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Gauteng Green Hydrogen GPG

Department of Economic Development
30112023

Witness Mokwana

GAUTENG
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

GGT2030
GROWING GAUTENG TOGETHER

GAUTENG
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

Outline

GAUTENG PROVINC
ECONOMIC DEVELOPMENT
REPUBLIC OF SOUTH AFRICA

1. Background
2. Global Energy Challenges
3. Hydrogen as Vector for Renewables
4. South Africa's Green Hydrogen Program
5. Legislation Framework
6. Gauteng Case for Domestic Utilisation of H2 to decarbonise Industry
7. Just Energy Transition

PURPOSE OF THE PRESENTATION

The presentation outlines the focus areas of Gauteng Provincial Government **Green Hydrogen Strategy and Opportunities** presented by the Green Hydrogen Economy.

2.

BACKGROUND

BACKGROUND

The region is under pressure to develop a truly comprehensive policy framework that combines the objectives of clean energy and industrialization.

The biggest challenge facing our society right now relates to how South Africa can decarbonize while providing economic opportunities for the most vulnerable, mitigating energy shortages and alleviate inequality.

Gauteng economy and its Industrial sector is facing severe risk and disruption due to impact of the impending carbon boarder tariffs being contemplated by some of our major international trading partners.EU Block to start implementing by 2026.

The Gauteng Economy is also under pressure to decarbonise while at the same time preserving the economy and ensure a just energy transition.

2.

International Energy Challenges

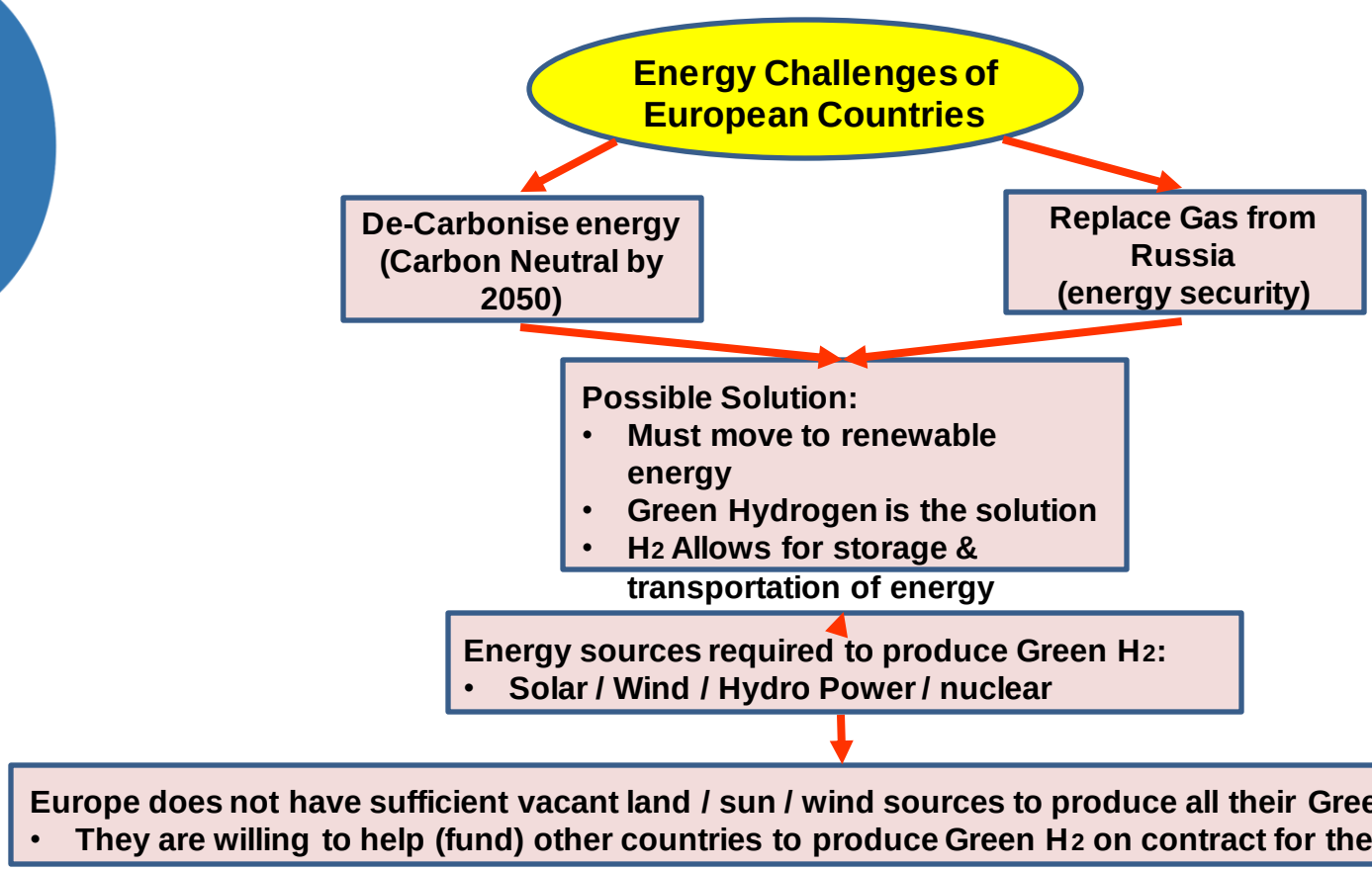
Global Energy Challenges

- Leveraging opportunities arising from international commitments for to decarbonise due under pressure to move away from non-renewable, polluting sources of energy to renewable sources of energy. This entails including the commitment to became becoming carbon-neutral by 2050.

- To enforce this plan legislation is being developed to ban, as an example, the use of the internal combustion engine (ICE) in vehicles, the use of coal burning power stations and the burning of natural gas.

- But Europe has challenges to achieve these goals.

Challenge of Renewable Energy Contintinti…



- European countries are keen to support initiatives in other countries that can produce Green H2.
- This support is offered in the form of Funding, Technology (R&D), Legislation and practical experience.
- Their aim is to secure their required volume of Green H2 from these oversees suppliers long before their target date of Carbon-neutral (2045).
- Germany has already signed agreements with Morocco, Chile and Namibia.
- There is a limited window of opportunity to secure long term contracts for the supply of Green H2 to Germany

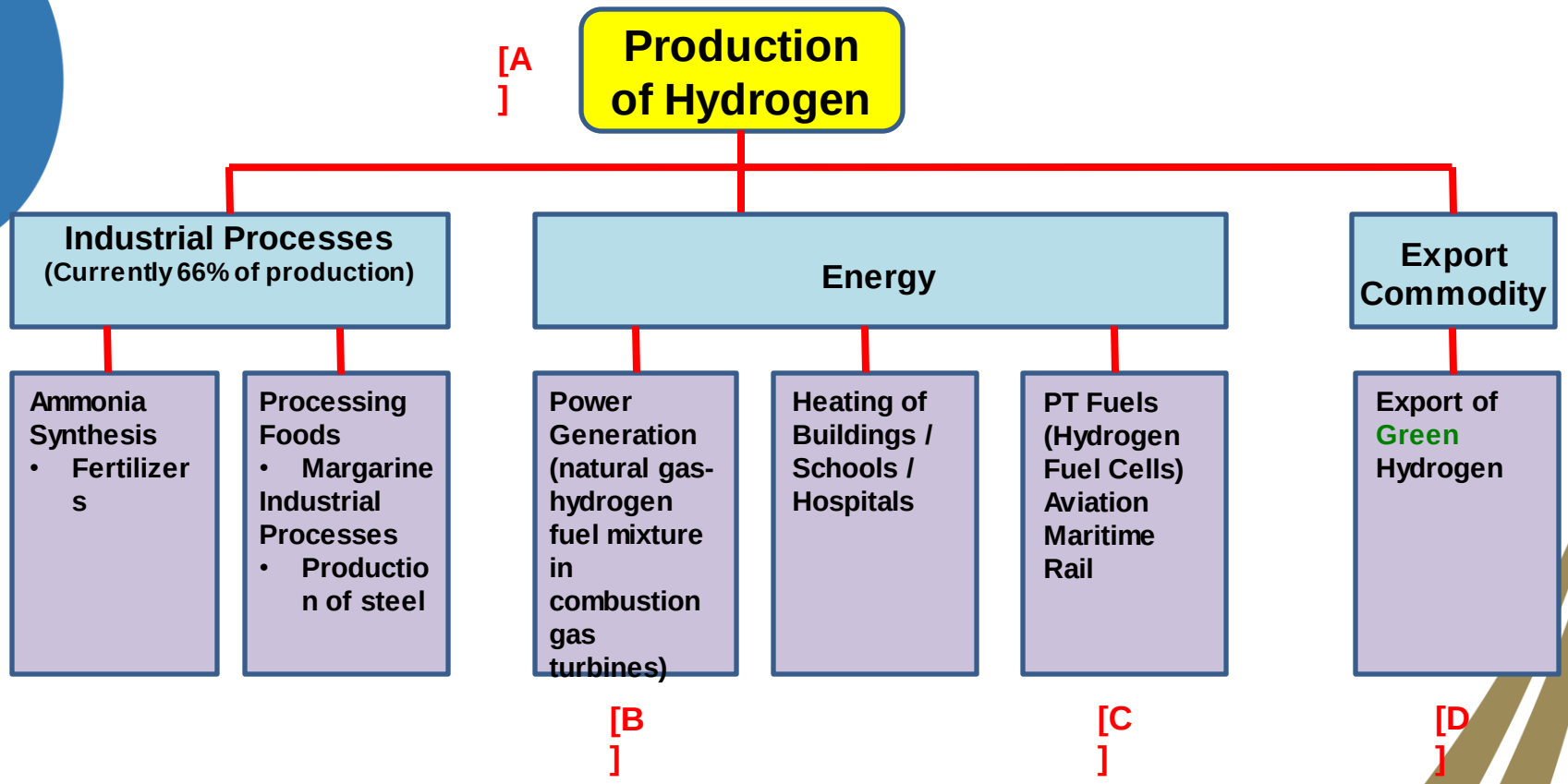
3.

Hydrogen as a vector for energy transition and renewables

HYDROGEN?

- Hydrogen is a gas that can be burnt like fuel. It is produced by using electricity to split water into hydrogen and oxygen molecules and is colour-coded according to the type of energy used in its production:
  - ***Brown*** hydrogen is produced using electricity from coal;
  - ***Grey*** and ***blue*** hydrogen is produced using electricity from gas;
  - ***Pink*** hydrogen is produced using electricity from nuclear; and
  - ***Green*** hydrogen is produced using electricity from renewable energy.
- The advantage hydrogen offers is that it can be stored and burnt when needed.
- The by-product of using Hydrogen as a fuel is water.

Uses of Hydrogen



H2 as a vector for renewables in SA

Transportation

Across both the road and rail sectors, fuel cell technology is able to provide unparalleled performance for vehicles. These FCEVs are able to outperform their fossil fuels and battery counterparts through better power to weight efficiencies, faster refuelling times and significantly longer ranges.

Sustainable aviation and shipping fuels with hydrogen PTX

Energy Sector

Can be used for energy storage renewable energy sector is how best to efficiently store the energy created in order to achieve smooth supply and maximise asset utilisation.

Currently, there is limited capacity to hold energy within grid systems and the massive cost involved with battery storage at scale makes it a poor option.

Hydrogen can help solve the intermittent supply issues associated with renewable energy by utilising electrolysis to convert excess electricity into hydrogen during times of oversupply. This hydrogen can then be utilised to generate power through

Industrial heat and feedstock -

Most compelling case for hydrogen is in its use for both industrial heat and in chemical feedstocks. Either combusted on its own, or in combination with oxygen, hydrogen can produce extremely high temperatures.

If green hydrogen is utilised for this purpose, then offers perhaps the only plausible decarbonisation alternative for large scale industrial heat users.

If the hydrogen needed for these processes were to be sourced from renewable energy, via electrolysis, this would fully green these fuels and feedstocks. As it currently stands green hydrogen is the only plausible option to decarbonise industrial feedstock

Building heat and power -

If green or blue hydrogen is blended into these smart mini- grids, then the largest carbon emission in the household (heating and power) can be entirely offset.

Pilot schemes that aim to transition existing natural gas grids over to running on 100% hydrogen are already underway in Northern Europe.

In areas where access to power or reliability of power are problematic, Hydrogen solutions are already being used to provide an alternative to carbon intensive diesel generators. Fuel cells are already widely used in the Southern Africa telecommunication infrastructure for off-grid power.

GPG HYDROGEN VALUE PROPOSITION

National Strategy focuses on unlocking international markets and domestic economic growth opportunities:

- Strategic focus on global market share and competitive trade positions
- Recognises need to speak to full value chain - market positioning necessitates domestic utilisation
- importance of redressing infrastructure challenge smaller isolated projects most likely to result in greatest GH2 usage - driven by internal demand and funded carbon incentives.

Gauteng draft GH2 strategy - national pathfinder for domestic utilisation - green industrialisation:

- Strategic focus on decarbonisation of mobility and industry via commercial mixed-energy roadmap.
- Provincial policy approach - net free emissions from carbon-intense industries - business growth from energy insecurity.
- employment opportunities from declining labour intense sectors - domestic market growth from regional carbon border tarrifs.

5.

South Africa's Green Hydrogen Program

HYDROGEN DEVELOPMENT HYSTORY IN SA

2007	2008 - 2018 **Various demonstrator projects include:**	2020
➢ Development of the National Hydrogen and Fuel Cell Technology Strategy by the Department of Science and Innovation and approval by Cabinet	➢ underground fuel cell powered mining locomotive; ➢ solar-to-hydrogen system; ➢ battery and fuel cell golf cart; ➢ fuel cell generator providing lights for the UWC Nature Reserve; ➢ fuel cells for power storage for homes and cellular phone tower base stations; ➢ a Hydrogen refueling station; ➢ fuel cell powered forklift, ➢ green Hydrogen fuel cell system with on-site production and storage; ➢ a Hydrogen in Mining test facility; ➢ Liquid Organic Hydrogen Carriers; ➢ the use of PGM catalysts for the production of Hydrogen and ➢ HySA demonstrated a 2.5kW fuel cell system at Poelano Secondary School	➢ The DSI, Hydrogen SA and North-West University initiate a process with the South African government to develop a Hydrogen Society Roadmap.

Recent developments on H2 in SA

JUNE 2021	SEPTEMBER 2021	NOVEMBER 2021	FEBRUARY 2022	MAY 2022	OCTOBER 2023
➢ Minister Ebrahim Patel sets up GH panel. Presidency announces that GH has been identified as the first of five 'Big Frontier' strategic investment opportunities	➢ Cabinet approves the Hydrogen Society Roadmap (HSRM) developed by the DSI	➢ At COP 26 in Glasgow, Scotland, South Africa mobilizes funding support for the country's decarbonization ➢ NCEDA releases GH Strategy at COP26	➢ The HSRM is released to the public. ➢ The GH panel completes the drafting of the GH commercialisation strategy for South Africa	➢ Anglo American launches nu Gen Zero Emissions Haulage Hydrogen Powered mine truck at Mogalakwena Mine	➢ the South African government approved the Green Hydrogen Commercialisation Strategy.

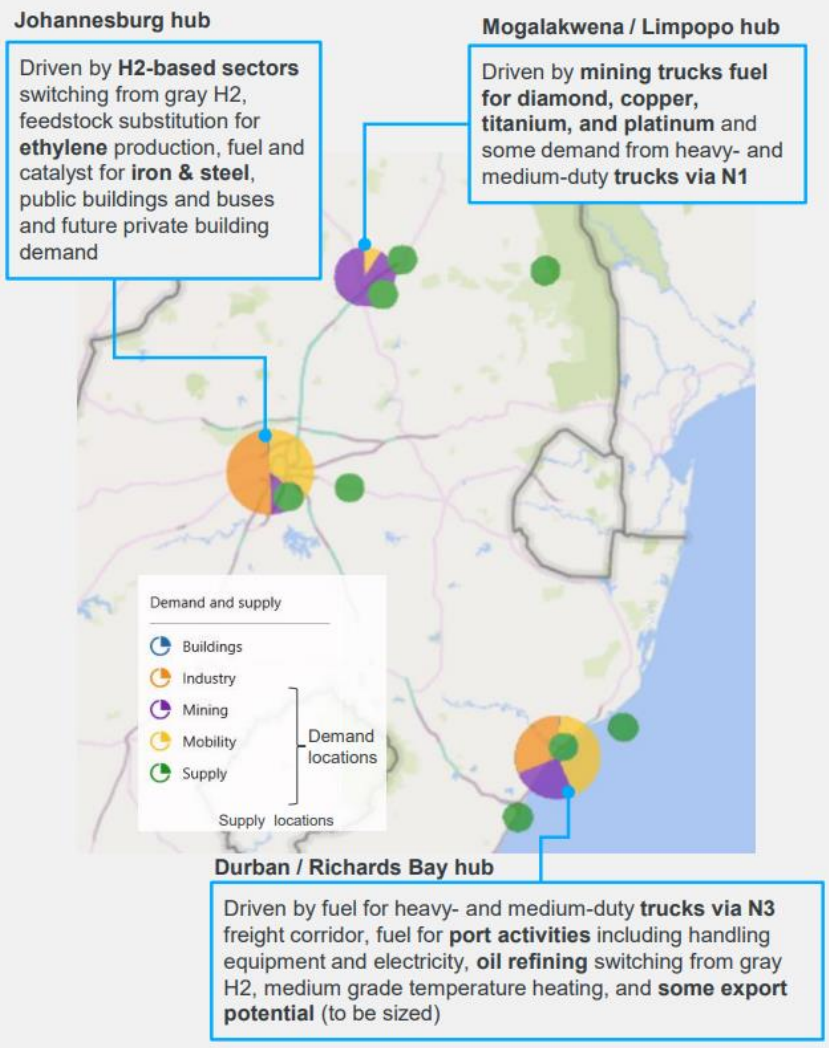
PLATINUM VALLEY – HYDROGEN VALLEY

Selected as pilot

Overview of Hydrogen Pilot Projects

Johannesburg · Durban / Richards Bay · Mogalakwena

	Hubs	Projects
Mobility	Johannesburg, Durban / Richards Bay	Buses conversion in Johannesburg, Pretoria & Durban
	Mogalakwena, Durban / Richards Bay	Mining trucks
	Durban / Richards Bay	FC drivetrain forklifts in Durban and Richards Bay ports
	Johannesburg	Forklifts and heavy-duty trucks in the Rustenburg area
	Johannesburg, Durban / Richards Bay	Heavy duty trucks conversion with refueling stations
	Durban / Richards Bay	Freight Trains between Durban & Richards Bay
	Durban / Richards Bay	Marine bunkering for ammonia powered bulk carriers
	Durban / Richards Bay	Berthing activities powered by H2 FC
Industry	Johannesburg	Ethylene in Sasolburg
	Johannesburg	Ammonia in Sasolburg
	Johannesburg	Iron & steel with ArcelorMittal (e.g., Vereeniging & Vanderbijlpark)
	Durban / Richards Bay	Durban paper mills converting natural gas to H2
Buildings	Mogalakwena	Data center in Limpopo Science & Technology Park power supply
	Johannesburg	Anglo American corporate office buildings in Rustenburg
	Johannesburg, Durban / Richards Bay	Public offices in Johannesburg, Pretoria and Durban
	Johannesburg, Durban / Richards Bay	Buildings in OR Tambo & King Shaka International Airport



GPG GREEN HYDROGEN

GPG GREEN HYDROGEN

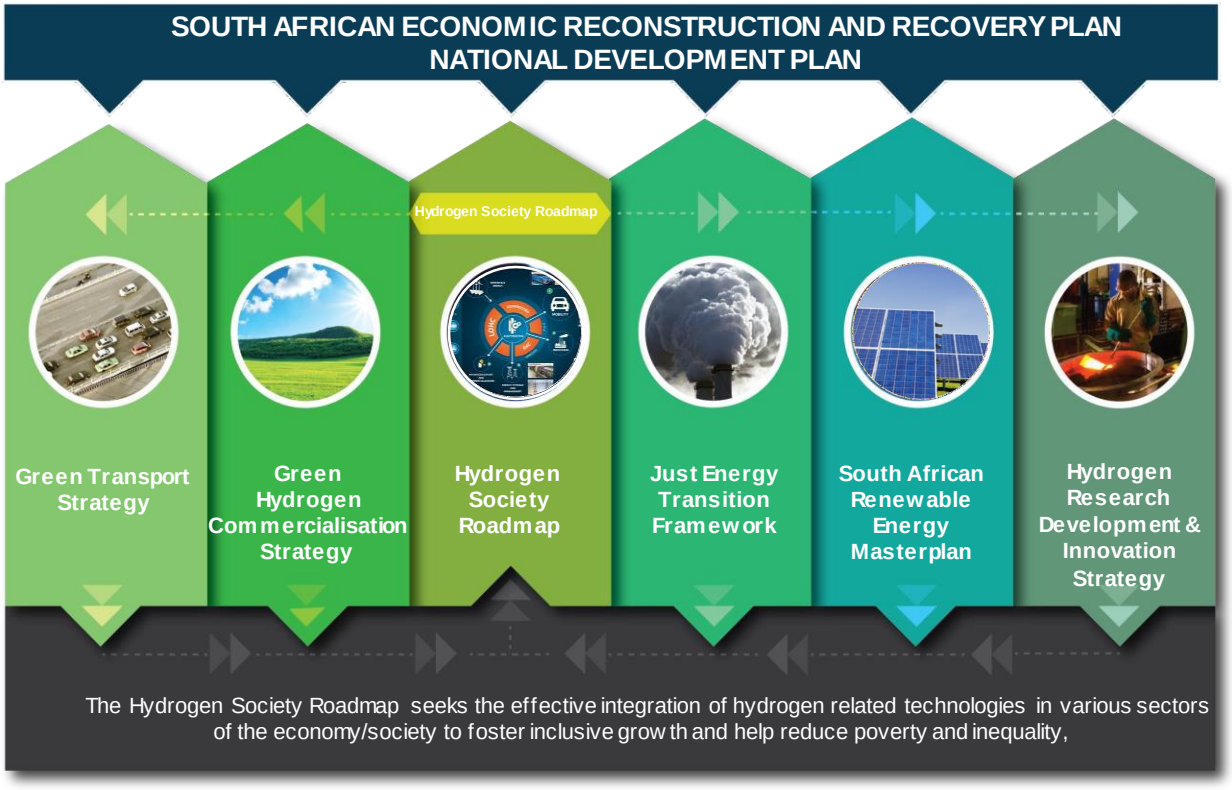
Gauteng draft GH2 strategy - national pathfinder for domestic utilization - green industrialization

Three Major commercialization paths for green hydrogen

1. Export of green hydrogen to major centres of demand such as Europe, Strategic focus on global market share and competitive trade positions
2. Green hydrogen presents an opportunity to decarbonize mobility, especially for heavy vehicle road transport, aviation, and rail transport as a mechanism to decarbonize this hard to abate sector.
3. Thirdly the use of green hydrogen as an industrial feedstock and industrial fuel will enable the decarbonization of industry value chains thereby assisting South Africa in attaining its CO2 reduction commitments and ensuring the viability and competitiveness of export in markets that are willing to pay a premium for zero-carbon goods.

4.

Legislation Framework


SOUTH AFRICAN ECONOMIC RECONSTRUCTION AND RECOVERY PLAN
NATIONAL DEVELOPMENT PLAN
Hydrogen Society Roadmap
Green Transport Strategy
Green Hydrogen Commercialisation Strategy
Hydrogen Society Roadmap
Just Energy Transition Framework
South African Renewable Energy Masterplan
Hydrogen Research Development & Innovation Strategy
The Hydrogen Society Roadmap seeks the effective integration of hydrogen related technologies in various sectors of the economy/society to foster inclusive growth and help reduce poverty and inequality,

5.

GPG GREEN HYDROGEN STRATEGY

FOUR CLEAR IMPERATIVES FOR GP REGARDING GREEN HYDROGEN

1) Address the energy crisis that has been plaguing the country for more than a decade and which has reached a new level of severity over the last year.
2) Decarbonisation to lead the achievement of South Africa's commitments to combatting climate change.
3) Protect the value of its substantial exports by decarbonizing its export value chains as a specific priority - value chains.
4) Seize the opportunity to localize portions of the manufacture of the capital equipment required for the export and domestic demand for green hydrogen.

The Gauteng Provincial Government approach to Green Hydrogen is anchored on the Microgrid Energy Programme focusing on renewable energy.

GAUTENG GREEN HYDROGEN OPPORTUNITIES

The six pathways for green hydrogen industrialization targeted by Gauteng are:

1) Leverage green hydrogen as a vector for a transition to a renewable and resilient electricity provision in Gauteng
2) Utilize green hydrogen to decarbonize heavy industry in Gauteng
3) Utilize green hydrogen for smart green mobility in Gauteng
4) Establish Gauteng as a hub for domestic use and export of sustainable aviation fuel
5) Promote localization of key capital equipment along the green hydrogen value chain
6) Decarbonize key export value chains in Gauteng through hydrogen.

GAUTENG GREEN HYDROGEN ECONOMY

Evolving key areas of concern include:

- ***Stimulation of project investments*** - visibility of future demand & regulatory certainty, including frameworks for off-takers to scale usage, stimulate value chains and enable investment.
- ***Mitigation of commercial risks and broadening of financing options available*** - enable industries to meet their energy needs and decarbonize whilst retaining competitiveness
- ***Localization & manufacturing*** - support of supply chain capability and capacity through township clusters, industrial parks and special economic zones
- Key levers to ***provincial and inter-provincial infrastructure*** to enable efficient trade flows - e.g. the "hydrogen corridor"
- **Advancement of projects with transitional pathways** to decentralized low or zero carbon energy supply offerings - focus on security, availability and self-sufficiency - projects to reach final investment decisions
- **Just energy Transition?-** scope for ***financial and regulatory freedoms*** and flexibilities, opportunity to reposition provincial influence on energy regulatory and administrative landscape and accelerate project deployments

GAUTENG GREEN HYDROGEN: ENERGY NETWORKS

Localized Energy Networks/ Industrial clustering:

- Offers a response to unmet demand, lack of access, unreliability, insecurity & transitional pathway to decentralized low or zero carbon energy supply offerings.
- Significant barriers to entry & market failures inhibiting new energy technology access & growth
  - Centralization of energy support and planning, high costs of renewable technologies & isolated nature of projects
  - Existing regulatory landscape, commercial and cleaner energy pathways are complex involving multiple actors and prohibitive
  - Scope to de-risk & mobilize investment
- **Industrial & domestic green energy microgrid programme -** demand visibility - proof of concept – financing
- *To proactively guide, stimulate and establish the required conditions for market access and growth, and in doing so enable and prove the commercial viability of a provincial-wide programme.*

GAUTENG GREEN HYDROGEN: ENERGY NETWORKS

Localized Energy Networks/ Industrial clustering

Spatial Energy Planning for Gauteng:

- Detailed spatial mapping of energy demand within a targeted region.
- Focus on industrial clusters
- Roadmap for diversified energy response – decarbonization, energy security, stability, and availability.
- Pathway projects to demonstrate diversified products: e.g. minigrids, renewables, green hydrogen.
- Investment readinesss/ de-risking of finance.
- Renewed engagement with international bodies.

GAUTENG GREEN HYDROGEN TEST CASE

Vaal Industrial Cluster:

- Partnership with **WWF** led by Sasol /AMSA/ AIRLIQUID/ etc who has ambitions to develop four industrial clusters in Southern Africa with the Vaal Industrial Cluster being a priority.
- Why the Vaal Region?
  - Large emissions footprint, requiring urgent redress to achieve the country's net-zero goals
  - Large industrial concentration presenting opportunities for scalable investment, resource & risk sharing, and aggregation through collaboration
  - The Vaal region has been classified as a Special Economic Zone, and is earmarked for re-industrialization and investments in green hydrogen

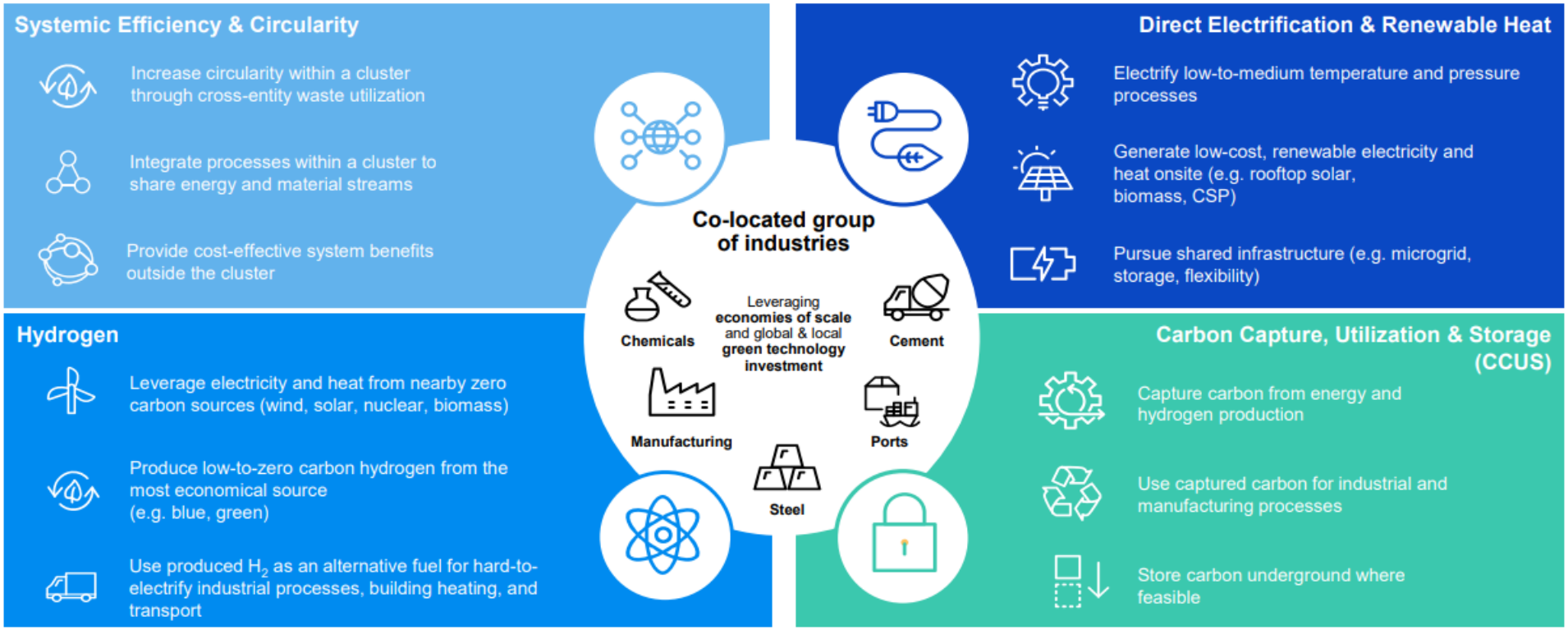
Vision of public organizations aligns with Vaal Industrial cluster Net-zero ambitions:

- **GDED**: Commercialization and industrialization of Green Hydrogen projects in Gauteng City Region, such as: Power generation from GH2, GH2 production from Sasolburg , Explore GH2 in mobility, green hydrogen skills academy, strategic localization / enterprise and supplier development initiatives.
- **VAAL SEZ**: looking into strategies surrounding hydrogen manufacturing to re-industrialize the Vaal region
  - Vaal has opportunities in the manufacturing of hydrogen, electrolyzers, solar batteries and solar panels.

GP GREEN HYDROGEN TEST CASE - VAAL INDUSTRIAL CLUSTER

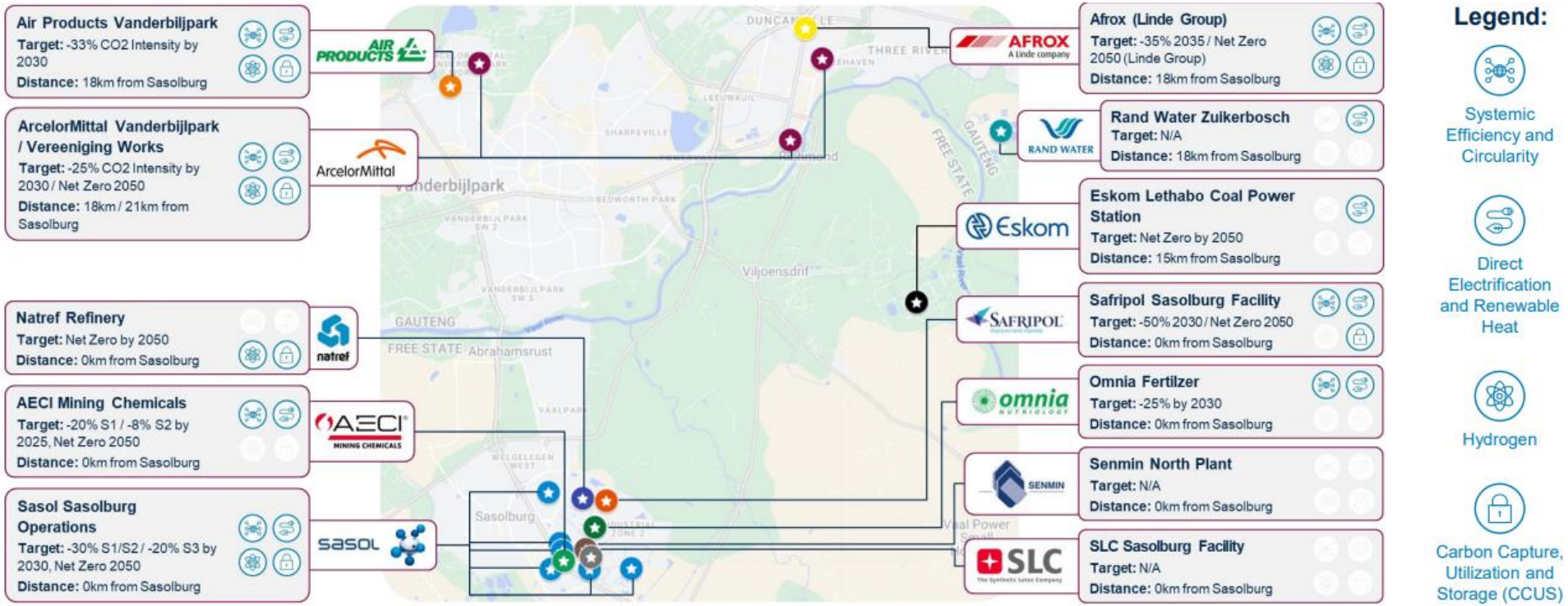
A combination of solutions have the potential to reduce the Vaal industrial cluster GHG emissions by up to 40% by 2030 (based on EU analysis):

Key decarbonisation levers include the following:



GP GREEN HYDROGEN TEST CASE - VAAL INDUSTRIAL CLUSTER

Many companies in the Vaal region are pursuing similar decarbonization and sustainability goals:



GP GREEN HYDROGEN TEST CASE - VAAL INDUSTRIAL CLUSTER

Industries in the Vaal can leverage off collaboration to accelerate their transition to net zero in the Vaal region:

Potential Partners

sasol, SENMIN, omnia NUTRIOLOGY, ArcelorMittal, AIR PRODUCTS, natref, RAND WATER, SLC The Synthetic Latex Company, AECI MINING CHEMICALS, AFROX A Linde company, Eskom, SAFRIPOL

Decarbonisation Priorities

- Low Carbon Hydrogen & Derivatives production
- Renewable Energy
- Sustainable Carbon
  - Carbon Capture for Utilisation
  - Biogenic
- Bio-feedstock sourcing for utilities, industry process feedstock, etc.
- Circularity

Business benefits and potential synergies

1. Ability to **leapfrog and learn from others** who have deployed tailored decarbonisation
   - Systemic Efficiency and Circularity
   - Direct Electrification and Renewable Heat
   - Hydrogen
   - Carbon Capture, Utilization and Storage
2. Opportunity for **shared and scalable investments** in renewable energy, low carbon hydrogen & derivatives production, sustainable carbon sources including industrial CO_2, structured circularity opportunities, pipeline infrastructure, electricity grid networks and green skills
3. **Sharing of best practices, tools and experts' guidance** from cluster members and from the WEF community

GPG GREEN HYDROGEN PARTNERSHIPS

Gauteng Provincial Government Green Hydrogen Formal Partners:

science & innovation
Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA

sasol

Private Sector: Partnered with through the Microgrid Programme

Gauteng Provincial Government Green Hydrogen Working Partners:

- The Presidency
- Northern Cape Provincial Government
- Mitochondria Energy Company

* European Union
* US Consulate
* German Government/GIZ

5.

JUST ENERGY TRANSITION

COMMERCIALISATION VALUE CHAINS

The successful implementation of the commercialisation strategy will depend on the execution of the six key elements :

1 PRIORITISE EXPORTS	2 STIMULATE DOMESTIC MARKET	3 SUPPORT LOCALISATION	4 SECURE FINANCING	5 PROACTIVE SOCIO ECONOMIC DEVELOPMENT
Target exports of green hydrogen and green chemicals by leveraging on South Africa's proprietary Fischer Tropsch technology and utilising financing support mechanisms including grants, concessional debt and contract for difference / price subsidies to improve the financial viability of these projects	In parallel to the export strategy, develop projects along the value chain to stimulate demand for green hydrogen in South Africa. "Low hanging fruit" opportunities to be prioritised to provide confidence in the domestic market. Examples include green steel, hydrogen valley mobility programme and sustainable aviation fuel projects.	Develop local industrial capability to produce fuel cells, electrolyser, ammonia cracking and balance of plant equipment and components by leveraging on South Africa's PGM resources. Together with demand stimulation this will drive longer term GH_2 price reduction allowing penetration in various sectors.	"Crowd in" and secure funding from various sources and in various forms including grants, concessional debt and contract for differences.	Maximise development impact (incl. skills and economic development and social inclusion). Ensure gender equality, BBBEE and community participation. Maximise job creation and alternative options for potential job losses.

6 ROLE OF GOVERNMENT IN POLICY AND REGULATORY SUPPORT

Position GH_2 as a key early contributor to decarbonization and a just transition in the country programme of work being collated by the JET-IP Task Team ensuring a fair proportion of climate finance is sourced to enable development of this industry.

Prioritize the execution of the green hydrogen commercialisation strategy and the development of a national GH_2 infrastructure plan

Drive the required policy and regulatory changes required to sustain long term growth of the new hydrogen industry.

Mobilise and coordinate the Government support required to support the development of this new industry for South Africa.

GH2 Value Chain and skills required

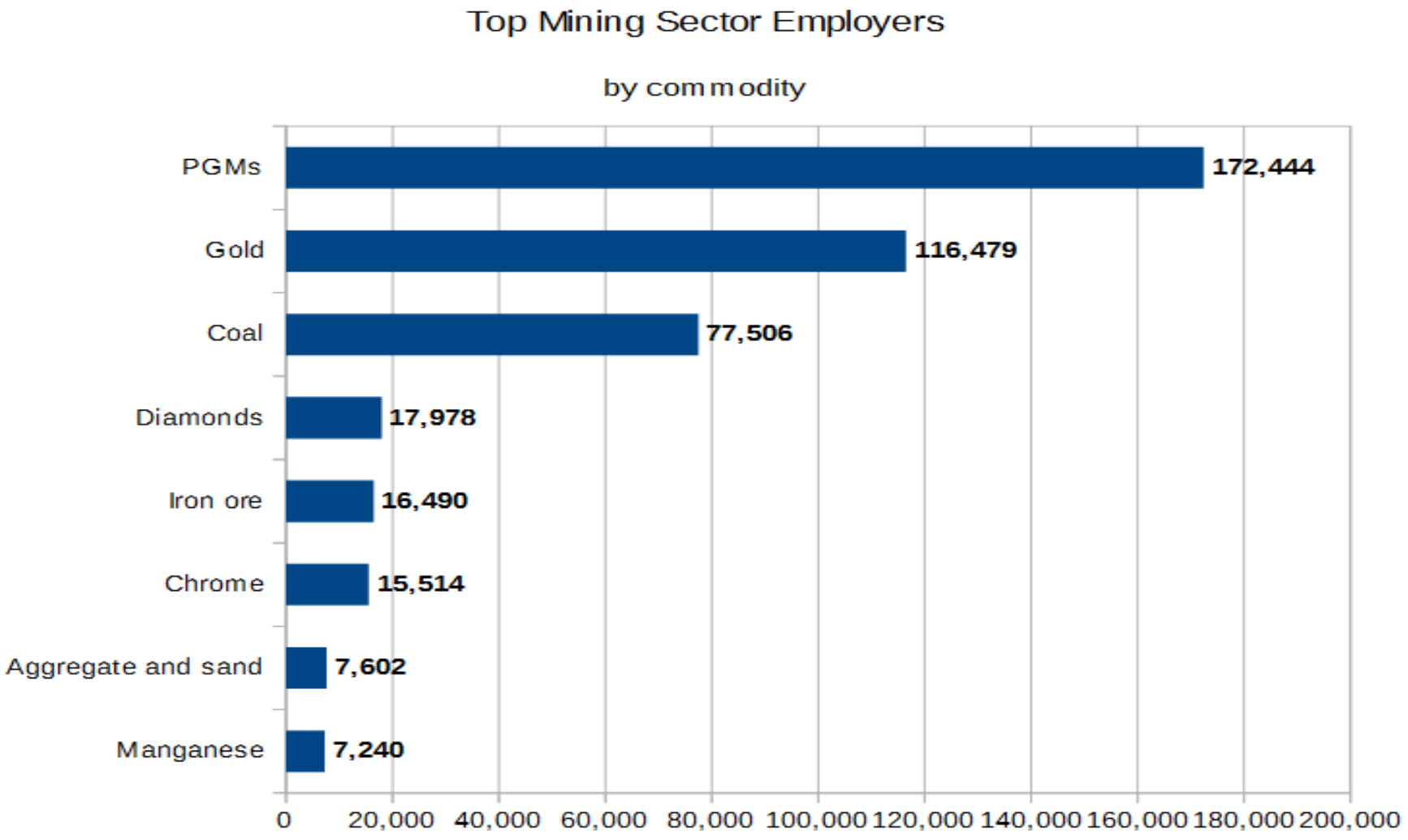
Value chain	Localisation opportunity (Priority)	Skills required	Skills sourcing	Government can build local skills capacity by...
Renewable Energy generation	Hydrogen and renewable energy specialists **(High)**	Circular economy skills	Outsource	• **Incentivising the private sector to support local capacity** as they outsource for missing and limited skills. • **Support educational institutions** with development and funding of training programmes focused on the GH industry. • **Creating financial incentives for the private sector** to roll out upskilling initiatives.
		Green architecture and future cities planning skills	Outsource	
		Green engineering and tech skills	Local, but limited	
		Natural capital skills	Outsource	
		Sustainable agriculture skills	Local, but limited	
Electrolysers and Balance of Plant	PGM mining and processing **(High)**	Technical engineering (renewable, marine)	Local, but limited	**Incentivising the private sector to support local capacity** as they outsource for technical engineering expertise specific to electrolyser manufacturing
	Recycling of used PGM products **(Medium)**	Circular economy skills	Local, and growing	**Supporting the roll out of upskilling initiatives** through funding and financial incentives to encourage quicker uptake by the private sector
	CCM* and MEA* electrolyser component manufacture **(High)**	Circular economy skills	Local, but limited	• **Incentivising the private sector to support local capacity** as they outsource for technical engineering expertise specific to **CCM and MEA component manufacturing**, **fuel cell stack manufacturing**, **green engineering**, and **circular economy integration**. • **Supporting educational institutions** with development and funding of training programmes focused on the GH industry.
		Green engineering and tech skills	Outsource	
		Manufacturing and Assembly	Local, but limited	
Beneficiated Products	Fuel cell stack and systems manufacture **(Medium)**	Circular economy skills	Outsource	
		Green engineering and tech skills	Local, but limited	
		Manufacturing and Assembly	Local, but limited	
	Automotive manufacture **(Medium)**	Manufacturing and Assembly	Local, and mature	
All	Systems Integration and Operation and maintenance **(High)**	Circular economy skill	Local, but limited	• **Incentivising the private sector to support local capacity** as they outsource for missing and limited skills. • **Incentivising the private sector to roll out upskilling initiatives** to develop growing skills, through funding models and financial incentives • **Developing ecosystem and research partnerships** to diversify mature skills into other segments of the GH value chain and other industries.
		Environmental justice skills	Local, and growing	
		Green career pathways	Outsource	
		Green architecture and future cities planning skills	Outsource	
		Operations management and system integration skills	Local, and mature	

Foundational skills South Africa has developed strong expertise in

Ancillary and support services/ Architecture and Engineering design services/ Business and Management services
Construction/ Finance and Legal services/ Information and Communications Technology/ Insurance and Healthcare services
Logistics and transport/ Manufacturing and Assembly/ Risk Management/ Skilled labourers/ Technical engineering

* CCM (catalyst coated membrane) and MEA (membrane electrode assembly)

EMPLOYMENT IN THE MINING SECTOR



THANK YOU