



GREEN HYDROGEN:

a healthy, wholesome alternative to fossil fuel

Picture the scene: dressed and ready for work, you walk to your car. Switching on your home refuelling station, you fill up the tank with hydrogen gas generated by pure sunlight and water before driving away.

FUTURISTIC IT MAY SEEM but the capability to turn renewable wind or solar energy into hydrogen fuel cells here in South Africa has already been developed.

“We have completed a generation one hydrogen plant that can produce half a kilogram a day from renewable energy sources, and upgraded it to a generation two plant that produces three kilograms a day,” says Dr Dmitri Bessarabov, director of the DST Hydrogen Infrastructure Centre of Competence (HySA Infrastructure) at the Faculty of Engineering on the Potchefstroom Campus.

Three kilograms of hydrogen is equivalent to about 11 litres of

petrol, which would be sufficient to meet the daily needs of motorists driving passenger cars, or better still scooters, over short distances.

Unlike petrol, though, hydrogen fuel cells emit zero greenhouse gases and its raw materials – sunlight, wind and waste biomass, among others – are free as the air and available in unlimited quantities.

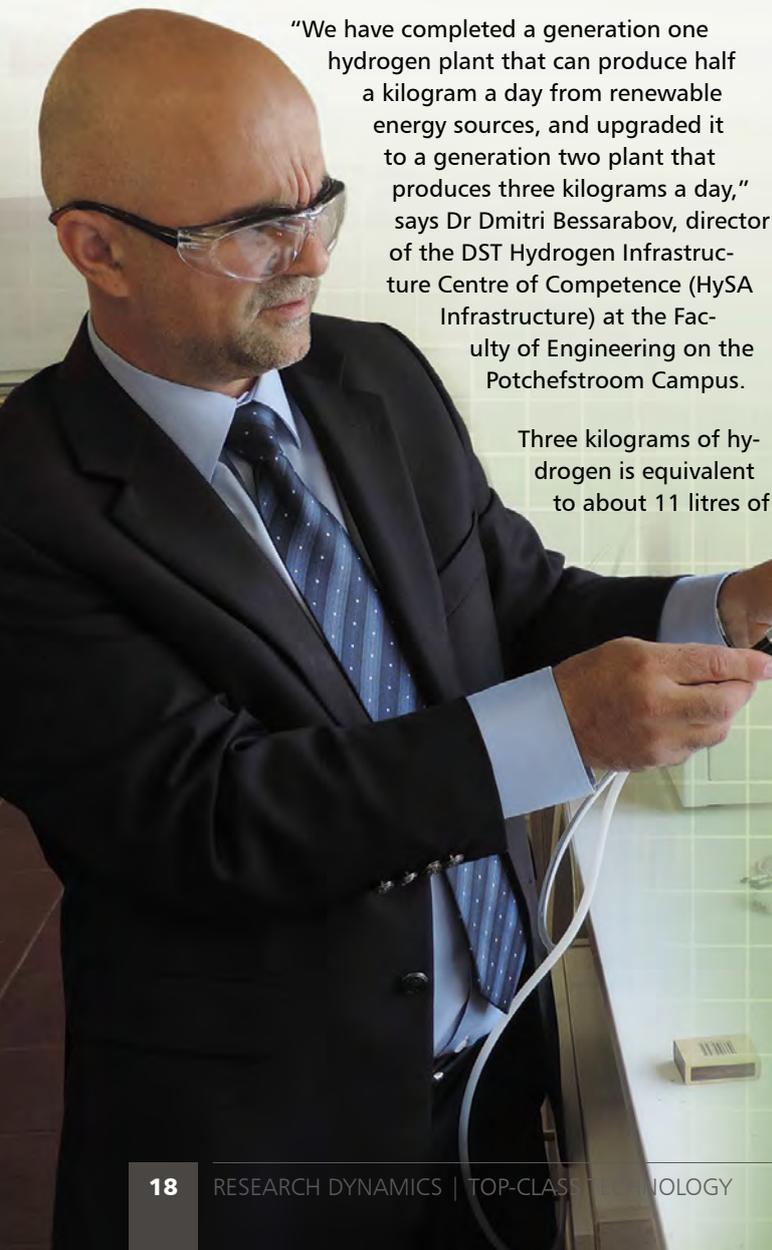
Households and industry can benefit

Hydrogen-powered vehicles are not yet commercially deployed on a large scale and once they are, it is likely to be some time before prices come down to the level of the average motorist. However, sustainable mobility is the way to go and when hydrogen vehicles do arrive on our roads, South Africa will not be found wanting in terms of renewable fuel to power them.

In the meantime, HySA Infrastructure at the NWU is powering ahead with plans to engage with industries such as petrochemicals, telecommunications, power, mining and glass and food manufacturing.

“The petrochemical industry uses millions of tons of hydrogen for oil refining annually,” Dr Bessarabov says. “Currently, the industry gets its hydrogen from natural gas, which is not green, CO₂ free hydrogen. Their hydrogen has to be delivered to them on a large scale, whereas hydrogen from renewable sources – solar and wind in South Africa’s case – can be produced on-site as and when needed.”

Renewable hydrogen could greatly benefit the telecommunications industry too. “Telecoms businesses are growing very fast and cellphone stations that are off the electricity grid need reliable power. “Renewable hydrogen can com-





pete very well with diesel generators, which need much more maintenance," he says.

"There is an even bigger market for hydrogen in the mining industry, which uses diesel underground and has issues with ventilation and toxic exhaust fumes. By using green hydrogen underground, mines could save on ventilation and there would be no toxic exhaust."

Even the food industry uses hydrogen, which is a common ingredient of margarines.

Conversion and compression go together

The research that Dr Bessarabov's team is doing at HySA Infrastructure consists of two synergistic projects: converting solar energy to hydrogen, and compressing the hydrogen so that it can be stored.

The conversion part, funded by the Department of Science and Technology (DST), has been progressing well. Apart from producing the first and second-generation plants mentioned earlier, it has developed a critical mass of human capital. "We have a strong team of students that knows that technology and can look at improving its efficiency. As we speak, two of our students are working in Canada on an internship programme at the world's leading hydrogen company, Hydrogenics."

The compression project started in January 2014 and has already resulted in the development of a hydrogen compressor that stands out from other models.

"We have developed an energy-efficient compressor that has no moving parts," Prof Bessarabov says. "This is important. Compressors with moving parts use more energy and are prone to mechanical friction, oil contamination, etc. Our compressor, based on solid-state ionic conductors, is silent and uses less energy."

This project is being funded by the DST and platinum-mining company Anglo American Platinum. The connection is that the compression technology HySA is using makes use of Platinum Group Metals (PMG) components.

This, too, is significant. The use of PMG components is a form of beneficiation, which entails adding value to the primary material through processing. Only a small portion of the minerals mined in South Africa is beneficiated on home soil and so opportunities such as this are considered highly desirable.

State-of-the-art system in the making

The compression project is still in the early stages, however. "According to the world standard, a hydrogen compressor must be 700 bars (a bar being a unit of pressure), and we have a compressor that is approximately half of that. There are also a lot of technical questions we have not answered yet," he says.

"But what we have here is a state-of-the-art system that fits very well with local conditions and could open up huge opportunities for South Africa in renewable hydrogen."

Over and above industries that already use hydrogen, such as petrochemicals and glass, new potential applications abound, such as in the materials handling business, Dr Bessarabov says.

"In the United States, all the big retailers use thousands of forklifts 24 hours a day to move their goods in warehouses. The forklifts are battery operated and can only run for six hours before they need to be recharged. A hydrogen forklift takes three minutes to fill up with hydrogen and can be operated 24 hours a day – plus there are no toxic batteries to dispose of."

Here's to a greener, wealthier future powered by healthy, wholesome hydrogen. **RD**

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