Source: *The Straits Times,* Front Page
Date: 4 July 2022

Singapore eyes green hydrogen as energy source with $25m institute

It is part of NUS' strategy to innovate ways to reduce country's reliance on fossil fuels

Cheryl Tan

A $25 million research institute aims to make green hydrogen a viable source of clean fuel which can power Singapore's energy needs.

The National University of Singapore's (NUS) Centre for Hydrogen Innovations is working to create breakthrough technologies that will make hydrogen a viable green energy source, as the Republic seeks to decarbonise its energy sector.

Professor Ho Teck Hua, NUS senior deputy president and provost, told The Straits Times that both the new centre as well as NUS' Green Energy Programme – which focuses on carbon capture and utilisation technologies – are part of the university's strategy of coming up with innovative ways to reduce Singapore's reliance on fossil fuels.

Low-carbon hydrogen imports have also been identified as a viable way forward in bringing the power sector – which now produces 40 per cent of the country's emissions – to net zero by 2050, according to the Energy 2050 Committee report, which was released in March.

In the first phase, the centre will primarily focus on hydrogen carriers for storage and transport – a fairly nascent area of research – as well as the global supply chain for hydrogen.

Professor Liu Bin, who will lead the centre, told ST: "While hydrogen can be imported through pipelines, this can only be done for short distances from countries like Malaysia. Liquefied hydrogen is very energy-intensive and would require investments in new infrastructure."

(The National University of Singapore's Centre for Hydrogen Innovations) is the first of its kind in South-east Asia and has received a total investment of $25 million, of which $15 million is an endowment gift from Singapore investment firm Temasek. So far, it has decided to fund nine projects in hydrogen research – each receiving up to $250,000.

Another method would be to convert hydrogen into a liquid chemical carrier that can be transported at room temperature using existing infrastructure. But more research is needed to extract hydrogen from its carrier.

Aside from looking into transporting hydrogen, the centre is also gearing up to produce hydrogen locally, to safeguard Singapore's energy security in the event of supply chain disruptions.

Hydrogen can be produced through the electrolysis of water, separating it into hydrogen and oxygen, as well as methane pyrolysis – a process which splits natural gas into hydrogen and solid carbon.

But in order to be considered a green fuel, both processes must be powered by renewable energy such as solar.

To accelerate the use of green hydrogen as a fuel for sectors such as transport and electricity, the centre will be working closely with industrial players in these areas.

It will also create a talent pipeline such that workers can contribute to different components of the hydrogen economy.

These training programmes range from degree programmes to short courses which target undergraduates, adult learners and industry leaders, among others.

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Temasek's head of strategic development Russell Tham said the investment company would support the centre in kick-starting its research and development efforts and developing talent for the hydrogen economy.

The centre also wants to work with policymakers to enable these novel hydrogen technologies to be adopted safely here.

Dr Victor Nian, chief executive of the Centre for Strategic Energy and Resources, an independent think-tank which is headquartered in Singapore, said that industries would also need to build strategic partnerships along the value chain, especially for building an ecosystem from hydrogen supply to demand among countries.

The Government would also have a role in accelerating the adoption of hydrogen for downstream applications, he added.

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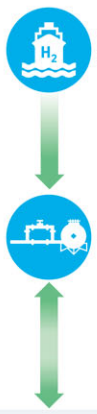
Source: *The Straits Times,* pB9
Date: 4 July 2022

Singapore's hydrogen economy

As Singapore looks to decarbonise its power sector to reach net-zero emissions by 2050, green hydrogen, produced from renewable sources such as solar or wind energy, is being explored as an alternative to fossil fuels. The National University of Singapore's (NUS) new Centre for Hydrogen Innovations is researching green hydrogen and how to make it commercially viable. Here is a look at the future flow of green hydrogen in Singapore.

IMPORTING HYDROGEN

If green hydrogen is imported from countries like Australia, infrastructure would be needed for storing and transporting hydrogen. As hydrogen is a highly combustible gas that is hard to liquefy, hydrogen carriers would be needed to hold and transport it at room temperature, so that existing infrastructure can be used.



Storage mediums

Liquid organic hydrogen carriers:
These are organic compounds that can absorb or release hydrogen through chemical reactions.

Ammonia

This is an effective hydrogen carrier as it can be easily liquefied and transported. A team from NUS is looking to develop more energy-efficient and greener methods to extract hydrogen stored in ammonia.

Adsorbents

These are porous materials, such as certain types of carbon, that can store hydrogen by physically absorbing the gas.

Water as a hydrogen carrier

Researchers are looking at converting water directly into a hydrogen carrier, instead of extracting hydrogen from water and incorporating the hydrogen gas into another carrier. This would circumvent the need for storage mediums and cut costs. It would also be safer as no combustible gas or chemicals would be involved.

APPLICATIONS

1 Transportation

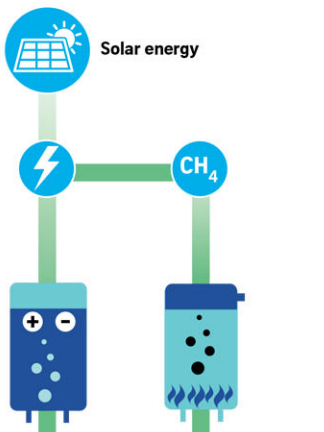
Hydrogen can be used to power fuel-cell electric vehicles.

2 Town gas and electricity

Piped town gas provider City Energy is studying replacing the hydrogen it uses in piped gas to households and businesses with green hydrogen.

LOCAL PRODUCTION OF GREEN HYDROGEN

The centre is looking into innovative technology to produce hydrogen locally. This will ensure national energy security in case of energy disruptions.



Electrolysis
This involves running an electric current through water, splitting it into hydrogen and oxygen.

Methane pyrolysis
This is a technological process which splits methane into hydrogen and solid carbon. The carbon can be repurposed for other uses, like as an adsorbent.

New battery system

- A separate team from NUS' department of materials science and engineering has devised a battery system that can combine electricity storage and hydrogen production through specially formulated chemicals.
- The system is powered by renewable energy such as solar energy.
- The battery system can be used to charge electric cars, as well as store electricity which can supply Singapore's electrical grid.

3 Heavy industry

Green hydrogen can be used as a clean-energy feedstock in heavy industries such as petrochemical plants, replacing the use of natural gas and other fossil fuels.

Source: NUS PHOTOS: BLOOMBERG, CITY ENERGY, ST FILE STRAITS TIMES GRAPHICS