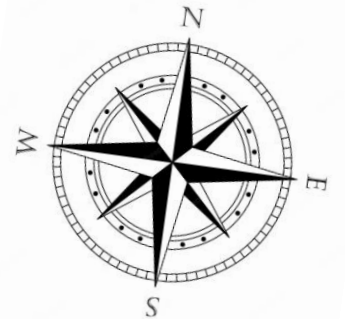


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# Hydrogen RCSS Environment in South Africa

**Dr Brian North**

**Formerly HySA Infrastructure/CSIR**



# Outline of presentation

Background to Hydrogen South Africa (HySA)

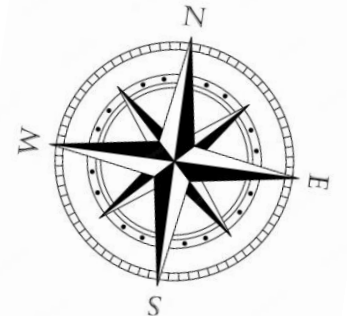
Existing Hydrogen RCS' in South Africa

H2FCT installations in South Africa

Hydrogen awareness in South Africa – International assistance

Important resources

Conclusions and Acknowledgement



# Origins of Hydrogen South Africa (HySA)

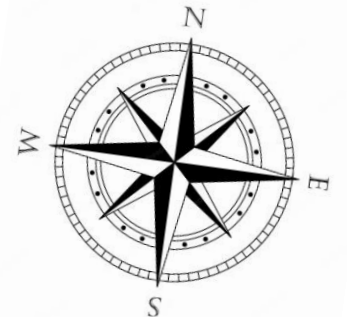
Q: What would a “Hydrogen Economy” mean to South Africa?

A: PGMs (in particular, Pt)

South Africa possesses some 75% of the world’s reserves.

Catalytic Converters → Fuel Cell Catalysts ?

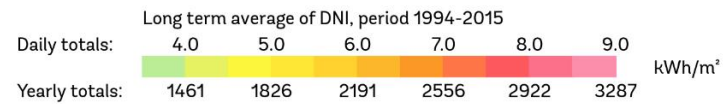
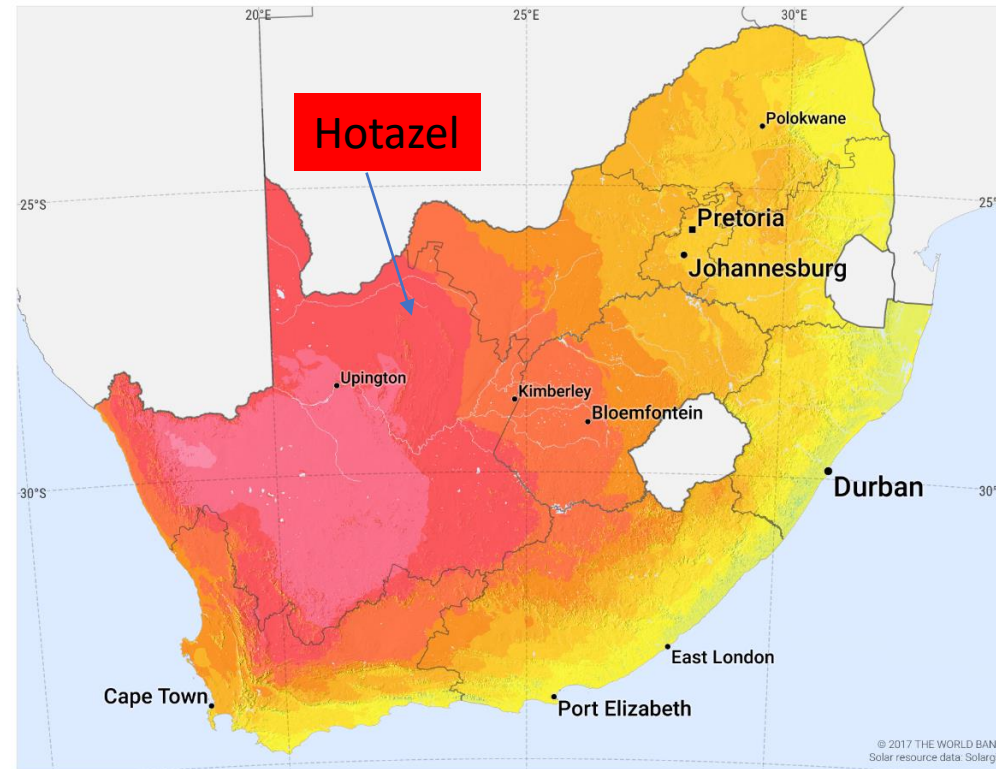
Additionally, South Africa has amongst the highest solar insolation in the world



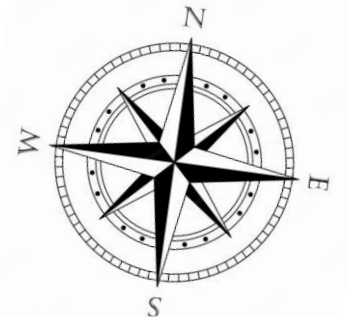
# SA has high insolation

SOLAR RESOURCE MAP

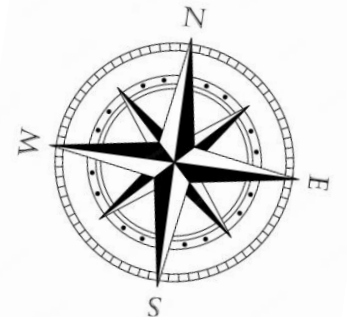
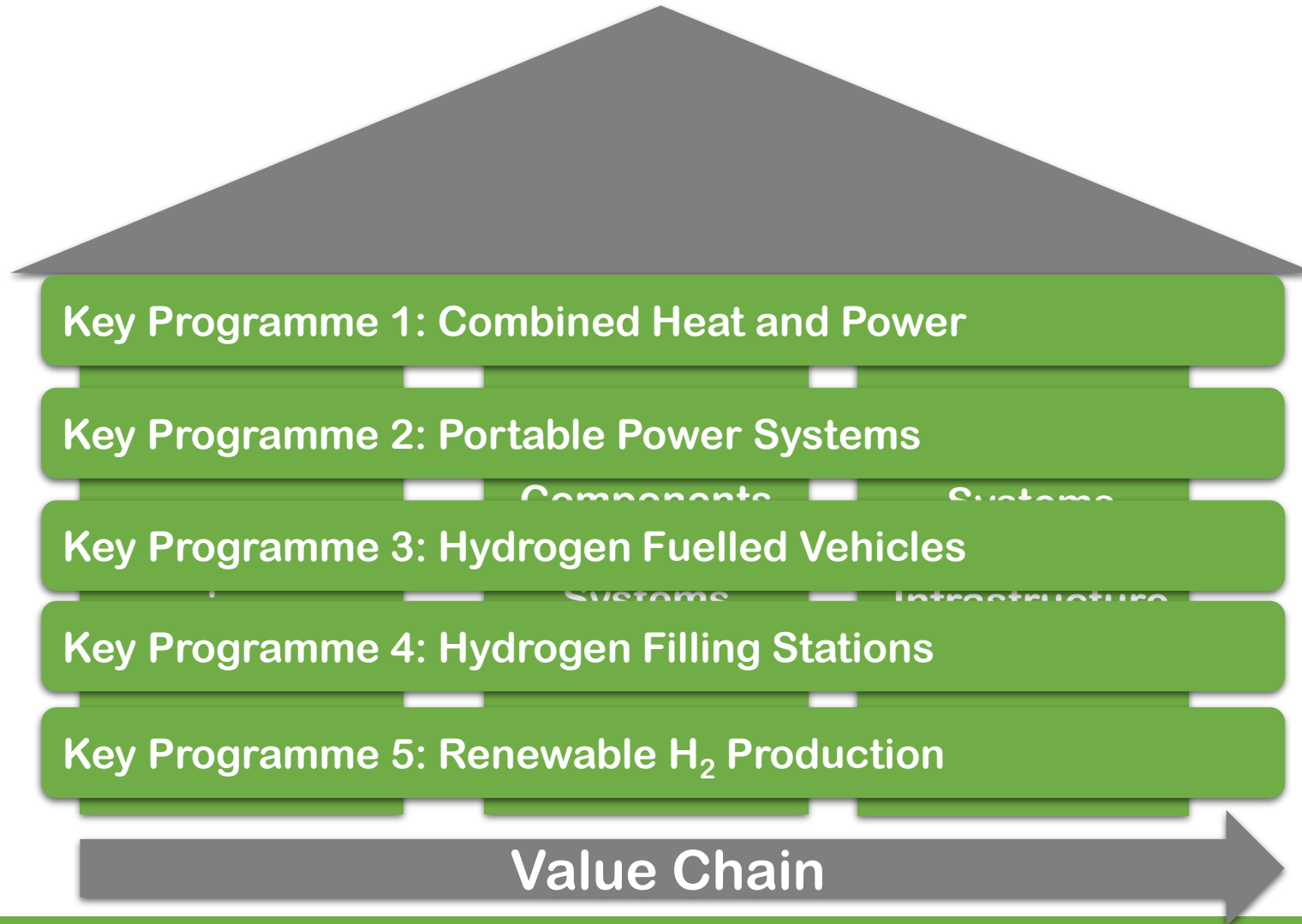
## DIRECT NORMAL IRRADIATION SOUTH AFRICA



This map is published by the World Bank Group, funded by ESMAP, and prepared by Solargis. For more information and terms of use, please visit: <http://globalsolaratlas.info>.



# HySA Initial Programmes



# South African hydrogen awareness

South Africa is still a relative newcomer on the hydrogen scene

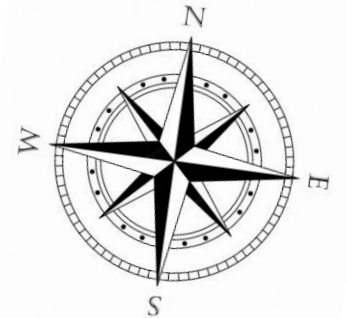
Public awareness of the energy carrier is low

Awareness at official level “dappled”

Some standards have been adopted, mostly through IEC mirror committee TC 105

SABS TC 22 SC 09 (Alternate fuelled vehicles) considering H<sub>2</sub> (and CNG/LNG) Standards

SABS initiating TC 197 mirror committee

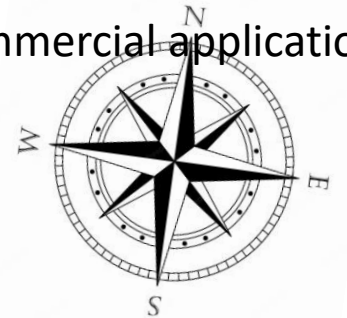


# Example: International Organisation for Standardisation (ISO)

## Technical Committee 197 on hydrogen technologies

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- **ISO 13984:1999** Liquid hydrogen — Land vehicle fuelling system interface
- **ISO 13985:2006** Liquid hydrogen — Land vehicle fuel tanks
- **ISO 14687-1:1999** Hydrogen fuel — Product specification — Part 1: All applications except PEM)fuel cell for road vehicles
- **ISO/TS 14687-2:2008** Hydrogen fuel — Product specification — Part 2: PEM fuel cell applications for road vehicles
- **ISO/PAS 15594:2004** Airport hydrogen fuelling facility operations
- **ISO/TS 15869:2009** Gaseous hydrogen and hydrogen blends — Land vehicle fuel tanks
- **ISO/TR 15916:2004** Basic considerations for the safety of hydrogen systems
- **ISO 16110-1:2007** Hydrogen generators using fuel processing technologies — Part 1: Safety
- **ISO 16110-2:2010** Hydrogen generators using fuel processing technologies — Part 2: Test methods for performance
- **ISO 16111:2008** Transportable gas storage devices — Hydrogen absorbed in reversible metal hydride
- **ISO 17268:2006** Compressed hydrogen surface vehicle refuelling connection devices
- **ISO/TS 20100:2008** Gaseous hydrogen — Fuelling stations
- **ISO 22734-1:2008** Hydrogen generators using water electrolysis process — Part 1: Industrial and commercial applications
- **ISO 26142:2010** Hydrogen detection apparatus — Stationary applications



# South African Fuel Cell and Hydrogen RCS'

**South African Bureau of Standards (SABS) develops voluntary standards**

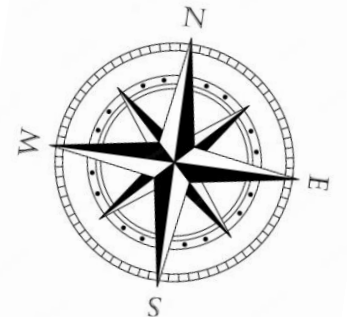
**These Standards can be used by regulators such as the National Regulator for Compulsory Standards (NRCS) to regulate industry**

**Technical Committees and Working Groups are created to facilitate the adaptation and/or adoption of standards (such as ISO)**

**Selection of which standards to adopt is largely needs based  
Other criteria such as impact on social and economic development also considered**

**H2FCT has lagged, largely due to an historic lack of need**

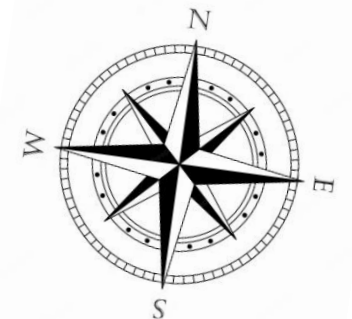
**Adoption of FC standards accelerated (through formation of International Electrotechnical Commission (IEC) mirror committee) TC105: Fuel Cell Technologies**





# Current SA Hydrogen Safety Codes and Standards

- **SANS 62282-1:** Fuel cell technologies Part 1: Terminology
- **SANS 62282-2:** Fuel cell technologies Part 2: Fuel cell modules
- **SANS 62281-3-100:** Fuel cell technologies Part 3-100: **Stationary** fuel cell power systems – Safety
- **SANS 62282-4-101:** Fuel cell technologies - Part 4-101: Fuel cell power systems for propulsion other than road vehicles and auxiliary power units (APU) - Safety of electrically powered industrial trucks
- **SANS 62282-3-200:** Fuel cell technologies Part 3-200: **Stationary** fuel cell power systems - Performance test methods
- **SANS 62282-3-201:** Fuel cell technologies Part 3-201: **Stationary** fuel cell power systems - Performance test methods for small fuel cell power systems
- **SANS 62282-3-300:** Fuel cell technologies - Part 3-300: **Stationary** fuel cell power systems - Installation
- **SANS 62282-5-1:** Fuel cell technologies Part 5-1: **Portable** fuel cell power systems – Safety
- **SANS 62282-6-100:** Fuel cell technologies Part 6-100: **Micro** fuel cell power systems - Safety



# South African Fuel Cell and Hydrogen RCS'

Additional South African National Standards cover aspects such as

- Hydrogen embrittlement
- Hydrogen detectors

SABS TC22 SC09 deals with Alternative Fuelled Vehicles

- FC Vehicles (measurement of speed and energy consumption)
- FC Vehicles (safety and protection against hydrogen hazards)

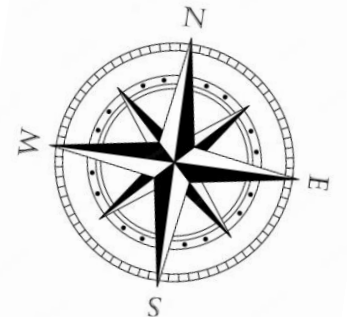
**SANS 10260-2:** Industrial gas pipelines: Distribution of hydrogen at consumer sites

- Limits hydrogen pressure to 16 bar
- Review being conducted by SABS TC 1019. Max pressure to be (has been?) raised to 50 bar

Area classification covered by SANS 60079-10-1-1:2010 & 10108:2005

Pressure vessel and explosive atmosphere standards also exist.

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# South African Commercial H2FCT installations

Project Description	Fuel Cell type and size	Project Partners
Fuel Cell mini grid providing primary power to 34 homes	3X5kW PEM FCs	Anglo Platinum and Ballard Power systems, plus other local companies
Back-up power to ICT equipment in three rural schools	3X5kW PEM FCs	DST, Anglo Platinum, Clean Energy, Air Products
Back-up power to vaccine fridges in a Johannesburg clinic	5kW PEM FC	DST, Anglo Platinum, Clean Energy, Powertech System Integrators, Air Products, Gridline Construction, City of Johannesburg
Base-load power to Chamber of Mines building in Johannesburg	100kW PAFC powered by natural gas	Department of Trade and Industry (dti), Chamber of Mines, Egoli Gas, Mitochondria Energy, Powertech System Integrators
Provision of power to UWC's Nature Reserve building	2.5kW PEM FC	DST, HySA systems, Hot Platinum
Telecomm back-up power	300 X 5kW PEMFCs (Methanol on-site reforming)	Idatech, Inala Technology, Ballard
Telecomm back-up power	133 X 5kW PEMFCs	Powertech System Integrators
Primary power to rural school (Poelano High School)	2.5kW PEMFC, 48000NL H2 stored at 14 bar.	HySA Infrastructure, Systems and Catalysis (under the SA Department of Science and Technology)
FCs at 1-Military hospital	7 MeOH and H2FCs	DSI, DPWI, DoD, HyPlat, Bambili Energy ++



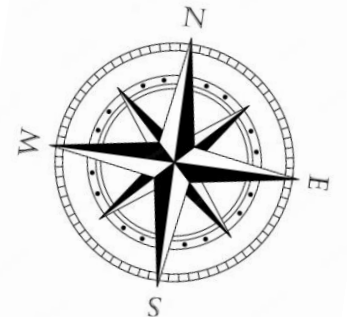
# Attempting to increase H<sub>2</sub> awareness

Concerns about lack of awareness were raised at ICHS 2015

An idea emerged, that took about a year to come to fruition:

Enlist the help of established international experts to run workshops to relay current H<sub>2</sub>FCT safety practices to SA audiences. The initial focus was on officials, such as Fire Departments and BCOs, but expanded to TEIs, Industry, Tech/Artisans etc.

- First workshop held in Pretoria in October 2016
- Second workshop held in Cape Town in May 2018
- Third conference/webinar held in March 2022



# Organised Workshops on HSCS

Pretoria (October 2016)

50-60 people

Approximately half were from Tshwane (Pretoria) Fire Department

Local companies, CSIR SHEQ and HySA Infrastructure staff

Cape Town (May 2018)

42 People

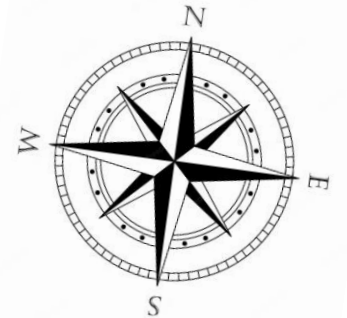
Approximately 1/3 were from Cape Town Fire Department

Local companies, HySA Infrastructure, Catalysis and Systems, Universities

Virtual Webinar, 2-3 March 2022

70 people, diverse audience

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# Important resources

## H<sub>2</sub>tools hosts information related to;

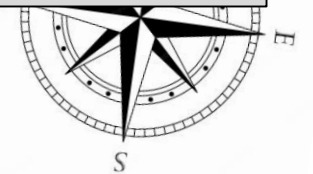
- Best H<sub>2</sub> safety practices.
- Compatibility of materials
- Lessons learnt from H<sub>2</sub> incidences – compendium.
- Safety trainings.
- Compendium of codes and standards and H<sub>2</sub> safety panels.

[www.H<sub>2</sub>tools.org](http://www.H2tools.org)

## Centre for H<sub>2</sub> Safety hosts information related to;

- Host conference on H<sub>2</sub> safety.
- Best practice on H<sub>2</sub> safety.
- Incidence coordination.
- Thought leadership
- Technical bulletins and Working groups on safety.

[www.aiche.org/chs](http://www.aiche.org/chs)



# Important resources (among others) Contd

## HySafe hosts information related to;

- Host international conference on H<sub>2</sub> safety.
- Generates report on state-of-the art with regards to H<sub>2</sub> safety.
- Promote cost-effective coordinated research on H<sub>2</sub> safety.
- Create and maintain a forum for communication between stakeholders.

[www.hysafe.org](http://www.hysafe.org)

## H<sub>2</sub>EDGE hosts information related to;

- Develop training and education materials and offer professional training courses.
- Coordinate development of certifications, credentials and standards for H<sub>2</sub> training needs.

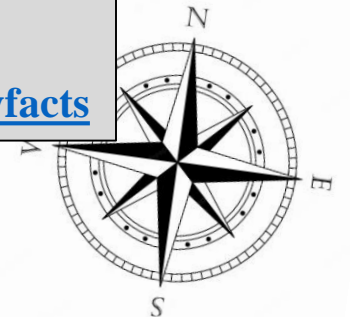
[www.grided.epri.com](http://www.grided.epri.com)

## HyFACTs hosts information related to;

- Develop and initiate dissemination of training materials for regulators and public safety officials
- Coordinate development of certifications, credentials and standards for H<sub>2</sub> training needs.

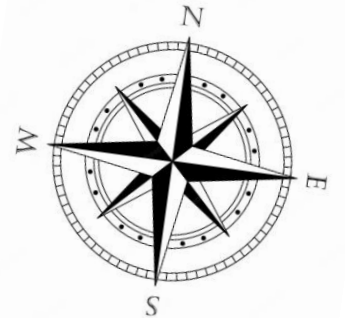
[www.h2euro.org/hyfacts](http://www.h2euro.org/hyfacts)

- Among many others.....



# Specific reference resources (a few..)

- SANS 10260-2 (Distribution of Hydrogen)
- ISO/TR 15916:2015 – Basic considerations for the safety of hydrogen systems
- Fundamentals of Hydrogen Safety (Molkov, HySafer, Uni of Ulster) (Bookboon)
- H2Tools, incl HyRAM and JRC (Europa)
- US NFPA
- H2 Incidents and Accidents Databases (“Euro”: JRC; “US”: H2Tools)
- Compendium of H2 RCS’ [IPHE RCSSWG Regulatory Areas for Action Compendium A4FINAL \(usrfiles.com\)](#)
- HySA: CSIR, NWU and UWC
- WIP: Gap analyses - Maritime TF (CSIR) and Bulk storage TF (SANDIA (Ehrhart))
- Watch this space – CSIR H2 RCS booklet



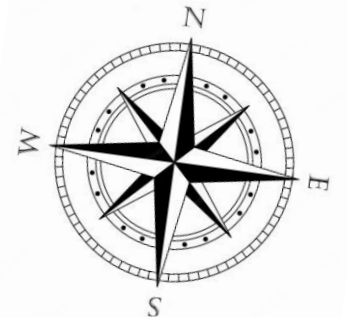


# Examples of H<sub>2</sub> safety incidents and lessons learnt

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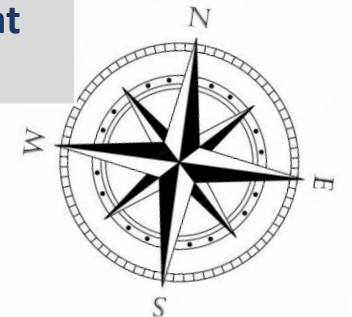
1. Hydrogen fuelling dispenser nozzle
2. Hydrogen leak caused by truck caught on an improperly stored hydrogen filling line
3. Fire causing cascading events at hydrogen fuelling station
4. A hydrogen explosion at a coal-fired power plant
5. Fatality and injuries caused by a hydrogen explosion
6. Inadequate maintenance causes hydrogen explosion

More information: [https://h2tools.org/lessons?search\\_api\\_fulltext=](https://h2tools.org/lessons?search_api_fulltext=)



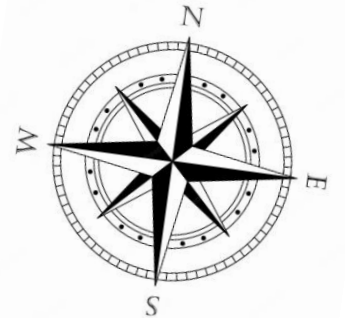
# Classification of Contributing Factors to H<sub>2</sub> safety incidences

Skills	Operations
Training deficits and issues	Human errors and fatigue
Design flaws	Change in procedures and incorrect SOP
Software errors	Equipment /Materials failure & Incompatibilities
Safety	Awareness
Situational awareness	Inadequate inspections
Poor decision making	Management and planning deficiencies
Inadequate oversights - failure to follow procedures	Lack of hydrogen detection/sensing equipment



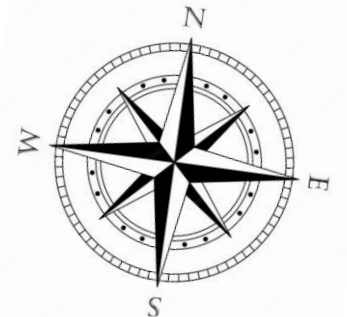
# Conclusions

- South Africa has a dedicated Hydrogen programme, HySA
- Codes and Standards are required to ensure:
  - We operate safely
  - We do not encounter barriers to trade of products
- SABS are initiating ISO 197 Mirror Committee
- South Africa is in an energy crisis - can hydrogen be used for short and long term energy storage?
- Can South Africa benefit from the global demand for H<sub>2</sub>? (Certification and Maritime RCS)
- “We are not alone” - The international RCSS community are keen to collaborate and share learning



# Aknowledgement

I would like to thank the South African Department of Science and Innovation for their funding of, and support and guidance for, the HySA programme



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# Hydrogen RCSS Environment in South Africa

**Thank You**

**Dr Brian North**  
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