South Africa capitalizes on growing hydrogen and fuel-cell market

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The global trend toward the replacement of fossil fuels with clean energy alternatives has driven development of both resources and technologies and provided new economic opportunities. The Republic of South Africa possesses 75% of known platinum group metal (PGM) reserves, and these metals are key catalytic materials used in most fuel cells. While mining and exporting raw PGM will generate some economic development in South Africa, the government's aim is to move from a resource-based to a knowledge-based economy. This type of transition is facilitated by the development of new high-tech industries, creating jobs, and adding value to the PGM by producing high-tech products in South Africa.

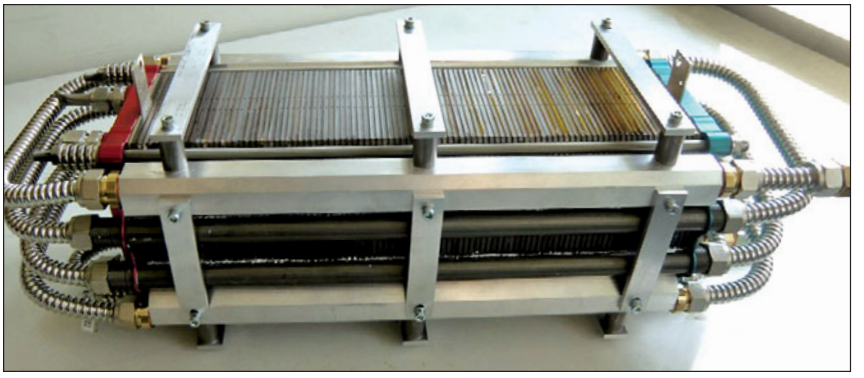
Hydrogen South Africa (HySA) is a 15-year program created by South Africa's Department of Science and Technology (DST) to capitalize on the emergent hydrogen and fuel-cell market. South Africa has specifically targeted this market because it is expected to expand internationally in the medium and long term, and their vast PGM resources give South Africans a competitive advantage. The strategic objectives for HySA are to develop local cost-competitive hydrogen generation, catalysis, and manufacturing systems based on existing and developing technologies, to supply 25% of global catalyst demand by 2020, and to promote equity and inclusion in the economic gains realized through the beneficiation of South Africa's PGM resources.

The first five-year stage of the HySA program ran from 2008 to 2012 and focused on establishing competency in current hydrogen and fuel-cell technologies. International experts from academia and industry were recruited and three Centers of Competence were established in Systems, Infrastructure, and Catalysis. This strategy effectively jump-started the program by providing technological knowledge and establishing collaborations across the spectrum of hydrogen and fuel-cell research, development, and manufacturing.

With the completion of the first stage, HySA Infrastructure Director Dmitri Bessarabov expressed confidence that "HySA will contribute to the South African mineral resource beneficiation strategy and will help to transform the resource-based economy into a knowledge-based one." HySA Catalysis Director Olaf Conrad shares this confidence and pointed out, "We have accomplished the first objective—in five years' time, South Africa has caught up on 30-plus years of progress and can now provide catalysts and some components equivalent to the current commercially available standard."

The beginning of the second phase of the HySA strategy was marked by the inauguration of the DST-mandated HySA Advisory Board on February 13, 2013. The Board is tasked with advising the DST on the HySA program and providing guidance as activities expand toward in-house technology development and manufacturing. Independent panels will be appointed to conduct periodic reviews of the HySA program and according to HySA Systems Director Bruno G. Pollet, "One of the principal objectives for HySA is to establish long-term project collaborations with industrial partners." Sharon Blair, Key Programme Manager at HySA Catalysis, describes their strategy: "In order to partner with us, companies must agree both to manufacture PGM- and non-PGM-based components and systems in South Africa and to incorporate South African innovations into existing and future products once they meet specified standards. To fulfil this agreement, companies provide us with technical and cost targets in the early part of our relationship." To maximize local economic development, each of the HySA programs has a strategy with a strong emphasis on South Africa-based manufacturing and technology integration.

Another important aspect of the second phase of the HySA program is to combine the push toward new technologies and manufacturing with human capital development and promotion of equity in South African society. In addition to training research students and expanding technology development, "regions of South Africa that have seen little or no economic development under the apartheid system are preferentially considered for economic development in this program," says Conrad. "Hydrogen fuel cell technologies offer an excellent opportunity to bring basic municipal services to remote areas thereby uplifting the livelihood of the



Fuel-cell stack developed as part of the HySA program. Photo courtesy of HySA Systems.

https://doi.org/10.1557/mrs.2013.116 Published online by Cambridge University Press

people. At the same time, jobs resulting from some manufacturing activities—but more significantly from spawned secondary commercial activities—create the basis for a self-sustained economic development of the benefiting regions," he says.

The third and final stage of the HySA strategy will be defined to some extent by the success of the second stage. The ultimate goal is the widespread integration of South African PGM technologies into new and existing hydrogen and fuel-cell products that are manufactured in South Africa and exported worldwide. The DST hopes that the targeted and aggressive nature of the HySA program will change the face of both the fuel-cell market and of South Africa's economic well-being, making South Africa a powerhouse in the hydrogen and fuel-cell arena.

The target outcome of the HySA strategy, as Pollet says, is "to make South Africa a world leader in hydrogen energy research and innovation and in the process to indirectly create industries and jobs for the people."

Jennifer A. Nekuda Malik

Chile partners with US National Science Foundation to provide opportunities for graduate research fellows www.nsf.gov/grow

The US National Science Foundation (NSF) announced a new research partnership with Chile through the Graduate Research Opportunities Worldwide (GROW) program. This is a coordinated effort that enhances international collaborative research opportunities for NSF Graduate Research Fellows. There are now GROW agreements between NSF and science agencies in 10 countries.

José Miguel Aguilera, president of Chile's National Commission for Scientific and Technological Research, says, "Chile has extraordinary Natural Labs where postgraduate fellows can conduct frontier scientific research."

GROW was announced in December 2012, at the sixtieth anniversary celebration of the Graduate Research Fellowship Program (GRF), NSF's flagship program for graduate students in science and engineering within NSF's mission. The Fellows, selected through the NSF GRF program and invited to participate in GROW, are hosted by a science agency in a partner country for a period of 3 to 12 months. While overseas, they receive a living allowance from the host country as they pursue their research in a host institution. They are also eligible to receive an international travel allowance from NSF. This partnership with Chile adds to existing collaborations with NSF partner agencies in Denmark, Finland, France, Japan, Norway, Singapore, Sweden, Switzerland, and South Korea. It is anticipated that additional partners from other countries will join GROW in the months ahead.

GROW supports NSF's broader commitment to address the internationalization of science and engineering and to provide multiple pathways to engagement with top researchers worldwide. GROW joins other recent NSF efforts such as Science Across Virtual Institutes (SAVI) and Partnerships for Enhanced Engagement in Research (PEER) in providing mechanisms to foster international partnerships and address global challenges.

Poland releases report on small modular reactors www.ncbj.gov.pl

In March, Poland's National Centre for Nuclear Research (NCBJ) released a report on the advisability of small modular reactors (SMRs). The report says that while SMR nuclear power plants (NPPs) might become important for the Polish power industry, it is very unlikely that they will play a key role as a base load electricity source in Poland, and they are unlikely to appear before 2030.

Research and development (R&D) on various SMRs—high-temperature reactors that might cogenerate electricity and heat—are conducted in many countries. The United States, Russia, Korea, France, Japan, and China are supporting works on innovative nuclear-reactor solutions with large financial outlays to make the best use of their research collected during operation of their high-power nuclear reactors, the report says.

Andrzej Strupczewski, NCBJ Nuclear Safety Chair, says, "Our government's policy is to develop in Poland by 2030 nuclear reactors of a combined electric power of 6000 MW. A few tens of SMR reactors would be needed to attain that power level. Such a large number of SMRs would be not only economically unjustified, but also technically unfeasible. Besides, since safety is an absolute priority issue, we in Poland are going to deploy only such reactors that can demonstrate a record of successful operation in other countries, have been verified in detail during the recently concluded stress test program, and meet the most stringent safety standards. Therefore they will be the third-generation reactors." NCBJ, located in the Świerk district of Poland, is the only research institution in the country operating a nuclear reactor.

According to the report, SMRs are not expected to replace high-power reactors; however, they may serve well for locations far from the national power grid (such as northern territories of Russia or in Alaska), or in small countries with small total power demand where high-power units are difficult to use because of an imbalance of the national power grid they introduce. In Poland, SMRs might be used by large industrial plants or by municipal central heating systems as sources of heat, says the report. If Poland is to be among the first beneficiaries of that new technology, NCBJ recommends that a program of R&D in that field be started now. □

https://doi.org/10.1557/mrs.2013.116 Published online by Cambridge University Press