South Africa's readiness for the Green Hydrogen Economy: regulations, codes and standards along the value chain

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Assessing South Africa's readiness for the Green Hydrogen Economy

The **RebelGroup** in Partnership with **LBST** undertook an assessment supported by GIZ and the Presidency

- Do we have the necessary technical regulations, codes and standards (RCS) for the Green Hydrogen Economy?
  - Value chain approach
  - Focus on Key use cases
- Can our Hydrogen be certified as "Green"?

The study executed as part of “Promoting the development of a hydrogen economy for South Africa”

The study consisted of four steps:

A Desktop Study

Reviewing the existing technical regulations, codes and standards (RCS) for production, transport, trade and application in the hydrogen and PtX industry on the international level and on the status quo in South Africa

Stakeholder Interviews

With a range of South African organisations

A Gap analysis

Development of final recommendations

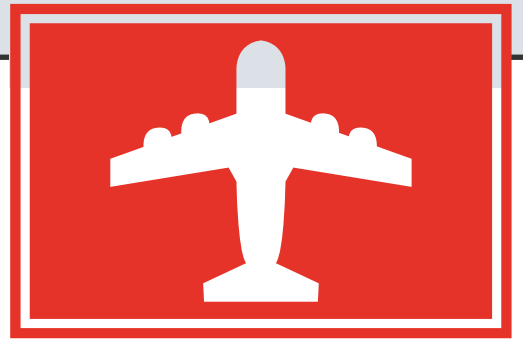
Value chain Approach to analysing RCS

	Production	Conditioning	Transport	End Use
Scope of analysis	Hydrogen production ▪ Electrolysis of water ▪ Steam methane reforming	Hydrogen conditioning ▪ Compression ▪ Liquefaction (LH_2) ▪ Hydrogenation (MeOH, LOHC, NH_3)	Hydrogen transport [road, rail, ship] ▪ Compressed gaseous hydrogen trailer ▪ Liquid hydrogen trailer ▪ Hydrogen gas pipeline ▪ Liquid H_2 derivatives transport	H_2 end use ▪ Road vehicles, trains, mining vehicles, etc. ▪ Maritime ships ▪ Aviation
Examples of relevant RCS	ISO 22734:2019 Hydrogen generators using water electrolysis	Machinery Directive 2006/42/EC and standard EN 1012-1	ADR for Europe or globally: UN Model Regulations (dangerous goods transport)	**Road:** UN GTR13 and UN ECE R134 (RSA is signatory to UN1958 & UN1998) **Maritime ship:** IMO **Aviation:** ICAO

To prioritise the recommendations, sample use cases were assessed in terms of RCS and Green certification

1

Sustainable Aviation Fuels (SAF) based on renewable hydrogen



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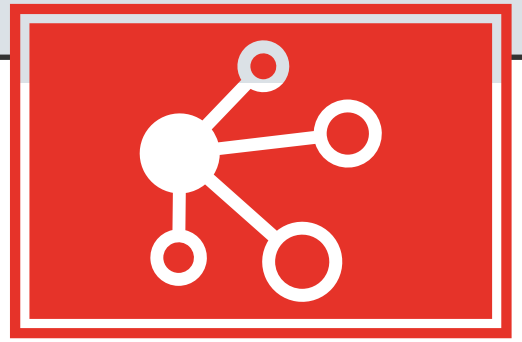
Export of renewable Hydrogen (and Ammonia)



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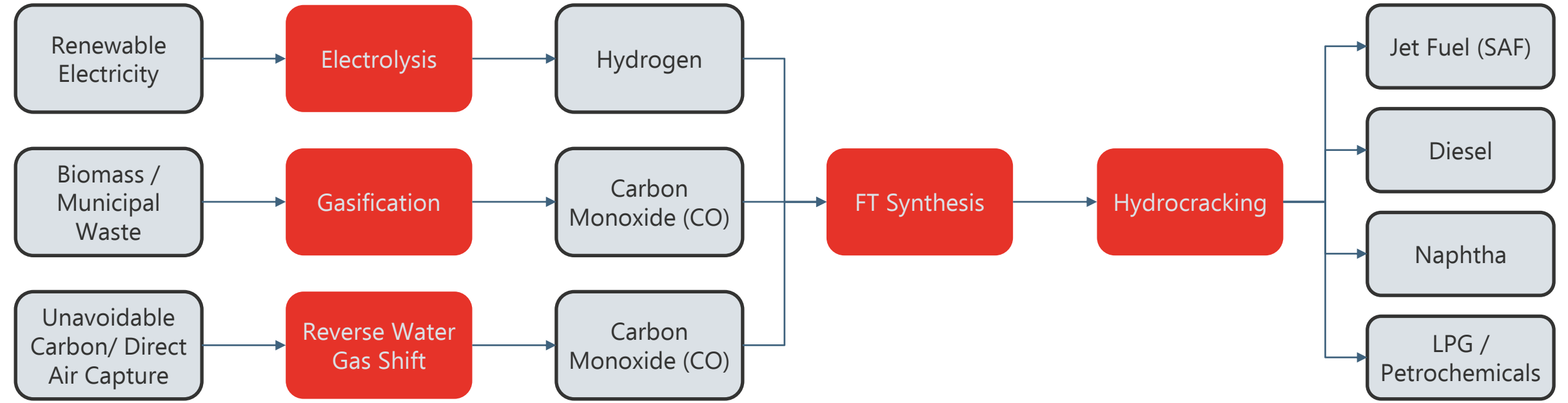
Road Transport

Case 1: SAF – The production of Sustainable Aviation Fuels

SAF is a "**drop-in" sustainable alternative** to fossil jet fuel, requiring no change to existing aircraft nor supporting infrastructure. South Africa has proprietary **Fischer-Tropsch (FT)** technology experience and knowledge for this process



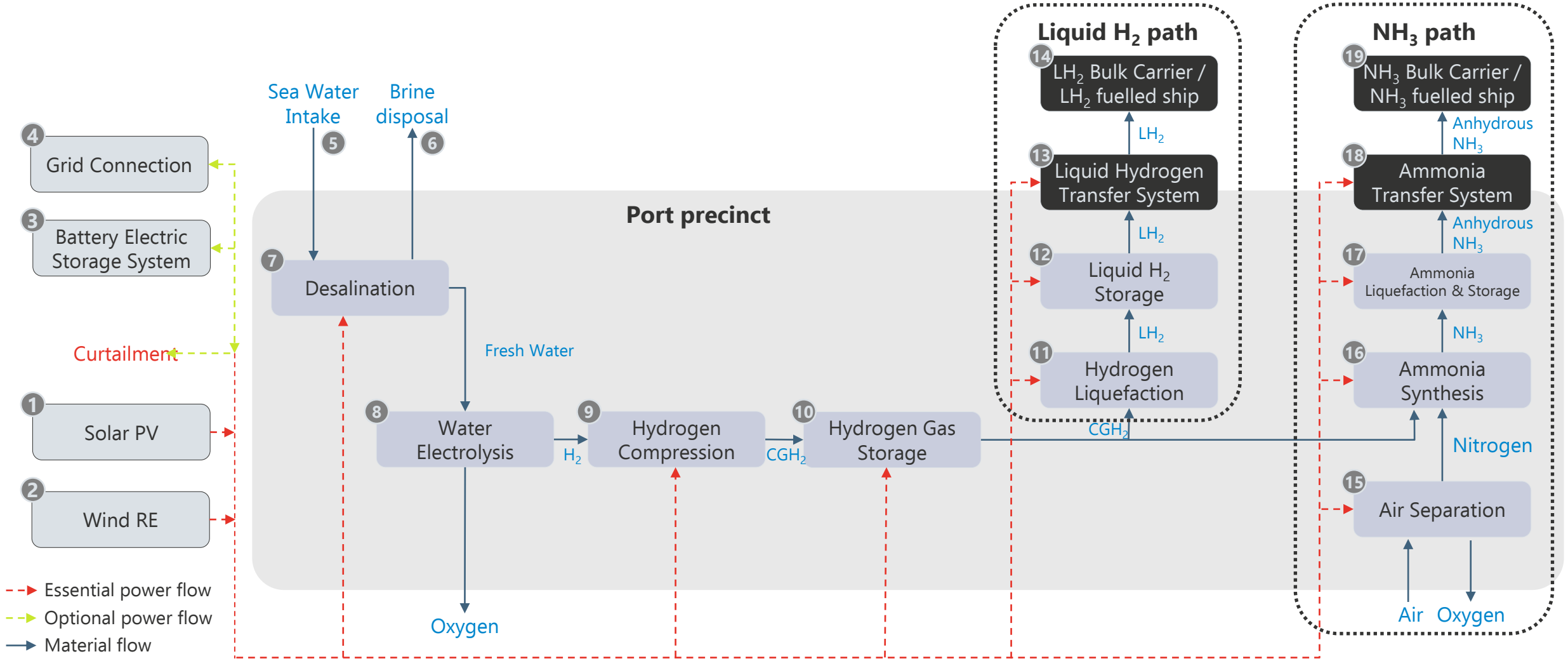
Determines eligibility for CORSIA: 10% reduction target
(needs to be from green sources)

Needs to comply with
ASTM D7566 (FT-SPK / FT-SPK/A))

Case 2: Green Hydrogen and Derivatives Export

- Like many other countries with high renewable energy potential, South Africa would like to export Green H_2
- The **closest major export market** for South Africa is **Europe**. The shipping route from Saldanha Bay to Rotterdam is 6102 nautical miles (11 300 km)
- H_2 can be shipped as: Compressed hydrogen gas (CGH_2), Liquid hydrogen (LH_2), Ammonia (NH_3), other synthetic fuels (e.g. methanol)
- Due to energy density considerations, CGH_2 is not viable at this distance. The limit for economically transporting CGH_2 is 4000 nm. LH_2 ships are not yet available commercially. Therefore, many H_2 stakeholders consider shipping NH_3 in the short-term
- Exporting green H_2, green NH_3 or other green synfuels requires:
  - **RCS** for the entire H_2, NH_3 or other fuel value chain
  - Implementation of a **Green certification** scheme acceptable in the client jurisdiction

Green liquid H_2/ NH_3 export and shipping fuel process



RCS for Green H_2/ NH_3/ MeOH export: status quo and gaps

Internationally

Standards: ISO, European and other

- H_2 electrolysis
- H_2 Compression
- H_2 (gaseous) storage
- H_2 Liquefaction
- H_2 (liquid) storage

Regulation

- Country specific permitting for all key processes
- IMO has adopted Resolution MSC.420(97) "Interim Recommendations for Carriage of Liquefied Hydrogen in Bulk".
- IMO IGF code has not yet implemented H_2 for use as propulsion fuel, but is in the process to achieve this.
- MSC 104/15/9: non-mandatory guidelines for safety of ships using ammonia as fuel

South Africa

Standards

- No SANS standards for any H_2 process

Regulation

- Various regulation form the OSH ACT No. 85 of 1993 are applicable including:
  - Hazardous Chemical Substances Regulations, 1995
  - Pressure Equipment Regulations, 2009
  - Construction Regulations, 2014
  - Explosives Regulations, 2003
  - Major Hazard Installation Regulations, 1993
- Gas Act and its regulations exclude H_2 as it is not a hydrocarbon

H_2 sustainability standards and certification schemes: International overview – national/ regulatory versus independent

EU: H_2 Guarantees of Origin

- Legal basis: RED II art. 19; 2018/21
- National H_2 GO systems under development in some Member States
- CertfiHy established EU-wide

EU: Voluntary Schemes

- Legal basis: RED II art. 25-30; 2018/21
- RFNBOs (H_2, derivatives); incl. imports
- Voluntary schemes (recognition by EC)
- CertifHy to become Voluntary Scheme

California: LCFS

- Established in 2011
- Hydrogen included since 2015
- Including imports

Japan: Guideline

- Published in May 2022
- Focus on blue H_2

UK: Low carbon H_2 standard

- Draft version of 2022

Australia: H_2 Guarantees of Origin

- Under development since 2020

China: H_2 standard

- Established in 2020
- First certification in 2022

Korea: H_2 standard

- Concept presented 2022
- Announced for 2023-25

TÜV SÜD: CMS70

- Established in 2011
- Renewable H_2

CertifHy

- Established in 2019
- Renewable & low carbon H_2

IPHE Working Paper

- Published 2021
- Renewable & low carbon H_2

TÜV Rheinland

- Published in May 2022
- Renewable & low carbon H_2

Bureau Veritas

- Published in May 2022
- Renewable & low carbon H_2

Green Hydrogen Standard

- Published in June 2022
- Renewable H_2

I-REC: H_2 code

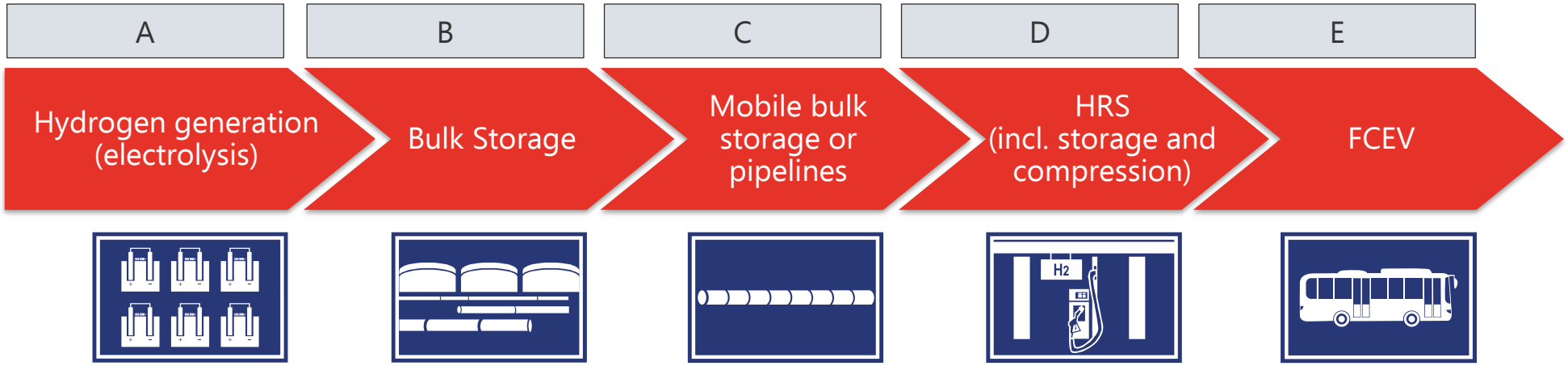
- Alpha version to be published

H_2 for Net Zero Initiative

- Announced for 2025

Case 3: Road transport - a critical H_2 application

- South Africa is at a nascent stage of developing a hydrogen economy
- As part of the *Hydrogen Society Roadmap* mobility by hydrogen has been identified as important component for a South African Hydrogen economy with potential to create value along the whole chain:



...but there are a number of key gaps in South Africa's RCS

Conclusions

International Green H_2 context

- **Various territories** with high renewable energy potential are proactively pursuing **H_2 strategies for own consumption and export,** (e.g. Australia, Chile, Egypt, Morocco, Namibia, Oman, Saudi Arabia, Tunisia, UAE, Ukraine, etc.)
- **South Africa** intends to develop the Green H_2 economy **for domestic use and export**

International progress on RCS across the H_2 value chain and Green H_2 certification, for example:

- Internationally, **many relevant standards exist for H_2**, e.g. ISO standards; however, standards work is **underway** in certain areas, e.g. heavy duty H_2 vehicle refuelling protocol to be completed and standardised by ISO 19885-3 end of 2023
- **Green H_2 certification options are available** & applicable to export markets as well as national markets (such as CertifHy™, GH_2, ...)

Status quo in South Africa

- Established RCS for H_2 value chain **inside battery limits**
- RCS **lacking for outside battery limits** and for new technologies or applications
- No Green H_2 Certification
- Hydrogen Society Roadmap highlights **criticality of RCS across the entire H_2 value chain**
- Industry **uptake of Green H_2** is starting

Implications

- A Green H_2 economy **requires a comprehensive approach to RCS** which includes a clear process understanding, and on-going effort to identify and close gaps
- Similarly, **Green H_2 certification** in RSA is **critical for exports of H_2** and downstream products to key markets. Most target markets define requirements ("certification follows the market"). For domestic consumption, international best practice should be followed
- Development of **RCS should be prioritised** based on the use cases; permitting procedures need to be complemented or developed, and step-by-step guidelines provided
- **International RCS and Green H_2 certification initiatives are a global public good** and **RSA should adopt, adapt and contribute** to these initiatives
- Given RSA's distance from international markets, RSA should also focus its attention to Green H_2 derivatives such as Green Steel, Green Cars, etc. Renewable-rich locations such as RSA have **potential for significant competitive advantages on global markets**
- The **required RCS spans multiple government departments' mandates**, buy-in of the departments needs to be enhanced to **take full responsibility** according to the H_2 roadmap. There needs to be **better alignment between the departments** and **strong leadership for coordination and target achievement**
- A **one-stop-shop approach for permitting** should be implemented (e.g. following the principles of "one environmental system" for the mining industry)

Our Recommendations

1. Codes and Standards	▪ SABS should drive a process specifically for hydrogen to address the gaps in the standards landscape
2. Regulations	▪ A **strong coordinator** needs to be appointed for better alignment between the departments & strong leadership for target achievement ▪ The relevant line **departments need to drive processes** to introduce new (or amend existing) regulations ▪ **Regulations shall refer to standards** to the extent possible and suitable in order to make maximum use of expertise in standards ▪ Permitting procedures must be complemented/ developed, **step-by-step guidelines** provided, a **one-stop-shop** approach established
3. Green H_2 certification	▪ Establish understanding of certification requirements in target markets, **select international scheme(s)** satisfying these requirements ▪ Develop **national certification scheme** using internationally recognized methodologies (notably for carbon footprint), or adopt an international scheme as national scheme for H_2 consumed in RSA; define issuing body (South African authority) within national scheme
Recommended overall approach for an agile process for developing the requisite RCS:	▪ RSA to develop **4-6 clusters** where the nascent H_2 ecosystem is nurtured. **International standards** would be applied and where necessary **exemptions** would be granted timeously ▪ After 2-5 years, once RSA has gained the learnings of what worked, and where there are gaps, RSA to **review the international standards for RSA conditions** (while keeping these to a minimum)

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