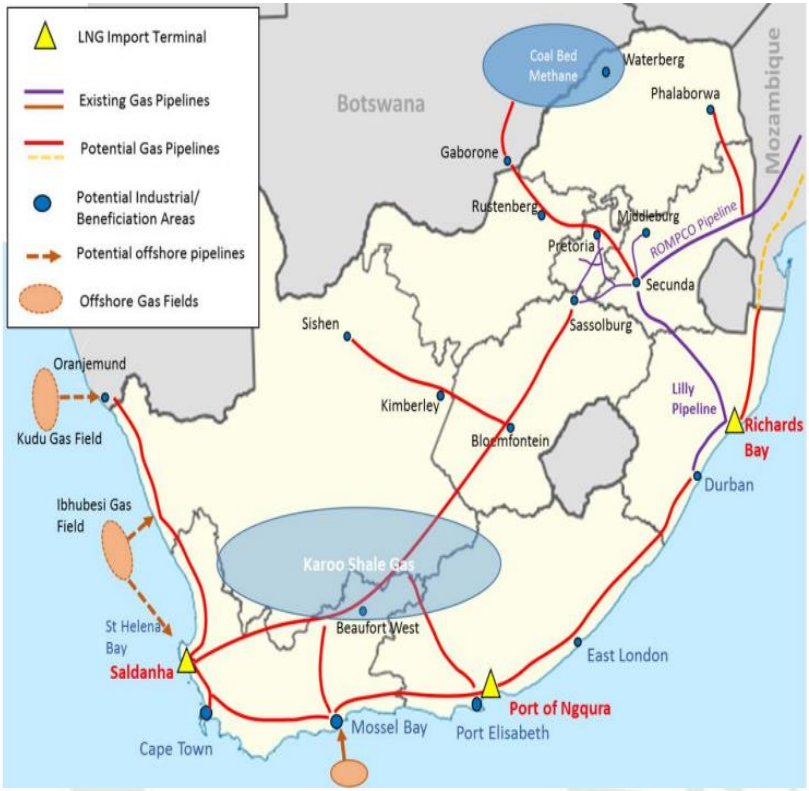
Compressor Assumptions

	Compressor
Compressor CAPEX per 100 km ($, 2014, mil)	10
Compressor CAPEX per 100 km (R, 2022 mil)	180,35
Compressor maintenance costs	5% of Compressor CAPEX
Compressor fuel costs	4% of throughput

Source: JICA (2017): Republic of South Africa Study on Natural Gas Utilisation



- **ROMPCO** – Compressor station at 500km to increase throughput by 20% (www.sasol.com)
- **Strategic Environmental Assessment (SEA**) report – 100-125 bar need compressor at 500km

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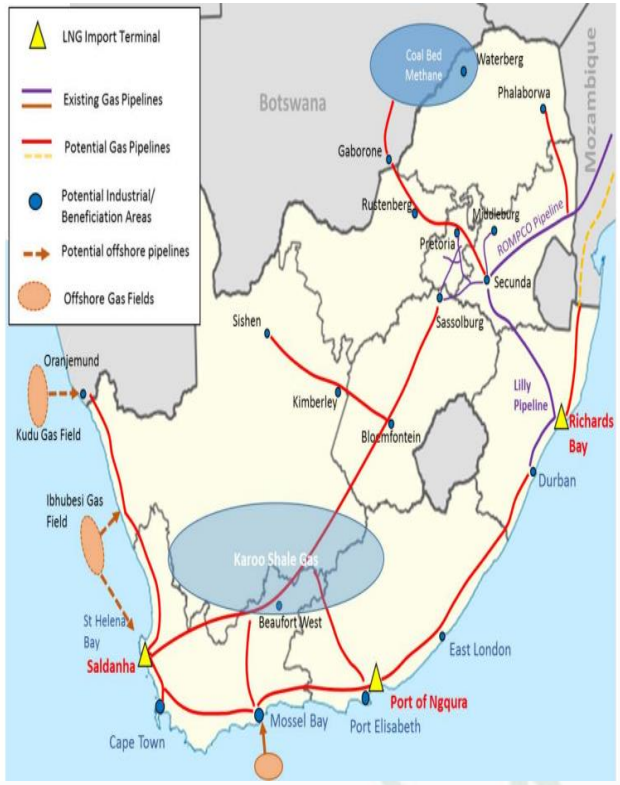
Terminals:

Conventional Onshore Port Terminals Assumptions

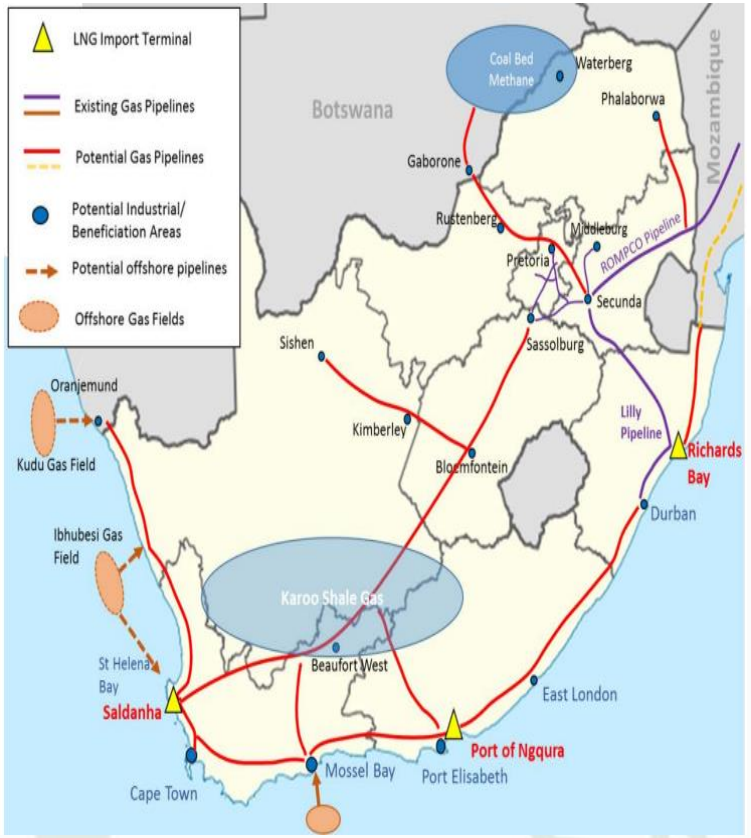
	Saldanha Bay	Ngqura	Richards Bay
Storage Size (m^3)	177,000.00	177,000.00	177,000.00
Send Out (mtpa)	4	4	4
Send Out (mmscfd)	500	500	500
Planning and Permitting period	2	2	2
Construction time	4	4	4
Lead time	6	6	6
Capex (2016 Rands, billion)	13,3	11,19	11,80
Capex (2022 Rands)	17,51	14,73	15,53
Fixed O&M cost ($/year, million, 2017)	65,79		
Fixed O&M cost (R/year, million, 2022)	1,171.00	985,98*	1,039,73*
Variable charge (ZAR/kL, 2017 rands)	34.58		
Variable charge (ZAR/GJ, 2022 rands)	2.00	2.00	2.00
Economic Life	25	25	25
Availability factor (%)	97	97	97



Source: Yellow-Transnet (2016): Long term planning framework, Chapter 6-Natural Gas Infrastructure Planning Blue - Feasibility Study for the Western Cape Integrated Liquefied Natural Gas Importation and Gas-to-Power Project Client: Green Cape Sector Development Agency.
Yellow- JICA(2017): Republic of South Africa Study on Natural Gas Utilisation

Floating, Storage and Regas Unit (FSRU)

	Build FSRU	Leased FSRU
Storage Size (m^3)	177,000	177,000
Send Out (mtpa)	4	4
Send Out (mmscfd)	500	500
Send Out (TJ/d)	525	525
Capex ($, 2017, mil)	275.00	0.00
Capex (R, 2022, billions)	4,87	0.00
Chatter cost ($/year, 2017, mi)	0	41,97
Chatter cost (R/year, 2022, mil)	0	747,60
Fixed O&M cost ($/year, 2017, mil)	7,30	7,30
Fixed O&M cost (R/year, 2022, mil)	130,01	130,01
LNG consumption (GJ/year, mil)	4,78	4,78
Fuel Cost ($/year, millions)	27,38	27,38
Variable cost (R/GJ)	90.79	90.79
Economic Life	25 *	25 *
Planning and Feasibility study	1	1
Construction/Ordering time	3	2
Lead time	4	3
Availability (%)	97	97
Start Date	2026	2026



*Require further detailed investigation

Source: Blue: Feasibility Study for the Western Cape Integrated Liquefied Natural Gas Importation and Gas-to-Power Project Client: Green Cape Sector Development Agency.

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Proposed Scenarios

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
	BAU (Base Case)	**Moderate Gas Demand**	**Regional integration**	**Gas as a Just Energy Transitioning fuel**
Demand	Small gas demand growth coming from Power sector - Ankerlig and Gourikwa and Non-power sectors – Industries, petrochemical sector and power	Moderate growth: Gas demand grows at a higher rate relative to BAU due to modest switching to gas. BAU demand and stronger gas demand growth coming from Industrial, transport, petrochemical sector and power due to government incentives/policy drive.	Gas demand grows at a much higher rate relative to Scenario 2 due to a strong drive from government to stimulate gas demand.	Gas grows at the same rate as Scenario 3 but reduces in later years. Demand for natural gas reduces as innovative fuels are introduced (such as hydrogen) for blending with natural gas to reduce net GHG emissions.
Supply	To include all existing gas fields, Committed fields with 1P, 2P and 3P and LNG Imports. Exclude the Regionals and the Contingent resources	Scenario 1 options with Potential RSA gas fields adjusted for uncertainties, CBM, etc.	Scenario 2 options (without LNG Imports due to resource constrain) + Potential SADC gas supply options adjusted for uncertainties, e.g. Piped gas	All existing, Committed and potential gas fields in RSA to be included. This scenario introduces GHG emission trajectory or carbon budget from 2022 to 2050 which enforces a significant reduction in GHG emissions, therefore need to determine which options are emitting more the others.

Presentation Outline

1 GMP Document Structure and Implementation Plan

2 Demand Side Drivers and Scenarios

3 Supply Side Inputs and Assumptions

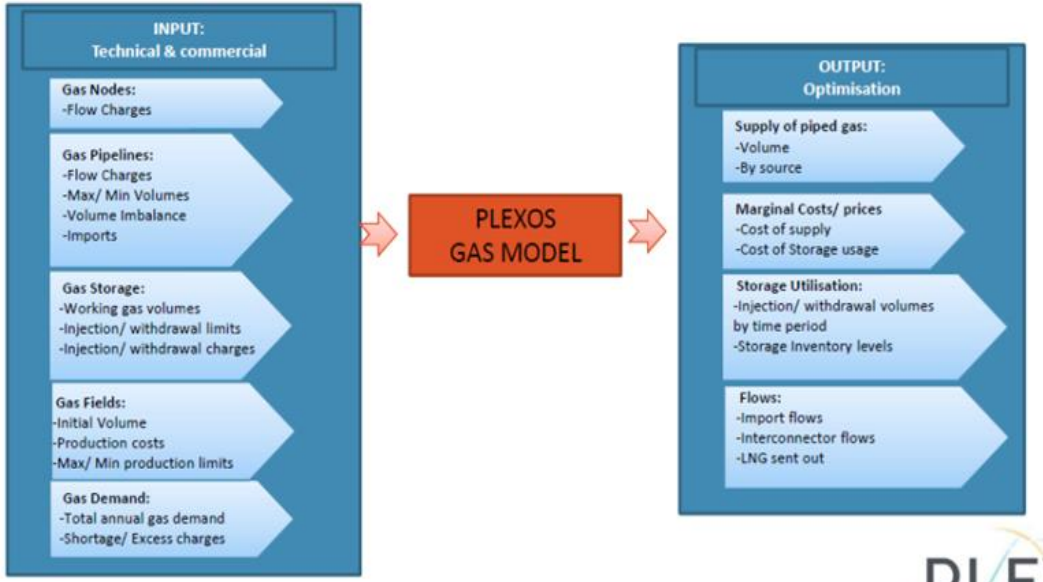
4 Modelling Approach and Output Results

5 Next Steps and Way Forward

6 Questions and Answers

Gas Model Approach

- Long-term simulations
- Planning (Capacity Expansion) Model: Futuristic
- Planning Horizon: 2022 – 205
- Demand Profile: Annually



PLEXOS BY ENERGY EXEMPLAR

Gas Modelling Objective

The linear programming formulation for the model is given by:

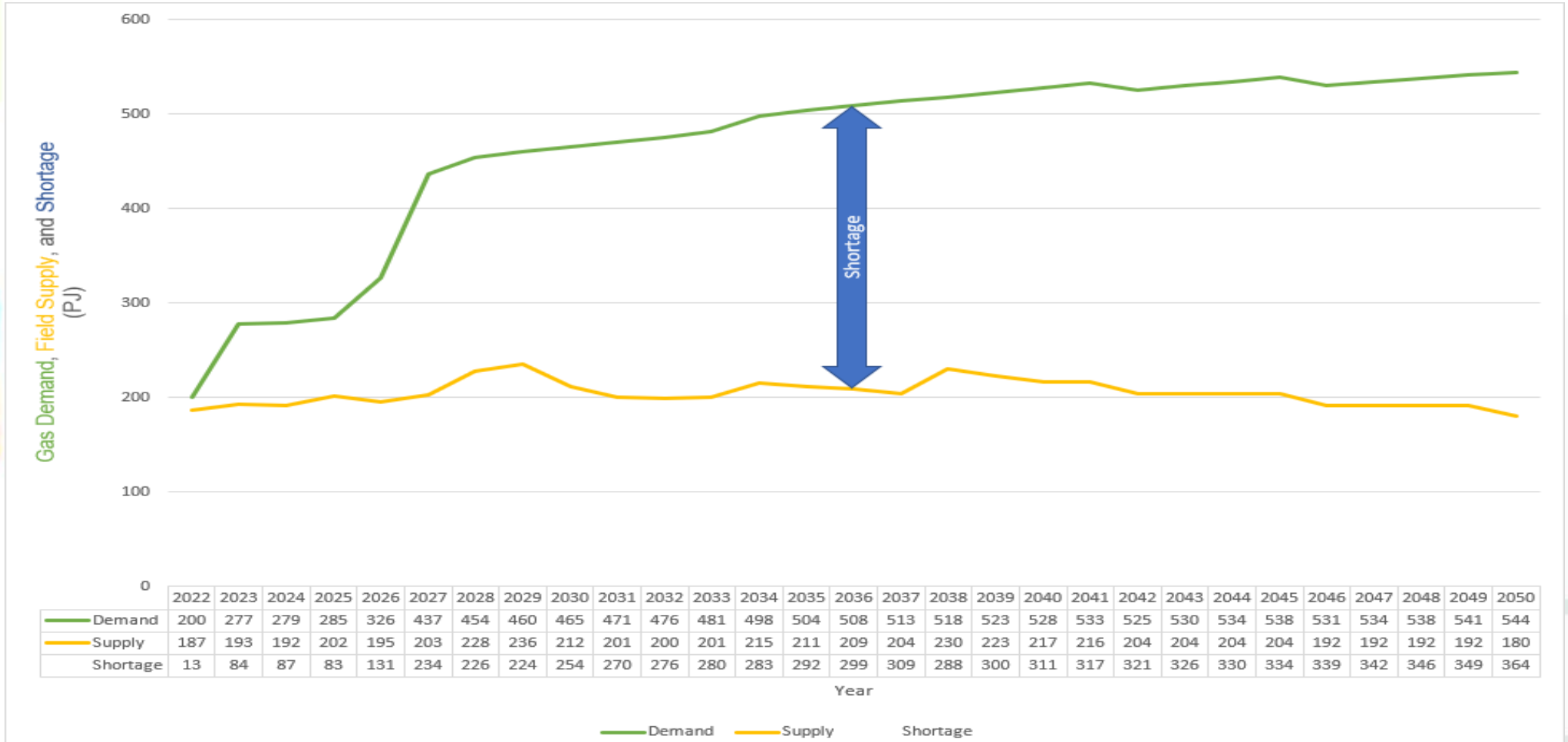
For each day and year,

Minimize: NPV ($\sum_{supply\ options} operation\ cost + \sum_{pipelines} operation\ cost +$
$\sum_{processing\ units} operation\ cost + \sum_{storage\ facilities} operation\ cost + \sum_{demand\ centers} shortfall\ penalty)$

Subject to:

- Energy system balance
- Supply/demand balance at each node
- Pipeline capacity constraints
- Production/supply capacity constraints
- Gas storage capacity constraints

Demand-Supply Balance



	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Demand	200	277	279	285	326	437	454	460	465	471	476	481	498	504	508	513	518	523	528	533	525	530	534	538	531	534	538	541	544
Supply	187	193	192	202	195	203	228	236	212	201	200	201	215	211	209	204	230	223	217	216	204	204	204	204	192	192	192	192	180
Shortage	13	84	87	83	131	234	226	224	254	270	276	280	283	292	299	309	288	300	311	317	321	326	330	334	339	342	346	349	364

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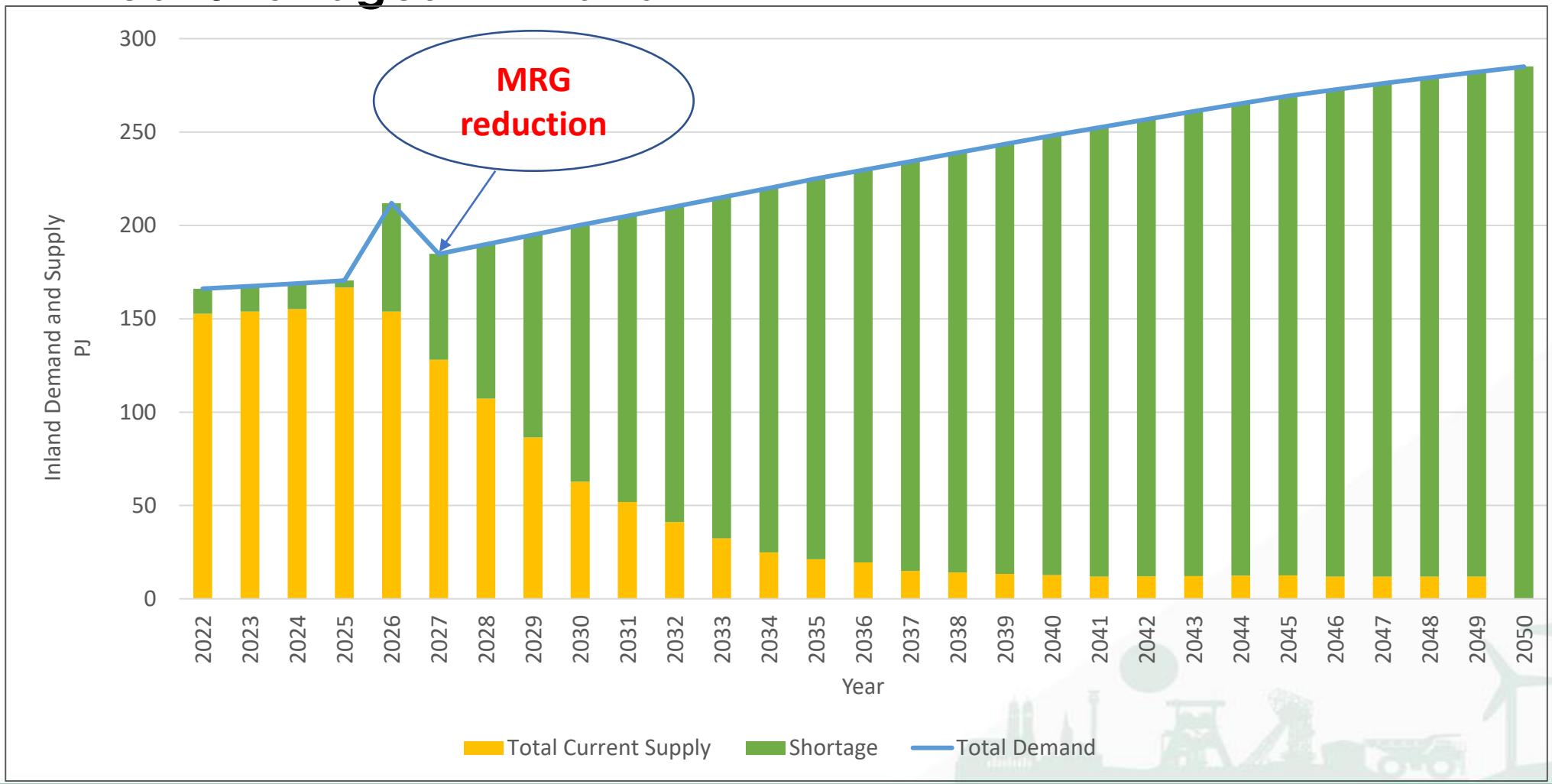
Annual Shortages in Inland



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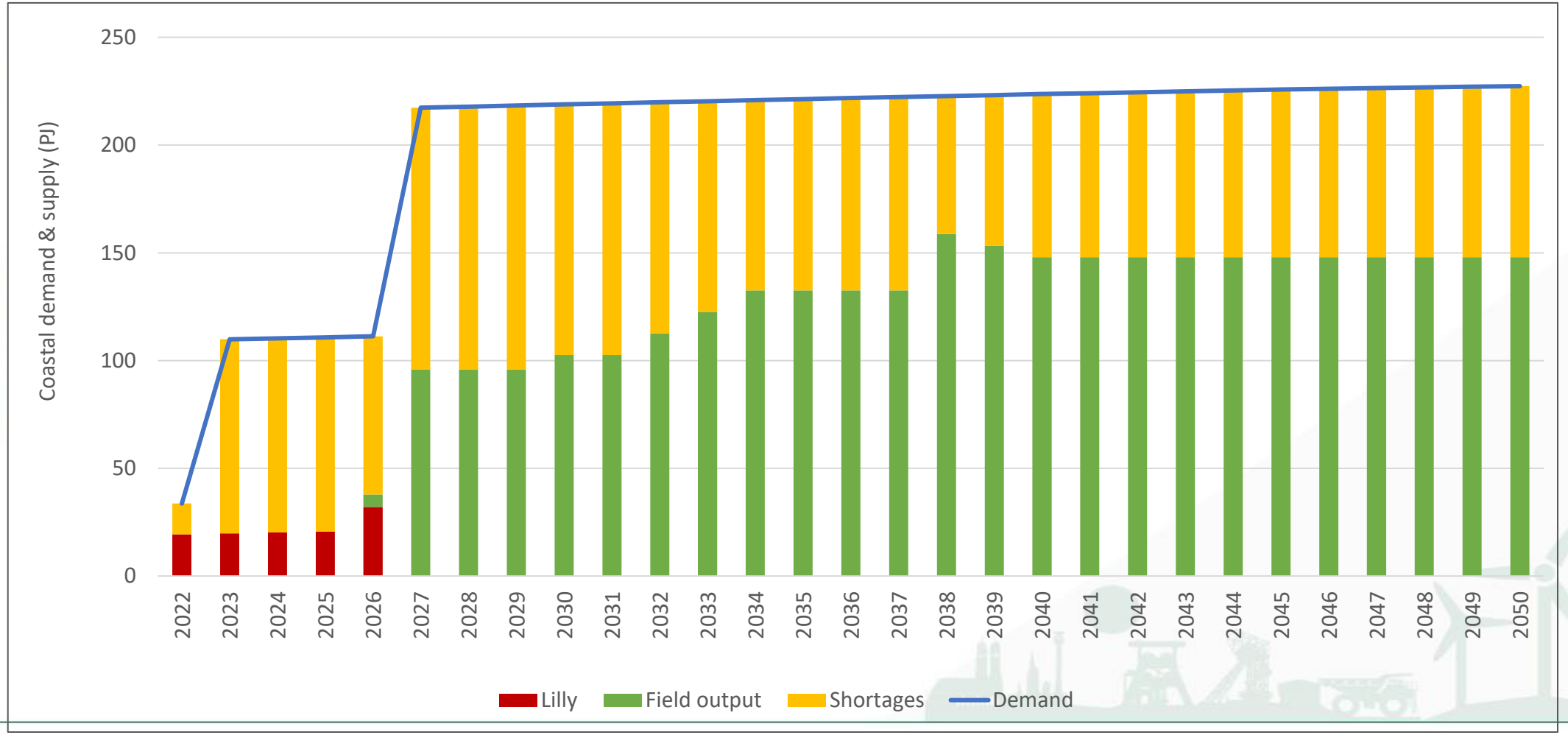
Annual Shortages in Coastal



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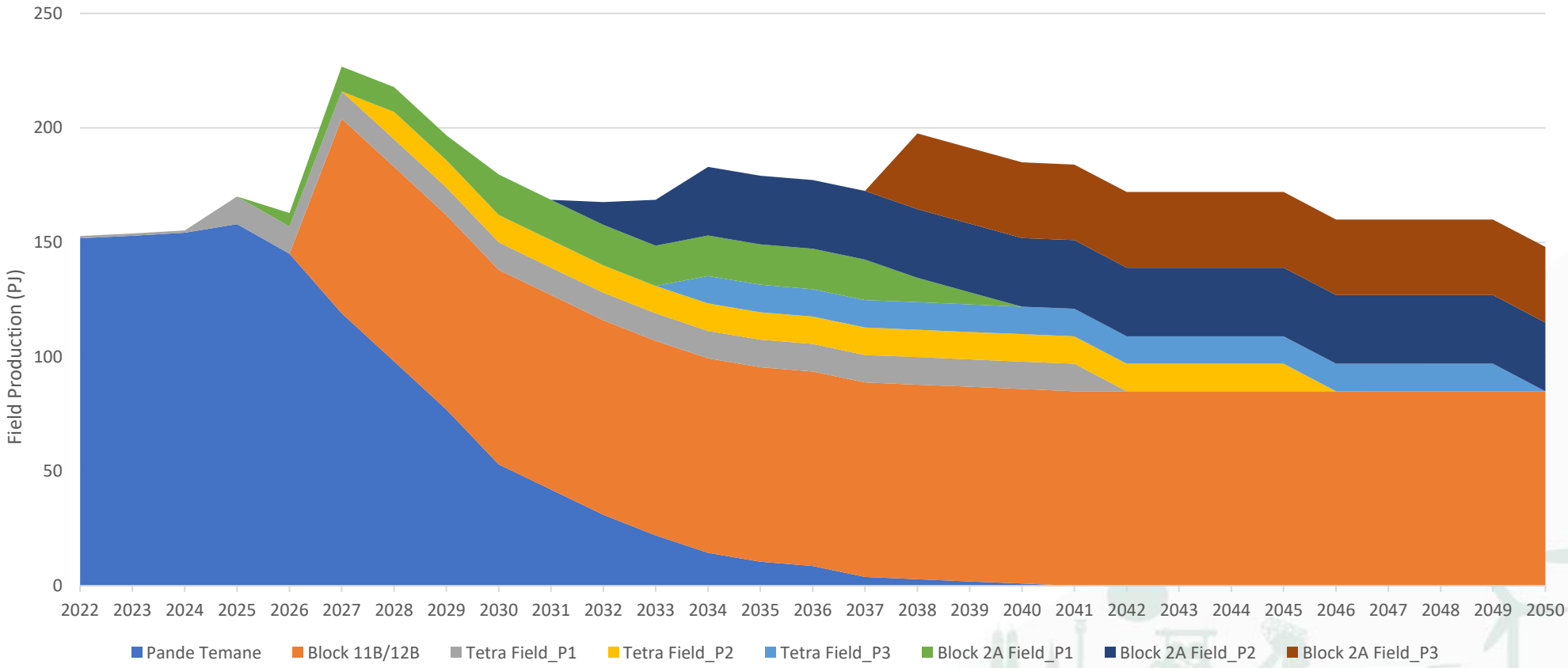
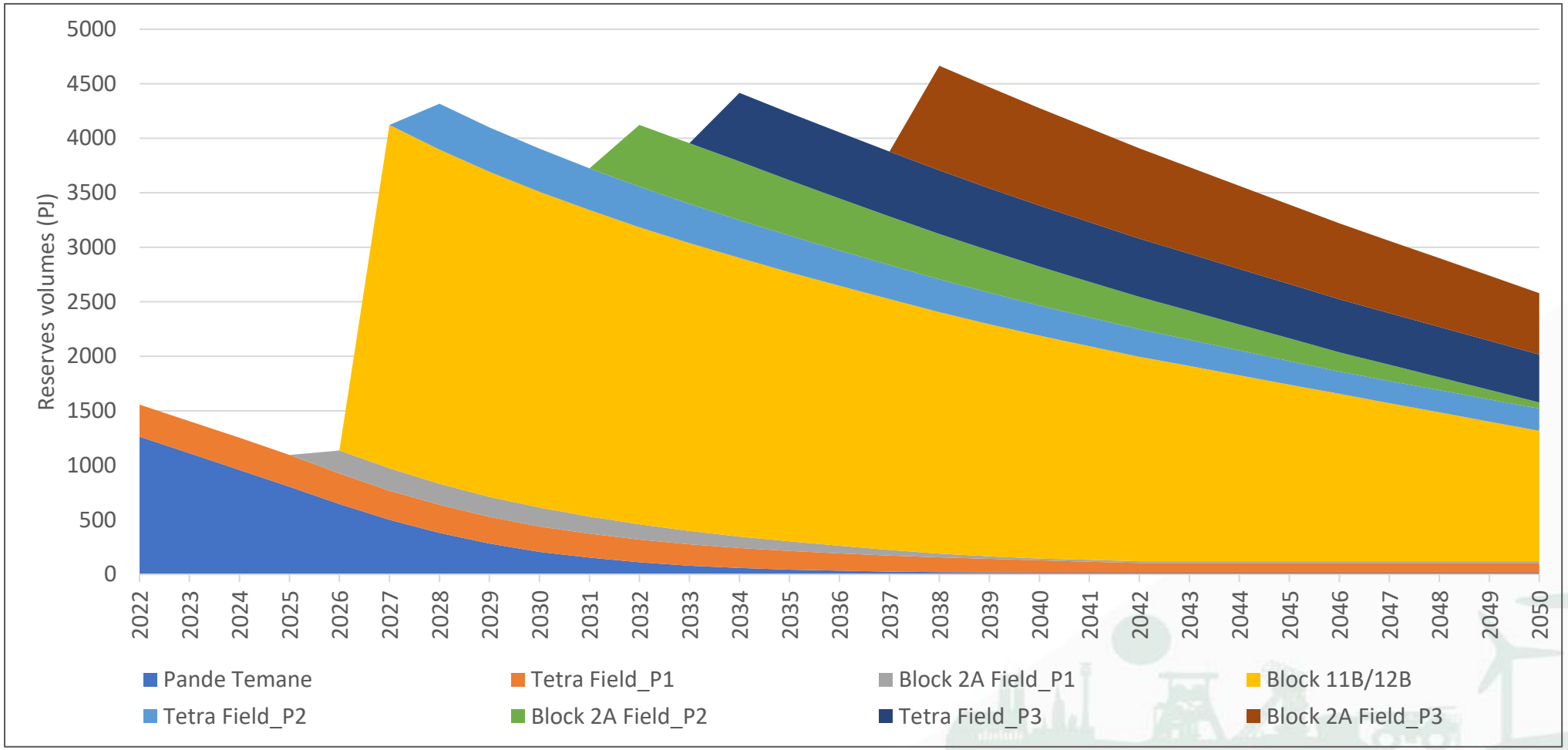
Analysis of Modelling Outputs

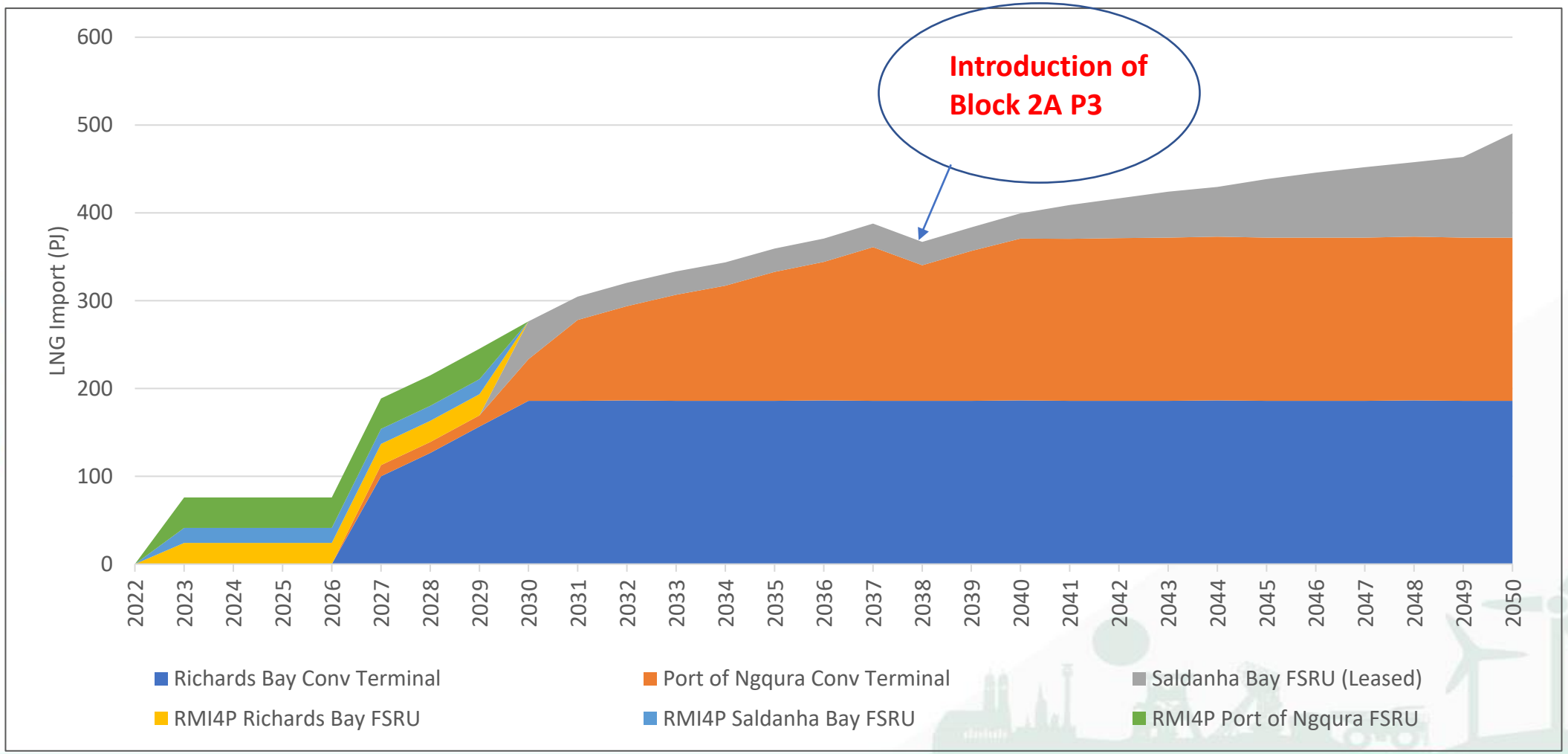
Field Production Rate Analysis



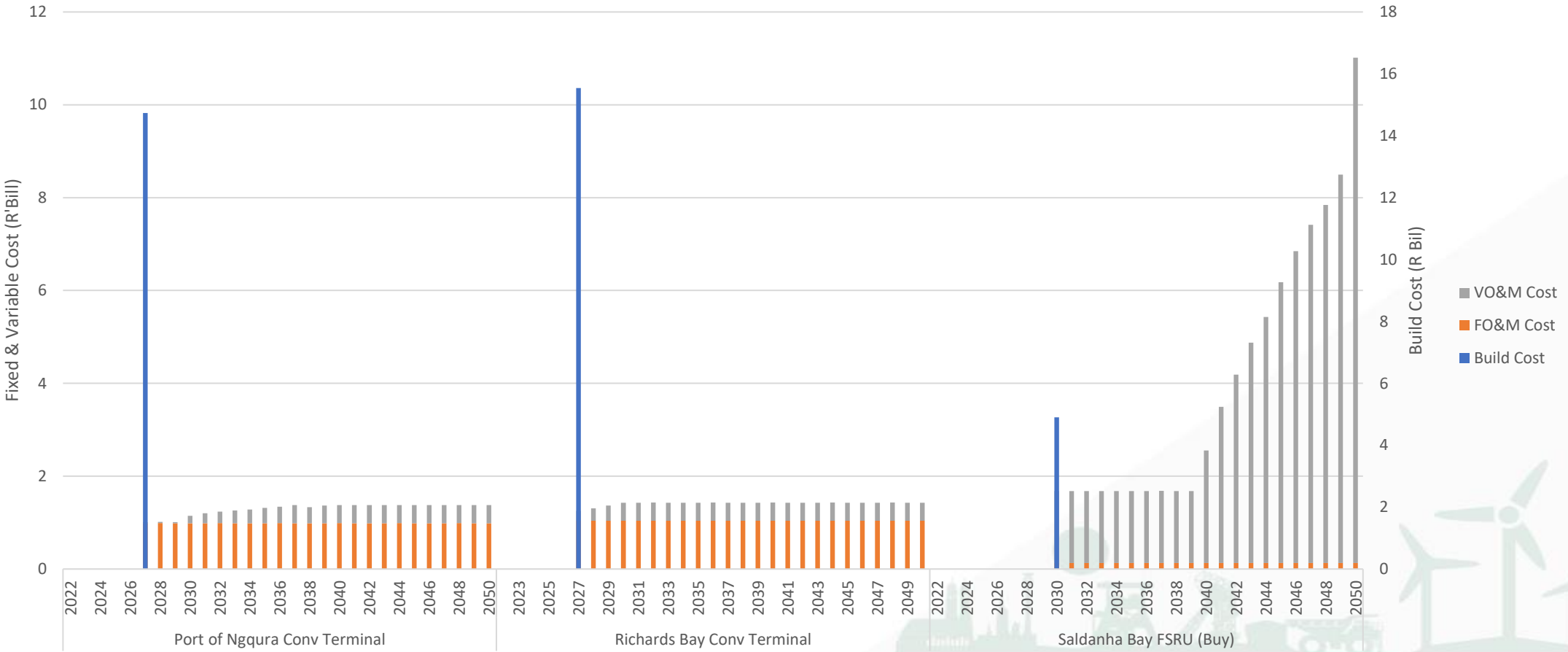
Field Reserves (Based on Production)



Annual Quantity of LNG Imported in Each Port



Cost Schedule of the Optimized LNG infrastructure
(In R Billion Real Values)



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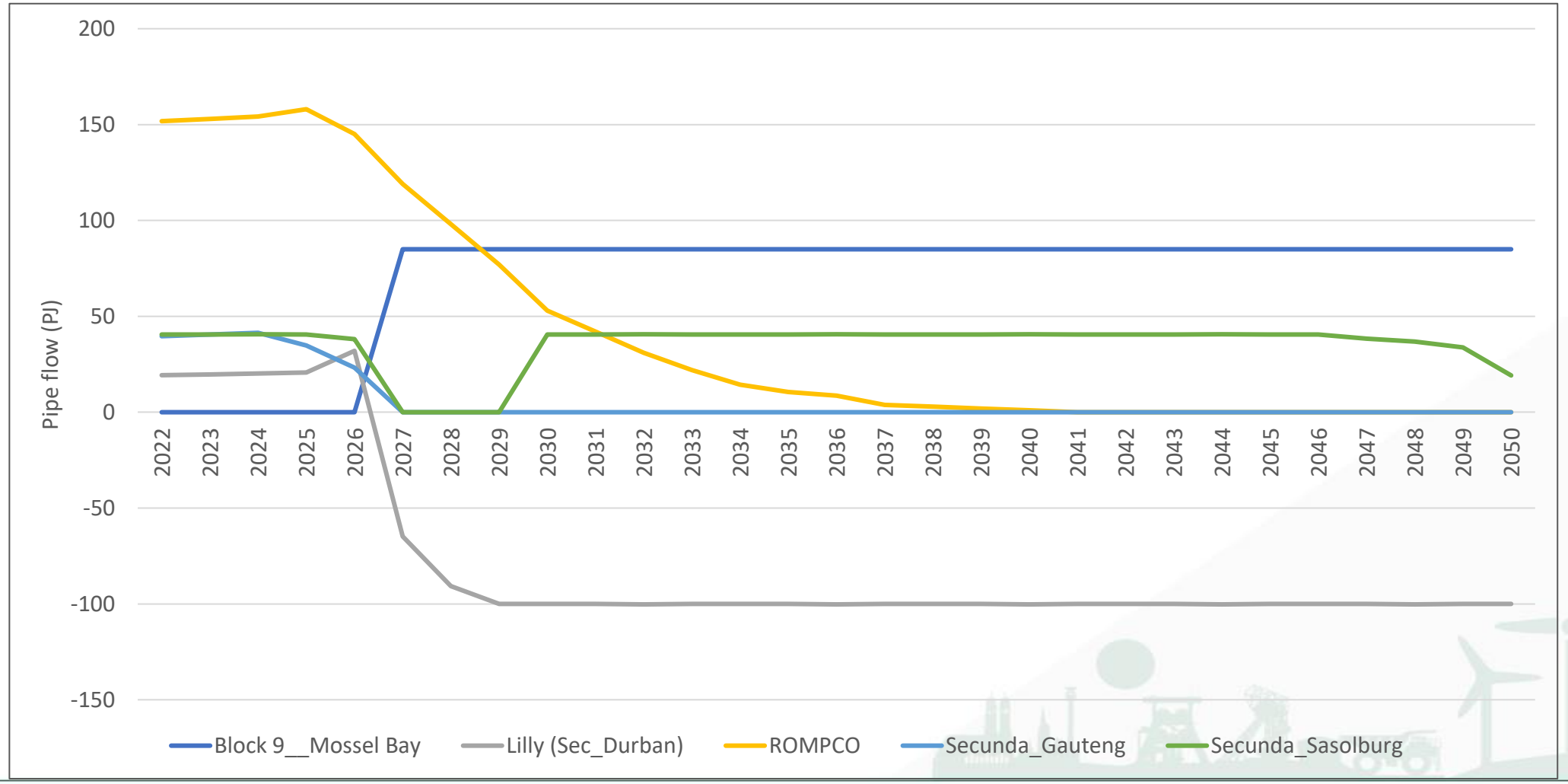
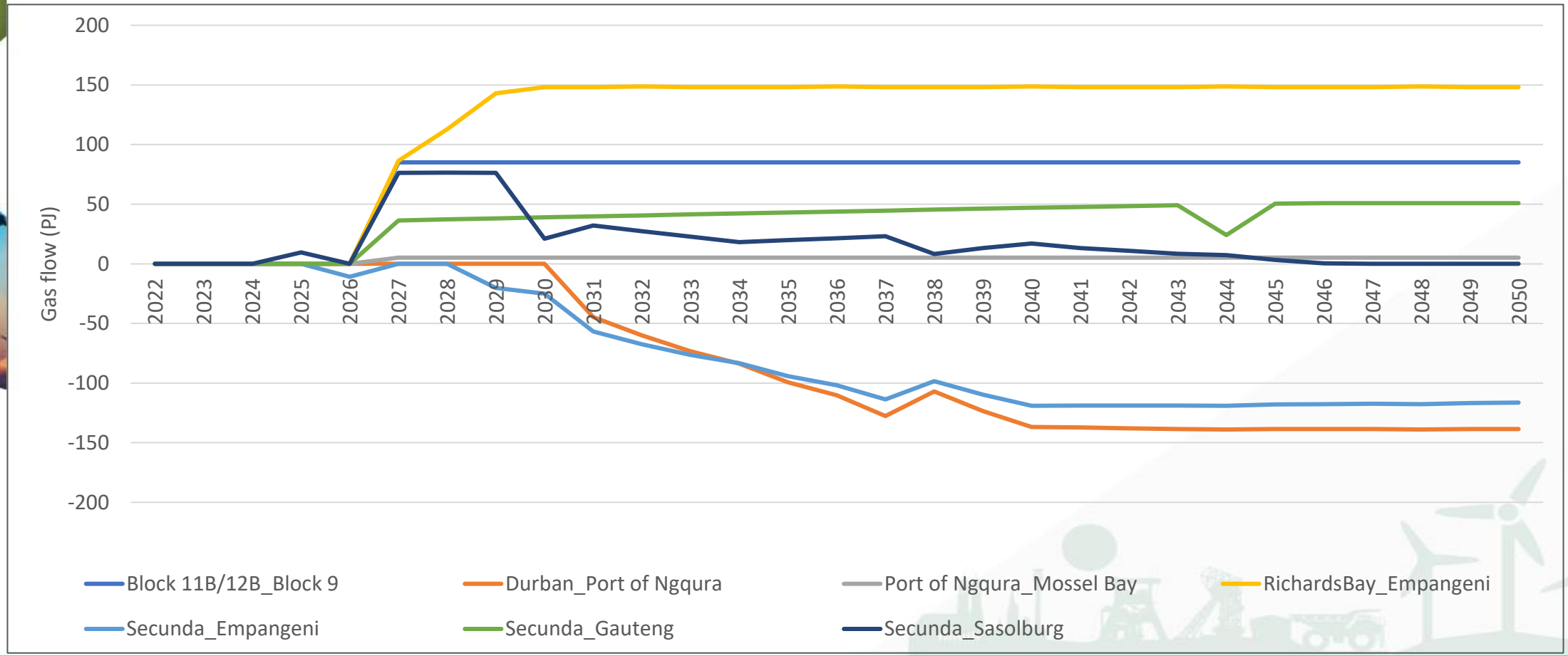
Existing Pipeline Flows



Potential Pipeline Flows : Western Route

Supply from Richards Bay and Port of Ngqura



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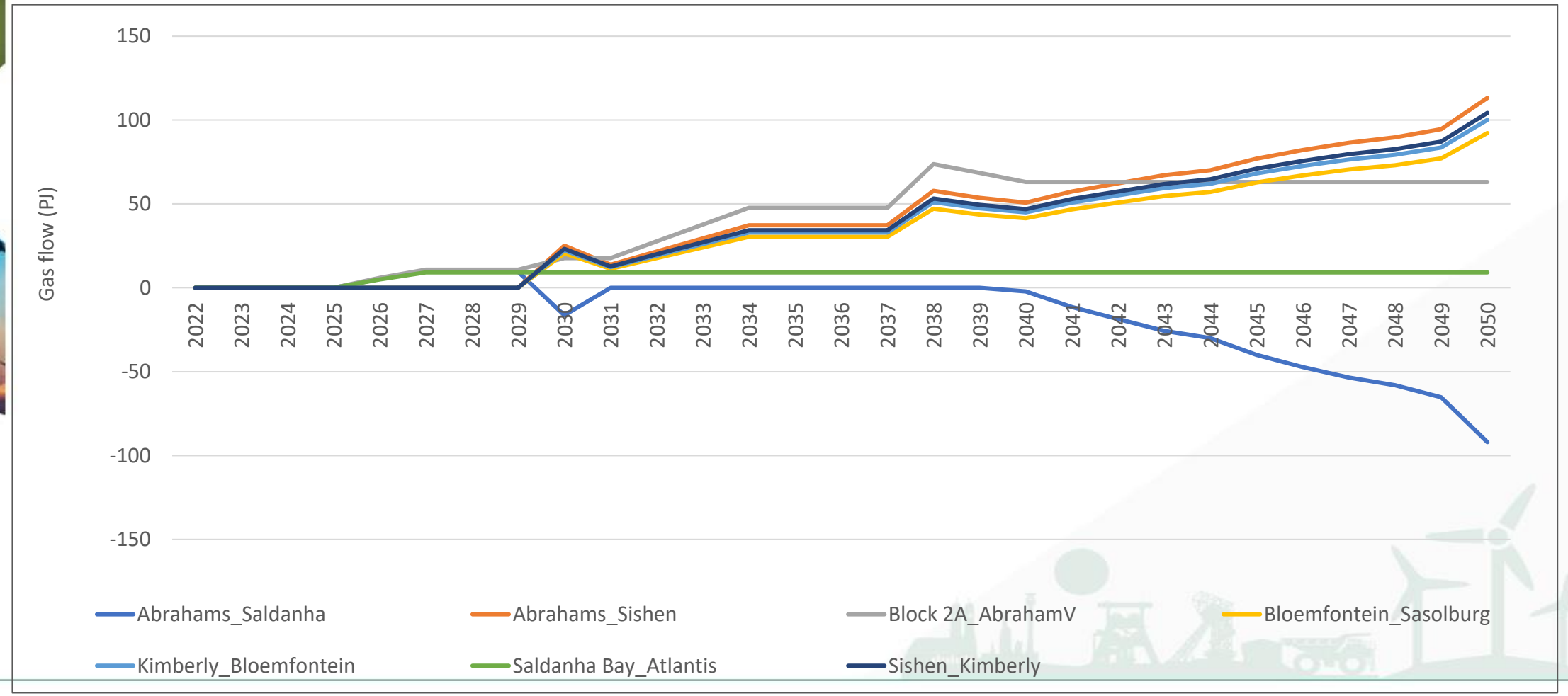
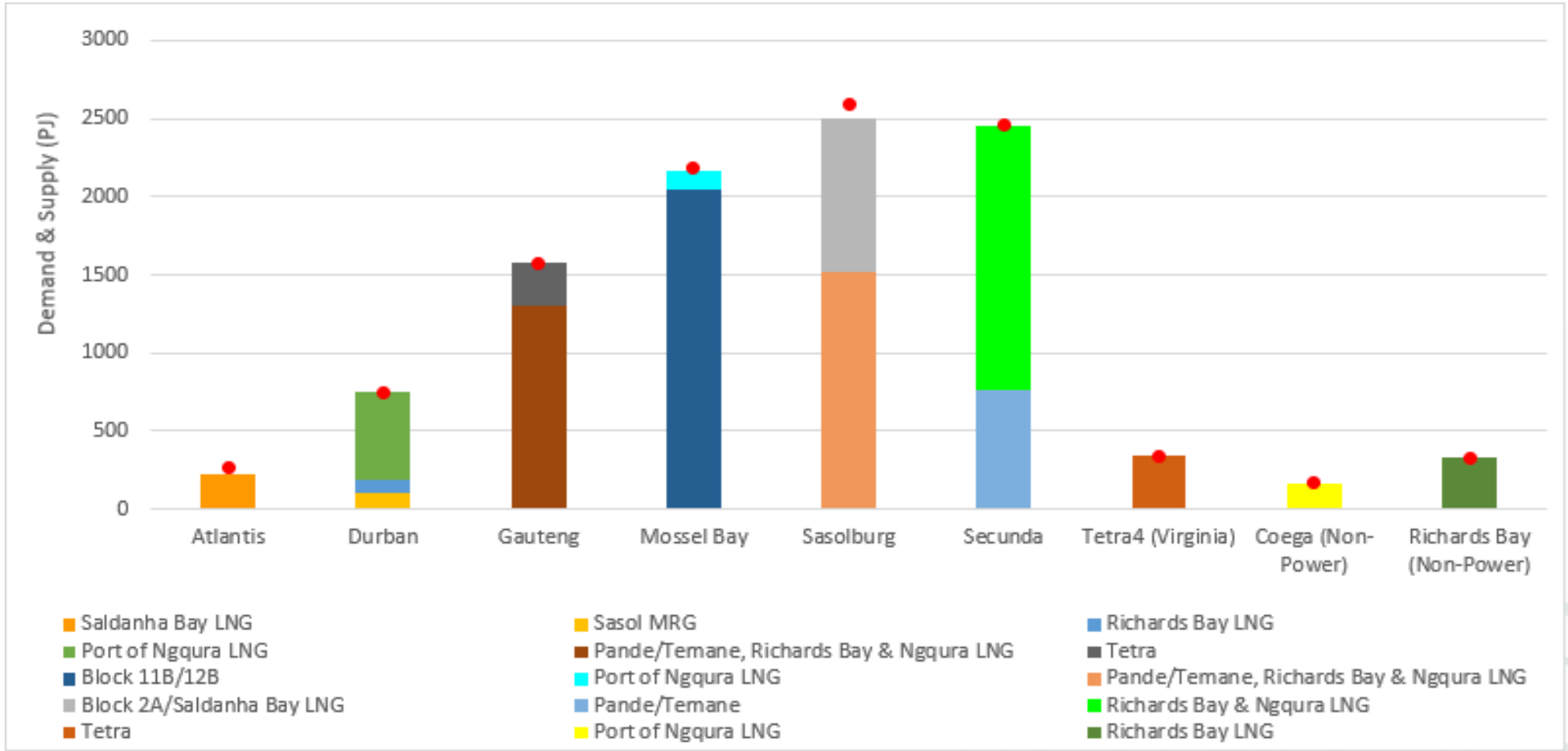
Potential Pipeline Flows : Eastern Route

Supply from Saldanha Bay and Block 2A



Demand Nodes and their Supply Sources (2022 – 2050)



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Next Steps and Way forward

Consultation on base case modelling results and alternative scenarios discussions

Technical government and industry stakeholder consultation

Gazetting GMP Policy Document for public comments

Cabinet memo for final GMP

June/July 2023

Aug 2023

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Closure

Thank you