

SA Women in Science Awards 2017

Hydrogen economy vital part of sustainable energy future

Dr Henrietta Langeni

Access to clean, affordable, adequate and reliable energy is essential for economic growth, which significantly contributes to poverty reduction, societal wellbeing and prosperity. We should build our future on sustainable energy sources that will continue to supply future generations' needs.

I believe that the hydrogen economy, a system that uses hydrogen to transmit energy from primary fuel sources to users, is a vital part of a sustainable energy future. Hydrogen is clean and has a high mass energy density. It is the most abundant element in the universe and can be produced from a variety of sources. Hydrogen can supply energy for use in buildings and transportation, and can also contribute to decarbonising many industrial sectors.

Hydrogen offers an important link between physical and chemical energy. As part of a sustainable energy future, physical energy from renewable resources, such as radiation from the sun and kinetic energy from wind and waves, can be converted into electricity and used directly for various applications. The sun doesn't shine 24 hours a day, and the wind doesn't blow every day everywhere, so excess energy needs to be stored until it is needed. Electricity can be stored as chemical energy in hydrogen, which is generated using a device called an electrolyser. The chemical energy in hydrogen is later converted back to electricity in an efficient manner using a fuel cell device, generating only water as a by-product. Hydrogen storage, therefore, enables the shifting of renewables-based electricity between periods of excess and shortage. Apart from power generation for the grid, hydrogen can provide a solution for the electrification of remote communities where grid connection is uneconomical.



Dr Henrietta Langeni manages the Hydrogen South Africa Infrastructure Centre of Competence at the CSIR, an entity of the department of science and technology. Photo supplied

As part of a sustainable energy future – besides power generation for use in buildings – hydrogen can be used in other commercial markets, e.g. as a clean transportation fuel. Vehicles powered by hydrogen combine hydrogen and oxygen in a fuel cell device to generate electricity, unlike conventional vehicles powered by petrol

or diesel. These hydrogen-powered fuel cell electric vehicles are quiet, efficient and clean, emitting only water vapour. In addition, when compared to battery-powered electric vehicles, they provide a longer range between each refuelling, and a shorter refuelling time. Furthermore, unlike biofuels, the use of hydrogen as a transport fuel

eliminates land-use impact such as decreased access to food and deforestation. Major car manufacturers including Toyota, Hyundai and Honda have already launched their first mass-produced hydrogen-powered fuel cell passenger vehicles. The Toyota Mirai (Mirai is Japanese for "future"), for example, is already sold commercially.

today in several parts of the world.

Hydrogen from clean energy sources can be used to enrich other fuel sources or converted to valuable chemicals used for energy or non-energy related applications, contributing to the decarbonisation of the economy. For instance, in Germany, there are power-to-gas plants that convert surplus electricity into hydrogen. The hydrogen is then injected into natural gas networks in small concentrations, facilitating the integration of renewables. Furthermore, hydrogen can be used as a feedstock for producing synthetic natural gas by combining hydrogen with carbon dioxide from waste sources. This renewable natural gas can substitute conventional natural gas for use in various applications. The first industrial-scale renewable synthetic natural gas plant was built by ETOGAS for Audi AG in Germany.

Hydrogen is already widely used today as an industrial feedstock, for example, in the production of ammonia and synthetic fuels, in the refining of crude oil, and in the food and chemical industries. For a sustainable energy future, the use of hydrogen from clean energy sources will contribute towards decarbonising several industrial sectors.

I believe that the hydrogen economy has the potential to play a pivotal role in future sustainable energy systems. Hydrogen is an essential integrator that can solve the intermittency problem associated with renewable energy, creating electricity for the grid and for remote, off-grid communities. It can also be used as transportation fuel in fuel-cell-powered electric vehicles. Given its versatility, hydrogen from clean energy sources can be used as feedstock in many industrial processes to make valuable products. Hydrogen can contribute in many ways across the economy and offers great promise to be at the core of the energy revolution towards a more sustainable energy future.

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