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Review

Hydrogen South Africa (HySA) Systems Competence Centre: Mission, objectives, technological achievements and breakthroughs☆

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ABSTRACT

A long-term (15-year) Hydrogen and Fuel Cell Technologies (HFCT) Research, Development, and Innovation (RDI) strategy was officially launched in September 2008 by the Department of Science and Technology (DST) in South Africa. The Hydrogen South Africa (HySA) programme is based upon the beneficiation of the country's large Platinum Group Metal (PGM) resources. HySA comprises of three Centres of Competence: HySA Catalysis, HySA Infrastructure and HySA Systems. HySA Systems, a Systems Integration and Technology Validation Competence Centre on HFCT was established in 2007 at the South African Institute for Advanced Materials Chemistry (SAIAMC) at the University of the Western Cape (UWC). The main objective with HySA Systems is to (i) develop Hydrogen and Fuel Cell systems, demonstrators, prototypes and products, (ii) perform technology validation and system integration and (iii) focus on system oriented material R&D in two key HySA-programmes: (1) Combined Heat and Power (CHP) and (2) Hydrogen Fuelled Vehicles (HFV). HySA Systems is also responsible for the development, prototyping, testing and commissioning of the following key technologies: High Temperature (HT) Membrane Electrode Assemblies (MEAs), HT-Proton Exchange Membrane (PEM) fuel cells, metal hydrides for hydrogen storage and compression systems, hydrogen fuel cell/battery power modules, palladium membranes, and lithium-ion batteries. HySA Systems has successfully: a) implemented some pilot plant manufacturing facilities/capabilities for HFC components and systems in South Africa, b) been partnering with key international HFC and local industries, c) established a local Supply Chain of SMMEs, d) set up industrial/commercial agreements with national/international HFC players, e) been disseminating their findings/work in High Impact Factor

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Journals and National/International Conferences, and f) innovated and thus generated Intellectual Property in key HFC technologies.

1. Introduction

HySA Systems is one of three National Competence Centres which makes up HySA (Hydrogen South Africa). Initiated by the Department of Science and Technology (DST) and approved by the Cabinet in May 2007, HySA is a long-term (15-year) programme within their Research, Development, and Innovation (RDI) strategy, officially launched in September 2008. This National Flagship Programme is aimed at developing South African intellectual property, knowledge, human resources, products, components and processes to support the South African participation in the nascent, but rapidly developing international platforms in Hydrogen and Fuel Cell Technologies. The programme strives towards a *knowledge-driven* economy meaning that innovation will form the basis of South Africa's economy; this includes an aggressive *capacity-development* programme's approach. HySA also focusses on (i) the "Use and Displacement of Strategic Minerals", (ii) ways of harnessing South Africa's mineral endowments to promote both the hydrogen economy and renewable energy use, and (iii) seeking the most cost-effective and sustainable ways of incorporating PGM-based components in hydrogen fuel cell and other technologies, in turns resulting in commercialisation ventures and a viable industry around mineral beneficiation (see speech from Derek Andre Hanekom – the South African Minister of Science and Technology http://www.info.gov.za/speech/DynamicAction?pageid=461&sid=39338&tid=119629).

Indeed, HySA has been implemented in the context of the DST's various innovation strategies, the Department of Mineral Resources' (DMR) minerals beneficiation strategy, the Department of Energy's (DoE) Integrated Resource Plan and the Department of Trade and Industry's (DTI) industrial development strategies. The principal strategy of HySA is to execute research and development work, with the main aim of achieving an ambitious 25% share of the global Hydrogen and Fuel Cell market using novel Platinum Group Metal (PGM) catalysts, components and systems since South Africa has more than 75% of the world's known PGM reserves. In order to achieve this, the structure is aimed at the parallel development of knowledge and technology across all areas of the Hydrogen and Fuel Cell value chain, allowing for the establishment of a strong R&D Hydrogen and Fuel Cell Technology exporting added value PGM materials, components and complete products. Each Centre has a unique responsibility, but all three are complementary within the common vision of fostering proactive innovation and developing the human resources required to undertake competitive R&D activities in the field of Hydrogen and Fuel Cell Technologies. The first five years of funding focused on developing infrastructures at each Centre with a major emphasis upon Human Capacity Development (HCD). Relevant international expertise was recruited by each Centre to access technical support and well-established implementation networks, and to ensure the programme and its deliverables remain market related and world-class. Furthermore, to achieve the HySA strategy objectives, the three HySA Centres of Competence Fig. 1 form a national network of research 'Hubs' and 'Spokes' through collaboration with institutions and partners from the R&D sector, higher education, as well as industry.

The HySA programme consists of five Key Programmes – see Table 1.

HySA Systems focuses on two Key Programmes and Key Technologies as shown in Fig. 2 and detailed below:

2. Key Programme 1 – combined heat & power

Fuel cell based Combined Heat and Power (CHP) systems have entered early commercialisation recently and are being deployed in 1000's in Japan (Ene.Farm) and Europe (Ene.Field,

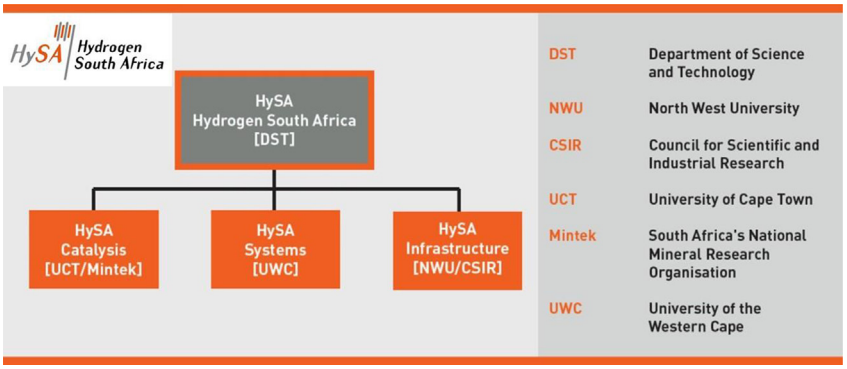

Fig. 1 – HySA structure and stakeholders.