SOUTH AFRICA'S JOURNEY TOWARDS A HYDROGEN ECONOMY

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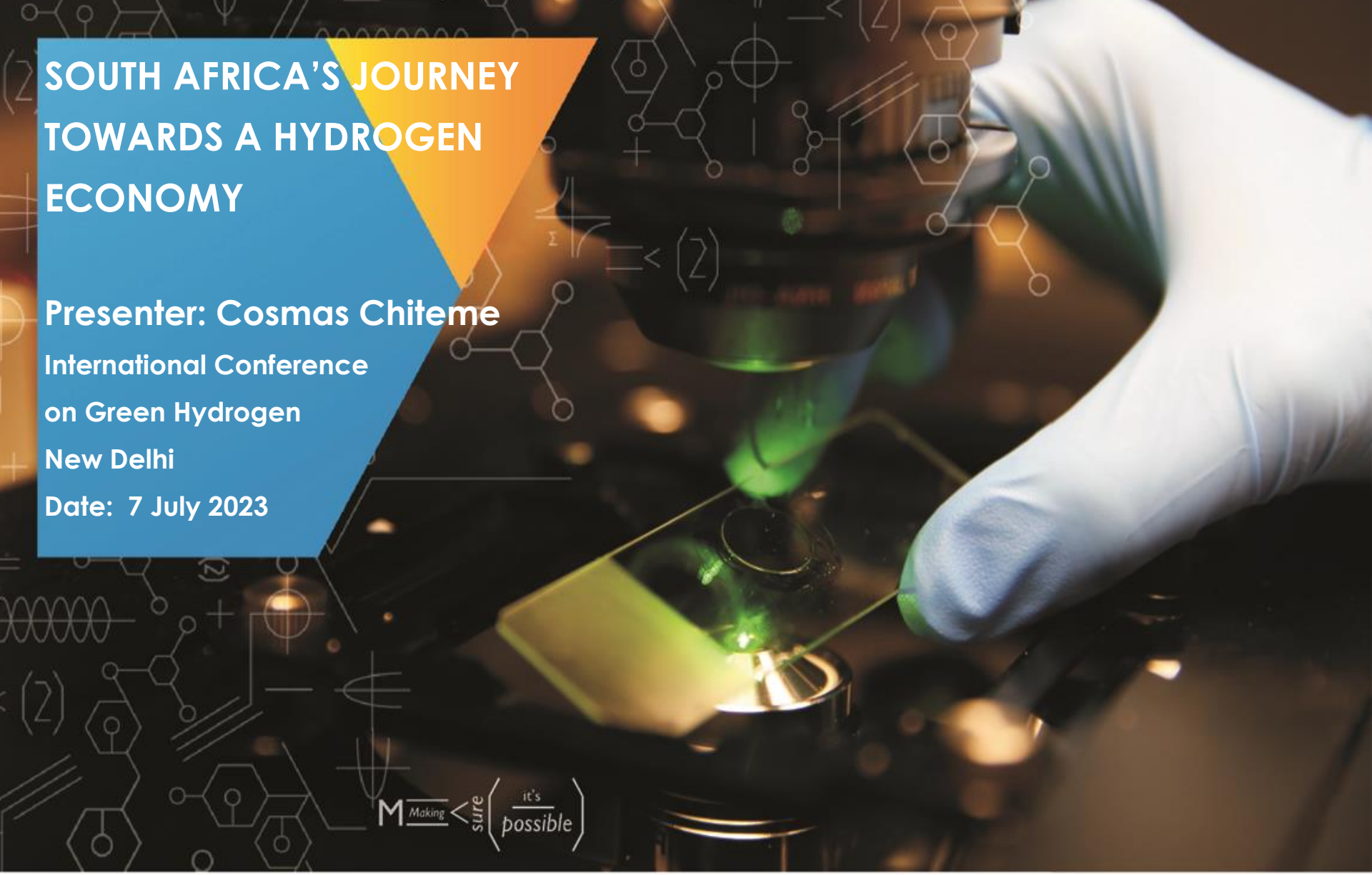
International Conference
on Green Hydrogen
New Delhi
Date: 7 July 2023



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

2030 NDP

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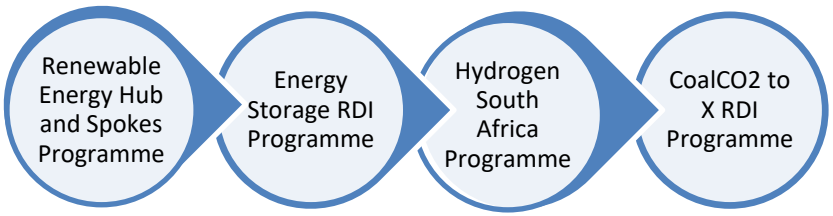
DSI MANDATE

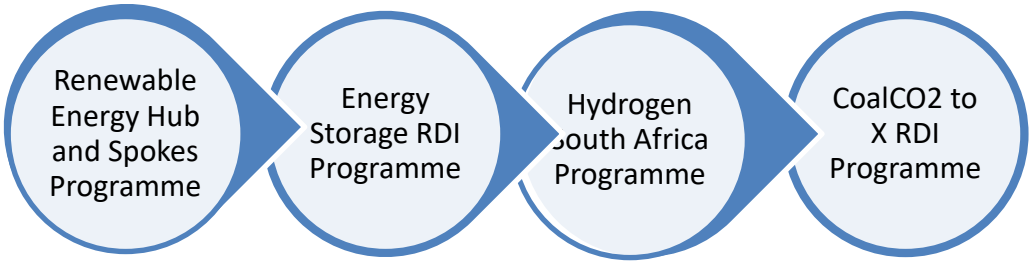
The Department of Science and Innovation (DSI) mandate is derived from the Science, Technology and Innovation (STI) White Paper. The DSI Energy Research, Development and Innovation (RDI) Programmes support:

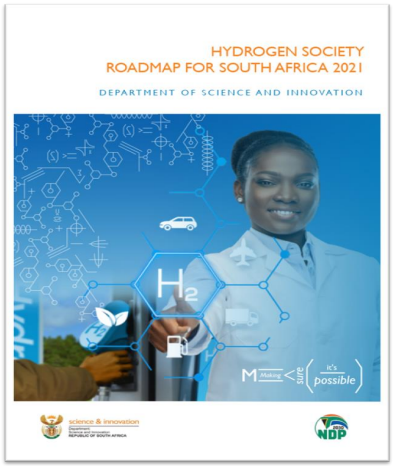
- Reduction in greenhouse gas emissions and air pollution while contributing to a more diverse and sustainable energy mix.
- Research, development and validation efforts to enable emerging technologies to be competitive with incumbent technologies in terms of cost and performance.
- Local value addition through leveraging our resource endowment.
- Knowledge generation and skills development.
- Strategic partnerships with public and private sector to reduce the institutional and market barriers to commercialisation.



TYPICAL EVOLUTION OF RDI PROGRAMMES

From RDI Strategies (Outputs) to National Initiative/Roadmap (Outcomes)

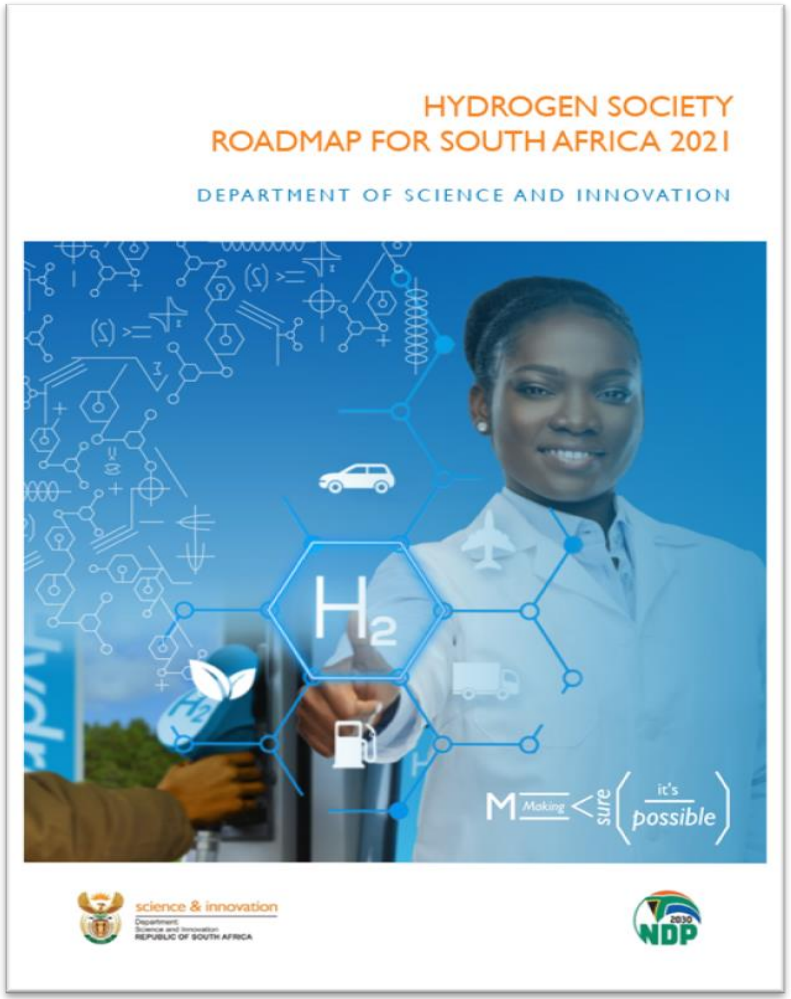




Typical Outputs:

- 192 (MSc and PhD) graduates in engineering and related fields
- 352 Publications in ISI journals
- 30 Intellectual property rights filed and 15 granted
- 23 Prototypes
- 27 Technology demonstrations in real world environment
- 18 Commercial products
- 7 Trade secrets declared
- 3 Spin-off companies.

THE HYDROGEN SOCIETY ROADMAP



https://www.dst.gov.za/index.php/resource-center/strategies-and-reports/3574-hydrogen-society-roadmap-for-south-africa-2021

Vision

An inclusive, sustainable and competitive hydrogen economy by 2050 with the goal of achieving a Just and inclusive net zero carbon economic growth for societal wellbeing by 2050.

Purpose

To align stakeholders on a common vision on hydrogen related technologies in order to create an environment where investment decisions can be made to unlock the social economic benefits for the country.

HIGH LEVEL OUTCOMES OF THE HSRM

The implementation of the HSRM is expected to contribute to the goal of a just and inclusive net-zero carbon economic growth for societal wellbeing by 2050 through the following high-level outcomes:

Green and enhanced power sector and buildings
[16]
Lead Department: DMRE
Supported by: DPWI

Decarbonisation of transport sectors: heavy duty trucks, shipping, aviation and rail
[8]
Lead Department: DoT
Supported by: DTIC, DFFE

Creation of a manufacturing sector for hydrogen products and components
[9]
Lead Department: DSI
Supported by: DTIC, DMRE, DSBD

Decarbonisation of energy intensive industry : iron & steel, chemicals, mining, refineries, cement
[8]
Lead Department: DTIC
Supported by: DFFE, DMRE, DPE

Creation of an export market for green hydrogen and green ammonia
[9]
Lead Department: DTIC
Supported by: DIRCO, NT

Transition from grey to blue to green hydrogen
[20]
Lead: Presidency
Supported by: DSI, DMRE, DTIC, DIRCO, DFFE, DPE, DPWI

Ensure that Gender, Equality and Social Inclusion (GESI) are at the core of the transition to a low carbon economy to tackle the triple challenges of poverty, inequality and unemployment

KEY ACTIONS & MILESTONES

2021-2024

PRODUCTION

- Small scale electrolysis production
- At least 1MW GH2 production piloted

USE

- At least 100 buses and trucks powered by H2 by 2025
- At least 20 forklifts converted to fuel cell power by 2025
- At least 5 refueling stations deployed by 2025
- Demonstration in power generation and stationary fuel cells in public buildings
- Industry demonstration including SAFs

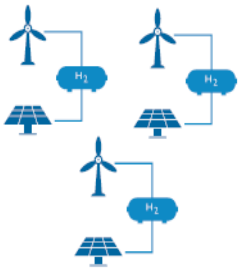
JOBS

- Upscaling of training and reskilling for new jobs

2025-2030

PRODUCTION

- 5GW electrolysis capacity under construction in NC
- 10GW electrolysis capacity deployed in NC by 2030
- 1.7GW electrolyser capacity deployed in H2 Valley by 2030
- At least 500kt H2 produced annually by 2030



USE

- At least 500 buses and trucks powered by H2 by 2030
- Power generation in turbines using H2 and ammonia
- Sector coupling and use in transport, industry

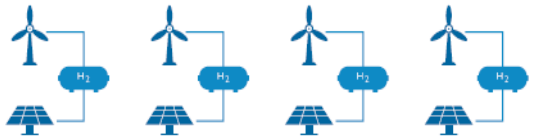
JOBS

- At least 20 000 jobs created annually by 2030

2030-2040

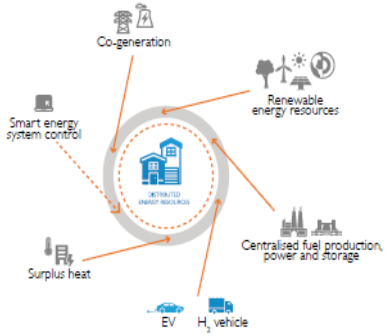
PRODUCTION

- Increase electrolysis capacity to at least 15GW by 2040



USE

- Sector coupling and full use in transport, industry and power



JOBS

- At least 30 000 jobs created annually by 2040

Establish targets and policy signals

Support demand creation

Mitigate investment risk

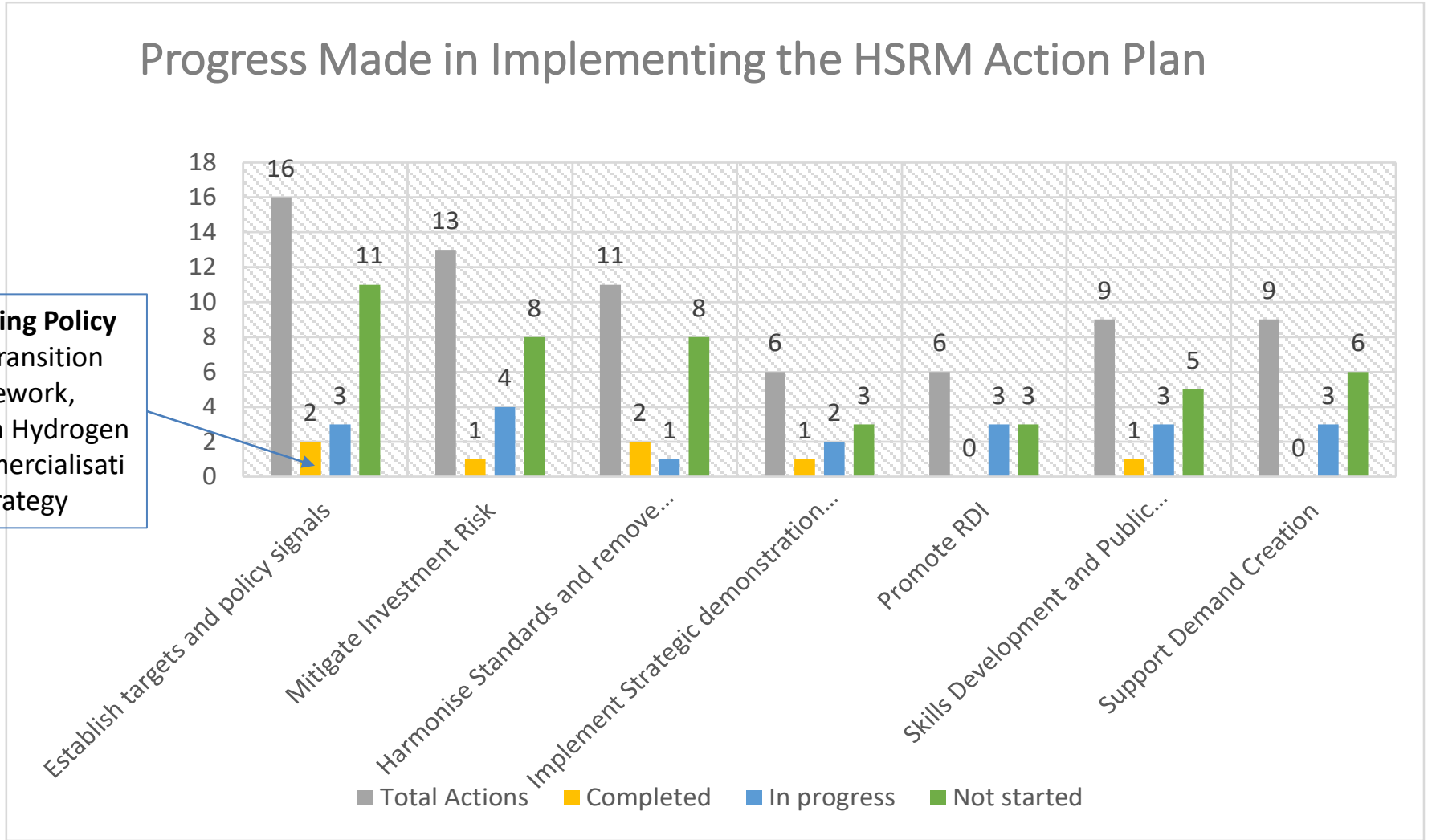
Harmonize standards and remove barriers

Promote Research, Development and Innovation

Strategic demonstration and deployment projects

Skills development and public awareness

PROGRESS MADE IN IMPLEMENTING THE PRIORITY ACTIONS BASED ON THE IEA FRAMEWORK



Enabling Policy
Just Transition Framework, Green Hydrogen Commercialisation Strategy

Approval of SIPs
Nine (9) projects registered

New catalytic projects
Sasolburg, Saldanha Bay

APPROVED STATEGIC INTEGRATED PROJECTS

Projects are recognized for their economic and social significance

a. The Prieska Power Reserve in the Northern Cape
b. The Ubuntu Green Energy Hydrogen Project in Northern Cape
c. Boegoebaai Green Hydrogen Development Programme in the Northern Cape
d. Atlanthia Green Hydrogen in the Western Cape
e. Upilanga Solar and Green Hydrogen Park in the Northern Cape
f. Sasolburg Green Hydrogen Programme in the Free State
g. SASOL HySHiFT (Secunda) in Mpumalanga
h. HIVE Ammonia in the Eastern Cape
i. Hydrogen Valley Programme of Anglo-American and their JV Partners (9 projects) along the Limpopo, Gauteng to KwaZulu-Natal Corridor

SIPs benefit from:

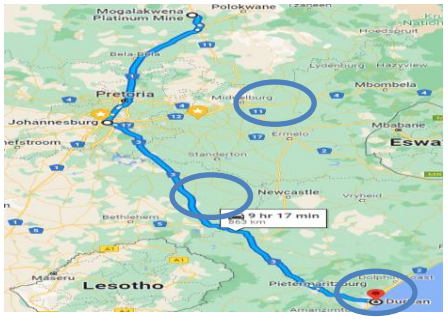
- Better Coordination
- Better access to resources through prioritization
- Faster Environmental approvals

CATALYTIC PROJECTS FROM THE HSRM AND EXPECTED OUTCOMES

CoalCO2-X™

- Coal fired flue gas conversion and use
- Local production of fertiliser salts and other chemicals,
- New economic opportunities to support just transition
- Emissions reduction.

Platinum Valley



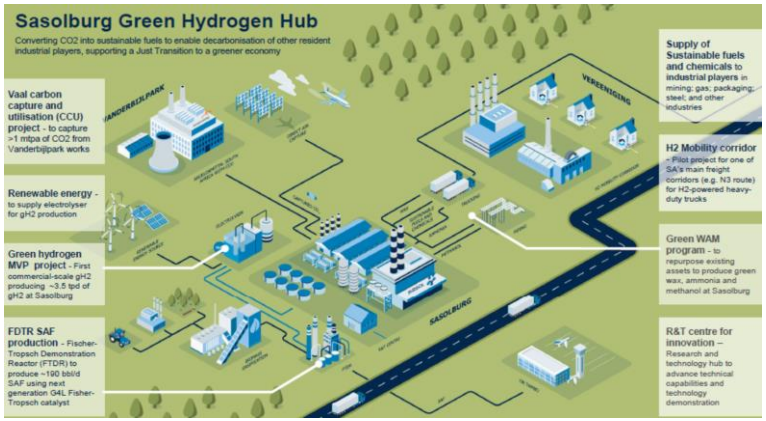
- Green hydrogen production and application hubs
- Decarbonisation of transport
- GDP contribution: USD3.9 bn to USD8.8 bn by 2050.
- 14 000 to 32 000 jobs per year by 2030.

Boegoebaai SEZ

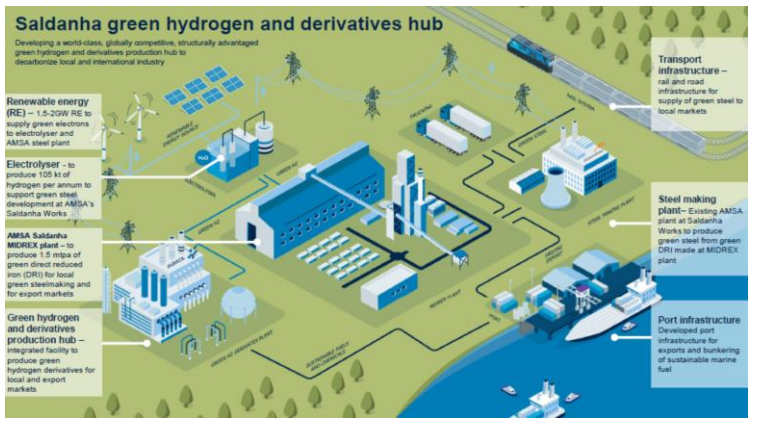
- Green Hydrogen and Green Ammonia for domestic use and for export
- Electrolyser Park
- Solar, wind and battery Park.

Sustainable Aviation Fuels

- Local production of aviation fuels for domestic use and export
- Decarbonisation of the aviation sector
- Sasol Secunda as Hub.

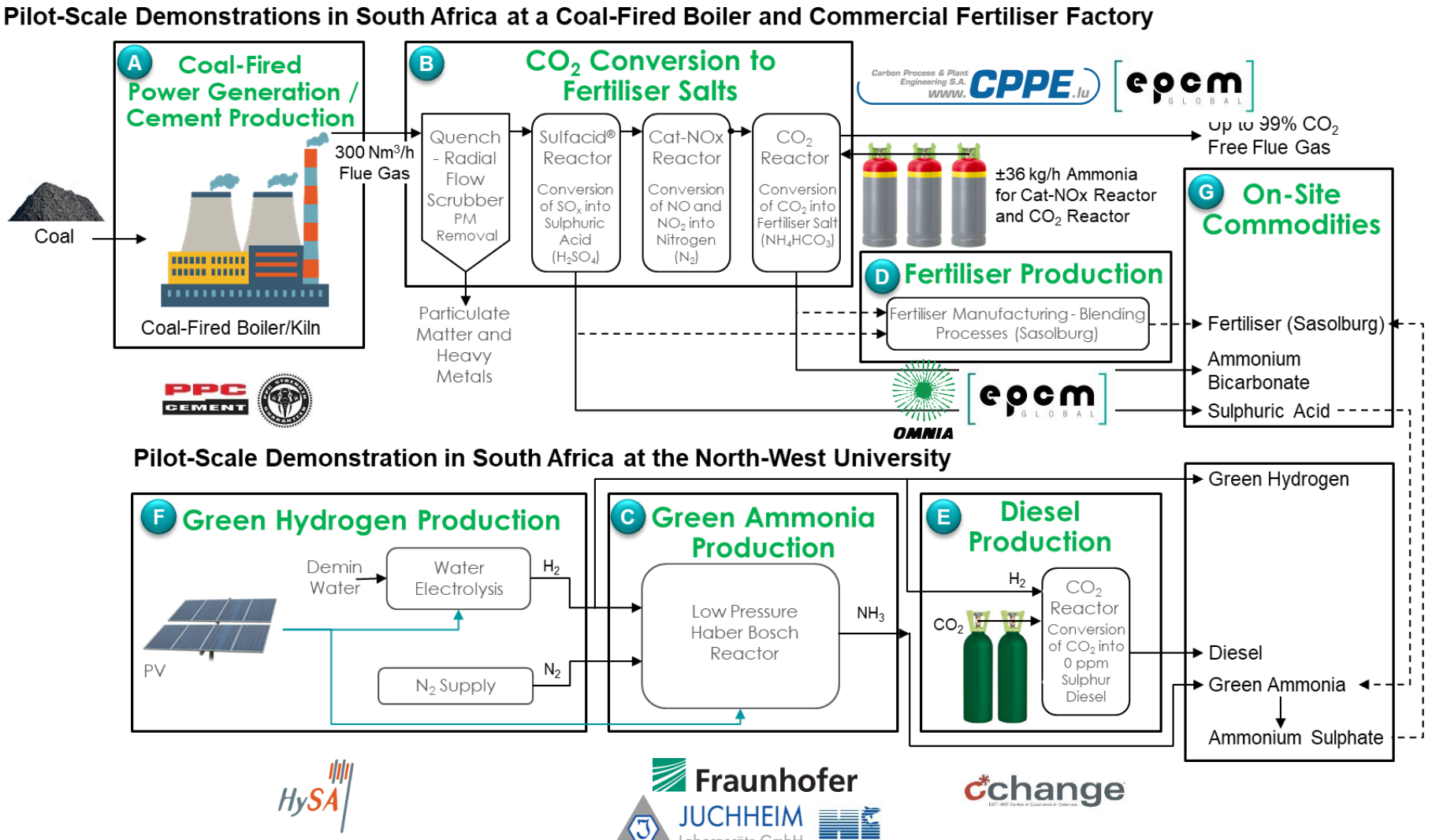


- Carbon dioxide capture from Vanderbijlpark steel plant
- Sustainable carbon for aviation fuels production
- Research & innovation centre for technology testing and validation



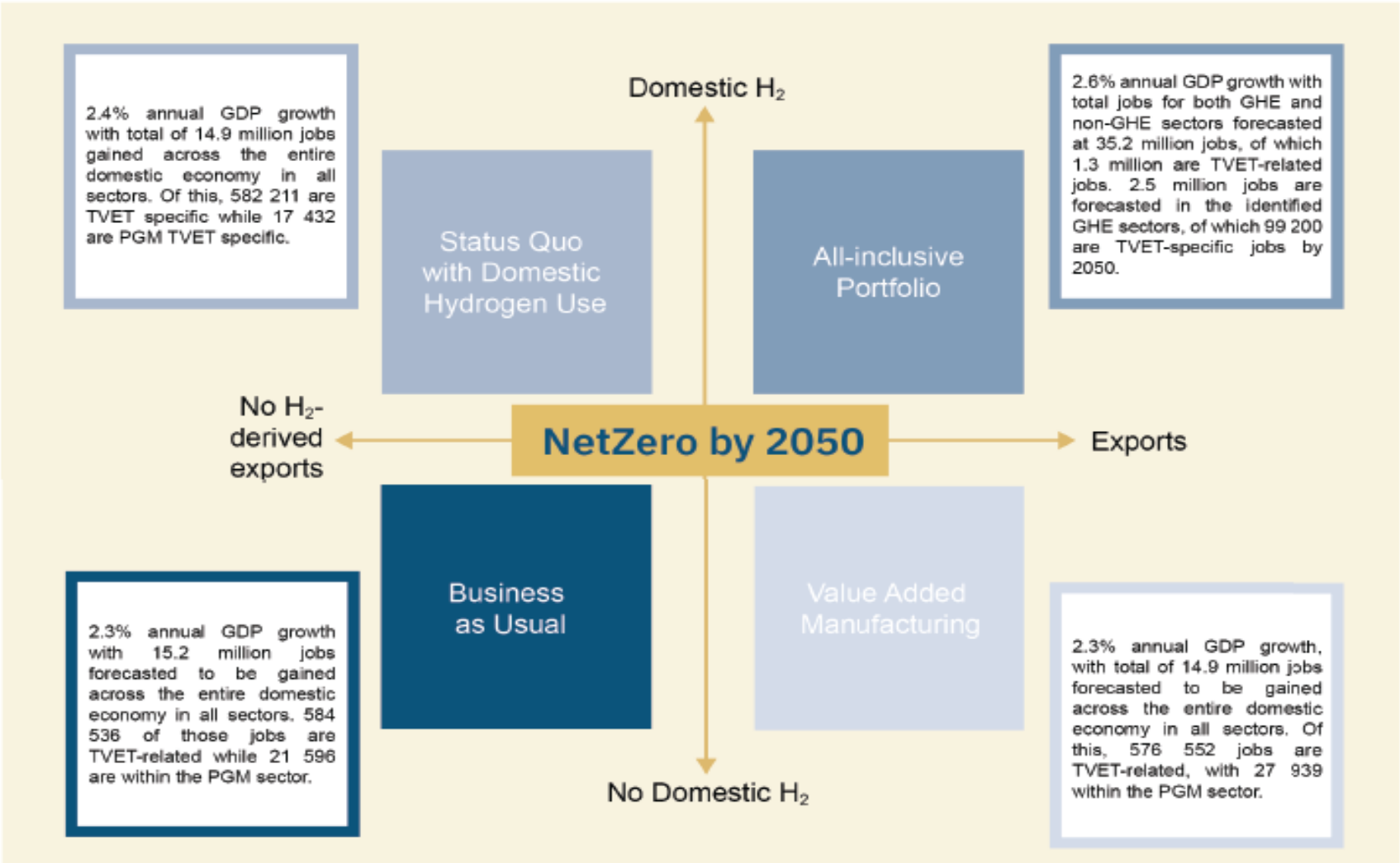
- Resuscitation of mothballed Saldanha steel works
- Green hydrogen production of 105 000 tonnes per yr. for green steel production

Development and Pilot Demonstration of Local and International Intellectual Property



Pictures from: edurev.in, cppe.lu, swivelsecure.com, indiamart.com

SCENARIOS FOR A GREEN HYDROGEN ECONOMY IN SOUTH AFRICA



Source: Ahjum et al., Green hydrogen and TVET employment prospects (2022)

THE ALL INCLUSIVE PORTFOLIO

Sector	Jobs 2030	Jobs 2040	Jobs 2050	TVET jobs 2030	TVET jobs 2040	TVET jobs 2050
Iron & steel	224 000	581 000	918 000	6 500	16 900	26 600
PGM mining	161 000	188 000	706 000	7 300	8 500	31 900
Power generation[a]	77 000	140 000	212 000	6 000	11 000	16 600
Fuel cells	<1 000	28 000	302 000	<100	900	9 700
Electrolysers	2 000	30 000	283 000	100	1 000	9 100
Ammonia	5 000	34 000	66 000	200	1 500	3 000
GH_2 production	1 000	26 000	52 000	<100	1 200	2 300
SUBTOTAL for GHE sectors[b]	470 000	1 027 000	2 539 000	20 300	41 000	99 200
Compared with South African economy at large						
TOTAL all sectors, (entire SA economy)[c]	**19 899 000**[d]	**26 727 000**[e]	**35 215 000**[f]	**774 000**	**1 035 000**	**1 361 000**

a Numbers for power generation exclude thermal coal power generation, which employs resp. 11 (2030), 6 (2040), and 1 (2050) thousand persons, of which 0.9 (2030), 0.4 (2040), and 0.1 (2050) thousand were TVET-educated in the All-inclusive Portfolio.

b For 2020 we estimate that the mentioned 7 sectors (with power generation excl. thermal coal) employed 327 thousand people, of which 14.6 thousand were TVET-educated (for 2019 these numbers were respectively 388 and 17.4 thousand).

c The Total all sectors jobs refers to the entire SA economy and not only green hydrogen economy jobs. In 2020 the entire South African economy employed about 15.6 million people, of which about 610 thousand were TVET-educated.

d Total all full-time equivalent jobs (including TVET) in the entire South African economy by 2030.

e Total all full-time equivalent jobs (including TVET) in the entire South African economy by 2040.

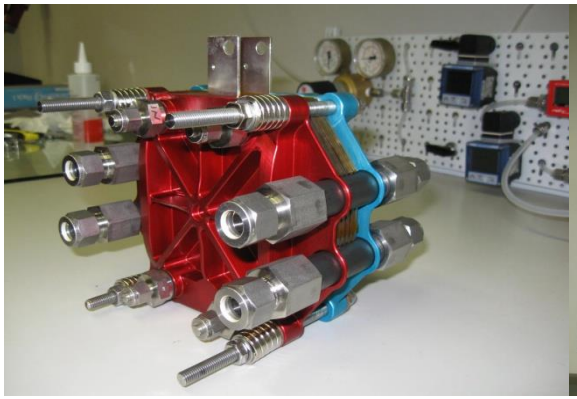
f Total all full-time equivalent jobs (including TVET) in the entire South African economy by 2050.

Source: Fadiel Ahjum et al., "Green Hydrogen and TVET Employment Prospects: An Assessment in a Context of Ambitious Decarbonisation for South Africa Towards 2050" (Working Paper, SAIIA-UK PACT and University of Cape Town, 2021)

CASE FOR LOCALISATION

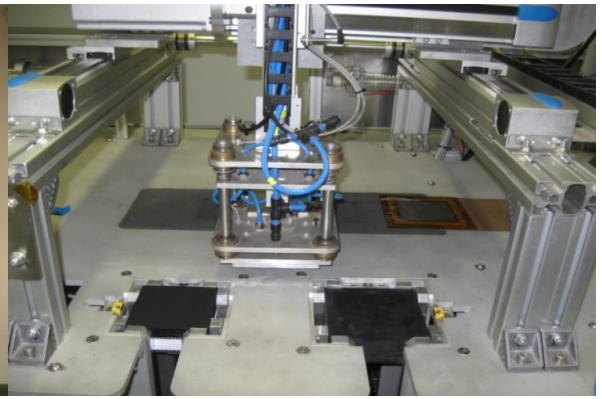
- **Government has supported the development of IP in key components such as:**
  - PGM based catalysts for fuel cells and electrolysers.
  - Membrane electrode assemblies (MEAs) for fuel cells and electrolysers used in green hydrogen production.
- **Commercialisation will be enhanced by the integration of the locally developed IP in all the projects, which would:**
  - Stimulate the local production of the balance of plant to support systems deployed locally and create more jobs in supporting industries.
  - Give higher reliability of the systems because of available local maintenance and support, as some of the systems will operate for>10 yrs.
  - Flexibility to modify systems for continued use, even after the systems have been phased out by original equipment manufacturers. MEAs are the most likely components to be replaced in the systems.
  - South Africa would be able to manufacture systems that are more adaptable to the local conditions and those found in the rest of the continent.

COMPONENTS & TECHNOLOGY DEVELOPMENT

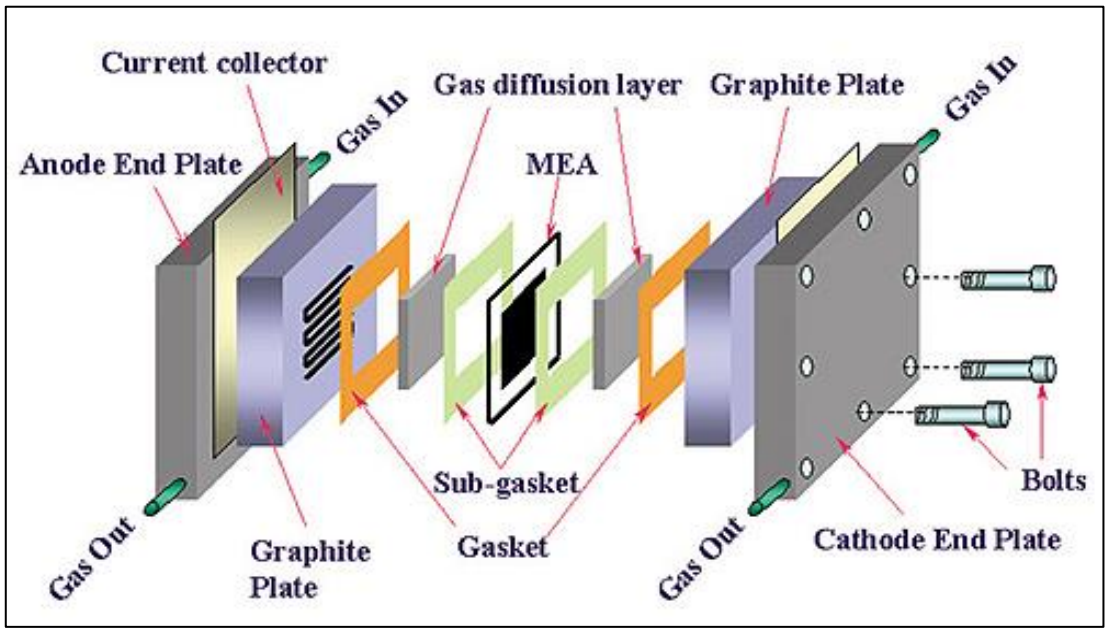


PEM fuel stack (HT)

Bipolar Plates

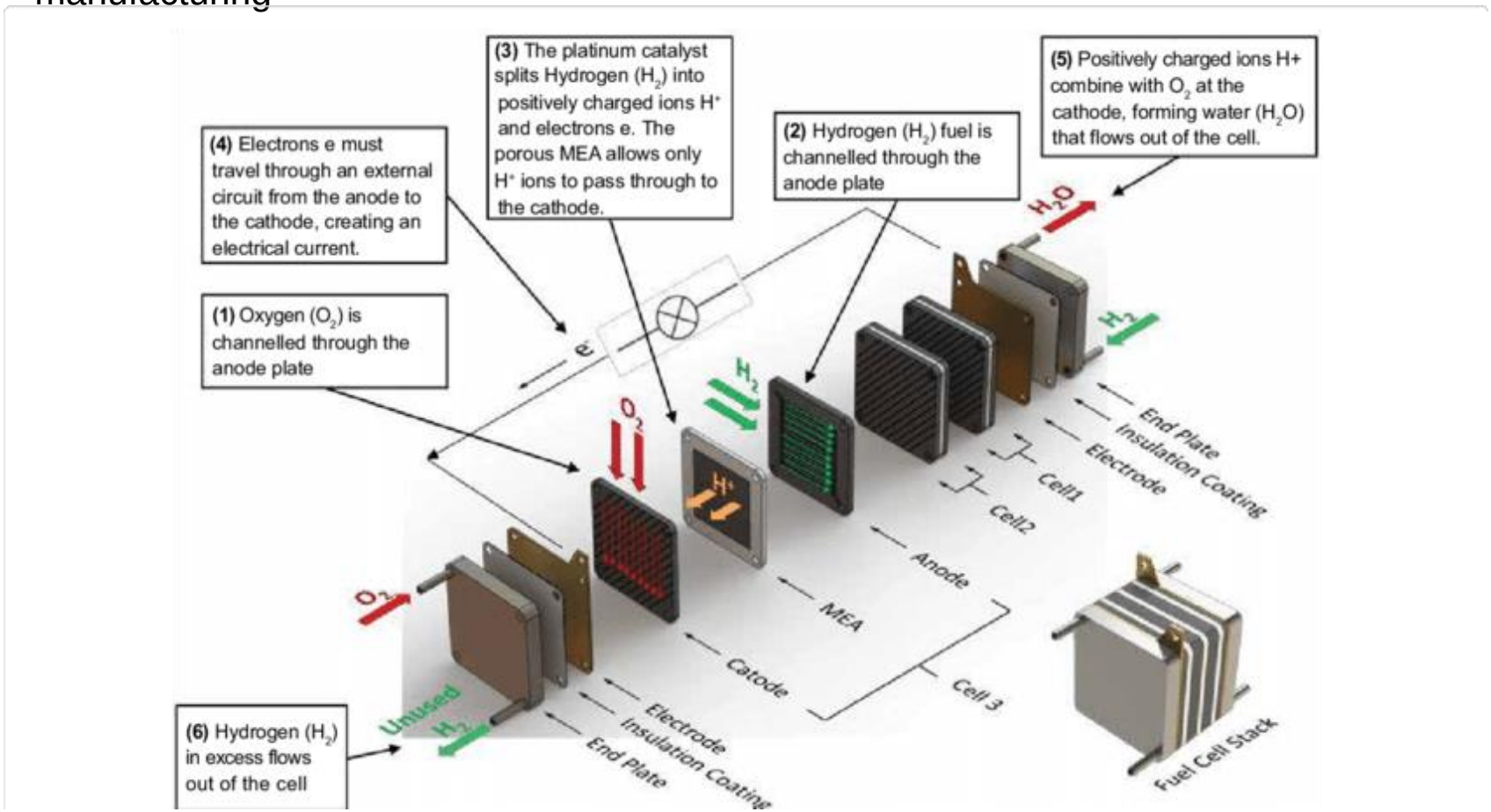


MEA pilot production line



Localisation of fuel cells and electrolysers for domestic manufacturing

- Hydrogen South Arica has a patent portfolio for Membrane Electrode Assemblies (MEAs) and catalyst based on PGMs which can be commercialized through partnerships with Global OEMs.
- The uptake of electrolysers (at least 15 GW by 2040) should be sufficient to support local manufacturing



SPATIAL DISTRIBUTION OF FUEL CELL DEPLOYMENTS FROM HYSA RDI PROGRAMME

Fuel Cell deployed to power learner equipment at Poelano Secondary School, Ventersdorp

Fuel Cell deployment to power COVID-19 facilities at 1 Military Hospital, Pretoria

Fuel Cell deployment to preserve vaccines Windsor at East Clinic, Randburg

Facility deployed to test hydrogen use in underground mining at North West University, Potchefstroom

Fuel Cell powered forklift and refueling infrastructure deployment at Impala Platinum Refineries, Springs

Fuel Cell deployed to support the Kwadukuza Disaster Management Centre

Fuel Cell powered scooters deployed at SAPO Head Office, Cape Town

Fuel Cell deployed at University of the Western Cape Nature Reserve, Cape Town

Planned fuel cell deployments at Masia Village, Limpopo, Mbizana Police Station in Eastern Cape.

Fuel Cells deployed to power learner equipment at Cofimvaba Schools

Fuel Cell deployment to provide power to Cofimvaba Science Centre, Cofimvaba

Skills Development in support of the Hydrogen Economy

- Training programme launched by the Deputy Minister of Higher Education, Science and Innovation on 2 November 2020.
- A total of 25 TVET graduates and 9 professionals from government departments and municipalities participated in the training programme.
- Participants were trained on the operations, maintenance, and installation of stationary fuel cells.
- Three of the trainees from the Programme were offered employment contracts at the end of the 6-week course.
- More partnerships with both the public and private sector are required to scale up the training.

Partners at the launch of the Training Programme

Trainees at 1 Military Hospital for their practical Training

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BAMBILI ENERGY

EW SETA

UNIVERSITEIT VAN PRETORIA
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YUNIBESITHI YA PRETORIA

LESSONS LEARNT IN FUNDING INNOVATIONS

- Consistent support from government through both policy and long-term funding commitment is key
- Regular and independent reviews based on international best practice and implementation of the review recommendations
- Participation in relevant international multilateral forums such as the IPHE is important for knowledge exchange and benchmarking
- Careful selection of the technology demonstration sites is key to increase public awareness and appreciation of the technology
- Collaboration between the public, private sector and academia is key to facilitate technology development, deployment and commercialization
- Commercialization is enhanced when anchored by locally developed IP
- Coordination of activities across the broader NSI is key to promote continued innovation.

KEY MESSAGES

- South Africa aims to use its mineral endowment, renewable energy assets, land availability and local industry capabilities to create a globally competitive Hydrogen Economy as part of its Economic Reconstruction and Recovery Plan.

- In line with the JET-IP, South Africa can be rebranded as a destination for Sustainable Investment that incorporates environmental, societal and good governance (ESG) principles.

- Gender, Equality and Social Inclusion are at the core of the transition to a low carbon economy to tackle the triple challenges of poverty, inequality and unemployment.

- The approval by Cabinet to extend the Hydrogen South Africa RDI Programme is an indication that South Africa remains committed to contribute to the growth of the Global Hydrogen Economy

- Government has initiated engagements with private sector and international partners to design appropriate operating models for the effective implementation of the Hydrogen Society Roadmap.

1 Military Hospital Deployment August 2020

South African Post Office Fuel Cell powered scooters, 2019

Anglo American Platinum Fuel Cell powered Truck 2022

Ro livhuwa
Siyabonga
Re a leboga
Ha khensa
Siyathokoza
Enkosi
Dankie
Thank you