

# Challenges in H<sub>2</sub> transportation, storage and end-use: The South African experience

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RD20 2024: New Delhi  
**02 December 2024**



science & innovation

Department:  
Science and Innovation  
REPUBLIC OF SOUTH AFRICA



# National policy update

## 1) **Hydrogen Society Roadmap (HSRM): Dept of Science, Technology and Innovation (DSTI)**

- Approved by Cabinet Sept 2021, launched by DSTI Feb 2022; Interministerial Committee to coordinate HSRM implementation of approved by Cabinet Feb 2024.
- DSTI investigating feasibility of establishing International Hydrogen Centre to enhance institutional capacity, and to assist government on implementation of HSRM.

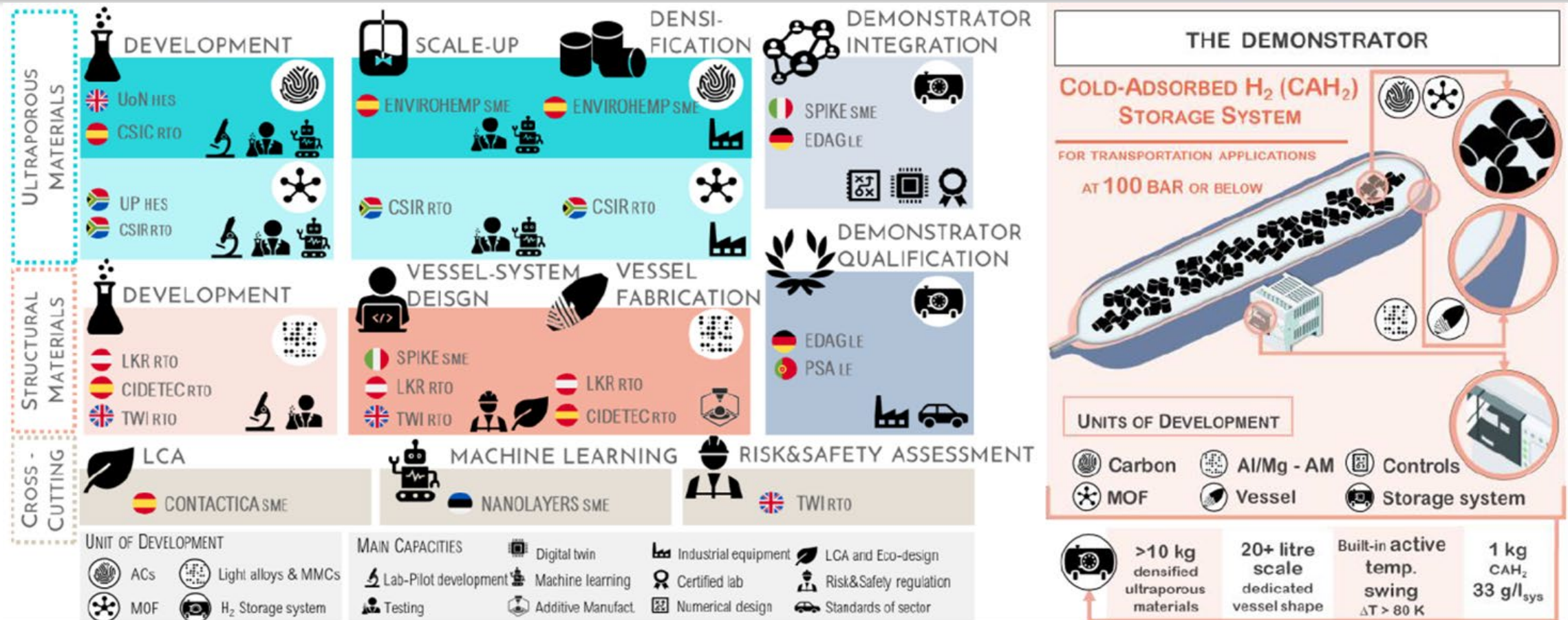
## 2) **Green Hydrogen Commercialisation Strategy: Dept. of Trade Industry and Competition (DTIC)**

- Developed by Industrial Development Corporation (IDC), approved by Cabinet Oct 2023.
- Aims: position SA as leading producer and exporter of green H<sub>2</sub>, contribute to economic growth, and just transition reducing CO<sub>2</sub> emissions.
- Projected that H<sub>2</sub> economy could add 3.6% to SA's GDP by 2050 and create approximately 370,000 jobs.
- Projected capital expenditure (CAPEX) for H<sub>2</sub> initiatives across the country now stands at slightly over US\$44 billion, with approximately 20% of these investments currently at the bankable feasibility stage. This includes the SIPs projects and newly announced projects.

## 3) **SA Renewable Energy Masterplan (SAREM): Under development Dept. of Mineral Resources & Energy (DMRE)**

- Aims: leverage growing demand for renewable energy and storage technologies—focusing on solar, wind, lithium-ion, and vanadium-based battery technologies to promote industrial and inclusive development within South Africa's renewable energy value chains.

# H<sub>2</sub> storage: Materials-based H<sub>2</sub> storage technology



- Funded Horizon Europe project (2022-2025).
- International demonstration platform for a technology initially funded by DSI.
- Complementing expertise: 13 Consortia partners

# H<sub>2</sub> storage: Composite cylinder design



3D printed liners with improved mechanical properties – allows for different shapes and sizes to be developed without molds

Electroless  
Cu

Electro-  
Cu

Electro  
-Ni



Examples of different shapes/sizes



1L demo unit printed and wrapped

# H<sub>2</sub> end-use: Decarbonising mining vehicles

## Driver

- The mining industry is under pressure to decarbonize by investors, clients & CBAM.
- 10% of South Africa's diesel is consumed by mining (410 mil liters).  
=> approximately 1,1 billion kg CO<sub>2</sub> per year from mining in S.A just from diesel.
- Most Mining Houses have NetZero targets (table)

## Proposed solution: H<sub>2</sub> Dual fuel engines

- Dual fuel H<sub>2</sub> is low-cost solution implementable during overhaul.
- Low risk – if H<sub>2</sub> supply is interrupted the mine is still operational.
- Operator friendly – mechanics are familiar with ICE technology.
- 40%-80% reduction in CO<sub>2</sub> emissions.
- Currently conducting a pre-feasibility study.



Descriptions	Anglo American	Exxaro	Seriti	Sibanye Stillwater	Glencore
Market Cap	R 1.05 trillion	R 75 billion	Pvt	R 186 billion	R 1.3 trillion
Commodities	PGM, Iron Ore, Coal, Copper	Coal, Zinc and Iron Ore, Ferro Alloys	Coal	Platinum, Gold	Copper, Cobalt, Nickel, Zinc, Lead, Ferroalloys
Carbon Neutrality	2040	2050	2050	2040	2050

# H<sub>2</sub> end-use: Mobility

## Platinum Valley Initiative

### 1) Mobile refueling station

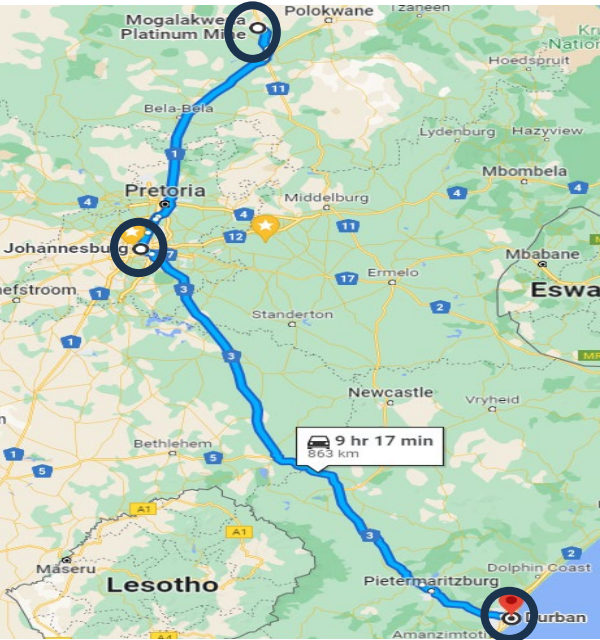
- to be developed by HySA Infrastructure in partnership with Toyota - received \$1m from Toyota and \$280k from government (DSTI).

### 2) On-road hydrogen mobility pilot project

- BMW SA, Sasol, Air Products South Africa and Anglo American Platinum
- Demonstrated in New Road, Midrand xDrive premises. Used BMW iX5 fuelled with H<sub>2</sub> produced by Sasol dispensing technology.

### 3) Project Rhyngow: initiative to catalyse scale-up of H<sub>2</sub> adoption in heavy-duty vehicles.

- The DSTI has joined the consortium of industrial partners, and has contributed US\$55k.



# H<sub>2</sub> conversion: PtX: Green methanol and derivatives

CO<sub>2</sub> from biogas upgrading module/plant

Other various CO<sub>2</sub> sources

Reactor  
Set-up

- ❖ Green Methanol production
- ❖ Dimethyl Ether (DME)
- ❖ Sustainable Aviation Fuels
- ❖ Other Chemicals

H<sub>2</sub> from renewable energy (solar, wind, etc.)

Other various H<sub>2</sub> sources

Technology demonstrable at the CSIR or identified Industry Partner

- ✓ Lab-scale Green Methanol demo rig at the CSIR

Methanol process optimization

Reactor  
design

Catalyst  
design



Next Step

Multi-litre scale  
green methanol  
demo rig

Goal



# H<sub>2</sub> general: decision support, policy (not technologies)

PtX Pathways: ~US\$ 1 million co-funded by German GIZ and CSIR

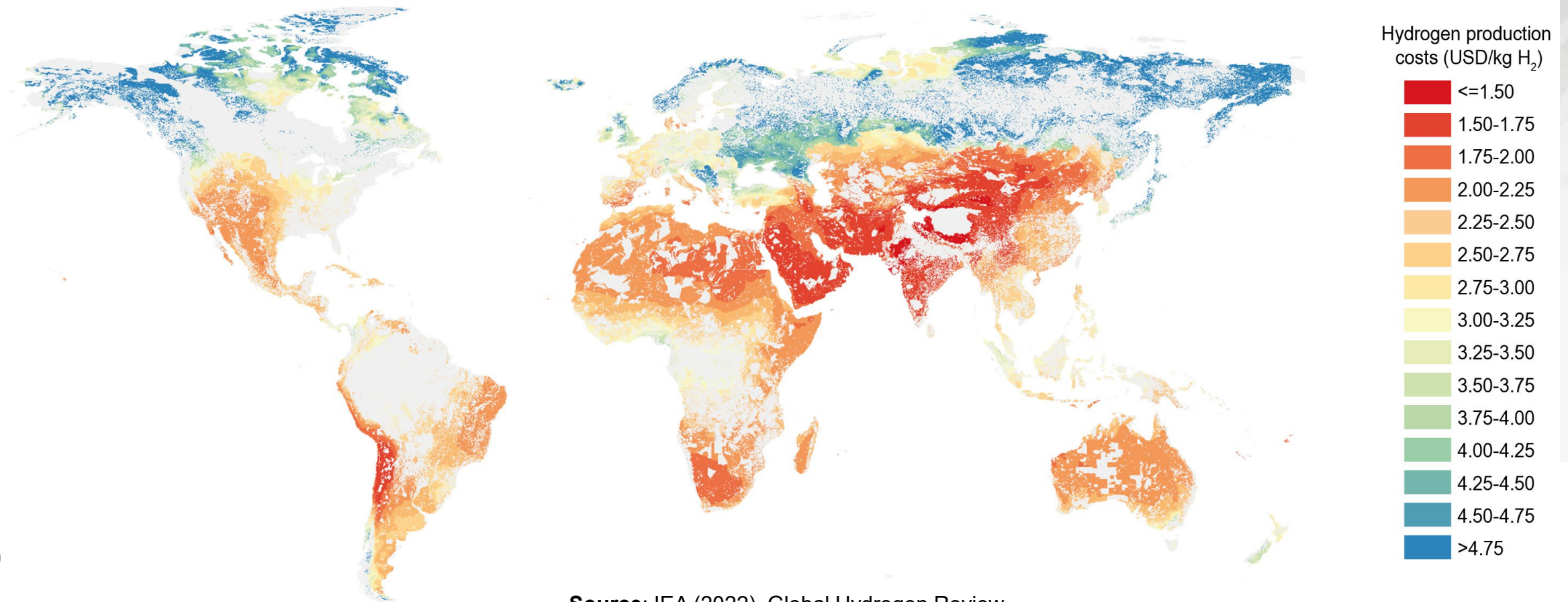
- Act 4.1: Allocation study: top-down sector coupling (led by Agora, performed by Fraunhofer)
  - Historically, emphasis on electrons, not molecules
- Act 4.2: Local demand
  - Focusing on maritime, logistics and mining
- Act 4.3: Business cases – cost of production on H<sub>2</sub> and PtX at/near 5 different ports
  - Saldanha Bay, Boegoebaai, Mossel Bay, Coega and Richards Bay
- Act 4.4: Safeguards – just energy transition; and safety codes and standards
  
- Act 5.1: Developing a concept for PtX application in a hard to abate sector: Shipping
  - Includes support to Dept. of Transport at decarbonization negotiations at IMO in London: LCA, measures.
- Act 5.2: Shipping training
  - Training of public sector officials in PtX in shipping
- Act 5.3: Study on infrastructure needed for a PtX economy
  - Primarily logistics study: rail, trucking, pipelines
- Act 5.4: Strengthen stakeholder dialogue process
- Act 5.5: *Scoping for* and Act 5.6: *Strategic cooperation with* coal-to-liquid and gas-to-liquid Fischer-Tropsch industry
  - Green FT fuels, like biofuels, are drop-in fuels that can be used in the *existing* fleet (alongside ammonia and methanol in the future fleet)
  - SA is home to 2 FT facilities: the 160 000 bbl/d Sasol (inland) and 45 000 bbl/d PetroSA (coastal)



# Drivers: Market opportunity

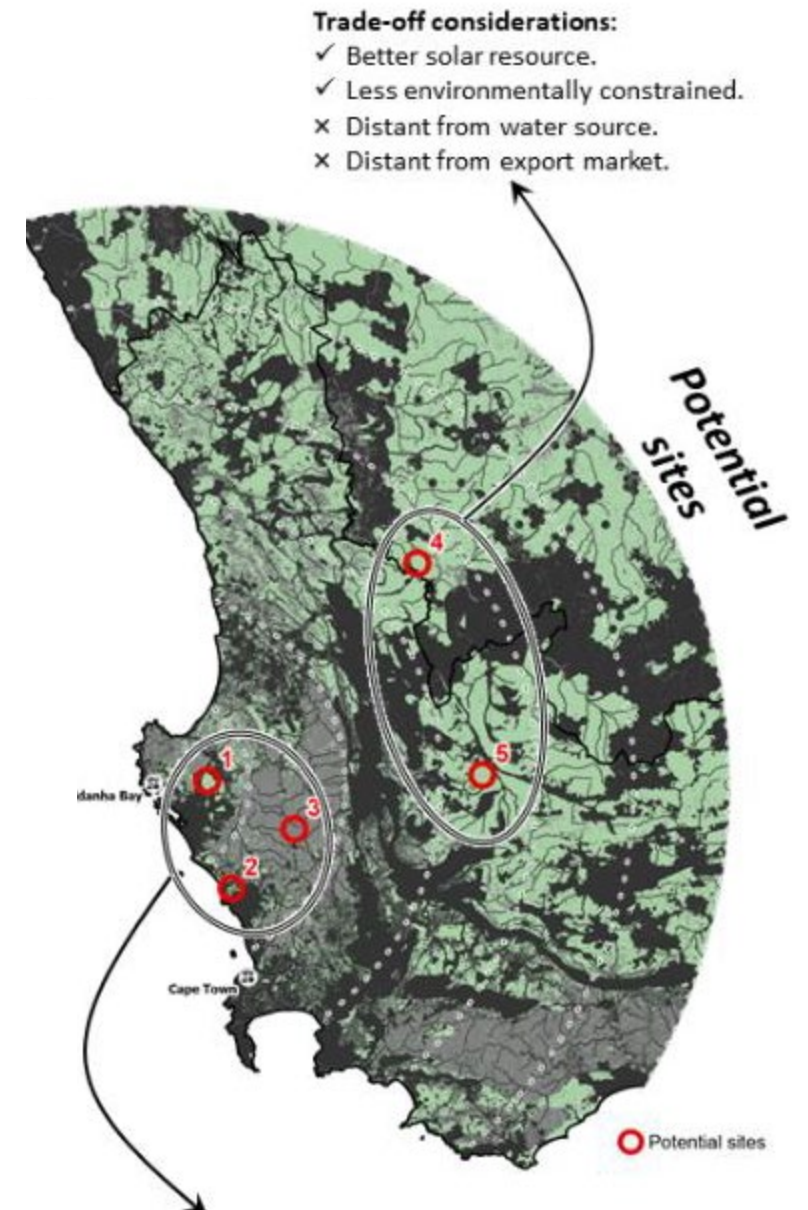
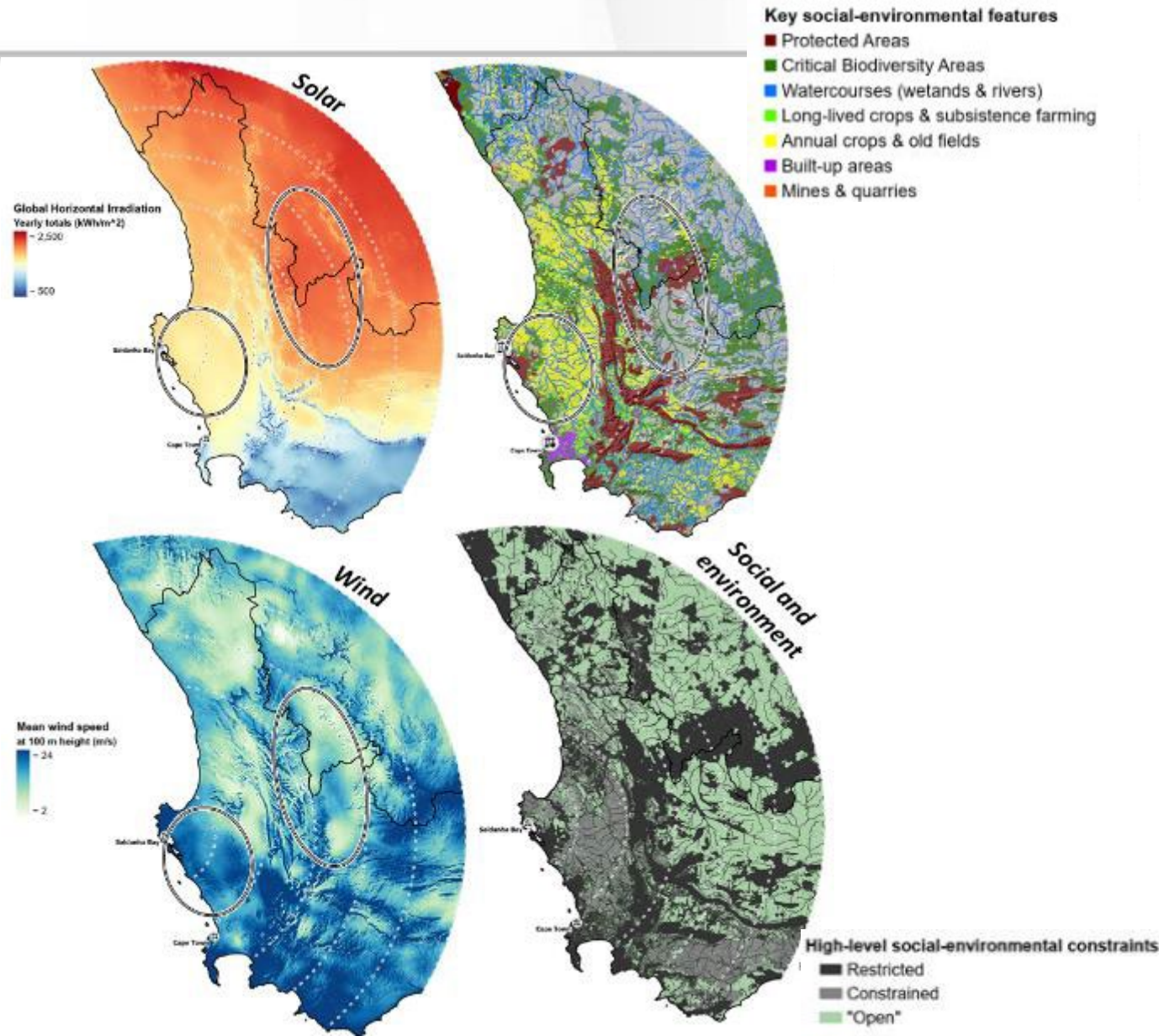
Excellent solar & wind resources in Southern Africa → bulk GH<sub>2</sub> costs competitive to other coastal countries

South Africa can export sunshine and wind

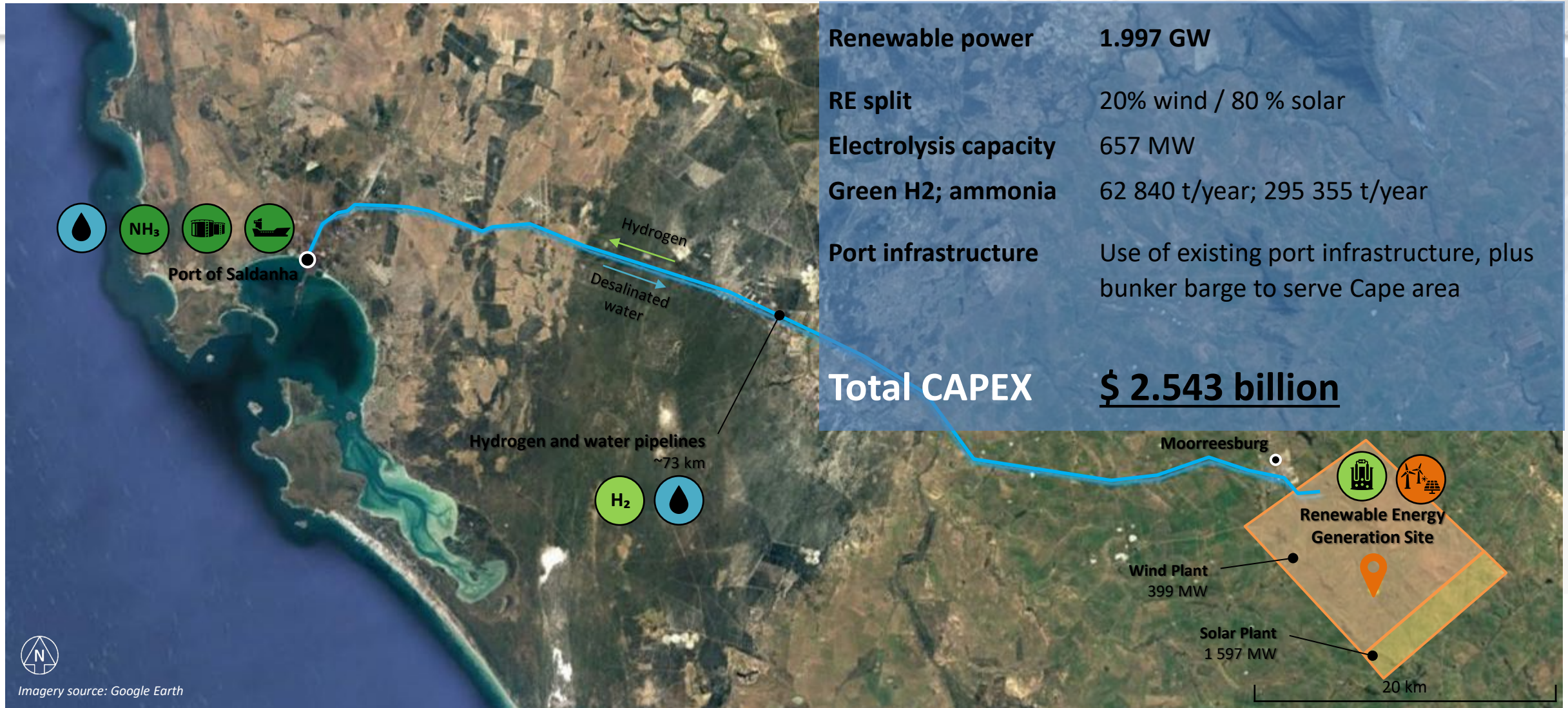


Source: IEA (2022), Global Hydrogen Review

# Environmental screening



# Example: World Bank-funded study for Saldanha Bay



Imagery source: Google Earth

The background is a dark blue gradient with a complex, abstract pattern of white and light blue lines and shapes. On the left side, there are several overlapping circles and squares, some of which are semi-transparent, creating a layered effect. The lines are thin and crisscross, forming a network-like structure. The overall aesthetic is modern and technical.

**Thank you**