Hydrogen from plastic waste • NTU find may pave way for cleaner fuel | **B2**

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NTU scientists find way to convert plastic waste into hydrogen fuel

Discovery could power vehicles and boost energy grid in as little as 3 years

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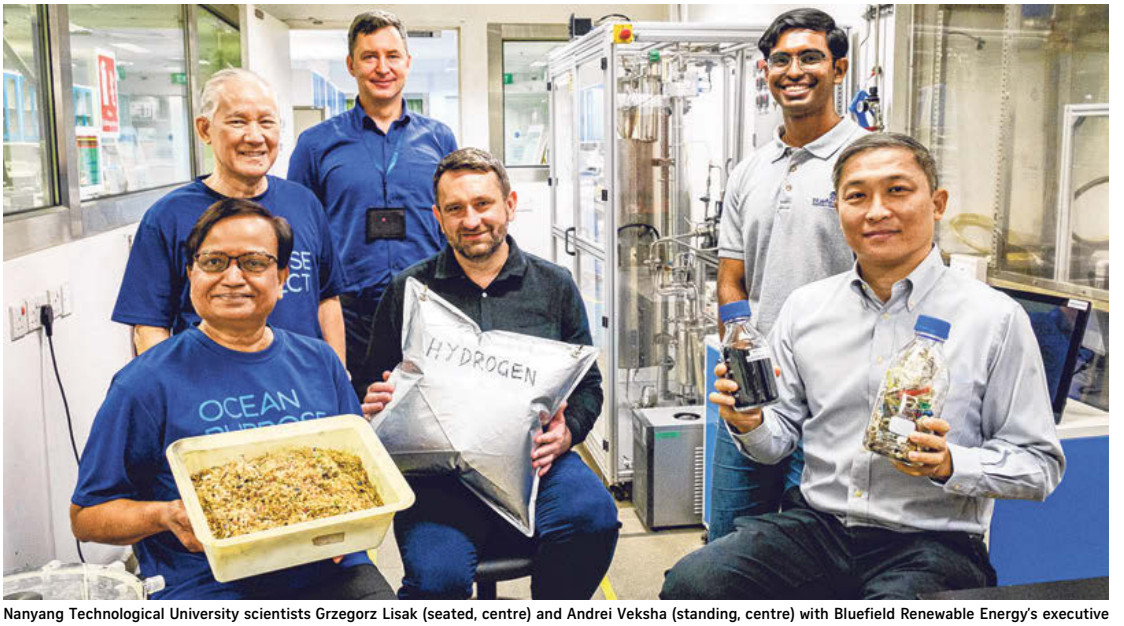

Nanyang Technological University scientists Grzegorz Lisak (seated, centre) and Andrei Veksha (standing, centre) with Bluefield Renewable Energy's executive director Tan Yong-Tsong (seated, right) and Mr Mohamed Irshad (standing, right), and Ocean Purpose Project's administrative and human resource lead Margaret Dcruz (seated, left) and lead engineer Richard Ho (standing, left). The scientists have found a way to use pyrolysis, a chemical process, to convert plastic waste (shown in the bottle in Dr Tan's left hand and in the container held by Madam Dcruz) into a gas mixture that is 78 per cent hydrogen and can be used to power gas turbines. Carbon nanotubes (in the bottle in Dr Tan's right hand) are a by-product of the pyrolysis process. PHOTO: NANYANG TECHNOLOGICAL UNIVERSITY

Scientists from Nanyang Technological University (NTU) have found a way to convert plastic waste into low-carbon hydrogen, which is considered a cleaner fuel than natural gas.

The discovery, which could power vehicles and contribute to the power grid in as little as three years, comes as the Republic looks to adopt hydrogen as an alternative fuel, as it does not produce carbon dioxide (CO2) when burned.

The latest United Nations Intergovernmental Panel on Climate Change report found that greenhouse gas emissions – such as CO2 – need to peak before 2025 and be reduced by 43 per cent by 2030 to limit dangerous climate change.

Plastic waste, which contains contaminated food packaging, styrofoam and plastic bags, can be challenging to recycle, meaning that it is currently incinerated or buried in landfills.

With 832 million kg of plastic waste generated in Singapore annually that cannot be recycled, NTU's new method – a high-temperature chemical process called pyrolysis – can convert the waste into energy that can potentially power up to 1,000 five-room flats for a year.

Associate Professor Grzegorz Lisak from NTU's Nanyang Environment and Water Research Institute (Newri), who led the project, told reporters during a virtual press conference yesterday that the other by-product from the pyrolysis process would be a form of solid carbon called carbon nanotubes.

Carbon nanotubes have an array of uses, such as in sensors, semiconductors and energy conversion devices like hydrogen fuel cells.

Newri senior research fellow Andrei Veksha said the gas mixture from the pyrolysis process is about 78 per cent hydrogen concentration, 20 per cent to 24 per cent methane, and a small amount of CO2.

It can be used for powering gas turbines to generate electricity, or if a purer form of hydrogen is required, the gases can be separated using existing technologies in the market, he said.

For instance, hydrogen-powered vehicles require very pure hydrogen of more than 99.9 per cent, as the presence of contaminants could affect fuel cell performance.

The remaining methane and CO2 gases can be recycled and used to power the reactor for pyrolysis.

The chemical reaction will also leave behind a small amount of char, which can be repurposed so that it does not end up at Semakau Landfill, said Dr Veksha.

To further refine the new conversion method and assess its commercial feasibility, the research team is test-bedding it on the NTU campus to treat local plastic waste, in partnership with Bluefield Renewable Energy, a local environmental company that specialises in converting waste into useful resources.

Dr Tan Yong-Tsong, Bluefield's executive director, said the company will concurrently be testing the NTU technology on its modular plants, using the hydrogen gas to power its reactors.

As part of the research project, marine litter was collected from local and Indonesian waters in collaboration with the Ocean Purpose Project, a non-governmental organisation and social enterprise based in Singapore.

At a demonstration facility that is owned by Ocean Purpose Project in Lombok, Indonesia, unsorted ocean plastic waste can be converted into high-profit by-products.

For instance, each tonne of plastic waste can yield 151kg of carbon nanotubes priced at $15,100, and 27kg of hydrogen that can be sold for $57.

The multimillion-dollar joint research project aims to develop feasible solutions to economically scale up the conversion of plastic waste to hydrogen over the next three years.

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