

NTU scientists design a new way to convert plastic waste into hydrogen for clean electricity

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Scientists from Nanyang Technological University (NTU) have developed a new method to convert plastic waste into hydrogen and carbon products.

These can be used to generate clean electricity and have a variety of industrial purposes respectively.

NTU Assoc Prof Grzegorz Lisak (right) with hydrogen produced from plastic litter owned by Dr Andrei Veksha (left). Photo by NTU

Turning plastic waste into hydrogen and carbon

Plastic waste is generally difficult to recycle because it comprises a mixture of different types of plastic. Plastic recycling plants therefore spend a lot of resources and labor to sort plastic waste before it can be processed.

NTU's new method fills this gap, as different types of plastic waste, even contaminated ones, can be used, co-inventor Associate Professor Grzegorz Lisak told a press conference.

Using the newly developed method, plastic waste is first broken down and heated into gas containing low concentrations of hydrogen molecules.

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Crushed plastic litter which is then fed into the pyrolysis system for processing. Photo by NTU

The gases then enter a reactor with a catalyst, and the technology allows the release of hydrogen and the formation of a type of solid carbon known as carbon nanotubes.

The process, called pyrolysis, is particularly effective because plastic waste is rich in hydrogen and carbon.



Lisak (right) and Veksha (left) with the pilot pyrolysis system. Photo by NTU

The hydrogen produced can be used to generate clean electricity and power fuel cells such as those found in electric vehicles, and is more environmentally friendly than fossil fuel-based gasoline.

The NTU research team said the solid carbon produced by their method is much easier to store compared to the polluting gaseous carbon dioxide emissions from the incineration of plastic waste.

Additionally, solid carbon can be easily sold as feedstock for the manufacture of specialty chemicals or biofuels.

Carbon nanotubes also have many applications such as solar panels, batteries, smartphones and automobiles.

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Photo by NTU

Use ocean plastics

The plastic waste used for this research project was collected from local waters in collaboration with Ocean Purpose Project, a non-profit organization based in Singapore.

In November 2021, researchers from NTU's Nanyang Environment and Water Research Institute (NEWRI) participated in a kayak race organized by the Ocean Purpose Project to collect plastic waste along Singapore's coastlines.

While helping to clean up our coastlines, plastic waste has also been used as research materials.



Garbage collected from the ocean in Pasir Ris. Picture of the Ocean Purpose project

NTU estimates that with the amount of non-recycled plastic waste generated in Singapore each year – around 832 million kg – the converted hydrogen energy could potentially power up to 1,000 five-room apartments for a year.

Converting the 269 million kg of plastic waste currently floating in the oceans into energy could also power an electric vehicle 20 to 40 million km, the NTU team estimates.

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That's about 500 to 1000 times the circumference of the Earth.

Scaling

The development of the technology is part of a multi-million joint project with Bluefield Renewable Energy, a local environmental company specializing in mobile waste-to-resource technologies.

The project aims to develop feasible solutions to economically scale up the conversion of plastic waste into hydrogen over the next three years.

Technologies to convert other difficult waste streams into valuable energy and resources – such as syngas, biochar, activated carbon and carbon nanotubes – are also being explored in this project.

Bluefield Renewable Energy CTO Craig Gavin added that the market is currently pivoting towards a hydrogen-powered economy.

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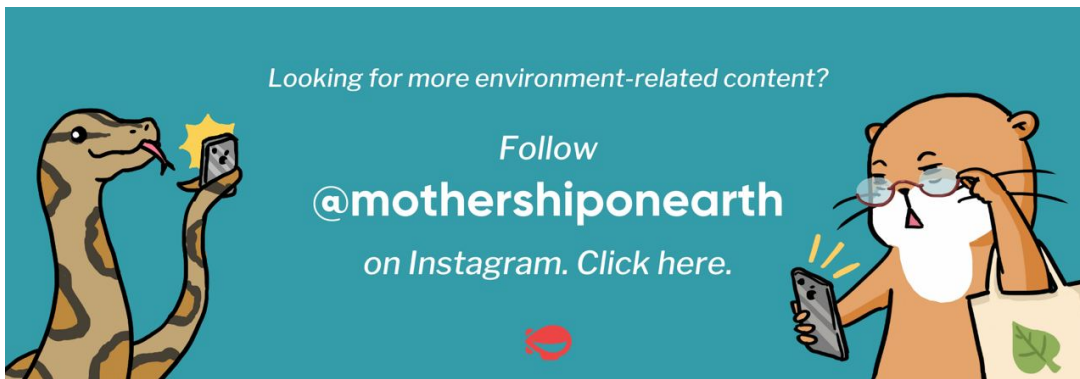


Photo from top of NTU and Ocean Purpose Project

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