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The fruit of the agave plant

Agave plantation in Mexico

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# Could the Ancient Agave Plant be the “Sweet Spot” for Green Hydrogen Production?

The International Energy Agency (IEA) calculates that the global market for green hydrogen will be US$48 billion by 2030. That’s putting a price of US$6 a kilogram (kg).

A Singapore-based research project is working on delivering Grimes Green Hydrogen (GGH) for closer to US$2 a kg by 2030.

So where is the “sweet spot” for the production of green hydrogen?

Syrup from the agave plant or sugar cane are both in front to qualify as the most economically viable feedstock to produce green hydrogen as a transport fuel or to generate electricity.

In a small laboratory in the Create Building in NUS University Town, there’s work going on right now to establish the best way for Singapore – often described as “renewable energy challenged” – to produce or acquire green hydrogen to replace natural gas, which currently fuels practically all of the country’s electricity needs.

American energy technologist Joseph Maceda runs the energy research project – with the help of three scientists and two engineers – basing it on the “proprietary, low-temperature, liquid-phase, electrochemical technology platform”, developed by his mentor, the late Dr Patrick Grimes.

As Chief Designer and CEO of **3G&S Technologies Pte Ltd**, Mr Maceda set up the company after being introduced to Singapore by local engineer Fong Saik Hay, as they’ve

known each other for 30 years, originally working together on fuel cell technology for the automobile sector.

What interests them both is the size of the global market for green hydrogen, which the International Energy Agency (IEA) calculates will be worth US$48 billion by 2030. That's putting a price of US$6 for a kilogram of green hydrogen.

Mr Maceda is convinced that he can deliver Grimes Green Hydrogen (GGH) in Singapore for closer to US$2 a kg by 2030.

"It's very expensive and energy intensive to produce green hydrogen by splitting water (H2O) by electrolysis – using renewable energy – and safely shipping hydrogen to where it's needed," says Mr Maceda.

Using the agave syrup – or cane sugar – as a feedstock and shipping it to Singapore, where it can be processed into green hydrogen, is seen as the best and cheapest way to supply "the cleanest fuel of the future". And with the major challenge of decarbonising the global economy at hand, various alternative technologies for green hydrogen can co-exist.

The aim is to have a GGH demonstration model ready in October, ideally to showcase for the first time at this year's Asia Clean Energy Summit (ACES) during Singapore International Energy Week (SIEW).

As they can also demonstrate the economic viability of green hydrogen production, they propose to have a 200 kg/d GGH pilot plant operational in Singapore by the end of 2024.

Together with their feedstock expert, Frank Nadimi, they have been lining up partnerships with potential agave growers and sugar cane suppliers in Australia and Brazil, which they see as the best sources of supply as there's unlikely to be any shortage of land to grow sufficient feedstock for green hydrogen production.

So, how much syrup is needed to produce green hydrogen for Singapore?

To meet 5% of Singapore electricity needs, for example, would require 125,000 tons of green hydrogen, which can come from 16 tanks – or 1.5 million tons – of agave or sugar cane syrup. That means 20 shiploads on 80,000 DWT long range tankers.

Mr Joseph Maceda Mr Fong Saik Hay

Mr Maceda says that to meet all of Singapore's total electrical needs would require 150,000 hectares per year to supply 30 million tons of syrup (agave and/or sugar cane).

The GGH research project is in the hands of a private company – 3G&S Technologies – which operates from the National Research Foundation's CREATE facility.

Mr Fong, previously with ST Engineering for 37 years, confirms that a number of entities are showing a close interest in GGH.

**Temasek** funded the early-stage research and 3G&S Technologies has joined hands with the Agency for Science, Technology and Research (A*STAR) on research collaboration.

"A*STAR is pleased to have worked with 3G&S Technologies to develop more innovative and economically viable ways to produce green hydrogen as a clean energy source," says Prof Yeoh Lean Weng, Chief Sustainability Officer (CSO), A*STAR.

***Issued on behalf of 3G&S Technologies Pte Ltd and Grimes Green Hydrogen by Sustain Ability Showcase Asia (SASA) and ABC Carbon.***

*For more information on the agave plant as a green hydrogen feedstock, or for more facts and figures on the Grimes Green Hydrogen project, please contact Ken Hickson.*

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