NBI
National Business Initiative
BUSA
BCG

Presentation of key findings from the NBI Just Transition Pathways project

Agriculture, Forestry & Other Land Use sector (AFOLU) & The Role of Gas

Tuesday, 2 November 2021
10:00-12:00 (SAST)

@NBISA
@BCG
@BusinessUnitySA

#NBIJustTransition
#NetZero2050

Meeting Protocols

Please submit any questions you may have using the Q & A function

Please make sure that your microphone is muted and your video is turned off if you are not speaking

Please note that this session is being recorded

If you have any technical issues, kindly reach out to:

- Nombulelo Ndaba NombuleloN@nbi.org.za
- Justine Alston JustineA@nbi.org.za

Public presentation of key findings – AFOLU sector and the role of gas

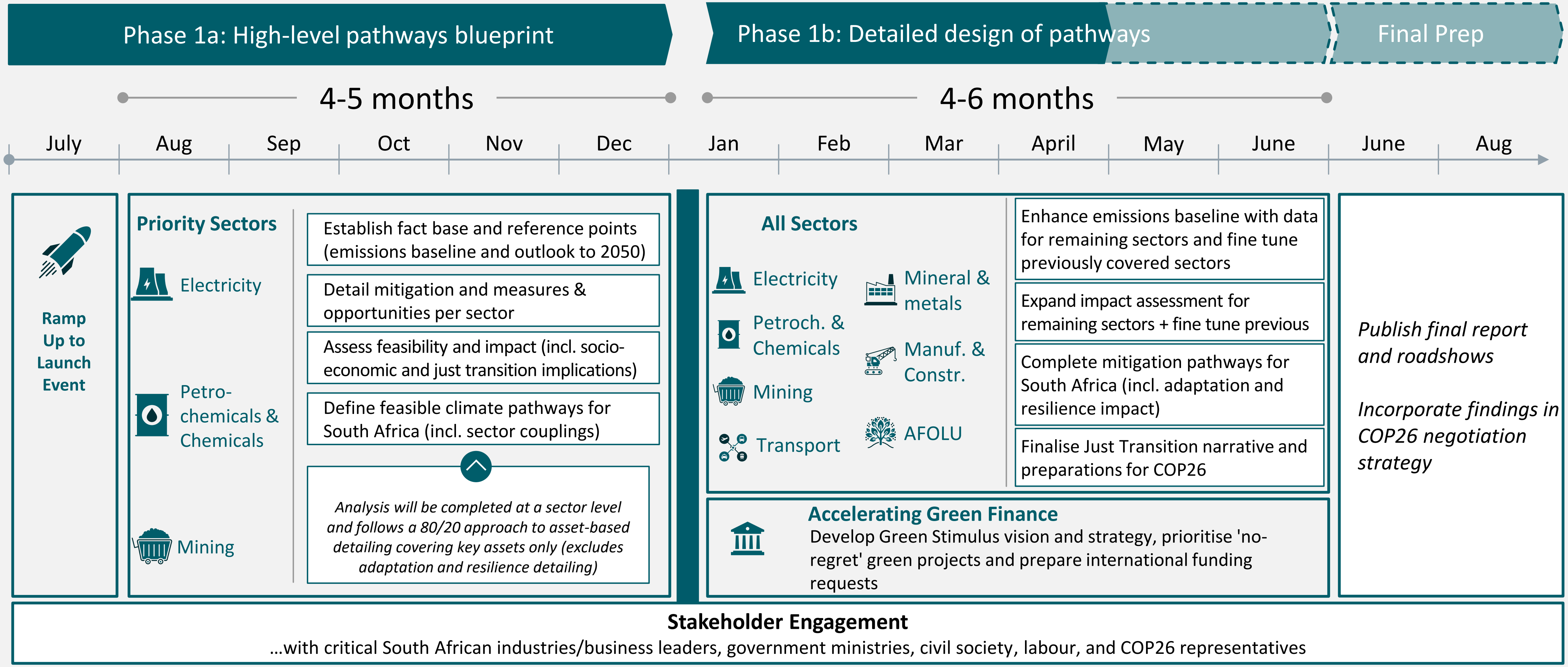
Welcome and Introduction	10:00 – 10:10
The context of this study	10:10 – 10:20
South Africa's AFOLU sector - Decarbonising & Building Climate Resilience	10:20 – 11:00
The role of gas in South Africa's decarbonisation journey	11:00 – 11:55
Outlook and next steps	11:55 – 12:00

Welcome and introduction

Steve Nicholls

Head of Environment
National Business Initiative

With this study we aim to drive collaboration and create a unified voice of South African business at COP 26 and beyond



Ramp Up to Launch Event

Priority Sectors

- Electricity
- Petro-chemicals & Chemicals
- Mining

Establish fact base and reference points (emissions baseline and outlook to 2050)

Detail mitigation and measures & opportunities per sector

Assess feasibility and impact (incl. socio-economic and just transition implications)

Define feasible climate pathways for South Africa (incl. sector couplings)

Analysis will be completed at a sector level and follows a 80/20 approach to asset-based detailing covering key assets only (excludes adaptation and resilience detailing)

All Sectors

- Electricity
- Petroch. & Chemicals
- Mining
- Transport
- Mineral & metals
- Manuf. & Constr.
- AFOLU

Enhance emissions baseline with data for remaining sectors and fine tune previously covered sectors

Expand impact assessment for remaining sectors + fine tune previous

Complete mitigation pathways for South Africa (incl. adaptation and resilience impact)

Finalise Just Transition narrative and preparations for COP26

Accelerating Green Finance

Develop Green Stimulus vision and strategy, prioritise 'no-regret' green projects and prepare international funding requests

Publish final report and roadshows

Incorporate findings in COP26 negotiation strategy

Stakeholder Engagement

…with critical South African industries/business leaders, government ministries, civil society, labour, and COP26 representatives

Note: AFOLU = Agriculture, forestry, and other land use| Source: NBI-BCG Project Team

NBI BUSA BCG

National Business Initiative

What this study aims to achieve

✓ *The questions the study aims to answer*

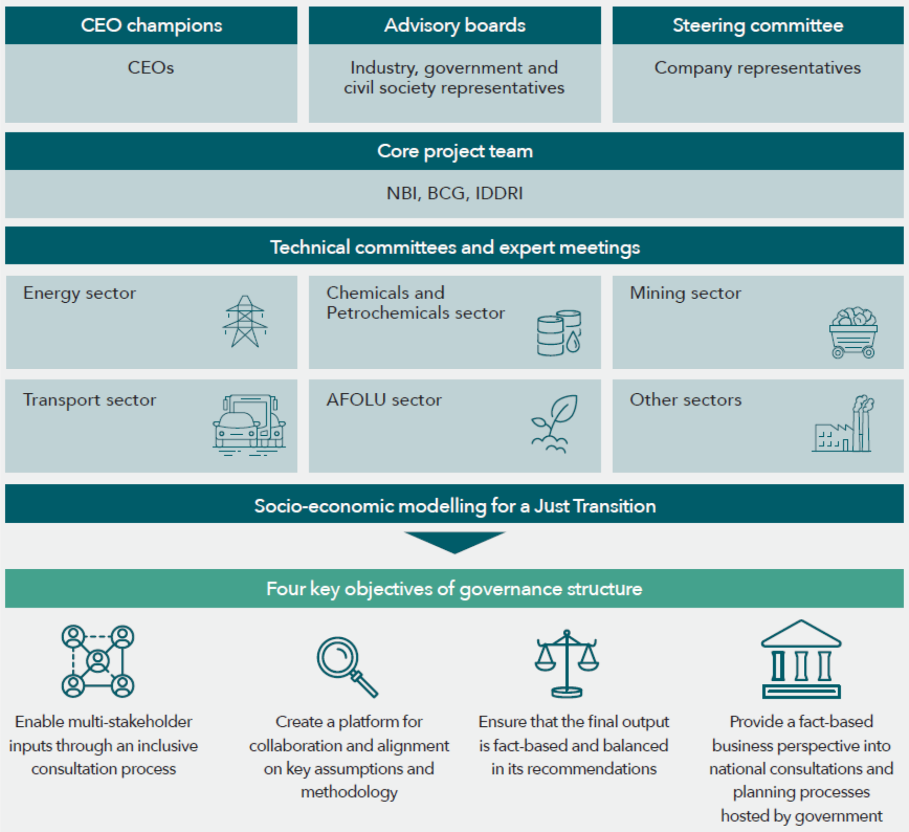
- What is the cost of inaction for South Africa?
  (i.e., of not responding to critical global economic drivers driven by global climate action)
- What would it take for South Africa to get to net-zero emissions?
  (Including practical solutions, barriers to overcome, investments and financing to enable the transition)
- What would be the social and economic implications for South Africa to reach net-zero emissions by 2050?

✕ *What the study is NOT aiming for*

- Not setting an ambition for **which level of** national emission reductions South Africa should reach **and when**
- Not prescribing **sector- or company-specific** emission reduction targets

We are creating an analytical fact-base to support decision making and support coordinated effort among national and international key stakeholders

To ensure representative, balanced and fact-based content a comprehensive governance structure is in place



CEO champions
CEOs

Advisory boards
Industry, government and civil society representatives

Steering committee
Company representatives

Core project team
NBI, BCG, IDDRI

Technical committees and expert meetings
Energy sector
Chemicals and Petrochemicals sector
Mining sector
Transport sector
AFOLU sector
Other sectors

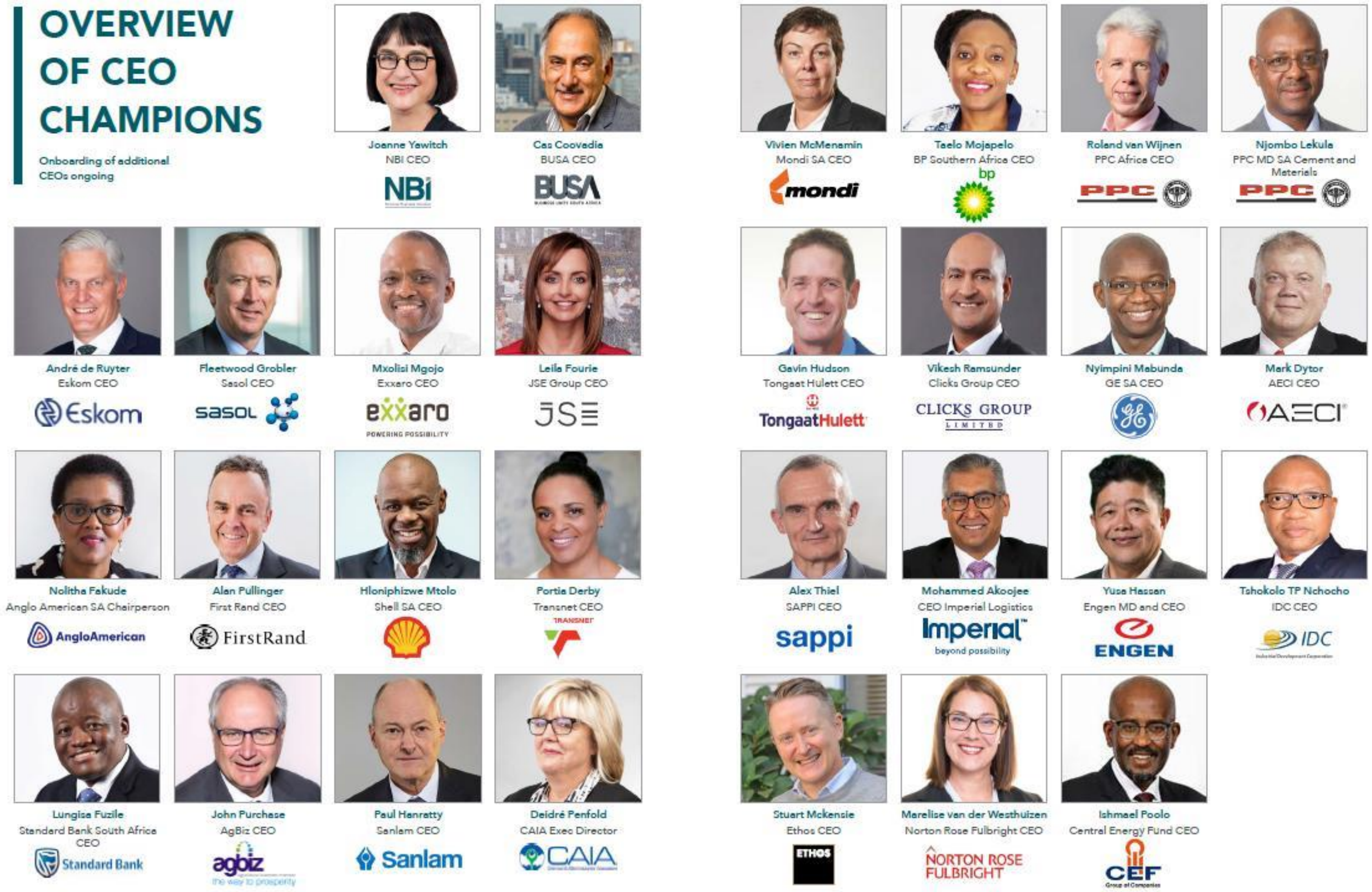
Socio-economic modelling for a Just Transition

Four key objectives of governance structure
Enable multi-stakeholder inputs through an inclusive consultation process
Create a platform for collaboration and alignment on key assumptions and methodology
Ensure that the final output is fact-based and balanced in its recommendations
Provide a fact-based business perspective into national consultations and planning processes hosted by government

4 Key objectives of governance structure

- Enable multi-stakeholder inputs through an inclusive consultation process
- Create a platform for collaboration and alignment on key assumptions and methodology
- Ensure that final output is fact-based and balanced in its recommendations
- Provide a fact-based business perspective into national consultations and planning processes hosted by government

Source: NBI-BCG Project Team



OVERVIEW OF CEO CHAMPIONS

Onboarding of additional CEOs ongoing

Joanne Yawitch
NBI CEO

Cas Coovadia
BUSA CEO

Vivien McMenamin
Mondi SA CEO

Taelo Mojapelo
BP Southern Africa CEO

Roland van Wijnen
PPC Africa CEO

Njombo Lekula
PPC MD SA Cement and Materials

André de Ruyter
Eskom CEO

Fleetwood Grobler
Sasol CEO

Mxolisi Mgojo
Exxaro CEO

Leila Fourie
JSE Group CEO

Gavin Hudson
Tongaat Hulett CEO

Vikesh Ramsunder
Clicks Group CEO

Nyimpini Mabunda
GE SA CEO

Mark Dytor
AECI CEO

Nolitha Fakude
Anglo American SA Chairperson

Alan Pullinger
First Rand CEO

Hloniphizwe Mtolo
Shell SA CEO

Portia Derby
Transnet CEO

Alex Thiel
SAPPI CEO

Mohammed Akoojee
CEO Imperial Logistics

Yusa Hassan
Engen MD and CEO

Tshokolo TP Nchocho
IDC CEO

Lungisa Fuzile
Standard Bank South Africa CEO

John Purchase
AgBiz CEO

Paul Hanratty
Sanlam CEO

Deidré Penfold
CAIA Exec Director

Stuart Mckensie
Ethos CEO

Marelise van der Westhuizen
Norton Rose Fulbright CEO

Ishmael Poolo
Central Energy Fund CEO

This project finds support across business

We will present and discuss our key findings for the **AFOLU** sector and the role of gas today

JUST TRANSITION AND CLIMATE PATHWAYS STUDY FOR SOUTH AFRICA

01

DECARBONISING SOUTH AFRICA'S POWER SYSTEM

JUST TRANSITION AND CLIMATE PATHWAYS STUDY FOR SOUTH AFRICA

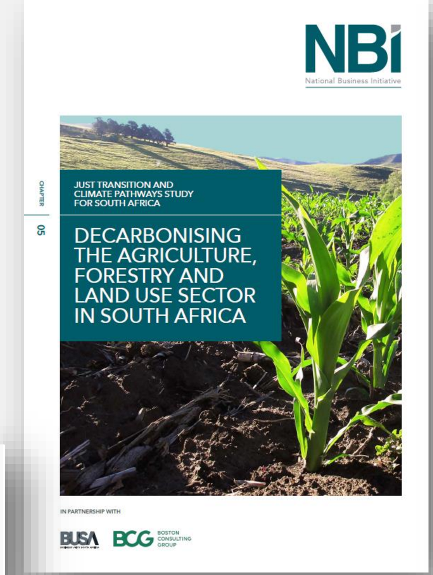
04

DECARBONISING THE SOUTH AFRICAN MINING SECTOR

JUST TRANSITION AND CLIMATE PATHWAYS STUDY FOR SOUTH AFRICA

02

DECARBONISING SOUTH AFRICA'S PETROCHEMICALS AND CHEMICALS SECTOR



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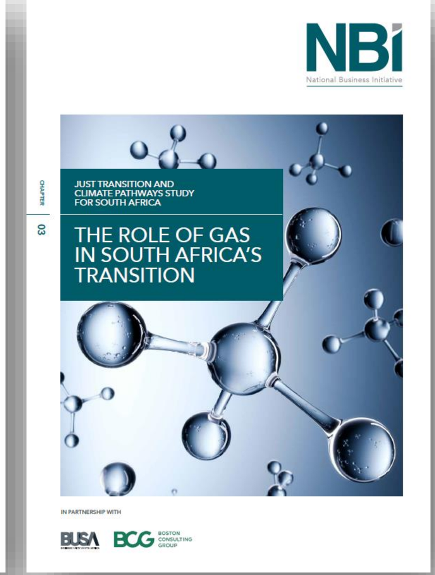
JUST TRANSITION AND CLIMATE PATHWAYS STUDY FOR SOUTH AFRICA

CHAPTER 05

DECARBONISING THE AGRICULTURE, FORESTRY AND LAND USE SECTOR IN SOUTH AFRICA

IN PARTNERSHIP WITH

BOSTON CONSULTING GROUP



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JUST TRANSITION AND CLIMATE PATHWAYS STUDY FOR SOUTH AFRICA

CHAPTER 03

THE ROLE OF GAS IN SOUTH AFRICA'S TRANSITION

IN PARTNERSHIP WITH

BOSTON CONSULTING GROUP

Both the AFOLU and gas reports will be published later this month

A note from our partner BCG

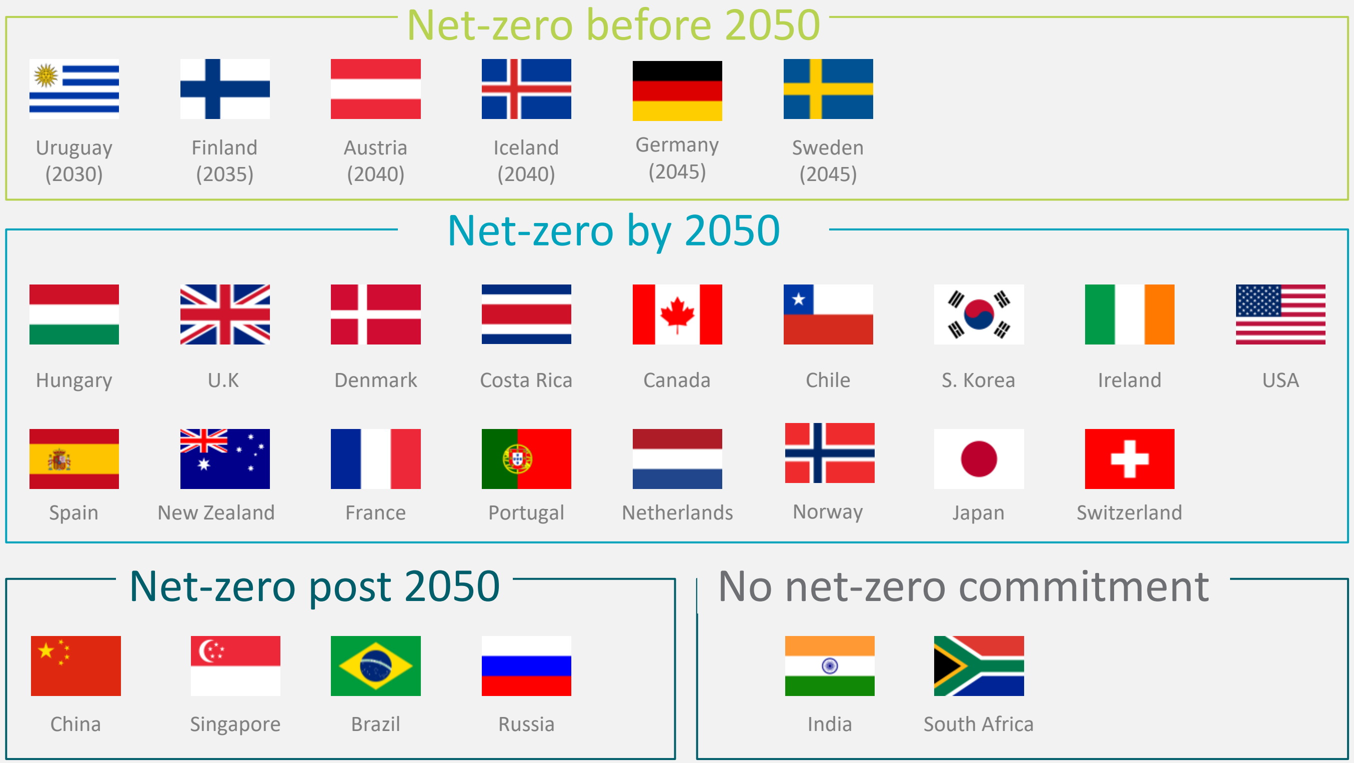
Lucas Chaumontet

Managing Director & Partner - Regional lead on Climate & Sustainability
Boston Consulting Group

The context of this study

Many countries have already set ambitious net-zero targets

Not exhaustive



Net-zero before 2050

Uruguay (2030)
Finland (2035)
Austria (2040)
Iceland (2040)
Germany (2045)
Sweden (2045)

Net-zero by 2050

Hungary
U.K
Denmark
Costa Rica
Canada
Chile
S. Korea
Ireland
USA
Spain
New Zealand
France
Portugal
Netherlands
Norway
Japan
Switzerland

Net-zero post 2050

China
Singapore
Brazil
Russia

No net-zero commitment

India
South Africa

Source: World Economic Forum, NS Energy, Climate Home News; NBI-BCG project team

SA committing to ambitious climate action as well

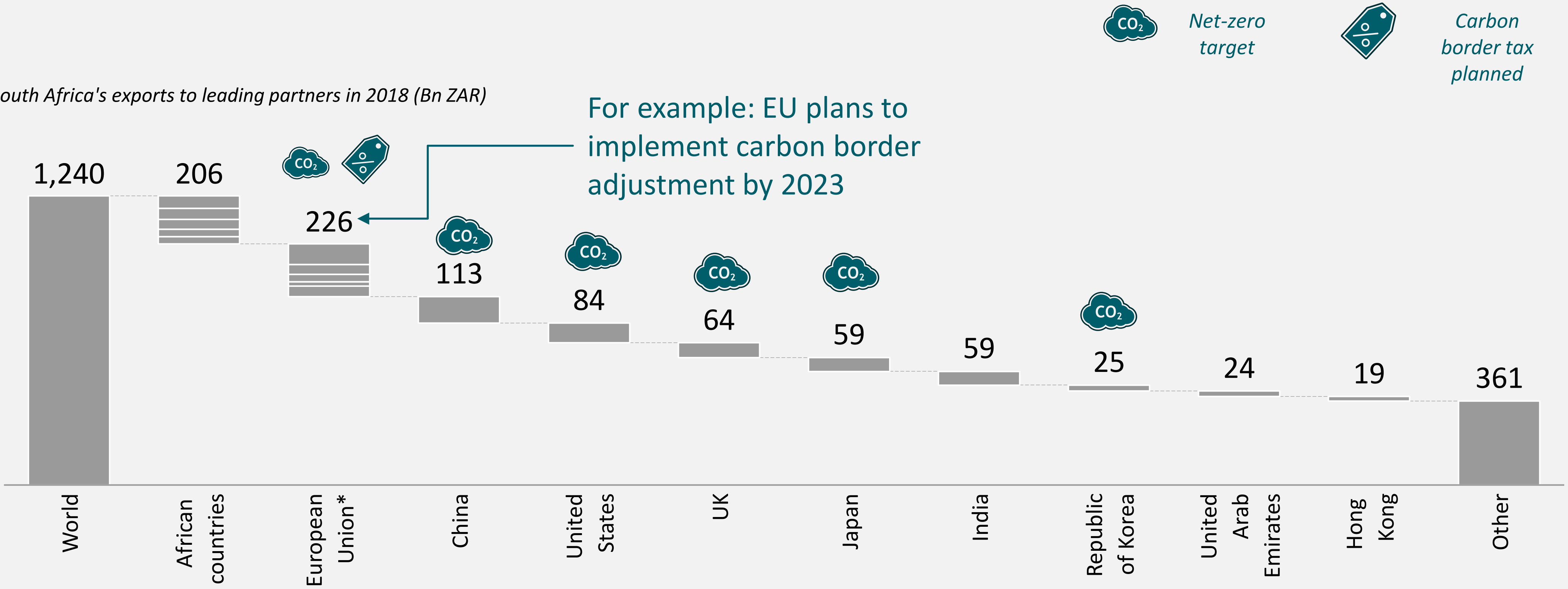
South Africa's Low-Emission Development Strategy 2050 (LEDS) states:
"We thus **commit to ultimately moving towards a goal of net-zero carbon emissions by 2050,** which will require various interventions to reduce greenhouse gas emissions"

Business Live interview 02-Oct-20
In a discussion on LEDS, DEFF Minister Creecy made several references to South Africa needing to be net carbon neutral by 2050

Key export markets like the EU already considering carbon border taxes – others may follow

Top export partners outside Africa have recently announced commitments to net-zero, putting SA exports at risk if carbon border taxes to be implements as planned in the EU – although Border Tax adjustments are currently not within WTO rules

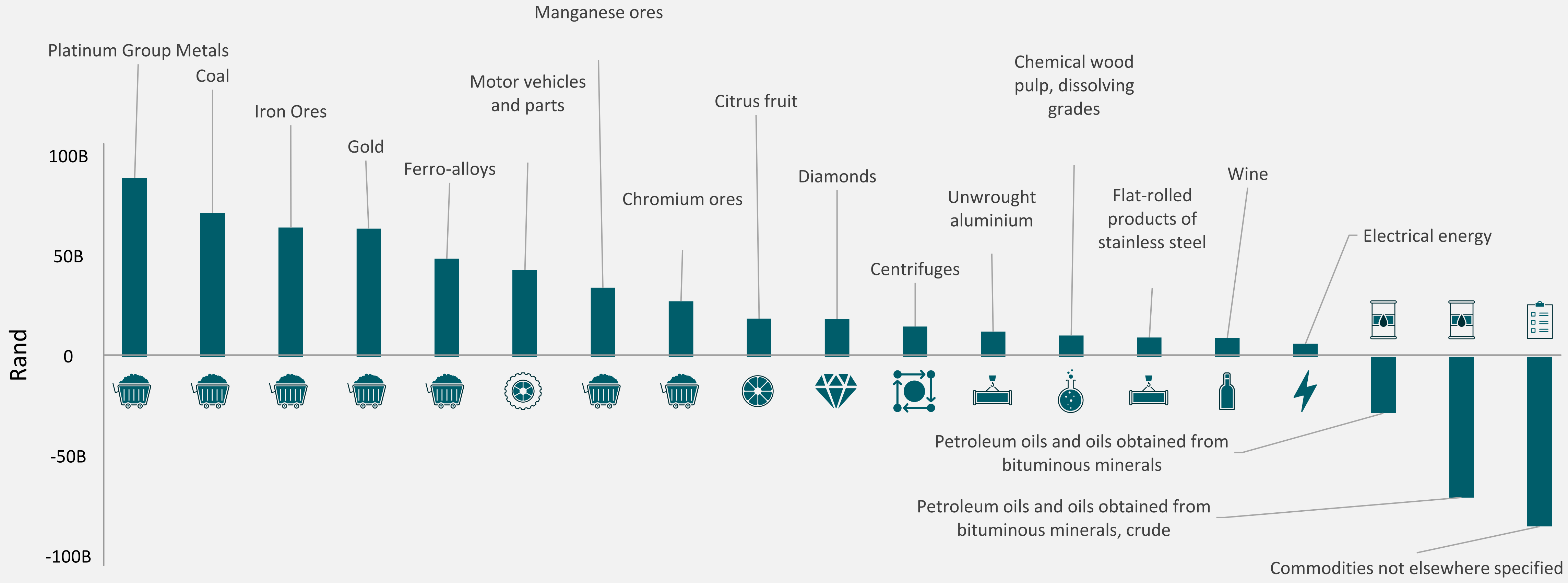
Volumes of South Africa's exports to leading partners in 2018 (Bn ZAR)



For example: EU plans to implement carbon border adjustment by 2023

* Top 4 trade partners within EU are Germany, Netherlands & Belgium, and among those with most aggressive targets. Note: Exchange rate based in 2018 average = R 13:24/US$ | Source: World Integrated Trade Solution 2018; Press research

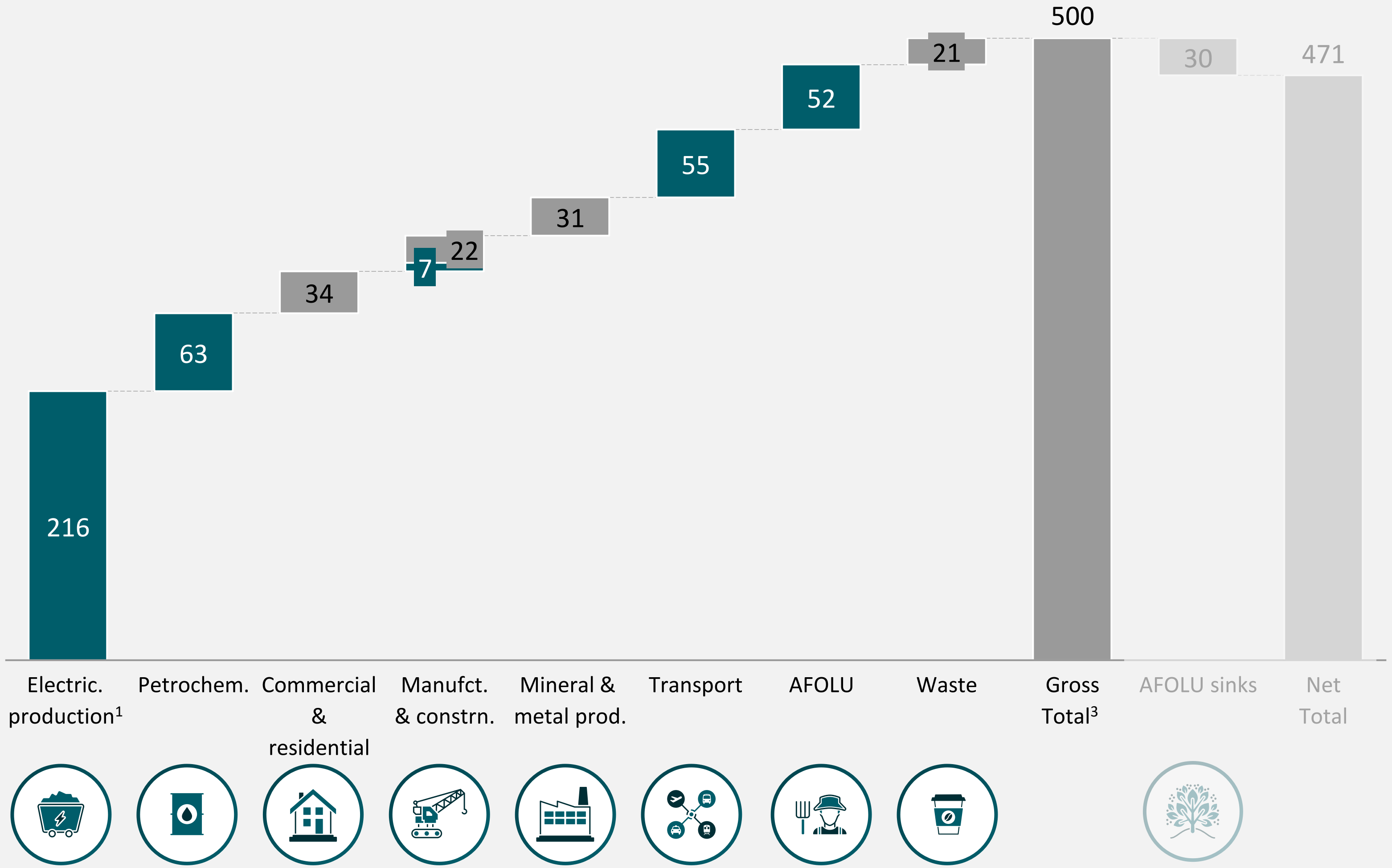
South Africa's trade vulnerability is particularly acute, commodity trade balance open to transition risk



Source: BCG analysis

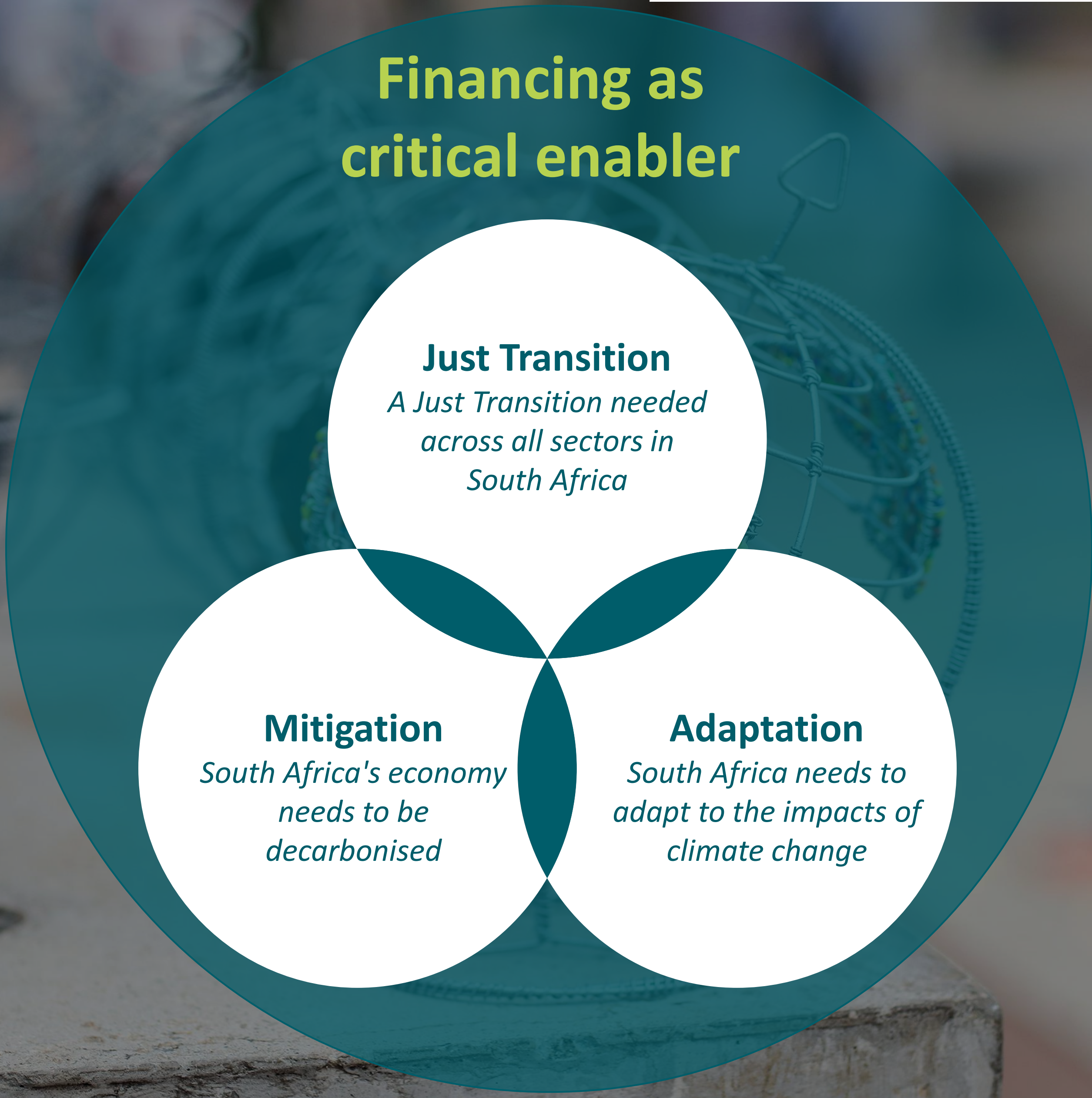
Sectors addressed so far account for ~80% of national emissions and are key to ensuring a Just Transition

Emissions updated in line with latest (2021) iteration of DFFE[4] 2017 GHG baseline



1. Emission figures based on view of Electricity & Heat Production of which electricity production contributes >97% of emission 2. GHGI does not explicitly state estimate for mining emissions so this has been estimated. Assumed scope 1 emissions share of top 12 companies is same as their market share (80%) and use this to gross up to 100% . To be validated with CDP data 3. Gross total excludes categories 1A5 as it is not linked to any sectors and 1B1 to avoid the double counting of fugitive emissions from coal mining which are included In the mining sector emissions approximation. Agriculture emissions: Agriculture (~51Mt, labelled as 'AFOLU excl. FOLU' in GHGI) + energy emissions in Agriculture/Forestry/Fishing (~4Mt). AFOLU sinks: FOLU (labelled as 'Land' in GHGI) + Other ('harvested wood products') from GHGI 4. According to DFFE (formerly DEFF) – however, revisions still to be published | Source: GHGI (2017), IEA (2015), WEO (2019), CDP (2015), GHGI (2015), CAT

South Africa is at significant risk from climate change, creating a need not just to decarbonise, but more importantly to adapt and ensure a just transition



Financing as critical enabler

Just Transition
A Just Transition needed across all sectors in South Africa

Mitigation
South Africa's economy needs to be decarbonised

Adaptation
South Africa needs to adapt to the impacts of climate change

Decisions taken now are critical

For example, South Africa must:

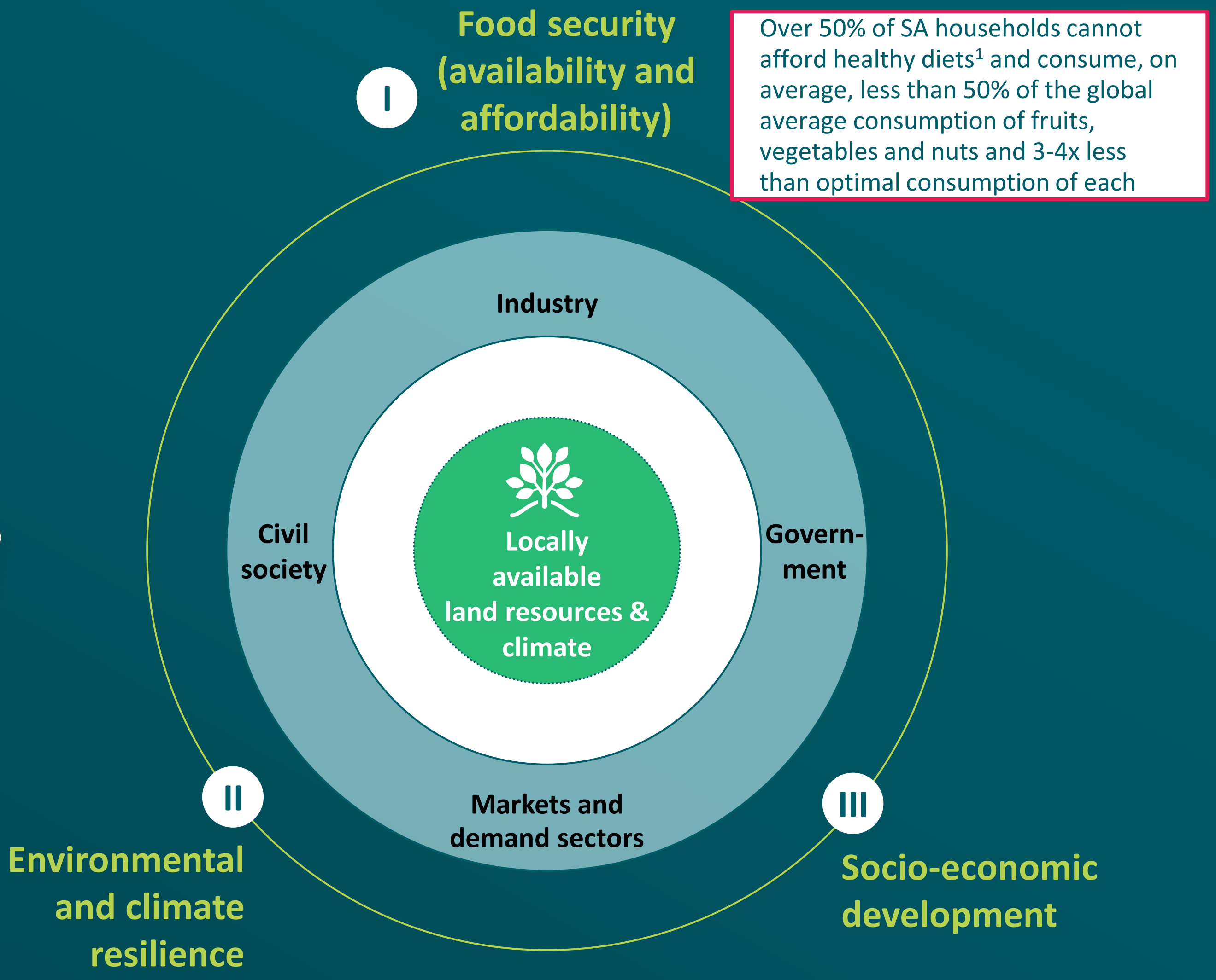
- Avoid infrastructure lock-in that will hinder long term competitiveness
- Recognise global shift in commodity value pools, plays to its strengths and invest in skills and technologies of the future, and drive international exchange of expertise and technology
- Pursue 'Green' sources of funds and preferential trade agreements to finance a Just Transition

South Africa's Agriculture, forestry and other land use sector - Decarbonising and building climate-resilience

Pathways towards SA's future AFOLU sector will need to meet objectives across dimensions

SA's future AFOLU sector needs to ensure food security, contribute to economic growth and socio-economic development

This, by sustainably leveraging SA's natural resources without harming the environment and climate



Over 50% of SA households cannot afford healthy diets[1] and consume, on average, less than 50% of the global average consumption of fruits, vegetables and nuts and 3-4x less than optimal consumption of each

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[1] Assuming 35% of household income is dedicated to food expenditure

Source: Stats SA "Living Conditions Survey"; Global Nutrition Report; BCG analysis

Key questions to address in AFOLU sector analysis

1. **How will AFOLU demand change?** *Changes in demand for SA's agricultural and bio-based products, given changing demographics and new demand sources for biomass*
2. **What are the risks to the AFOLU sector?** *Physical risks imposed on and created by SA's AFOLU sector and vulnerability of SA's agricultural sector*
3. **What are net-zero pathways for the AFOLU supply base?** *Key decarbonisation and adaptation levers for AFOLU in SA*
4. **What are the socio-economic implications?** *Risks, opportunities and socioeconomic impact (jobs, GDP etc.) of the AFOLU net-zero pathways*
5. **How to enable the optimal pathway?** *Address key challenges and enablers, and critical sector interdependencies*

The future of South Africa's AFOLU sector

1 The South African AFOLU sector is at significant climate risk – ensuring food security and sustainable and healthy diets for all South Africans, and maintaining the sector's socio-economic contribution requires the **development of a climate-resilient AFOLU sector**

2 Global climate change could impact South Africa significantly: In low and moderate mitigation scenarios, South Africa's average inland temperature could rise **2–4 °C** by 2050, ~**2 times the average global temperature increase**, and average rainfall could decrease **>60 mm/annum** in most western and northern regions of the country

3 Export earnings, farmworker and plantation worker livelihoods, and food availability are at risk, particularly in the Western and Northern Cape, which are expected to face the **worst water stress**, but also account for **~95%** of South Africa's deciduous fruit exports, **~25%** of national agricultural earnings, and **~35%** of national agricultural employment

4 On a farm and plantation level, adaptation measures, such as **climate-breed matching**, and **fire and pest prevention systems** can build resilience, production-efficiency, and reduce emissions per unit produced. On a system level, improved **water-use monitoring and transmission infrastructure**, data-backed agricultural and forestry **water allocation**, and **accessible climate event monitoring** will be critical to ensure climate resilience

5 To enable effective adaptation, it will be critical to build capacity and improve and expand agricultural and forestry extension services – this requires a **doubling of AFOLU-related research and development (R&D) spending** in line with NDP targets, roll-out of **demand-side incentives**, such as market access and deployment of **blended finance mechanisms**

6 The AFOLU sector accounts for **~10% of national emissions** – driven by livestock (**75%**), fertiliser use (**18%**) and fuel combustion (**7%**) – and adaptation measures taken in the sector could drive some emission reduction. However, significant emissions remain and to fully decarbonise the sector, dedicated mitigation levers need to be deployed

- a In light of a growing population, **food demand will grow by ~50%** by 2050, causing the AFOLU emissions baseline to **grow by ~40%** if current, nutritionally-inadequate diets are maintained, or **shrink by ~37%** if sustainable (low red meat), diverse and nutritionally-balanced diets are adopted
- b Regardless of diet progression, ensuring best-practice reduces emissions and builds resilience. Best-practice **livestock health, feed, manure, and breeding management** can eliminate ~**19%** of annual emissions, **sustainable land and fertiliser management**, and integration of **renewable energy** to meet energy demand eliminate **17%** and **19%** of annual emissions, respectively
- c However, with best practices implemented, by 2050, emissions can only be reduced by **~40%** versus the 2017 baseline, **with current diets**, and by **~70% with sustainable, healthy diets**, leaving **16–39 Mt CO2e/a** in residual emissions that must be addressed using more disruptive levers, such as hydroponics, and in the more distant future lab-grown meat

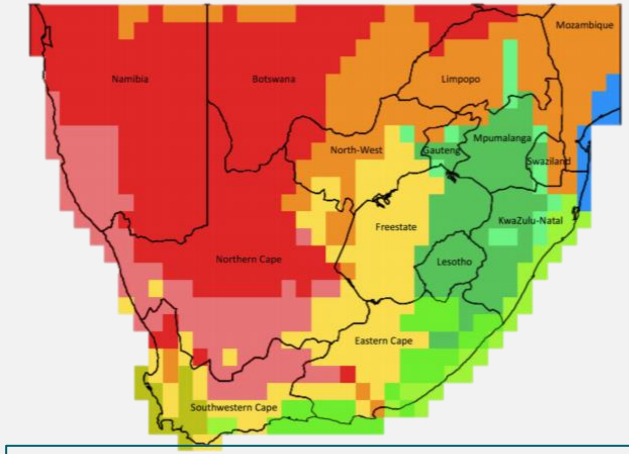
7 A sustainable, healthy diet for all could require **>170%** increases in soybean and vegetable production, and **~20%** increase in deciduous fruit production by 2050, even if production for export and livestock is diverted to local food demand. This would require land-use prioritisation for hardier, nutritionally-dense foods and import strategies for starchy staples

8 A Just Transition needs to unlock sustainable and healthy diets for all South Africans. However, sustainable, nutritional diets currently cost **~4 times more** than the average, nutritionally-inadequate, local diet, and **~1.5 times more** than the cheapest nutritional, carbon-intense diet in South Africa. Subsidisation of healthy diets may be funded by reductions in the healthcare burden of obesity, however, measures to build a climate-resilient food supply could further increase production cost – therefore it will be critical to ensure affordability of future food supply

9 To ensure a Just Transition, **small-scale producers** must be supported to increase productivity and gain both agricultural and business skills. This requires improved extension services and climate monitoring, access to finance and off-take incentives for sustainable practices. It may also require tenure reform; **farmworkers** require new work opportunities and **agri-dependent communities** need to be identified and plans made to diversify economic opportunities

Significant increase in hot desert zone and shift from warm to hot temperature zones expected across both scenarios

Koppen Geiger climate zones in SA
(1961- 1990)

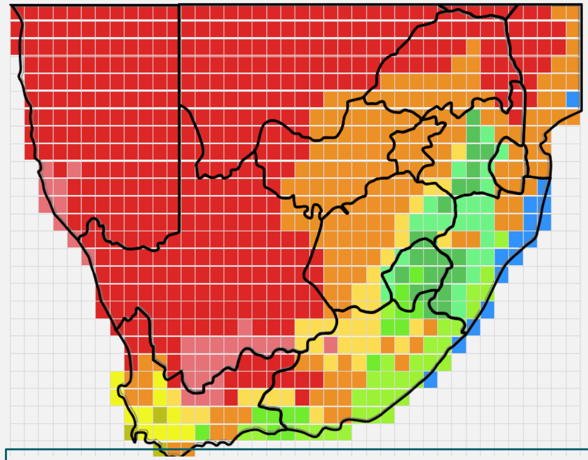


Cold and hot desert in the West

Cold steppe in the center & south-west

Warm temperature regions in the east & south-east

RCP4.5 (eq.[1])
(2040-2060; 2°C MIROC3.2-medres model)

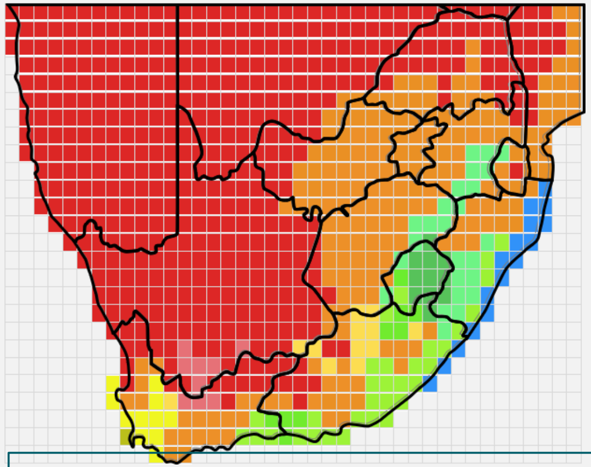


~25% increase in size of hot desert

~18% increase in size of hot, arid steppe

Warm temperate partially replaced by hot temperate

2050 RCP8.5 (eq.[2])
(2040-2060; 3°C MIROC3.2-medres model)



~48% increase[3] in size of hot desert

~34% increase[3] in size of hot, arid steppe

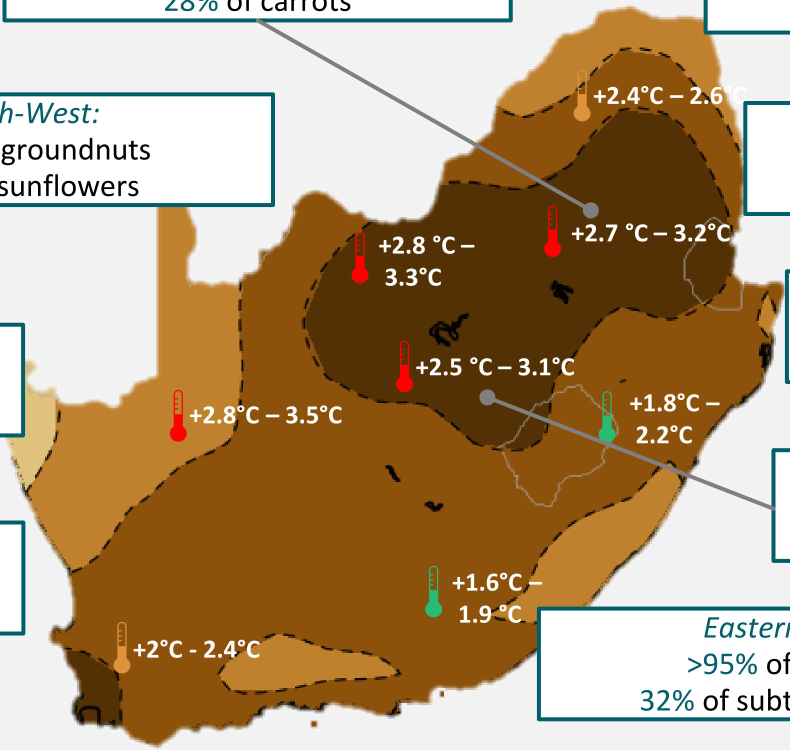
Warm temperate replaced by hot temperate except in Lesotho. ~124% increase[3] in size of tropical savannah (east coast)

🟥 *Arid, Desert, Hot*
🟥 *Arid, Desert, Cold*
🟧 *Arid, Steppe, Hot*
🟨 *Arid, Steppe, Cold*
🟨 *Temperate, Dry & Hot Sum.*
🟨 *Temperate, Dry & Warm Sum.*
🟩 *Temperate, Dry Win., Hot Sum.*
🟩 *Temperate, Dry Win., Warm Sum.*
🟩 *Temperate, no dry season, Hot Sum.*
🟩 *Temperate, no dry season, Warm Sum.*
🟦 *Tropical, Savannah*

1. 2°C global temperature increase 2. 3°C global temperature increase 3. Relative to base period
Source: Theoretical and Applied Climatology (2015); Agricultural Research Council & DAFF; NBI-BCG team

Overall, Western and Northern Cape, with >30% of SA agri. jobs, at highest risk from climate change

Annual rainfall and temperature change by 2050 (RCP8.5) and key commodities by region (% of national production)



Gauteng:
29% of white meat
28% of carrots

Limpopo:
79% of tomatoes
54% of citrus

North-West:
>95% of groundnuts
31% of sunflowers

Mpumalanga:
45% of legumes
51% of pine forest

Northern Cape:
9% of deciduous fruit
18% of wheat

KwaZulu-Natal:
>95% of sugarcane
57% of eucalyptus forest

Free State:
43% of maize; 58% of sunflowers;
42% of soybean

Western Cape:
86% of deciduous fruit
44% of wheat

Eastern Cape:
>95% of lucerne
32% of subtropical fruit

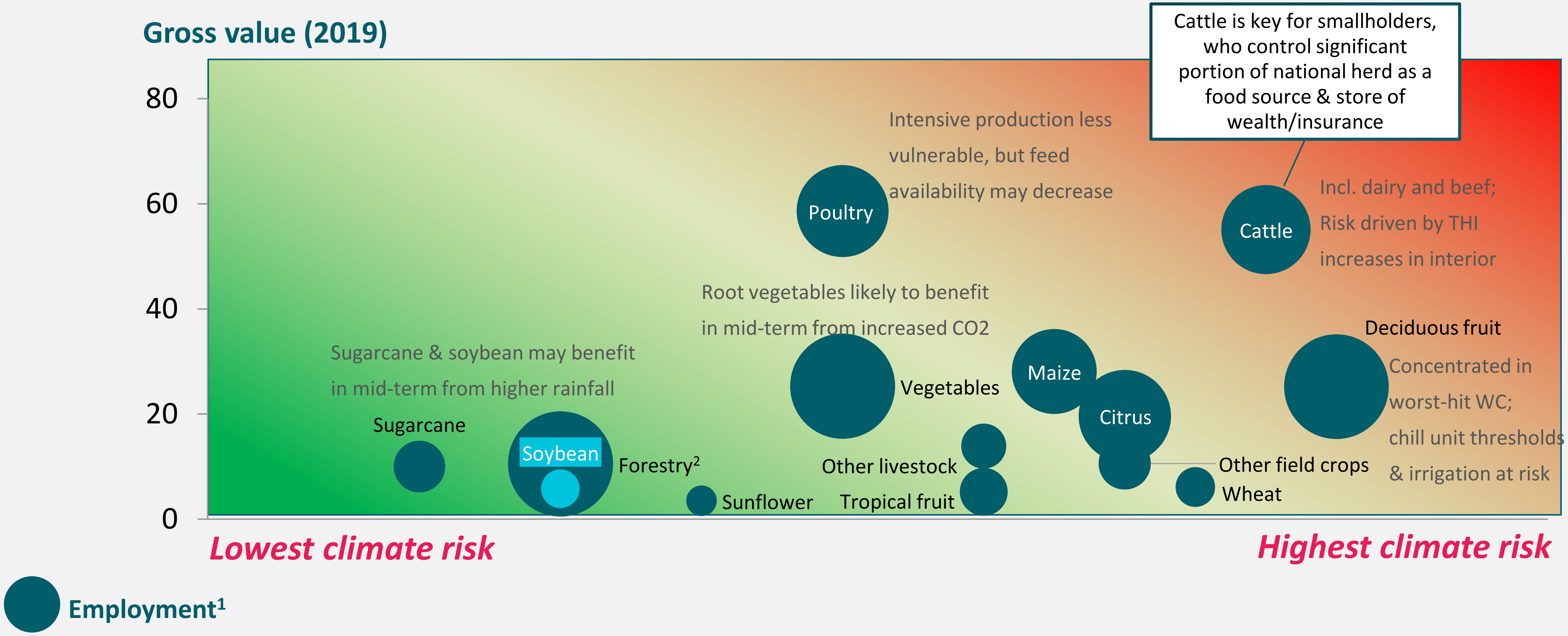
Annual rainfall change by 2050 vs pre-industrial baseline (mm/annum)

- 🟨 -20mm to -40mm
- 🟧 -40mm to -60mm
- 🟫 -60mm to -80mm
- ⬛ -80mm or more

1. Relative to 1961-1990 baseline 2. 'Risk' defined based on relationship between projected climate change impacts on municipalities and the relative economic importance of agriculture to those municipalities | Source: CSIR "Green Book"; Statistics South Africa "Census of Commercial Agriculture 2017"; LTAS Phase I; 3rd National Communication; Green Book; NBI-BCG team

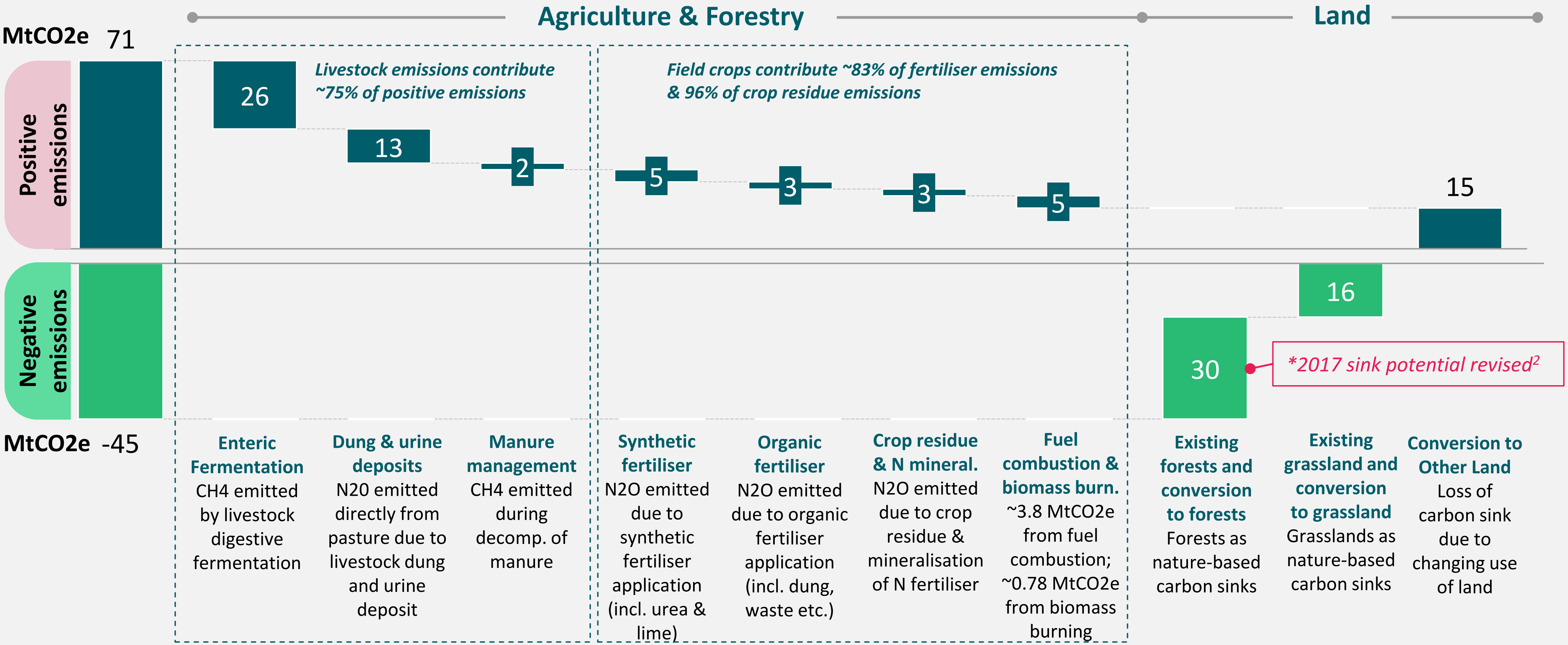
Significant value and jobs at risk due to potential negative climate impact on cattle, deciduous fruits and maize

Indicative



1. Excludes employment in mixed agriculture (~186k jobs) 2. Does not include jobs down the value chain, only primary stage | Note: Gross income and employment statistics only account for primary products (i.e. products that are consumed directly or sold for further processing) | Source: Statistics South Africa "Census of Commercial Agriculture: 2017" ; Statistics South Africa "Abstract of Agricultural Statistics 2020"; Forestry SA

Livestock sector drives ~75% of direct AFOLU emissions; natural carbon sink anchored in forests and grasslands



Livestock emissions contribute ~75% of positive emissions

Field crops contribute ~83% of fertiliser emissions & 96% of crop residue emissions

**2017 sink potential revised[2]*

Notes: Synthetic fertiliser emissions split based on crop system emissions estimations by Tongwane et al.

1. Horticulture includes all vegetables & nuts (incl. root vegetables) but not legumes 2. 2021 update to GHGI | Sources: DEFF (GHG Inventory 2000-2017)

Lever implementation timing will be dictated by progression of techno-economic feasibility and degree to which smallholders are supported

			Short-term (within next 24 months)	Mid-term (by 2030)	Long-term (beyond 2030)
N2O	Horticulture & Field Crops	1	Targeted fertiliser application, no-fertiliser zones		Introduce green ammonia
		2	Introduce livestock to existing systems	Provide broader access to organic fertiliser	
		3	Scale-up use of nitrification inhibitors	Lower cost, more efficient inhibitors	
		4	Introduce crop cycling, cover cropping, lower till	Fully implement no-till cultivation	
CH4	Livestock	5	Selective breeding & culling	Genetic selection of specimens with lower emissions intensity	
		6	Young forage, more maize silage	Tannin forage, finer processing	
		7	Anaerobic manure digestors, nitrif. inhibitors	Sophisticated manure storage & use systems	
		8	Regular checks, vaccination, parasite control	Matching genotypes to biomes	Methanogen vaccines
CO2	All AFOLU	9	Increased energy efficiency & switching to own production	Replacement of existing electricity supply with RE, begin machinery electrification	Full fuel switch to RE
		10	Improving soil carbon sequestration potential on croplands and grazing pastures, polyculture forestry, maintaining plantations in growing phase to maximise 'carbon pump'		

Both BAU and sustainable diet scenarios see similar absolute increases in food consumption, but different diets produce different emissions intensity

	Business as usual diet scenario	Sustainable diet scenario
Key drivers	29% population growth	
	~10% increase in proportion of population in 'middle-income' bracket	
	Income-driven shift to e.g., red meat, away from e.g., maize	Sustainable diet shift to fruit, veg., legumes, away from red meat

	Business as usual diet scenario			Sustainable diet scenario		
	Staples	Red meat	Fruit & veg	Staples	Red meat	Fruit & veg
Demand shifts (2020-2050)	+21%	+30%	+29%	-51%	-71%	+111%

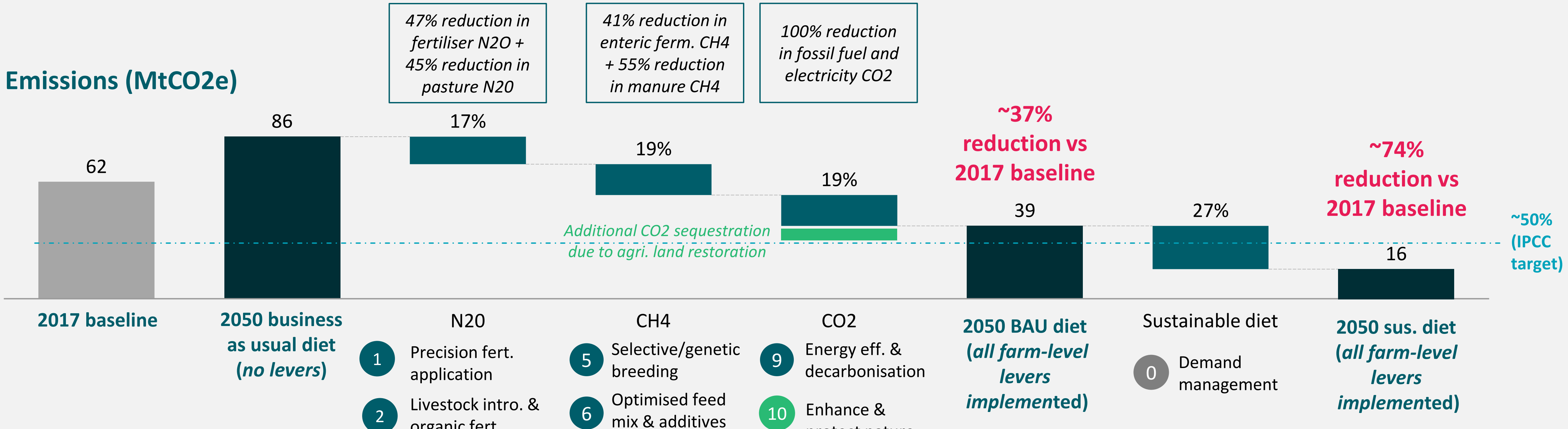
	Staples	Red meat (beef, herd)	Fruit & veg
Emissions intensity (kg CO2e/ '000 kcal.)	~0.5	~36	~1

1. Using average SSA prices/ adult person, scaled up 3.5x for family of 4

Source: University of Oxford "Our World in Data"; Bureau for Food and Agriculture Policy (BFAP); Lancet Global Health; NBI-BCG team

If business-as-usual diet assumed, ~40% AFOLU emissions reduction by 2050 possible if all farm-level levers implemented

Emissions (MtCO2e)



N20
1. Precision fert. application
2. Livestock intro. & organic fert.
3. Nitrification inhibitors
4. Land preparation & crop mgmt.

CH4
5. Selective/genetic breeding
6. Optimised feed mix & additives
7. Improved manure mgmt.
8. Improved animal health mgmt.

CO2
9. Energy eff. & decarbonisation
10. Enhance & protect nature-based sink potential

Sustainable diet
0. Demand management

Livestock

Field Crops & Hort.

Field Crops & Hort.

Forestry

Source: NBI-BCG team

Adaptation and mitigation needs to be pursued together to ensure climate resilience

Initial view - to be discussed

Field crops | Horticulture | Forestry | Livestock

Mitigation

Field crops / Horticulture

1. Drive **precision application of fertilisers** and deploy **green fertilisers** in longer term
2. **Introduce livestock to leverage organic fertilisers** to meet fertiliser demand
3. Application of **nitrification inhibitors**
4. Ensure adoption of **crop cycling**, **cover cropping**, **no till**

Livestock

5. **Improved herd management:** selective breeding & culling, genetic selection of lower emissions specimens
6. **Improved feed management**: feed additives, higher quality /young feed & more granular processing
7. **Optimised manure management:** appropriate collection, storage/covering, use of digestors & nitrification inhibitors for pasture deposits
8. **Improved health management:** vaccination, pest control, biome-genotype matching

All sectors

9. Drive reduction **from energy use:** improved efficiencies, switching electricity supply to RE and electrifying fossil fuel-driven processes and machinery and using RE
10. **Restore crop and grazing land, polyculture forestry, improved forest management**

Adaptation

Field crops / Horticulture

1. Improve **metering of water flows** and drive **more responsible and informed allocation of water reserves**
2. Develop and plant **temp., drought and pest resilient cultivars**
3. Implement **pest netting & organic pesticides**

Forestry

4. Deploy climate and pest **resilient hybrids and diversify tree species**
5. Implement **fire & pest mgmt.** practices (e.g. fire breaks, trimming and use of alien biomass, active forest health monitoring)

Livestock

6. **Sustainable intensification**
7. **Improved herd management:** selective breeding & culling, genetic selection of lower emissions specimens, switching to hardier breeds/animals
8. **Improved health management:** Deploy parasite control, vaccinations, improved feed
9. Explore and deploy **alternative protein sources/new production methods** (e.g., lab meat, fish protein, etc.)

All sectors

10. Assess land changes and shift to **more suitable areas where possible**
11. Develop & deploy **extreme weather event mgmt. systems**

Source: BCG analysis

NBI BUSA BCG

Furthermore, ensuring water availability and enabling farmers to implement levers relies on investment in water monitoring , research and extension services

Non-exhaustive - to be discussed

Treasury estimates **R670Bn** needed in the **next 10 years** to restore and upgrade national water systems[1]

- Agriculture accounts for ~60% of national water consumption
- Increasing demand must be met with better **management of agricultural water reserves (e.g., dams)** and more **accurate metering of water usage**
- Etc.

Funding for a unified **climate monitoring and adaptation research** effort required

- Climate research in SA largely siloed, affecting uniformity of approaches and results
- Funding of a **virtual centre of excellence** for climate research in agriculture needed
- Etc.

Investment and deployment of specialists required to **rehabilitate extension services**

- Extension services managed on a provincial level and dysfunctional in many regions
- **Robust extension services** crucial to both lever implementation and ensuring success of land redistribution
- Etc.

1. Department of Water and Environmental Affairs estimate

Source: Department of Water and Environmental Affairs; Expert interviews

Replacement of cheap staples and increased consumption of fruit and veg., legumes, nuts and oils results in higher cost of sustainable diet

Average monthly household cost of different food baskets in SA

Stats SA Living Conditions Survey (LCS)

R1027
/month

- Real average household food expenditure in South Africa (2014/15)
- Based on survey of ~28 000 households

BFAP Thrifty Healthy Food Basket

R2900
/month

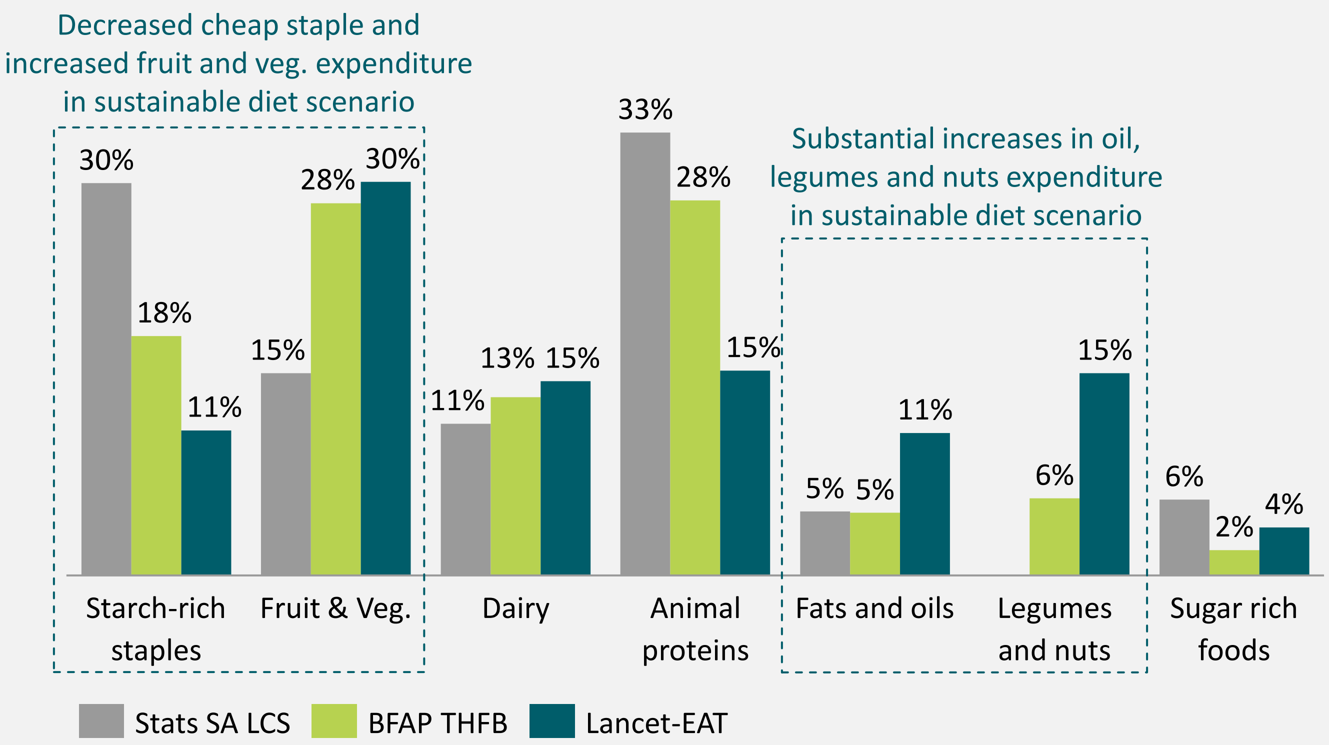
- Lowest cost SA food basket that meets full macro nutrient requirements (aligned with DoH Dietary Guidelines)
- Affordable for ~50% of SA households[1]

Lancet EAT sustainable healthy diet

R4300
/month

- Healthy diet, optimised to minimise carbon intensity of basket
- Affordable for ~20-30% of SA households[1]

Average % household food expenditure for different food baskets



Decreased cheap staple and increased fruit and veg. expenditure in sustainable diet scenario

Substantial increases in oil, legumes and nuts expenditure in sustainable diet scenario

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[1] Assuming 35% of household income is dedicated to food expenditure

Source: Hirvonen et al "Cost and Affordability of the Lancet-EAT Diet"; BFAP 2020 Baseline; Stats SA Living Conditions Survey

A sustainable diet scenario certain to put pressure on local fruit, vegetable and legumes production – potentially impacting export earnings

Non-exhaustive

Soyabeans (ktonnes/a)

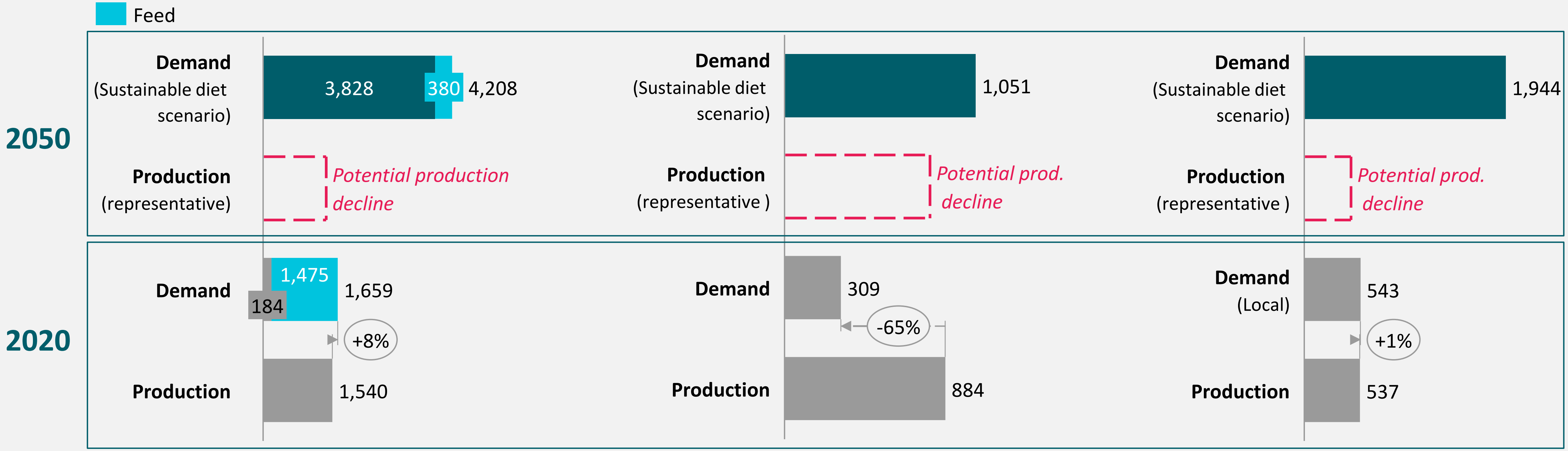
Demand to shift from animal to human food – potentially requiring imports

Apple (ktonnes/a)

Excess prod. for export to diminish with increased fruit consumption

Tomato (ktonnes/a)

Imports likely required given strong demand increase



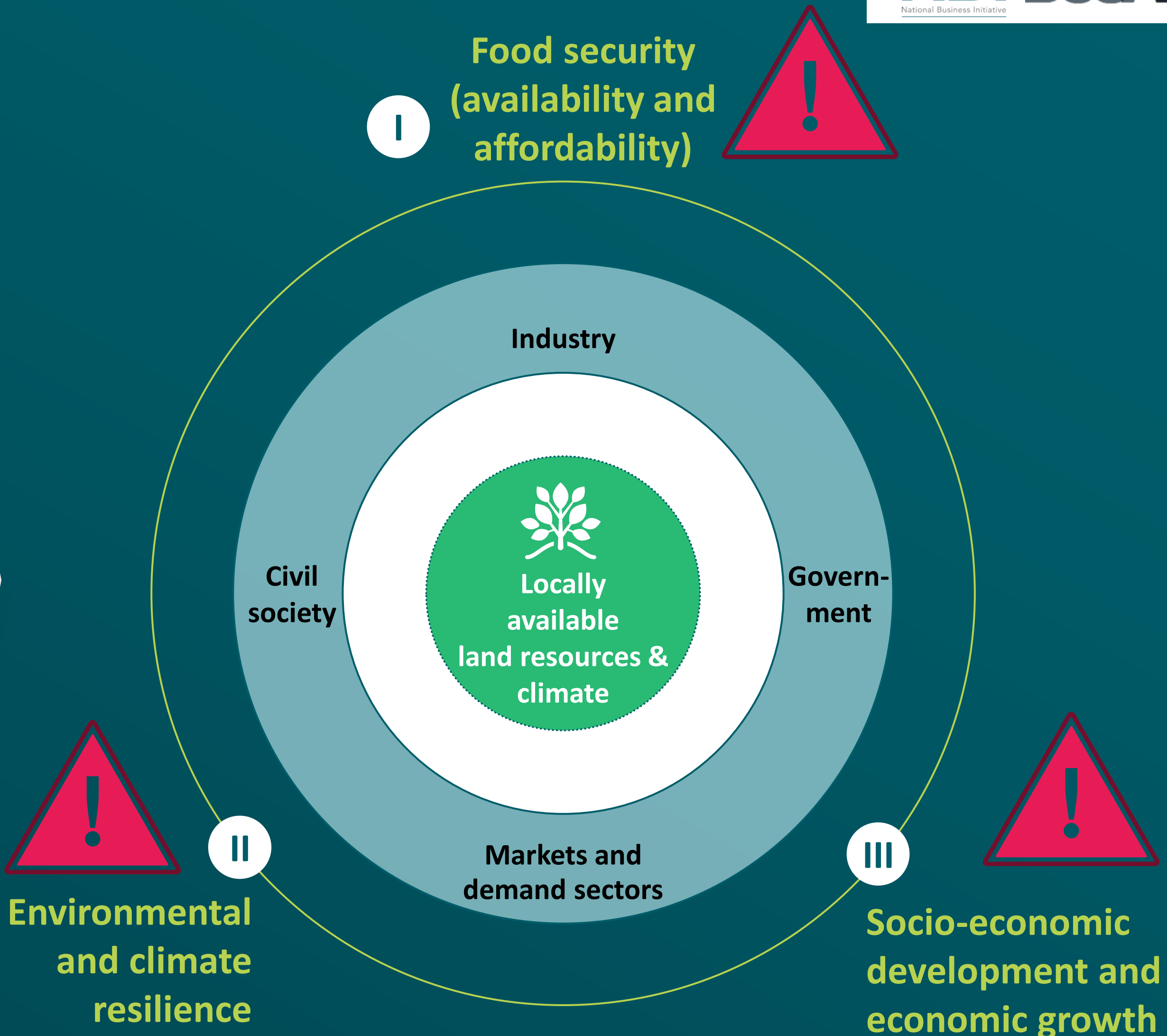
Source: FAOSTAT; CSIR; 3rd National Communication; NBI-BCG team

AFOLU at risk from climate change across all dimensions

In particular, food security at risk by potentially increasing food prices:

- **Sustainable, healthy diets** need to be adopted to enable adaptation and mitigation
- But those diets could cost **~4x more than** the average food spend in SA today, and **~1.5x more than** the cheapest healthy, but non-sustainable local diet today

Need to ensure affordability of supply via both avoiding significant cost increases and ensuring socio-economic development



Source: BCG analysis

Key actions to ensure effective lever implementation and maximise food security, environmental, and socio-economic benefits

	Short-term (Within next 3-4 years)	Long term (after 2030) – significant climate impact
Sector-wide	• **Incentivise sustainable practices:** Deploy certification schemes, rollout user-pays irrigation and develop granular monitoring of irrigation flows • **Enhance farmer capacity to implement**: Grant title deeds and promote cooperative formation for smallholders, implement DAFF extension strategy, develop a centre of agri. research excellence to ensure consistent messaging • **Align financing options to AFOLU challenges:** Deploy blended finance mechanisms, index-based insurance products and water-risk filters in agri. financing	• **Drive demand shifts**: Tax to incentivise more diverse, locally grown foods and subsidise healthy, sustainable diets using savings in healthcare sector • **Develop regional land-use prioritization hierarchies:** Develop clear hierarchies, prioritising high value, hardier foods • **Diversify employment opportunities and income sources:** Develop agro-industrial value chains around emerging farmer cooperatives and build strategies to transition livestock farmers to alternate roles
Livestock	• **Develop local knowledge**: Fund breeding programmes and development of local breed database to inform targeted extension deployment • **Develop demand-side decarbonisation incentives**: Deploy mobile auction sites	• **Drive breed shifts:** Promote switches from cattle to hardier and lower emissions goat and sheep, drive demand changes using taxation
Field Crops & Hort.	• **Improve contribution of emerging farmers**: Roll out crop aggregation platforms, giving smallholders access to medium-to-large retail markers • **Drive innovative solutions**: Double national spending on local research to develop more resilient cultivars and drive pilot green NH3 projects in commercial sector to provide off-takes for green chemicals production	• **Enable emerging farmer commercialisation**: Develop legal and policy framework to develop smallholder cooperatives that produce resilient cash crops (e.g., olives or dates, millet)
Forestry	• **Develop viable 2nd gen. biomass economy**: Fund conclusive study of usable biomass availability in SA; Use biomass collection to provide employment and pilot biomass hubs to facilitate commercialisation with petrochemicals sector	• **Enable expansion**: Review water-licensing process to expand biomass, sequestration and sustainable timber availability in SA
Land use	• **Demand-side incentives for sustainable land management**: Develop a carbon crediting market and ecosystem services incentivisation framework and increase carbon taxes to increase carbon credit value • **Increase funding to LandCare programmes**	• **Secure international green financing**: Leverage appetite for international biodiversity finance to drive integrated land rehabilitation and agriculture decrabonisation and adaptation programmes

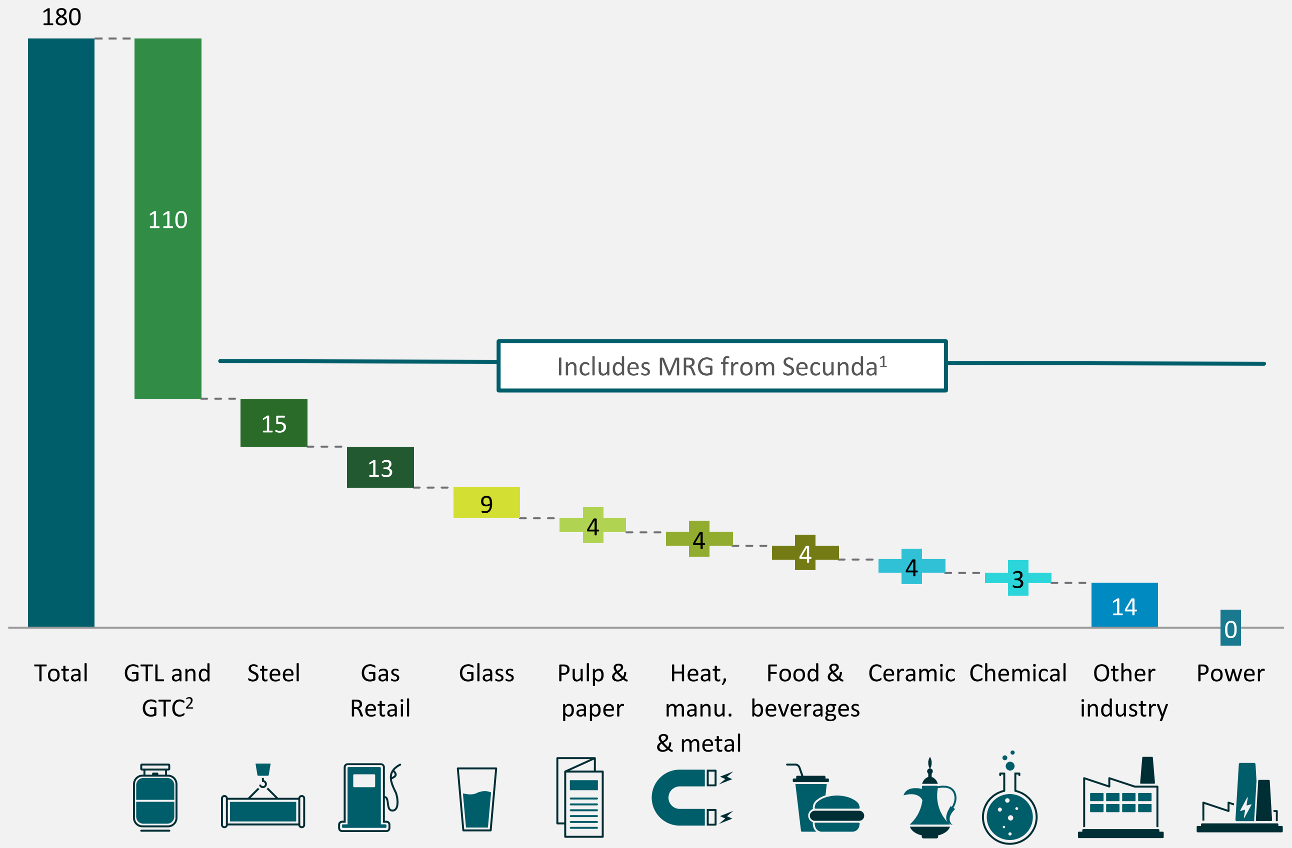
Source: BCG analysis

Q&A

Please post your questions in the chat

The role of gas in South Africa – towards a net-zero future for South Africa

SA currently consumes ~180PJ/a of gas, mainly in the synfuels sector…



1. Excluding any latent unmet demand; Household gas demand negligible (<1PJ/a) and not included 2. Excluding PetroSA | Note: MRG= Methane Rich Gas, GTC= Gas-to-Chemical, GTL= Gas-to-Liquid
Source: Quantec baseline SAM; Capital IQ; Sappi annual integrated report 2019; ArcelorMittal audited financial statements 2019; AECI 2019 annual integrated report; Omnia integrated annual report 2019, StatsSA; NBI-BCG project team

…and also drives high socioeconomic impact

~46-56k

Jobs across the gas value chain in South Africa

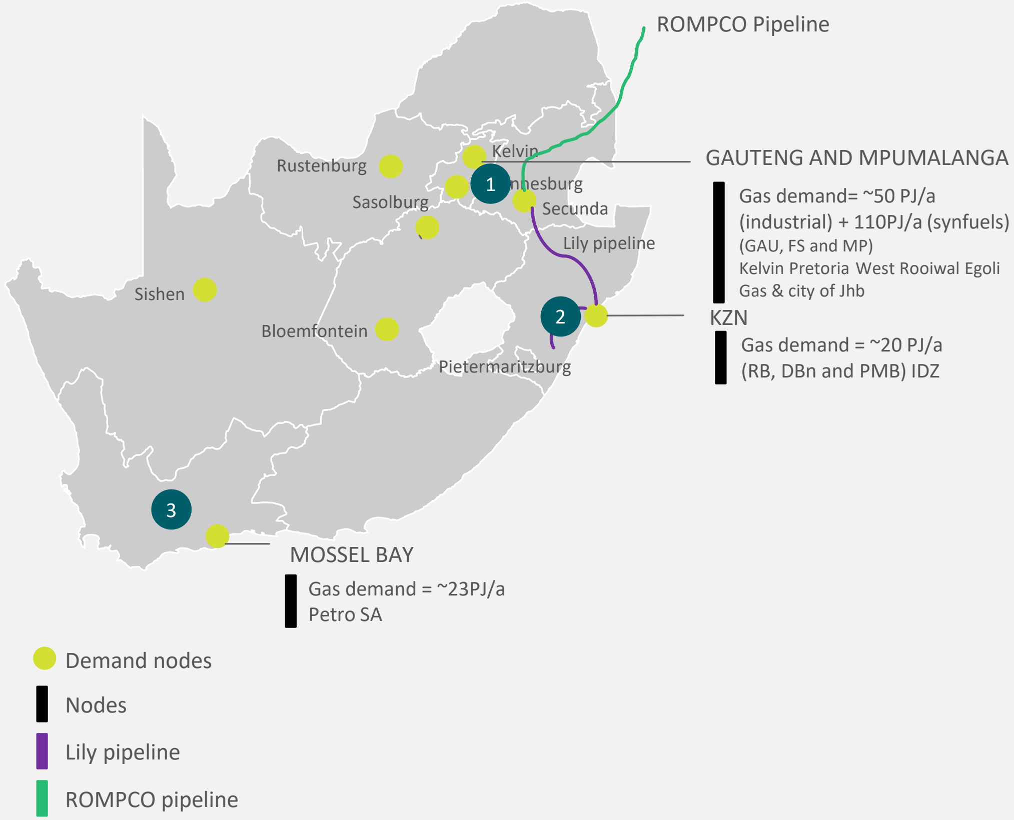
R150-215Bn

Taxable revenue from the gas value chain

1-2%

Contribution to national GDP from the value chain

Regionally, current gas demand clustered in Gauteng, Mpumalanga and KwaZulu-Natal



Demand is centred around Secunda/Sasolburg and the industrial hub in Richards Bay

① Gauteng and Mpumalanga: ~160 PJ/a
  - Synfuels demand for gas ~110PJ/a supplied via ROMPCO and a transition pipeline
  - Sasol supplies neighbouring facilities to Secunda, namely Egoli gas & Steel industry players (~50PJ/a consumed by inland industrial users)

② KZN: ~20 PJ/a
  - Supported by Lily pipeline which is connected from end terminal of ROMPCO pipeline in Secunda to Richards Bay
  - Line supplies MRG to industrial clients within Richards bay industrial zone mostly focused on Refinery operations

③ Western Cape:
  - Supply from Block 9 feeds PetroSA's GTL refinery in Mosel Bay, though this is assumed to be exhausted as of the end of 2020

Pande-Temane is SA's only major gas supply today (via the ROMPCO pipeline)

This supply is at risk with reserves declining from ~2025 – can be supplemented with capital investments on existing assets & LNG

Note: MRG = Methane rich gas; GTL= Gas-to-liquid
Source: IGUA 2020 Annual Report; Sasol Production Reports; Sasol Form 20F 30 June 2021; Expert interviews; NBI-BCG Project Team

Four key sectors will drive future gas demand in SA

Electricity

As outlined in the power report: RE + battery storage + gas is the cheapest option to decarbonise power & ensure security of supply (at least ~150GW RE req. by 2050)

Gas used for mid-merit and mostly peaking capacity across all net-zero power pathways

Synfuels

Coal feedstock substitution the only way to significantly decarbonise sector (currently >90% of sector emissions from CTL)

Affordability of gas supply is critical to unlocking gas demand to phase out coal

Broader Industry

Industry estimates there to be at least ~68PJ/a of latent demand today, on top of 50PJ/a consumed today

Industrial sector could ramp up gas demand to phase out coal as an energy source, pending the affordability of supply

Transport

Gas is not expected to play a major role in SA's transport sector, but could play a role in decarbonising in HDVs for freight road transport

Note: Household gas demand excluded (limited future role for gas for household heating) as this would require additional distribution infrastructure and create the risk of stranded assets; RE = Renewable Energy; CTL= Coal-to-Liquid; HDV= Heavy Duty Vehicles | Source: EIU; IRP; BCG expert interviews; LNG-IPP site; EMIS Enerdata, NBI-BCG project team

RE archetype has lowest cost and relatively narrow risk envelope or variability in cost, even under most unfavourable assumptions

Key sensitivities tested

CO2 price

Less than optimal RE location

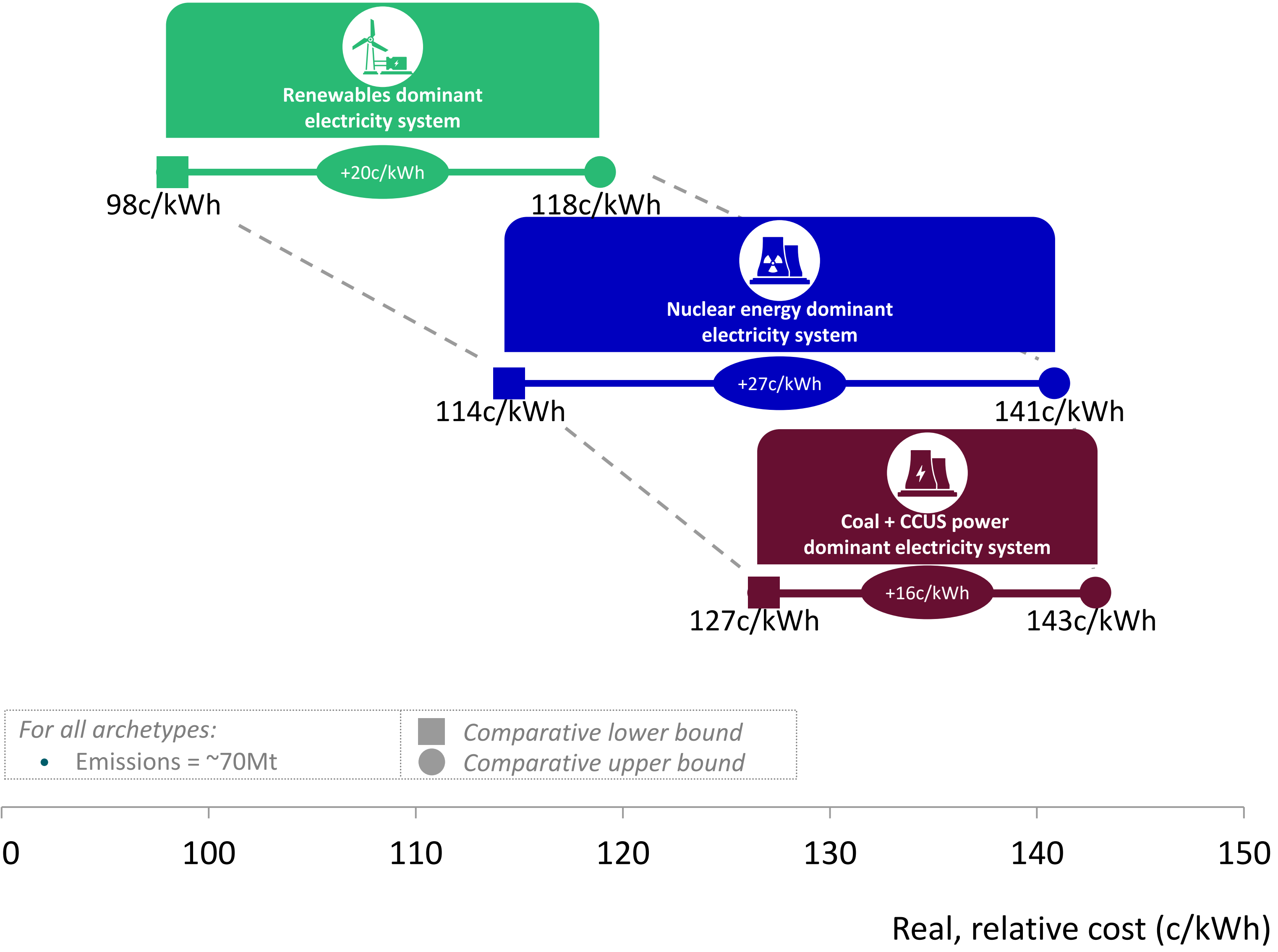
System Inertia

Transmission Losses

Water Use

Carbon Capture Costs

WACC



Note: CO2 price of R0/ton used for each archetype
Source: Plexos model, NBI-BCG Project Team

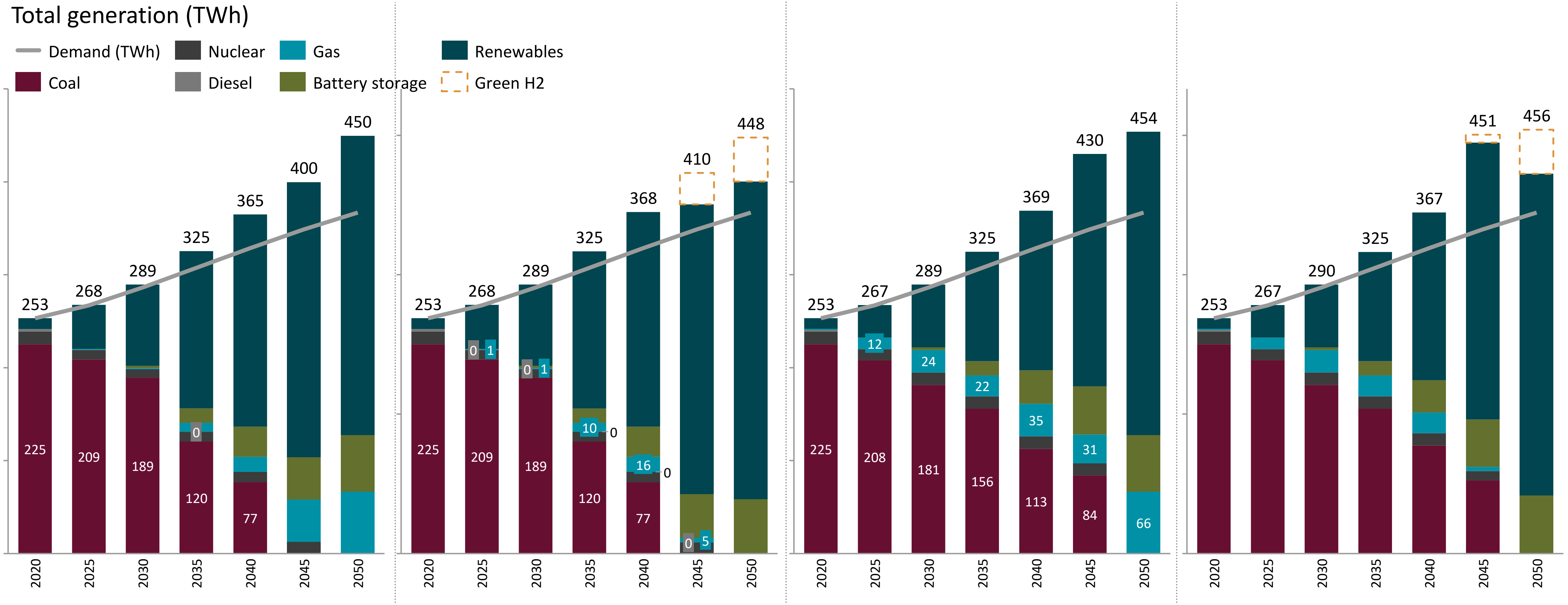
Recap

Across power sector pathways, gas is used predominantly for peaking (<10% utilisation) & to a lesser extent for mid-merit (<30%)

1 **Lowest emissions pathway**

2 **IRP pathway (coal, gas & RE)**

Gas & DACCS | ***Green H2*** | ***Gas & DACCS*** | ***Green H2***



Note: Total generation (TWh) includes curtailed energy (i.e. curtailment not subtracted out); Average battery storage of ~4 hours used in modelling | Source: Plexos model, NBI-BCG project team

SA’s 2030 gas demand could range from 180-550PJ/a, higher uncertainty in longer term with 0-560PJ/a in 2050

🟪 Industrial 🟦 Electricity ■ Transport 🟩 Synfuels

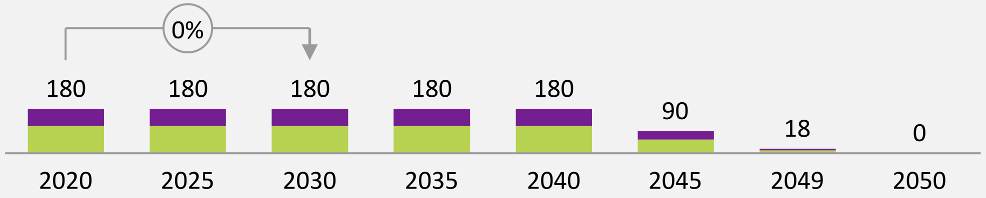
Level of decarb. ambition

− *Moderate ambition - current policy*

+ High ambition – beyond current policy

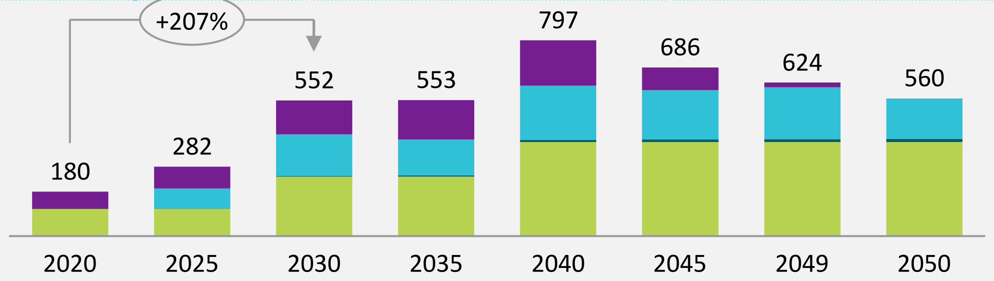
1 No additional gas IRP policy scenario

~4 600 PJ	**~180 PJ/a**	**9 400 Mt**
Cumulative gas demand	Peak demand	Cumulative sector emissions



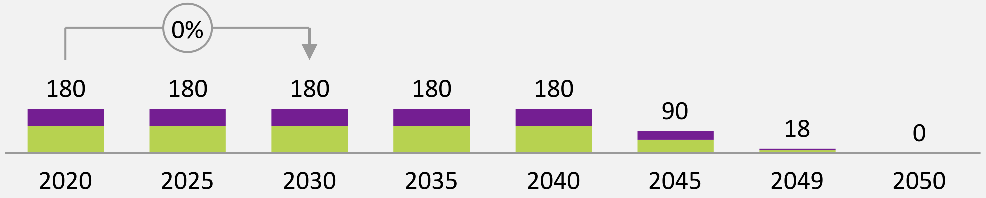
2 High demand IRP policy scenario

~16 100 PJ	**~800 PJ/a**	**9 000 Mt**
Cumulative gas demand	Peak demand	Cumulative sector emissions



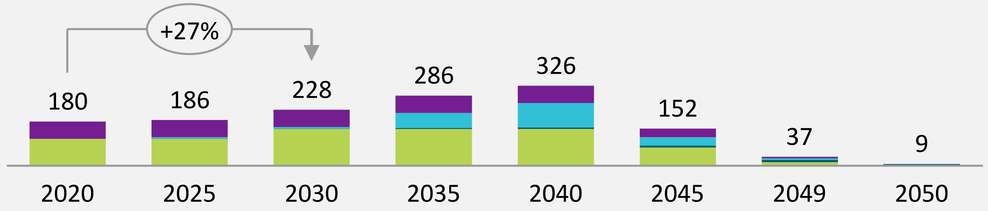
3 No additional gas low emissions scenario

~4 600 PJ	**~180 PJ/a**	**8 400 Mt**
Cumulative gas demand	Peak demand	Cumulative sector emissions



4 Low demand low emissions scenario

~6 400 PJ	**~330 PJ/a**	**7 800 Mt**
Cumulative gas demand	Peak demand	Cumulative sector emissions



− *Only current gas consumption, no additional gas supply w/ diesel in place of gas for power*

+ *Additional gas supply, beyond current consumption*

No additional gas supply vs. additional gas supply unlocked

Note: Cumulative emissions are net of any negative emissions tech (e.g., DACCS) | Source: NBI-BCG project team

Back-up: Detailed assumptions per gas demand scenario

Electricity | Synfuels | Broader Industry | Transport

Level of decarb .ambition

Moderate ambition - current policy

1 No additional gas IRP policy scenario

- Electricity: Mid-merit & peaking needs of system met with diesel, complemented with DACCS post-2040 (IRP gas & DACCS path w/ diesel in place of gas)
- Synfuels: Gas demand remains flat at current levels (~110PJ/a) to 2040, linearly ramping down to 0PJ/a 2040-2050
- Broader Industry: Gas demand remains flat at current levels (50PJ/a) to 2040, linearly ramping down to 0PJ/a 2040-2050
- Transport: Gas demand remains flat at current levels of 0PJ/a

2 High demand IRP policy scenario

- Gas demand ramps up with current policy pre-2030[1], add'l OCGT & CCGT capacity post 2030 & DACCS[2] post-2040 (as per IRP gas & DACCS path)
- Gas ramps up to ~20% of Secunda feedstock by 2030 (+60PJ/a) and ~40% by 2040 (+ ~140PJ/a); PetroSA revived w/ demand of ~70PJ/a by 2030
- Gas avail. affordably, unlocking ~70PJ/a latent demand pre-2030, growing by 3% post 2030 in line with GDP & ramping down to 0PJ by 2050
- Gas demand increases to 2PJ/a by 2030 (15PJ/a by 2050)[3]

High ambition – beyond current policy

3 No additional gas low emissions scenario

- Mid-merit & peaking needs of system met with diesel, until green H2 avail. from ~2040 (low emissions green H2 path w/ diesel in place of gas)
- Aligned to the no gas IRP scenario – current consumption to 2040
- Aligned to the no gas IRP scenario – current consumption to 2040
- Aligned to the no gas IRP scenario – no gas consumption

4 Low demand low emissions scenario

- Gas demand peaks ~2035 in line with coal decomm. and is subst. with green H2 from ~2040 (low emissions green H2 path)
- Gas demand increases by 40PJ/a by 2030, in line ~20% gas feedstock for Secunda, ramping down to 0PJ/a post 2040; Petro SA not revived
- Aligned to the no gas scenarios
- Gas demand increases to 2PJ/a by 2030 (10PJ/a by 2050)[4]

− *Only current gas consumption, no additional gas demand w/ diesel in place of gas for power*

No additional gas supply vs. additional gas supply unlocked

\+ *Additional gas demand, beyond current consumption*

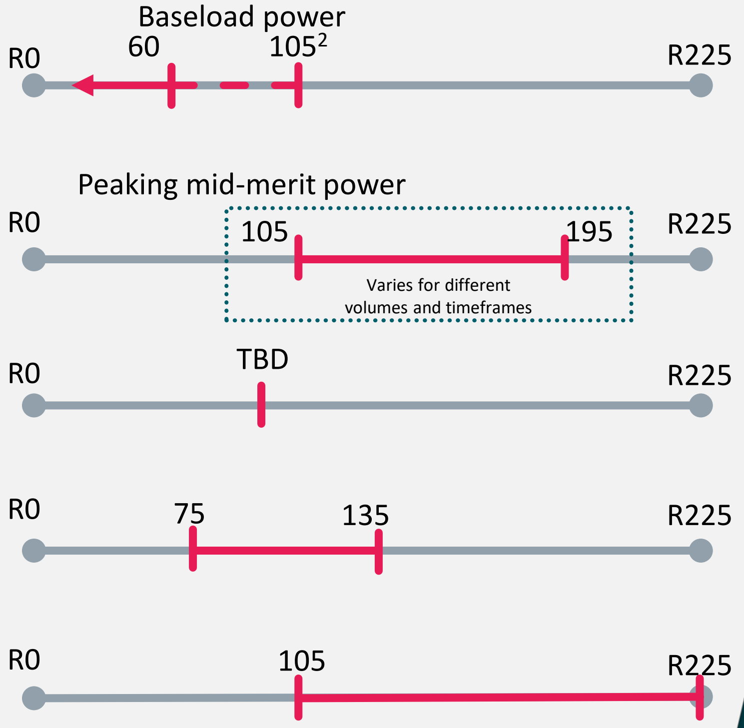
---

1. Pre-2030 gas capacity as per current policy: IRP (3GW) , RMIPPPP (1GW), conversion of existing OCGTS (3.8GW) & latent demand (1.4GW) w/ add'l CCGT & OCGT capacity post 2030 as per Plexos pathways w/ some residual gas capacity in 2050; 2. Direct Air carbon capture & storage; 3. In line w/ IEA Reference Tech Scenario; 4. in line w/ the IEA Sustainable Development Scenario | Note: IRP = Integrated Resource Plan; DACCS = Direct Air Carbon Capture and Storage, OCGT = Open Cycle Gas Turbines; CCGT = Closed Cycle Gas Turbines | Source: NBI-BCG project team

Affordability is critical bridge supply & demand – esp. in synfuels & industry

	Potential peak demand, PJ/a[1]
Electricity	140-240PJ/a All peaking & mid-merit
Synfuels	~150-310PJ/a *(Up to 390PJ/a with PetroSA)*
Broader industry[3]	70-190PJ/a
Transport[4]	10-15PJ/a

Gas Affordability Rand/GJ (landed)



Ensuring the right supply infrastructure play is critical to unlocking demand and meeting affordability thresholds

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1. Range based of the low and high demand scenarios; 2. R105/GJ short to mid-term affordability for industrial GTP, R60//GJ for system base load 3.Based on upper limit of current customer affordability range R45-75/GJ (delivered) and NBI Climate Pathways/BUSA GWG assumption of R105-140/GJ for latent Industrial demand 4. Based on US benchmark. Upper bound could be as high as ~R300/GJ based on 2020 average wholesale list price for diesel (0.05%)

Note: GTP figures are premised on system cost modelling, GTP could have much higher price flexibility once price/commercial considerations are factored in

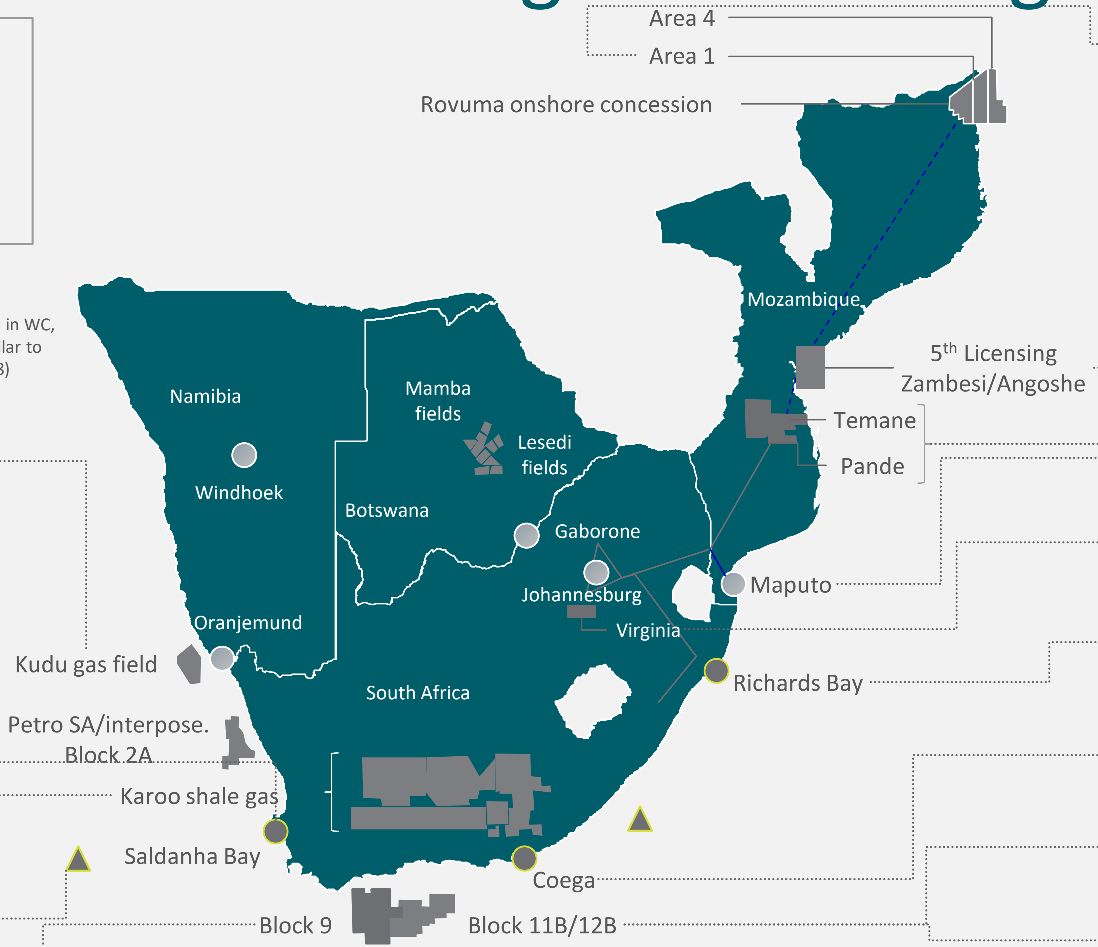
Source: IGUA Annual Report 2020; NBI-BCG project team

Range of local, regional and international supply options to meet future demand and bridge diminishing supply…

Complexity/ Progress

- 🟢 High
- 🟡 Medium
- 🔴 Low

- —— Transmission pipeline
- - - - - Potential pipeline
- ● Import LNG hub
- ▲ Offshore ship



Could be located in WC, EC or KZN (similar to options 6-8)

11 **LT supply: Onshore LNG hub**
Unlimited reserves | 77-128PJ/a

17 **LT supply: Kudu Gas fields**
Reserves = 1500PJ

16 **LT supply: Block 2A**
Reserves = ~1700PJ

12 **LT supply: Karoo shale gas**
Reserves = 13000-494000PJ

8 **ST/MT supply: FSRU Western Cape**
Unlimited reserves | Variable capacity[2]

3 **ST: Ship-to-ship bridging solution**
Unlimited reserves | Capacity dep. on demand

Block 9 depleted

14 **LT supply: Rovuma**
Area 1 reserves = 630000PJ; Area 4 = 670000PJ

15 **LT supply: Buzi Fields**
800-3300PJ/a

7 **MT: Pande Temane PPA**
Reserves = 800PJ | ~160PJ/a

6 **MT: Pande Temane PSA**
Reserves = 725-920PJ

1 **ST supply: LNG from Matola via Rompco**
Unlimited reserves | ~190PJ/a

2 **ST supply: Virginia Fields gas liquefaction**
Unknown reserves | ~2.5PJ/a

4 **ST/MT supply: FSRU KwaZulu-Natal**
Unlimited reserves | Variable capacity[2]

5 **ST/MT supply: FSRU Eastern Cape**
Unlimited reserves | Variable capacity[2]

9 **LT supply: Brulpradda**
Reserves = 1200-6100PJ (gas & condensate)

10 **LT supply: Luiperd**
Gas reserves = 3100PJ; condensate = 1800-2400PJ

1. Complexity refers to all dimensions: infrastructure overlay, technical and commercial; 2. Potentially similar to annual capacity of option 1 (~190PJ/a) | Note: Options which are greyed out are excluded from scope of view due to small scale and complexity | Source: Local stakeholder interviews; IGUA-SA Annual Report 2020; NBI-BCG Project Team

Not exhaustive | Focus on supply options with higher commercial traction

…With this analysis focusing on the supply options with higher levels of commercial traction

	Short term (2021-2024)			Mid term (2024-2030)			Long term (2030 and beyond)			
	FSRU KZN	FSRU EC	FSRU WC	LNG - Matola	PSA gas	PPA Gas	Brulpadda	Luiperd	Onshore hubs	Rovuma + other Moz fields[3]
Total reserves	Unlimited	Unlimited	Unlimited	Unlimited (global LNG market)	Tbc - ~440k undeveloped net acres	~530PJ[2]	1200-6100PJ	Gas: 3100PJ C: 1800-2400PJ	Unlimited	Area 1: 63000PJ Area 4: 67000PJ
Annual capacity	Variable[1]	Variable[1]	Variable[1]	~190PJ/a (SA only)	-		-	-	77-128PJ/a	
Commercial operation date	Tbc	Tbc	Tbc	TBC – *FiD initially planned for Q4 2021 (at the earliest) – likely delayed given uncertainty on minimum demand*	FiD already taken on PSA – *pending outcome of further upstream exploration activities*	Tbc	Tbc	Tbc	Tbc	2025
Must-believes to supply SA	Demand anchor in KZN large enough to justify investment	Political support is maintained and COEGA industrial development proceeds	Demand anchor in WC large enough to justify investment	GP & MP markets can absorb higher costs of delivered gas relative to today and GTP can anchor demand	Moz. demand insufficient; buy-in from Moz. Gov. obtained and negotiations successful	PTC-5 reserves are viable	Gas can be extracted and piped to shore at low cost	Gas can be extracted and piped to shore at low cost	Brulpadda/ Luiperd piped gas option not developed	Sufficient demand at the right affordability level to trigger investment

1. Dependent on demand; 2. Includes gas and condensate; 2. As per Sasol Form 20F - ~420PJ proved developed reserves + ~110PJ proved undeveloped reserves; 3. Other Mozambique fields = Buzi Fields & Zambezi basin | Note: FSRU = Floating storage regasification unit; LNG = Liquified Natural Gas; KZN = KwaZulu-Natal; WC = Western Cape; EC = Eastern Cape; PSA = Production Sharing Agreement; PPA = Petroleum Production Agreement | Source: Local stakeholder interviews; Sasol Form 20F; NBI-BCG project team

Key guiding principles to identify & assess optimal strategic gas infrastructure play for SA

1. **Optimise socio-economic impact** - job creation, trade impact and the impact on adjacent sectors in the value chain
   Integrated Just Transition report to be released later in the report series

2. **Ensure cost-optimal gas prices** - the delivered price of gas (factoring in the upstream molecule cost, mid-stream costs, complexity and impact on SA's bargaining power)

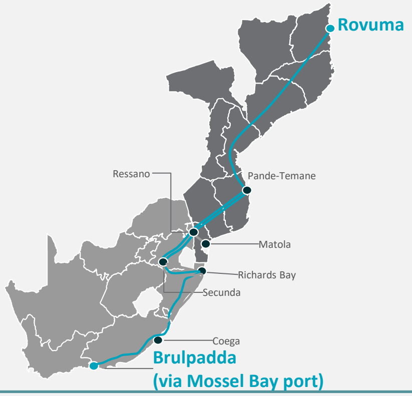
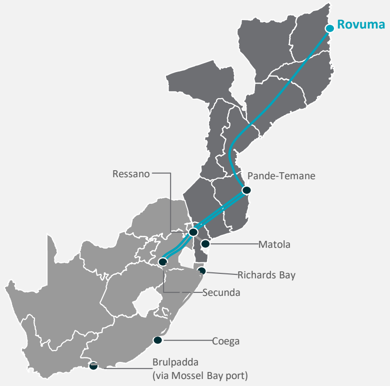
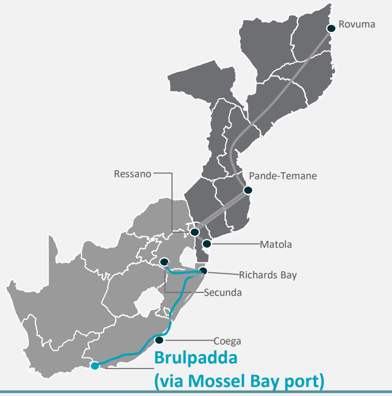
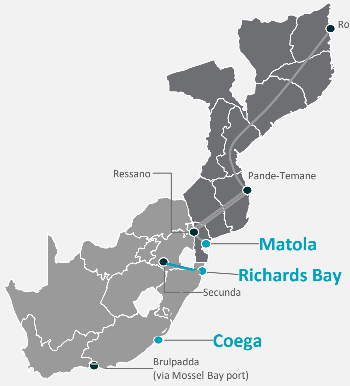
3. **Minimise climate and environmental impact** – emissions impact and broader environmental impact (e.g., degradation of land)

4. **Avoid** (where possible) **and manage the risk of stranded assets & carbon lock-in,** ensuring all supply investments are resilient to demand uncertainty & allow for optionality for alternatives to gas pre-2050 (e.g., green H2)

Source: NBI-BCG project team

5 long term strategic gas infrastructure plays

Highly contingent on timing of LNG options (Coega, RB, WC, Matola)

		① **No Additional Gas play**	② **Rovuma + Brulpadda play** *(piped gas & expl. play)*	③ **Rovuma play** *(piped gas play)*	④ **Brulpadda play** *(exploration play)*	⑤ **LNG play**
Long-term supply landscape (post-2030)						
Supply	◔	Supply ramps down to 0PJ from 2040	• FSRU in KZN or LNG from Matola • FSRU in WC & EC			
	◕	No long-term gas supply for SA	• Rovuma pipeline for Gauteng & Mpumalanga, Brulpadda to supply Western Cape and connect Western Cape & Eastern Cape demand	• Rovuma pipeline for Gauteng & Mpumalanga	• Brulpadda to supply Western Cape and connect Western Cape & Eastern Cape demand	• Pipeline to connect FSRU KwaZulu-Natal to Gauteng & Mpumalanga
Demand		• **Inland**: Inland synfuels & industry demand ramp down to 0PJ/a 2040-2050	• Enables gas pathway for synfuels post 2030, enables conversion of Eskom CFPs post 2030	• Enables gas pathway for synfuels post 2030, enables conversion of Eskom CFPs post 2030	• Gas pathway for synfuels challenged, limited potential to convert Eskom CFPs post 2030	• Potential to enable gas pathway for synfuels and conversion of Eskom CFPS post-2030
		• **Coastal**: KZN industry demand ramps down to 0PJ/a 2040-2050	• Pre-2030 GTP demand is coastal (shift to inland post-2030), enables unlocking of latent industry demand, potential to revive PetroSA[1]	• PetroSA not revived	• Potential to revive PetroSA[1], all GTP demand coastal	• PetroSA not revived, potential to unlock latent industry demand

◔ Short- to mid-term (pre-2030)

◕ Long-term (post-2030)

1. Revival of PetroSA via Brulpadda gas highly dependent on final cost of gas from Brulpadda | Note: CFPs = Coal Fired Power Stations; KZN = KwaZulu-Natal; GTP = Gas to power | Source: NBI-BCG project team

Long term = 2030-2050

LNG play preferred for SA in the long term

Highly contingent on timing of LNG options (Coega, RB, WC, Matola)

			No additional gas play	**Rovuma + Brulpadda play** *(piped gas & expl. play)*	**Rovuma play** *(piped gas play)*	**Brulpadda play** *(exploration play)*	**LNG play**
1	Minimise adverse SE impacts	*Trade impact[1] (Rand Bn)*	🟩 **ZAR 10-15 Bn** imports for SA[3]	🟥 **ZAR 140-370 Bn** imports for SA[4]	🟥 **ZAR 180-610 Bn** imports for SA[5]	🟩 +ZAR 0 relative to other plays	🟥 **ZAR 130-550 Bn** imports for SA[6]
		Broader socio-econ. impact	🟥 Competitiveness & license to operate of synfuels sector challenged, potential high costs associated with carbon tax etc.	🟩 Potential PetroSA revival, inland synfuels sustained, conversion of Eskom coal stations	🟩 Conversion of Eskom coal stations, inland synfuels sustained, industrial demand unlocked	▨ Potential PetroSA revival, but SE impact of decomm coal plants and mostly coastal GTP	🟩 Conversion of Eskom coal stations, inland synfuels demand sustained, potential to unlock industrial demand
2	Ensure cost-optimal gas prices	*Mid-stream capex required[2] (Rand Bn)*	▨ n/a	🟥 **ZAR 70-120 Bn** (Rovuma) **+** **ZAR 90-100 Bn** (Brulpadda)	🟥 **ZAR 70-120 Bn**	🟥 **ZAR 90-100 Bn**	▨ **ZAR 20-50 Bn** (FSRU); **ZAR 25-50 Bn** (inland pipeline)
		Complexity (e.g., legal, environ.)	▨ n/a	🟥 For Rovuma: high utilisation required; complex stakeholder landscape; risk of insurgency; risk premium		🟥 Significant technical challenges to be overcome w/ offshore location of reserves	🟩 Low complexity (legal & beyond) flexible supply option w/ limited additional midstream infra required
		Impact on SA's bargaining power	▨ n/a	▨ Rovuma: Moderate bargaining power for SA Inc given that pipeline feasibility anchored on SA demand Brulpadda: Moderate bargaining power for SA Inc due to captive supply set-up (i.e., Brulpadda only feasible if local large scale demand comes online)			🟩 Potential for higher bargaining power for SA Inc (due to diversified supply, contingent on supply aggregation)
3	Min. climate impact	Cum. Emissions (Mt)	🟥 8400-9400 Mt cumulative emissions across sectors	🟥 ~8400 Mt cumulative emissions across sectors since only high demand scenario feasible for piped gas options			▨ 7800 – 8400 Mt cumulative emissions across sectors
4	Avoid carbon lock-in risk	Risk of lock-in	🟩 Low lock-in risk with no new infra. required in short- to mind-term	🟥 High infrastructure & tech lock-in risk due to high capex requirements, long lifetime of infrastructure and long investment lead-times			🟩 Low infrastructure and tech lock-in risk with low FSRU capex req., limited additional infra. (only inland pipeline) & mostly flexible tech

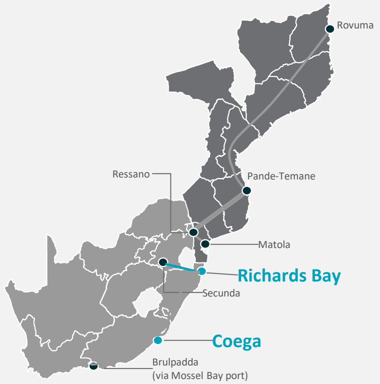
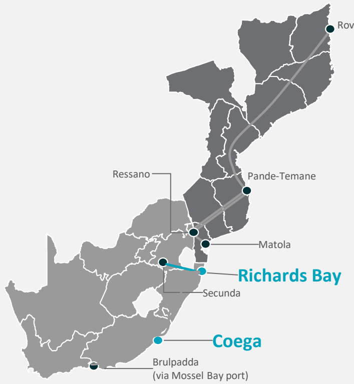
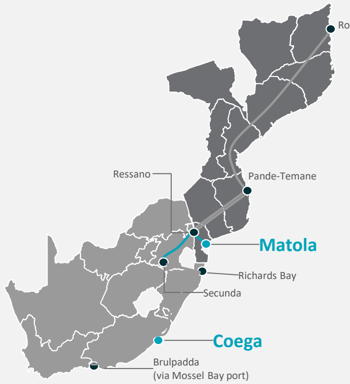
Total cost – not NPV. Range reflects demand scenarios

Deep dive on value chain emissions to follow

🟥 Relative con 🟩 Relative pro ▨ Neutral

1. Reflects range of molecule costs across all plays, and range in gas demand in piped gas & LNG plays; 2. Range reflects high and low gas demand scenarios with ~700PJ/a and ~200PJ/a respectively – with the high case requiring expansion of existing ROMPCO infra; 3. Low case: all Gau, Mp & KZN gas supplied by RB; high case: all gas supplied by Matola; 4. Assuming Rovuma supplies all inland demand and Brulpadda all coastal demand; 5. Assuming Rovuma supplies all inland and coastal demand; 6. Assuming RB & Coega supplies all inland and coastal demand | Note: Assuming exchange rate of R 15/$ | Source: NBI-BCG project team

Within LNG play, 3 scenarios considered which vary in the sequencing of supply options across short- to long-term

	RB, Coega & Saldanha (in parallel) **Assuming FSRU in RB online in short- to mid-term, before Matola, for KZN & inland demand. FSRU in Coega and Saldanha as required*	**Coega then RB & Saldanha** **Assuming only FSRU in Coega in short- to mid-term delaying the FSRU in RB; with RB (and Saldanha as required) in the longer-term*	**Coega and Matola** **Assuming only FSRU in Coega in short- to mid-term delaying RB and with only Matola coming online in longer-term for coastal and KZN demand*
Long-term supply landscape (post-2030)			
Supply	🕒 FSRU in KwaZulu-Natal or LNG from Matola • FSRU Western Cape & Eastern Cape	• FSRU in Eastern Cape • LNG from Matola	
	🕘 Pipeline to connect FSRU KwaZulu-Natal to Gauteng/Mpumalanga, leveraging existing pipeline servitude (Lily pipeline)	• FSRU KwaZulu-Natal (and Western Cape) + Pipeline to connect FSRU KwaZulu-Natal to Gauteng/Mpumalanga • FSRU in Western Cape	• FSRU Eastern Cape • FSRU in Western Cape
Demand	• **Inland**: Enables gas pathway for synfuels post 2030, enables conversion of Eskom CFPs post 2030	• Gas pathway for synfuels challenged; enables conversion of Eskom CFPs post 2030	• Gas pathway for synfuels not feasible; limited potential to convert Eskom CFPs post 2030
	• **Coastal**: Pre-2030 GTP demand is coastal (shift to inland post-2030), enables unlocking of latent industrial demand, PetroSA not revived	• All pre-2030 GTP demand is coastal (shift to inland post-2030), challenge unlocking latent industrial demand, PetroSA not revived	• All GTP demand is coastal, challenge unlocking latent industrial demand, PetroSA not revived

🕒 Short- to mid-term (pre-2030) 🕘 Long-term (post-2030)

Note: FSRU = Floating Storage Regas. Unit; GTP = Gas to Power; CFPS = Coal Fired Power Stations | Source: NBI-BCG project team

Long term = 2030-2050

Developing all 3 South African FSRU's in parallel is the preferred supply scenario for South Africa

		RB, Coega & Saldanha (in parallel)	Coega then RB & Saldanha	Coega and Matola
① Minimise adverse SE impacts	*Trade impact[1] (Rand Bn)*	🟥 **ZAR 130-460 Bn** imports for SA[3]		🟥 **ZAR 170-550 Bn** imports for SA[4]
	Broader socio-econ. impact	🟩 Conversion of Eskom coal stations, inland synfuels sustained, industrial demand unlocked	🟥 Some industrial users at risk of shutting down due to ST increase in price, potential to convert inland Eskom stations only post 2030	🟥 Limited ability to convert inland Eskom stations post 2030, industrial users at risk of shutting down w/ unaffordable supply
② Ensure cost-optimal g as prices	*Mid-stream capex required[2] (Rand Bn)*	⬛ **ZAR 20-50 Bn** (FSRU); **ZAR 25-30 Bn** (inland pipeline from RB)		⬛ **ZAR 20-50Bn** (FSRU); **ZAR 40-50 Bn** (Coega-inland pipeline)
	Complexity (e.g., legal, environ.)	🟩 Low complexity (legal & beyond) flexible supply option		🟩 No additional midstream infrastructure required in SA
	Impact on SA's bargaining power	🟩 High bargaining power for SA Inc because it enables large scale gas supply contracts, contingent on aggregation of supply	⬛ Moderate bargaining power for SA Inc due to disconnect in timelines for demand-supply; ability to secure large-scale supply contract uncertain	🟥 Low bargaining power for SA Inc (due to non-diversified supply)
③ Min. climate impact	Cum. Emissions (Mt)	⬛ 7800 – 8400 Mt cumulative emissions across sectors		
④ Avoid carbon lock-in risk	Risk of lock-in	⬛ Moderate infrastructure and tech lock-in risk with RB inland pipeline although low FSRU capex requirement		🟩 Low lock-in risk with no RB inland pipeline and low FSRU capex requirement

Total cost – not NPV. Range reflects demand scenarios

Deep dive on value chain emissions to follow

1. Reflects range of molecule costs across all plays, and range in gas demand in piped gas & LNG plays; 2. Range reflects high and low gas demand scenarios with ~700PJ/a and ~200PJ/a respectively – with the high case requiring expansion of existing ROMPCO infra; 3. Assuming RB supplies inland & Coega supplies coastal demand; 4. Assuming Coega supplies all coastal and Matola all inland demand | Note: Assuming exchange rate of R 15/$ | Source: NBI-BCG project team

🟥 Relative con 🟩 Relative pro ⬛ Neutral

What is a carbon lock-in and how does it occur?

- Tendency for carbon-intensive technological systems (incl. infrastructure) **to persist over time**
- Systems reinforce political, market, and social factors that make it difficult to move away from them, **locking out lower-carbon alternatives**
- As a result, by investing in assets prone to lock-in, **future flexibility could be restricted** and the costs of achieving agreed climate protection goals increased

Deep dive: Risk of carbon lock-in (2/2)

Leveraging gas could result in a carbon lock-in – however, the key risks of a lock-in can and must be addressed

Type of lock-in	Risk mitig. measure
Infrastructure & tech lock-in e.g. • Long life of physical infrastructure • Long lead times with investments made now, payoffs occur later, creating sunk cost	***Ensure infrastructure is flexible (e.g, can be repurposed)*** ***Ensure financial resilience to long term drops in competitiveness***
Institutional lock-in, e.g., • Regulatory frameworks • Contracts and economic rules	***Set phase out targets / limits*** ***Incentivize phase out***

For liquid fuels production, total coal value chain emissions (CO2e) are at least 2.2x higher than the upper-bound benchmarks for LNG and piped natural gas

Coal

Mining and transportation (14.3 GJ)	CTL (14 GJ)	☆ 1 Bbl of elec. (6 GJ)
0.008 CO2t / Bbl	1.00 CO2t / Bbl	1.01 CO2t / Bbl
2% eff. loss	57% eff. loss	58% eff. loss

LNG

Gas extraction (12.1 GJ)	Liquefaction (12.0 GJ)	Shipping (10.9 GJ)	☆ Regassification (10.2 GJ)	GTL (10 GJ)	☆ 1 Bbl of elec. (6 GJ)
0.03 - 0.9 CO2t / Bbl	0.07 - 0.09 CO2t / Bbl	0.05 – 0.09 CO2t / Bbl	0.004 - 0.01 CO2t / Bbl	0.20 CO2t / Bbl	0.37 – 0.46 CO2t / Bbl
0.6% eff. loss	9.0% eff. loss	7.0% eff. loss	2.0% eff. loss	40% eff. loss	51% eff. loss

Piped gas

Gas extraction (10.2 GJ)	Pipeline transportation (10.18 GJ)	GTL (10 GJ)	☆ 1 Bbl of elec. (6 GJ)
0.03 - 0.13 CO2t / Bbl	0.09 – 0.1 CO2t / Bbl	0.20 CO2t / Bbl	0.28 – 0.41 CO2t / Bbl
0.6% eff. loss	1.5% eff. loss	40% eff. loss	41% eff. loss

☆ **Key assumptions**

- Estimates required to produce 1 Bbl of liquid fuels
- CO2e emissions reflect the full value chain emissions including both CO2 and CH4 (reflecting a 25x conversion factor for CH4)
- Regassification and transportation energy efficiency losses adjusted for delivery to inland; Diesel assumed to be delivered via CTL process, rather than import

Note: Chinese and Russian benchmarks used as upper bounds for LNG and Piped gas respectively; IEA pipeline emissions estimation method used |
Source: NBI-BCG project team; 3rd IPCC assessment report; IEA; Report: Life cycle greenhouse gas perspective on exporting liquefied natural gas from the united states (2019)

For power generation, among local sources, the total LNG value chain emissions are ~20% lower than coal, and piped gas ~30% lower than coal

Coal

Mining and transportation (9.9 GJ)	CTP (9.7 GJ)	1 MWh of elec. (3.6 GJ)
0.005 CO2t / MWh	0.34 CO2t / MWh	0.35 CO2t / MWh
2% eff. loss[1]	63% eff. loss	64% eff. loss

LNG

Gas extraction (6.8 GJ)	Liquefaction (6.7 GJ)	Shipping (6.1 GJ)	Regassification (5.7 GJ)	GTP (CCGT) (5.6 GJ)	1 MWh of elec. (3.6 GJ)
0.02 – 0.05 CO2t / MWh	0.04 – 0.05 CO2t / MWh	0.03 - 0.05 CO2t / MWh	0.002 – 0.003 CO2t / MWh	0.20 CO2t / MWh	0.29 – 0.34 CO2t / MWh
0.6% eff. loss	9.0% eff. loss	7.0% eff. loss	2.0% eff. loss	36% eff. loss	47% eff. loss

Piped gas

Gas extraction (5.74 GJ)	Pipeline transportation (5.71 GJ)	GTP (CCGT) (5.6 GJ)	1 MWh of elec. (3.6 GJ)
0.01 – 0.07 CO2t / MWh	0.03 – 0.05 CO2t / MWh	0.20 CO2t / MWh	0.25 – 0.32 CO2t / MWh
0.6% eff. loss	1.5% eff. loss	36% eff. loss	37% eff. loss

Key assumptions

- Estimates required to produce 1 MWh of electricity
- CO2e emissions reflect the full value chain emissions including both CO2 and CH4 (reflecting a 25x conversion factor for CH4)
- Regassification and transportation energy efficiency losses adjusted for delivery to inland; Diesel assumed to be delivered via CTL process, rather than import

Note: Chinese and Russian benchmarks used as upper bounds for LNG and Piped gas respectively; IEA pipeline emissions estimation method used |
Source: NBI-BCG project team; 3rd IPCC assessment report; IEA; Report: Life cycle greenhouse gas perspective on exporting liquefied natural gas from the united states (2019)

4 key questions to answer to assess trade-offs of gas vs. diesel in power…

① What is the operational cost savings of switching to gas pre-2035?

② How much CO2 emissions are avoided?

③ What is the cost of converting existing diesel OCGTs to gas?

④ What is the cost of the stranded assets (post-2035) for the additional midstream infrastructure required for gas?

Source: NBI-BCG project team

…indicating that the switch to gas saves cost and reduces cumulative emissions

⊕ **R14-28bn** operational savings (fuel cost + variable opex) pre-2035

Key assumptions:

- *Gas demand as per the GTP demand in the low demand scenario*
- *Gas price: R140/GJ, diesel price: R200-300/GJ*

⊕ **10Mt** cumulative CO2 emissions pre-2035

Key assumptions:

- *Emission factors: diesel = 0.27t CO2/MWh, gas = 0.20t CO2/MWh*
- *Heat rate: diesel CCGT = 49%, diesel OCGT = 31%, gas CCGT = 64%, gas OCGT = 40%*

⊖ **R3bn** capex to convert existing diesel OCGTs to also run off gas – up to R1.8bn of which may already have been spent on Gourikwa & Ankerlig conversion

Key assumptions:

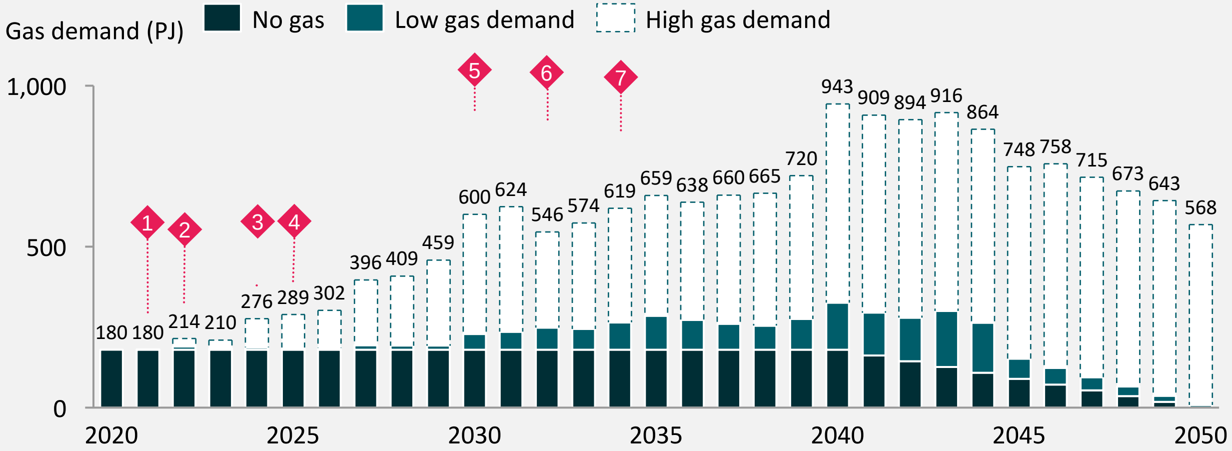
- *Conversion cost for OCGTs in line with ~R1.8bn for Gourikwa & Ankerlig*

⊖ **R7bn** residual capex from the R13 bn FSRU inv. remains at 2035 (i.e., capex not yet paid back)

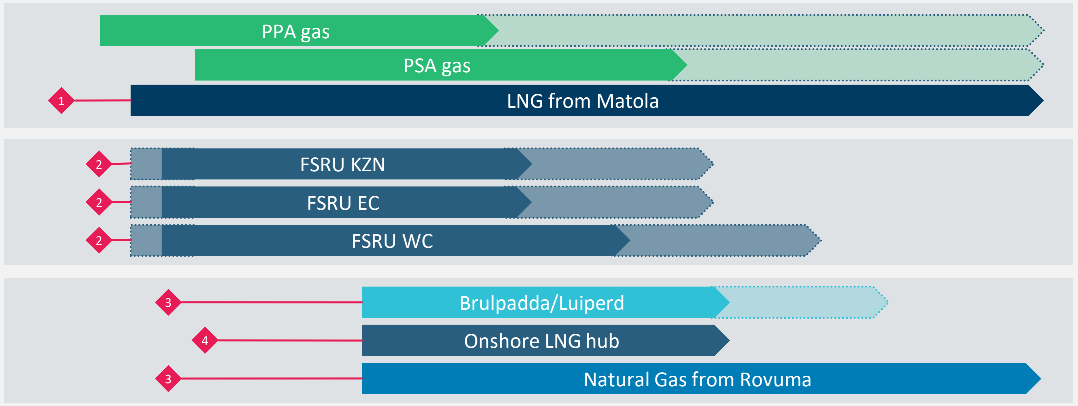
Key assumptions:

- *FSRU cost: US$200 mn/mtpa*
- *Other mid-stream infra. (i.e., the inland pipeline from Richards Bay) not included. Decision can be taken post-2035 pending clarity on GTP locations*

Given uncertainty, SA's approach to gas needs to be flexible and responsive to critical outcomes and decisions



Supply source options and indicative timelines:



Key decisions/outcomes to monitor in the next 15 years

1
- Outcome of further upstream exploration activities for PSA
- Outcome of feasibility study: Kelvin PS[1] conversion

2
- FiD on Matola Terminal pending certainty on minimum demand
- Outcome of Eskom feasibility study for conversion of existing power plants
- Publication of Gas Master Plan
- Decision on FSRU in EC
- Decision on FSRU in KZN
- Decision on FSRU in WC
- Outcome of REIPPPP[2] Round 5

3
- Decision on ROMPCO expansion and Richards Bay Pipeline
- FID Rovuma pipeline

4
- Decision on viability and scale of supply from Luiperd/ Brulpadda
- Decision on shift to onshore hub (Richards Bay, COEGA, Western Cape)

5
- Sasol's Secunda complex Conversion

6
- Rovuma potentially coming online

7
- Viability of Green H2 for industrial and power use

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1. PS = Power Station; 2. REIPPPP = Renewable Energy Independent Power Producer Procurement Programme

Note: Beyond 2022, timelines of key decisions are indicative and could vary. Ongoing investments in PPA to maintain license

Source: NBI & NBI-BCG project team

Actions required in next 3-5 years

Critical **no-regret action** required across the gas value chain

Demand

Electricity

- Reduce the 20-year term of the PPA's being considered for power ships to prevent supply infrastructure lock in
- Develop power station repurposing plans
- Assess feasibility of converting existing OCGTs to gas
- Provide regulatory visibility on post-2030 gas demand
- Limit GTP usage to mid-merit and peaking capacity only

Synfuels

- Firm up demand and affordability figures needed to back out coal from Secunda complex and revive PetroSA

Industry

- Identify potential industrial users and gauge 'commitments in principle' to understand potential to aggregate with power and synfuels demand, especially in Gauteng and Mpumalanga

Supply

- Maximise supply from remaining reserves at Pande-Temane under PPA and PSA
- Enable and fast-track the parallel development of FSRUs in Richards Bay, Coega and Saldanha
- Decide on an official entity to serve as the market aggregator to take balance sheet risk, consolidate off-take agreements, and secure long-term, competitively priced LNG supply contract(s)
- Investigate potential to repurpose gas infrastructure for green hydrogen/ green fuels
- Establish inter-governmental collaboration between SA and Mozambique focusing on South Mozambique gas extension
- Develop clear roadmap on how to fund gas as a transitionary energy source leveraging climate finance

Just Transition

- Finalise local content requirements for upstream participation as part of the Upstream Petroleum Resources Development Bill to promote a national Just Transition.

Source: NBI-BCG project team

The role of gas in South Africa's decarbonisation journey (1/2)

1 As SA decarbonises its economy, **gas can, if affordably supplied**, play a key transition role by providing flexible capacity in the **power sector** and substituting coal as a lower emission energy source in **industry** and lower emission feedstock in the **synfuels sector** until greener alternatives become commercially viable.

2 Today, South Africa consumes **~180 Petajoule per annum (PJ/a) of gas**, predominantly in the synfuels sector (110PJ/a) and industrial sector (70 PJ/a), which supports up to **56k jobs across the value chain**, up to **ZAR 215 bn in taxable revenues** and contributes **~1-2% of GDP**

3 All of today's gas demand is located in **Gauteng (50PJ), Mpumalanga (110PJ) and KwaZulu-Natal (KZN, 20PJ - MRG)** and supplied by gas from **Pande-Temane located in Mozambique (~160PJ)** and **Methane Rich Gas (~20PJ - MRG)** from Sasol operations via the Lily pipeline.

4 The **reserves of the Pande-Temane gas fields, are declining** and **supply is expected to be constrained from ~2025 onwards** presenting a security of supply issue and a risk to the decarbonisation ambitions of key sectors in the SA economy **(a 'no additional gas' demand scenario could lead to more cumulative emissions in the long run** and higher fuel and operational expenditure (OPEX) costs in the power sector in particular)

5 South Africa's potential future gas demand could **increase by 30% by 2030**, driven by four key sectors: 1) **Power**: as gas-to-power (GTP) demand picks up (peaking and mid-merit only) to ensure security of supply and provide flexible balancing capacity for renewables; 2) **Synfuels**: as additional gas is brought in as a lower emissions alternative to coal as a feedstock; 3) **Industry**: to phase out higher emitting fossil fuels as energy sources for industrial heat generation and other processes; and 4) **Transport**: as a short-term alternative to diesel (albeit at a small scale)

6 The price of delivered gas relative to sector-specific affordability thresholds will drive actual gas demand; **SA's decarbonisation ambition (CO2 Tax and carbon budget) and alternative energy choices are key factors in determining affordability thresholds**: The power sector's affordability threshold for mid-merit and peaking gas and the transport sectors' affordability threshold are the highest given the high price of the diesel alternative; however synfuels and industrial affordability thresholds are much lower given the relatively cheap cost of the coal alternative

7 SA's **realised future gas demand is uncertain in the absence of a Gas Masterplan. The realised demand is sensitive to the scale, pace and location of predominantly peaking GTP plants** deployed in the power sector, and the **extent to which the synfuels sector uses gas as a transitionary feedstock** (to decarbonise operations – highly dependent on affordability) – with potential **demand in 2030** ranging from **~228–552 PJ/a** in a low vs. high demand scenario, with **peaks of ~326 PJ/a and 797 PJ/a,** respectively. In both scenarios, gas demand would either need to be phased out by 2050 or offset with negative emissions technology, e.g., Direct Air Carbon Capture and Storage (DACCS).

8 In both the high and low demand scenarios, **inland gas demand in Gauteng and Mpumalanga could exceed the capacity of the current ROMPCO pipeline with ~277 PJ/a by 2030** in the high scenario (vs. current capacity of ~212 PJ/a), and **221 PJ/a by 2035 in the low scenario**. In both scenarios, **new gas supply infrastructure could be required** with the key swing factor being the location of GTP projects which serve as the enabling demand anchor given the time horizon, scale, and affordability threshold of GTP demand.

The role of gas in South Africa's decarbonisation journey (2/2)

8 To achieve the optimal supply setup for South Africa, all new supply options must be assessed against four key guiding principles: **1) Minimising socio-economic impact; 2) Ensuring optimal gas prices; 3) Minimising climate and environmental impact; and 4) Avoiding the risk of stranded assets and carbon lock-in.**

9 Supply options vary over the short- (2021–2024), mid- (2024–2030) and long-term (2030+). In the short- to mid-term, key options are **Liquified Natural Gas (LNG) via Floating Storage Regasification Units (FSRUs), and extending piped gas supply from Pande-Temane** (via technical work on the reserves and **Petroleum Production Agreement (PPA)/Production Sharing Agreement (PSA)**). In the long-term, key supply options are piped gas from Rovuma (+ other Moz. gas fields) and gas from exploration activities in the Brulpadda and Luiperd gas fields.

10 Considering these options, five strategic gas infrastructure plays exist for South Africa: **1) No additional gas; 2) Piped gas and exploration (Rovuma and Brulpadda); 3) Piped gas only (Rovuma only); 4) Exploration only (Brulpadda only); and 5) LNG**. The **LNG play is the preferred option for South Africa**.

- Play 1: A no additional gas play has the lowest infrastructure lock-in risk, but also the lowest socio-economic benefit and could lead to ~400–600 Megatonne (Mt) higher cumulative emissions in the long-run which could yield higher carbon tax costs for impacted users.
- Plays 2–4: These are only relevant in a high demand scenario and present a high risk of stranded assets and carbon lock-in, with large capital investments required of ~ZAR70–200 bn. Rovuma piped gas in particular is highly complex with significant political and security risks to be addressed.
- •Play 5: The LNG play is the preferred option for South Africa given the flexibility it provides should demand ramp down post-2040 and the positive socio-economic benefit it brings – although the negative impact on the trade balance will need to be offset by new green export industries (e.g., e-Fuels).

12 Within the LNG play, a **multi-hub approach is preferred with FSRUs in Matola, Richards Bay, Coega and Saldanha**. Three scenarios for their deployment are considered: Scenario 1: where all three South African FSRUS are developed in parallel; Scenario 2: where Matola and Coega are developed ahead of Richards Bay and Saldanha; and Scenario 3: where Richards Bay is not developed, but Coega, Saldanha and Matola go ahead.

13 Developing all **three South African FSRU's in parallel is the preferred supply scenario, relative to the other scenarios which delay FSRUs in Saldanha and/or Richards Bay**, as it **increases the optionality** for South African consumers and therefore could enable a **more competitive delivered LNG price**. A scenario where Richards Bay is not developed restricts and locks the inland market into supply from Matola and should, therefore, be avoided.

14 A **market aggregation mechanism** is critical to **aggregate demand volumes** over time and geographies to ensure the lowest cost of gas for South Africa – larger-scale supply contracts are priced closer to long-run marginal cost of production and are therefore more value accretive than smaller-scale volumes bought at spot market prices.

15 **South Africa needs to actively and urgently manage its gas strategy to mitigate the risk of unconstrained demand and ensure all supply infrastructure economics** are resilient to a potential drop in demand 2040–2050, and that the midstream infrastructure can be repurposed for the transport of green fuels and/or green H2 in the future, with solutions to address methane leakage and the repurposing of gas infrastructure requiring significant further research and development.

Q&A

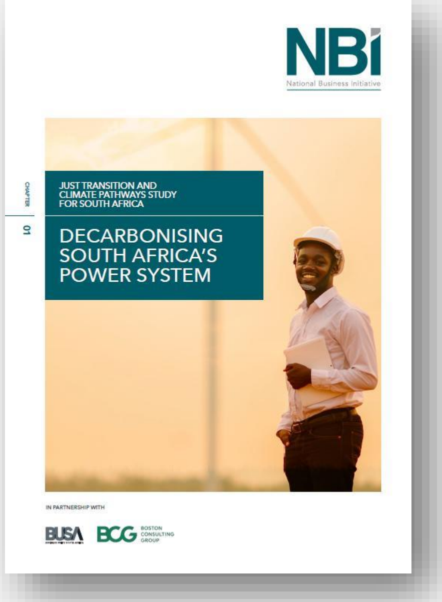
Please post your questions in the chat

Outlook and next steps

Steve Nicholls

Head of Environment
National Business Initiative

This is our 3rd (of 3) wave of reports to be released during COP26



NBI
National Business Initiative

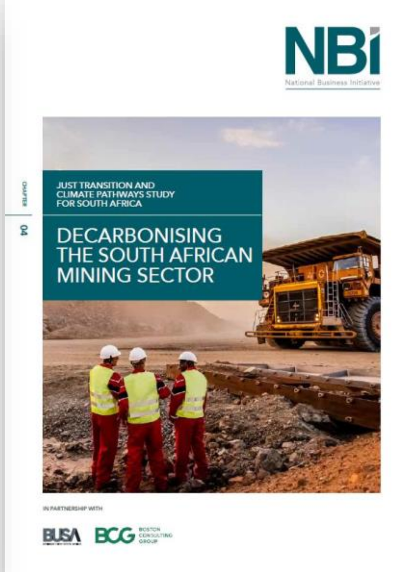
CHAPTER 01

JUST TRANSITION AND CLIMATE PATHWAYS STUDY FOR SOUTH AFRICA

DECARBONISING SOUTH AFRICA'S POWER SYSTEM

IN PARTNERSHIP WITH

BUSA BCG BOSTON CONSULTING GROUP



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CHAPTER 04

JUST TRANSITION AND CLIMATE PATHWAYS STUDY FOR SOUTH AFRICA

DECARBONISING THE SOUTH AFRICAN MINING SECTOR

IN PARTNERSHIP WITH

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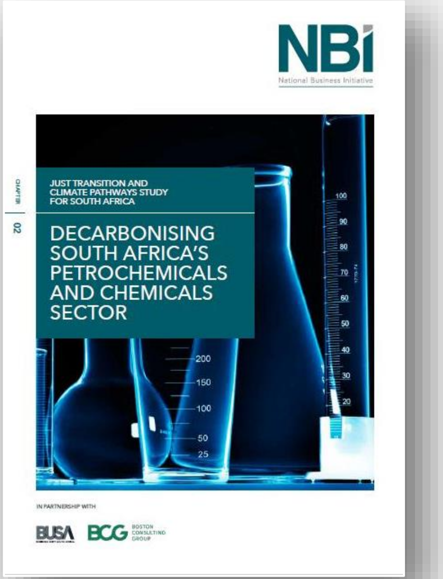

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CHAPTER 02

JUST TRANSITION AND CLIMATE PATHWAYS STUDY FOR SOUTH AFRICA

DECARBONISING SOUTH AFRICA'S PETROCHEMICALS AND CHEMICALS SECTOR

IN PARTNERSHIP WITH

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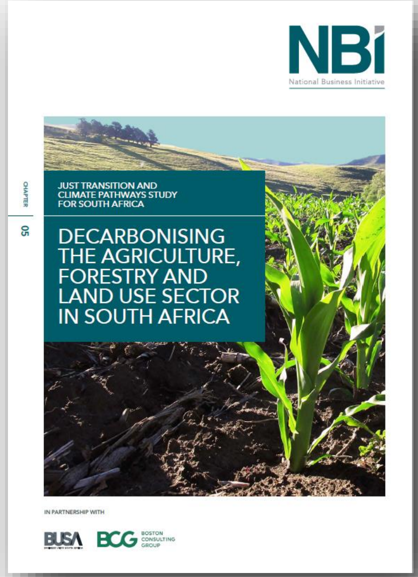

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CHAPTER 05

JUST TRANSITION AND CLIMATE PATHWAYS STUDY FOR SOUTH AFRICA

DECARBONISING THE AGRICULTURE, FORESTRY AND LAND USE SECTOR IN SOUTH AFRICA

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CHAPTER 03

JUST TRANSITION AND CLIMATE PATHWAYS STUDY FOR SOUTH AFRICA

THE ROLE OF GAS IN SOUTH AFRICA'S TRANSITION

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Decarbonising the South Africa's transport sector

The COP26 South Africa Pavilion will be jointly hosted by business and government

This is an opportunity for us to showcase the opportunities that have emerged from Just Transition Pathways work on an international platform and position South Africa as a major investment destination to attract finance for our Just Transition to a low carbon, resilient and socially sustainable and inclusive future.

THANK YOU TO THE SPONSORS OF THE AFOLU SECTOR AND GAS ANALYSIS

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Thank you

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