

# CAREER OPPORTUNITIES IN HYDROGEN AND FUEL CELL TECHNOLOGIES



South Africa, in line with the global trend, sees the hydrogen economy as the way forward. This is mainly due to the diminishing stocks of the world's fossil fuels, such as oil, and the impact of their combustion on climate change.

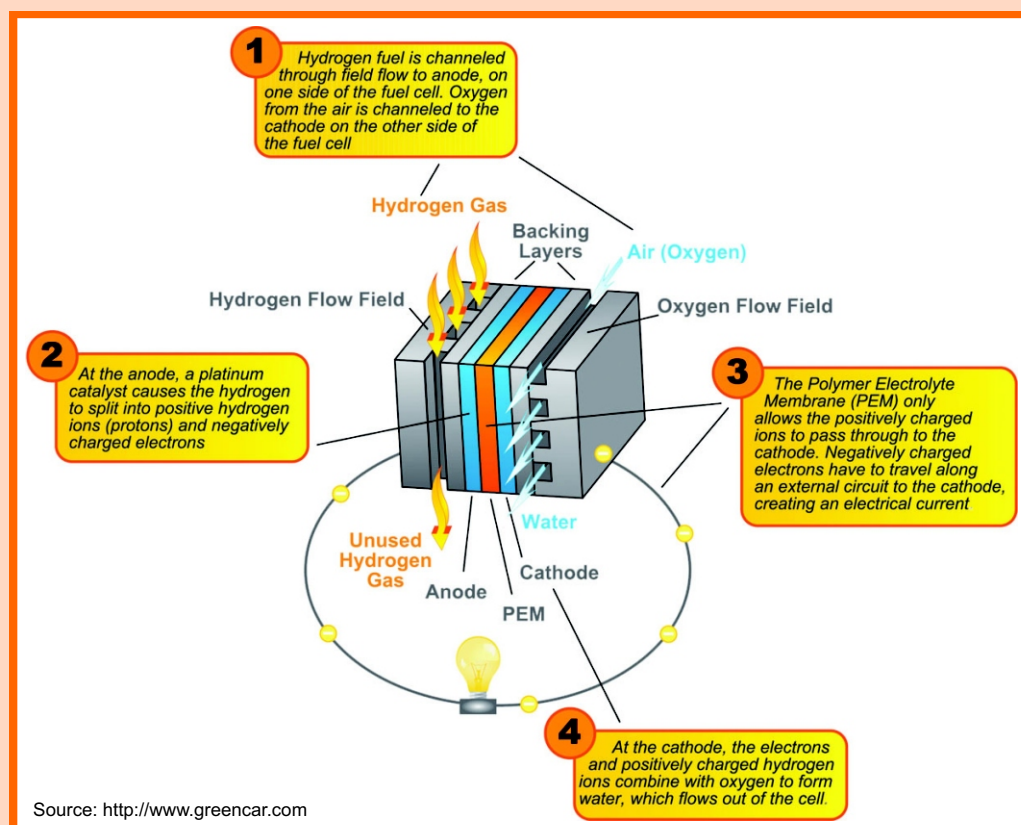
With over 75% of the world's platinum reserves (the key catalytic component of Polymer Electrolyte Membrane (PEM) fuel cells), South Africa is ideally positioned with both the raw materials and the scientific expertise to drive a developing hydrogen economy. The hydrogen and fuel cell industry in South Africa is growing and a number of opportunities for scientists and engineers are being created.

## WHAT IS HYDROGEN & FUEL CELL TECHNOLOGY (HFCT)?

Hydrogen and fuel cell technology is a technology which uses both hydrogen and fuel cells to generate electricity. Hydrogen is the simplest element and the most plentiful gas in the universe. It is used as an energy carrier that stores and delivers energy in a usable form. Using hydrogen as an energy carrier will reduce the country's dependence on importation of oil and also reduce greenhouse gas emissions that cause global warming, if the hydrogen is produced from clean sources of energy. Fuel cells directly convert the chemical energy in hydrogen to electricity, with water and heat being the by-products. A fuel cell operates like a battery but, unlike a battery, it does not run down or require recharging.

## HOW FUEL CELLS WORK

A fuel cell consists of an electrolyte and two catalyst-coated electrodes. Oxygen passes over one electrode (the cathode) and hydrogen over the other (the anode), resulting in the generation of electricity, water and heat. When the hydrogen gas is passed over the "anode" of the fuel cell, with the help of a platinum catalyst, the hydrogen atom splits into a proton and an electron, which take different paths to the cathode. The proton passes through the electrolyte. The electrons create an electrical current that can be utilised before they return to the cathode, where they react with the oxygen and the hydrogen protons, forming a water molecule.



## WHAT IS THE FUTURE OF HYDROGEN AND FUEL CELL RESEARCH?

For some time now there has been significant funding provided by the South African government through the Department of Science & Technology (DST) and other institutions, and backed up by the private sector, to fast-track hydrogen & fuel cell technology research and innovation and also to encourage learners at high schools to study maths and science subjects to enable them to enter this field.

South Africa has great potential to manufacture various components in the hydrogen and fuel cell technology value chain. This is partly because of the country's rich platinum-group metals reserves. Hence, the manufacturing of Membrane Electrode Assemblies (MEAs) and PEM fuel cells in South Africa has the potential to create jobs and add significant value to this huge mineral resource. In order to achieve this, there is also a pressing need to attract top level postgraduates to become part of the growing research programmes of Hydrogen South Africa (HySA) at universities and other institutions.

It must be stressed however that very high standards are set to gain entry to some of the faculties such as Engineering or Science. Because this research field requires such a broad spectrum of disciplines, one could choose any of the Science degrees or diplomas, including Physics and Chemistry, Applied Science or Material Science, Chemical or Mechanical Engineering, Electrical Engineering, Thermodynamics, Electronics or Metallurgy. These subjects could be useful for research in hydrogen and fuel cell technologies. A four-year BSc Engineering degree or BSc Honours degree opens doors for postgraduate studies at various universities and other tertiary institutions in this research field. Excellent academic results are rewarded by attractive bursary support at many of the universities and other scientific institutions around the country. The criteria for these bursaries differ from institution to institution, however most require postgraduate academic records with an average of 75% and above.



Student evaluating metal hydrides using test bench



Student characterising fuel cell MEAs using automated test bench



Student characterising fuel cell MEAs



For more information visit [www.hydrogen.org.za](http://www.hydrogen.org.za) or  
contact SAASTA on 012 392 9300

The Department of Science and Technology's Hydrogen South Africa  
(HySA) Public Awareness Platform is hosted by the South African  
Agency for Science and Technology Advancement (SAASTA).

Sources: [www.hydrogen.org.za](http://www.hydrogen.org.za) | [www.fuelcells.org](http://www.fuelcells.org) | [www.fuelcelltoday.com](http://www.fuelcelltoday.com)

## UNIVERSITIES WHICH OFFER POSTGRADUATE RESEARCH PROGRAMMES IN HYDROGEN AND FUEL CELL TECHNOLOGIES

Several of South Africa's universities and science councils are already engaged in research on fuel cell technologies. Three Hydrogen Centres of Competence have been established at the following institutions:

The University of the Western Cape hosts HySA Systems Competence Centre. The main objective of this centre is to perform technology validation and system integration in three key areas relevant to HFCT: (i) Combined heat and power (ii) Portable power, and (iii) Fuel cell vehicles. The group has been involved in fuel cell and hydrogen research and development since the mid-1990's and holds several local and international patents relating to these investigations. The focus of the centre is on high temperature PEMFCs, solid state hydrogen storage systems and lithium-ion batteries.

The HySA Catalysis Competence Centre, co-hosted by the University of Cape Town and the South Africa's Mineral Research Technology Organization (MINTEK) is involved in research and development (R&D) on fuel-processor catalysts, principally for hydrogen purification. Its facilities include modern laboratories for preparation, characterization and testing of catalysts. Cross-cutting R&D activities that may be relevant to the emerging fuel cell industry technologies are nanoparticulate catalysts of active materials and chemical catalysis.

The main R&D focus of the HySA Infrastructure Competence Centre, co-hosted by North West University and the Council for Scientific and Industrial Research (CSIR), is to develop technologies for hydrogen production, storage and distribution.

These institutions have collaborative agreements with several universities in South Africa involved in R&D programmes that advance knowledge generation in HFCT. These Universities include: University of Witwatersrand, University of Johannesburg, University of Limpopo, Tshwane University of Technology, Nelson Mandela Metropolitan University and Stellenbosch University. Details can be obtained from the individual institutions.



A hydrogen fuel cell bus developed in Germany



Student working on hydrogen purification test bench



'A Hi Fambeni' hydrogen fuel cell powered tricycle locally developed by HySA

**HySA** Public Awareness  
Hydrogen South Africa

