

K&L GATES



SINGAPORE

The H₂ Handbook

Legal, Regulatory, Policy, and Commercial
Issues Impacting the Future of Hydrogen

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PART I - BACKGROUND

Any analysis of the legal and commercial issues surrounding hydrogen's use as an energy source has to begin with Singapore's unique characteristics. Singapore is a Southeast Asian city-state with a total land area of 725.7km² located at the crossroads of important shipping routes. It has the busiest port in the world and the second highest population density globally with a landmass the size of New York City.¹

Singapore's energy economy had traditionally focused on maintaining its dominance in the following areas:

- Among the top five export petroleum refining centres in the world.²
- The world's busiest marine bunkering port.³
- Asia's leading bulk liquids hub.⁴
- Asia's leading oil trading hub.⁵
- Asia's leading oil and oil product pricing centre.⁶

Despite relying on carbon-intensive industries to fuel economic growth, Singapore ratified the Paris Agreement as of 21 September 2016⁷ and introduced a carbon tax from 1 January 2019 to help reduce greenhouse gas emissions.⁸

¹ Maritime Port Authority Of Singapore, *Premier Hub Port* (Sept. 17, 2020), <https://www.mpa.gov.sg/web/portal/home/maritime-singapore/introduction-to-maritime-singapore/premier-hub-port>.

² NS Energy Staff Writer, *Top Five Countries in Asia-Pacific Region for Oil Refining Capacities*, NS ENERGY (Jan. 1, 2020), <https://www.nsenergybusiness.com/features/countries-oil-refining-asia-pacific/#:~:text=Singapore%20ranks%20fifth%20with%20a,refining%20facility%20in%20the%20country>.

³ Editor, *Top 10 Bunkering Ports*, MARITIME FAIRTRADE (Jan. 19, 2019), <https://maritimefairtrade.org/top-ten-bunkering-ports/>.

⁴ *The Future of Asia's Leading Transshipment Hubs*, TANKTERMINALS.COM (July 8, 2019), <https://tankterminals.com/news/the-future-of-asias-leading-transshipment-hubs/#:~:text=July%20%2C%202019%20%5BEner8%5D,liquid%20bulk%20and%20chemical%20industry>.

⁵ *Id.*

⁶ Esa Ramasamy, *Singapore's Role as a Key Oil Trading Centre in Asia*, in *ENERGY PERSPECTIVES ON SINGAPORE AND THE REGION* 31–41 (2015).

⁷ National Environment Agency, *Singapore's Efforts in Addressing Climate Change* (Oct. 20, 2020), <https://www.nea.gov.sg/our-services/climate-change-energy-efficiency/climate-change/singapore-s-efforts-in-addressing-climate-change>.

⁸ National Climate Change Secretariat, *Carbon Tax* (May 4, 2021), <https://www.nccs.gov.sg/singapores-climate-action/carbon-tax/>.

commitment toward halving its 2030 peak greenhouse gas emissions by 2050 and to achieve net-zero emissions “as soon as viable” in the second half of the century.⁹ In line with these targets, Singapore is exploring hydrogen solutions as a route to reduce its carbon footprint.¹⁰

The Singapore government has recently identified three major challenges in developing a hydrogen economy, while

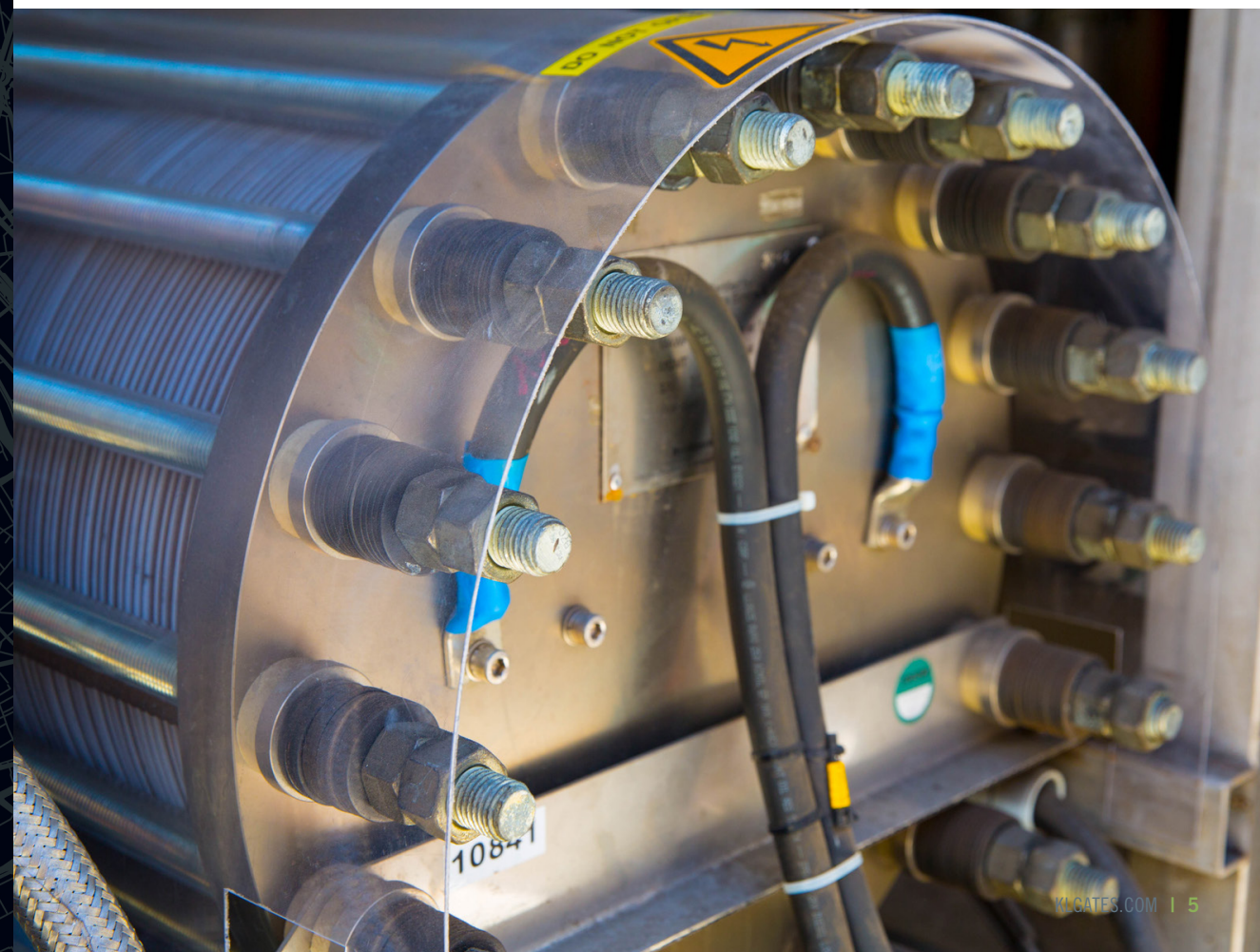
setting out its proposed steps to meet these challenges:¹¹

- Global supply chains for hydrogen must be established.
- Extensive infrastructure for hydrogen import, storage, transport, and end-use need to be put in place.
- The current price of producing and importing hydrogen is high, making wider adoption difficult.

⁹ Matthew Mohan, *Singapore Targets to Halve Peak Emissions by 2050, Achieve Net Zero Emissions 'as Soon as Viable' in Second Half of Century*, CNA – SINGAPORE EDITION (Feb. 28, 2020), <https://www.channelnewsasia.com/news/singapore/singapore-targets-to-halve-peak-emissions-by-2050-achieve-net-12480032->

¹⁰ Energy Market Authority, *Singapore's Energy Story* (July 26, 2020), <https://www.ema.gov.sg/ourenergystory>.

¹¹ See Leng Tan, Second Minister For Trade And Industry, *Speech at the LNG And Hydrogen Gas Markets Asia Conference Newsroom* (Oct. 27, 2020), <https://www.mti.gov.sg/Newsroom/Speeches/2020/10/Speech-by-2M-Dr-Tan-See-Leng-at-the-LNG-and-Hydrogen-Gas-Markets-Asia-Conference>.



PART II - GOVERNMENT VISION AND MEASURES

Singapore's energy policy is centred on managing its energy trilemma—balancing the trade-offs between energy security, competitive prices and environmental sustainability. To this end, Singapore sees hydrogen not only as an energy source but also as part of the solution to reaching its emissions reductions goals. In 2020, the Singapore government announced a multiagency initiative aimed at researching low-carbon development technologies.

Under this initiative, Singapore has set aside SGD 49 million (approximately US\$37 million) to fund low-carbon energy research and test-bedding efforts in hydrogen and carbon-capture utilisation and storage.¹² The study will assess the following:

- Technical feasibility of hydrogen imports in reducing longer-term emissions.

- Downstream applications in Singapore.
- Potential sources of hydrogen imports based on availability, cost, and supply security up to 2050.

More than 95 per cent of Singapore's electricity comes from natural gas, with the Singapore government confirming that it aims to continue relying on natural gas until 2070 for a substantial part of its energy needs.¹³ Presently, Singapore's Energy Market Authority has launched an incentive scheme by providing grants up to SGD 44 million (approximately US\$33 million) to encourage the adoption of advanced combined cycle gas turbines that run on natural gas and potentially could run on hydrogen blend in the future to offset the first mover disadvantage faced by industry players.¹⁴

¹² Reuters Staff, *Hyundai Begins Building Electric Vehicle Hub in Singapore*, REUTERS (Oct. 13, 2020), <https://www.reuters.com/article/idUSKBN26Y0J9>.

¹³ Audrey Tan, *Natural Gas to Remain Singapore's Key Energy Fuel for 50 Years*, THE STRAITS TIMES (Oct. 30, 2019), <https://www.straitstimes.com/singapore/environment/natural-gas-to-remain-spores-key-energy-fuel-for-50-years>.

¹⁴ Energy Market Authority, *Advanced CCGTS* (Mar. 31, 2020), <https://www.ema.gov.sg/advanced-ccgt.aspx>.



Singapore has announced several partnerships with international bodies and other countries to keep pace with global technological developments and to work together on practical projects to develop hydrogen markets, supply chains, and standards. The following are examples of some of the memorandums of understanding (MOU) entered into by Singapore companies:

- Keppel Data Centres Holding (Keppel DC), City Gas, and City-OG Gas Energy Services (a business venture between City Gas and Osaka Gas) will explore using liquefied natural

gas (LNG) and hydrogen to power Keppel DC's floating data centre park in Singapore.¹⁵

- Singapore's PSA Corporation, Jurong Port, City Gas, Sembcorp Industries and Singapore LNG Corporation will develop ways to utilize hydrogen as a green energy source alongside Japan's Chiyoda Corp and Mitsubishi Corp.¹⁶
- Singapore and Chile have signed an MOU to study the research and development, application, supply chain and standard setting for the deployment of hydrogen.¹⁷

¹⁵ City Gas, *Keppel Data Centres, City Gas, City-Og Gas Energy Services Sign MOU to Explore Use of LNG and Hydrogen to Power Floating Data Centre Park* (Oct. 26, 2020), <https://www.citygas.com.sg/press-release/keppel-data-centres-city-gas-city-og-gas-energy-services-sign-mou-to-explore-use-of-lng-and-hydrogen-to-power-floating-data-centre-park/>.

¹⁶ Reuter's Staff, *Singapore, Japanese Companies Join to Explore Hydrogen as Energy Source*, REUTERS (Mar. 30, 2020), <https://cn.reuters.com/article/instant-article/idUSKBN21H0Z0>.

¹⁷ Press Release, Ministry of Trade and Indus. Singapore, *Singapore and Chile Sign Memorandum of Understanding for Collaboration on Low-Carbon Hydrogen Technologies*, (Feb. 16, 2021), <https://www.mti.gov.sg/-/media/MTI/Newsroom/Press-Releases/2021/02/Press-Release--Singapore-and-Chile-sign-MOU-for-collaboration-on-lowcarbon-hydrogen-technologies-on.pdf>.

- Singapore signed an MOU with Australia to drive cooperation on low-emissions solutions including hydrogen and carbon capture, utilisation and storage.¹⁸

Singapore has also set forth its vision to phase out internal combustion engine vehicles and have all vehicles run on cleaner energy by 2040.¹⁹ As of 2018, Strides (the private-hire subsidiary of SMRT Taxis, the taxi division of Singapore’s public transport service provider) has announced plans to collaborate with Toyota Motors to roll out the first hydrogen fuel cell taxis in Singapore.²⁰ However, as of January 2020, only 0.2 per cent of the present car population consists of electric vehicles because private car ownership, let alone private electric vehicle ownership, is regarded as a luxury, not a necessity, in Singapore.²¹ Currently, no hydrogen fuel cell vehicles are available for public purchase by consumers in Singapore. Regardless, hydrogen fuel cell vehicles could still be the next step beyond existing electric vehicles.

The excess electricity from Singapore’s current solar energy assets that is wasted during off-peak hours can also be used to generate completely green hydrogen. While Singapore only generates 1.8 per cent of its electricity from renewable sources, solar energy could meet 43 per cent of Singapore’s power demand during mid-day by 2050.²² Singapore’s end goal is to ensure renewable energy sources, storage and transportation are as effective and efficient as possible, and hydrogen will have its part to play as an “energy battery” in the coming years.

However, the necessary construction of hydrogen supply points and the supporting distribution network would lead to a financial “chicken and egg” situation where the market is waiting for the infrastructure and vice versa. However, it is noteworthy that a similar “chicken and egg” situation was forecasted for Singapore’s nascent LNG bunkering industry in 2017 until an influx of LNG infrastructure projects were launched in anticipation of the International Maritime Organization’s 2020 global sulphur cap for bunker

fuels.²³ A similar tipping point is possible for hydrogen as fuel cell technology becomes more cost efficient and widespread adoption becomes necessary.

As of 21 April 2021, Shell has announced that it is “working with several partners to trial the use of hydrogen fuel cells for ships in a first-of-its-kind study for the

energy firm and in Singapore.”²⁴ Shell will develop and install an auxiliary power unit on an existing roll-on/roll-off vessel, which will transport goods, vehicles, and equipment on lorries between mainland Singapore and Shell’s Pulau Bukom manufacturing site for 12 months.²⁵

²³ Jasmine Ovcina Mandra, Interview: *Lng Bunkering No Longer a ‘Chicken and Egg’ Situation*, OFFSHORE ENERGY (June 28, 2018), <https://www.offshore-energy.biz/interview-lng-bunkering-no-longer-a-chicken-and-egg-situation/>.

²⁴ Channel News Asia – *Singapore Edition*, *Shell to Trial First Hydrogen Fuel Cells for Ships in Singapore*, (Apr. 21, 2021), <https://www.channelnewsasia.com/news/business/shell-to-trial-first-hydrogen-fuel-cells-for-ships-in-singapore-14664100>.

²⁵ *Id.*

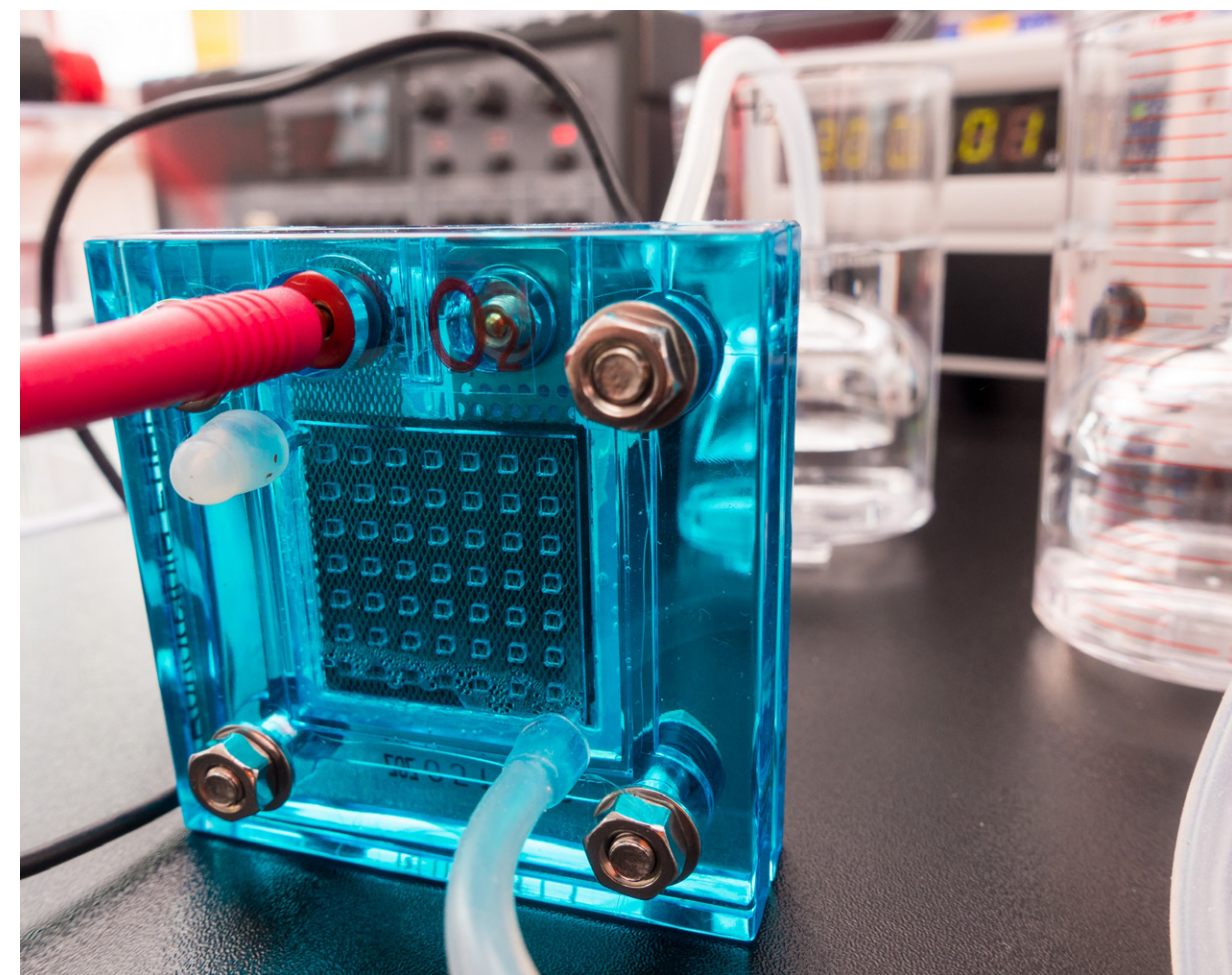
¹⁸ FuelCellsWorks, *Australia and Singapore to Work Together to Accelerate Low Emissions Technologies Such as Hydrogen* (Oct. 26, 2020), <https://fuelcellsworks.com/news/australia-and-singapore-to-work-together-to-accelerate-low-emissions-technologies-such-as-hydrogen/>.

¹⁹ Dylan Loh, *Singapore Vows to Be First in Southeast Asia to Ditch Petrol Cars*, NIKKEI ASIA (Feb. 19, 2020), <https://asia.nikkei.com/Spotlight/Environment/Singapore-vows-to-be-first-in-Southeast-Asia-to-ditch-petrol-cars>.

²⁰ Christopher Tan, *SMRT’s Private-Hire Arm Strides to Offer Hydrogen Cars*, THE STRAITS TIMES (Apr. 17, 2018), <https://www.straitstimes.com/singapore/transport/smrts-private-hire-arm-strides-to-offer-hydrogen-cars>.

²¹ Sharon See, *Charged Up: Singapore’s Journey to the Future of Cars Begins Now*, THE BUSINESS TIMES (Feb. 22, 2020), <https://www.businesstimes.com.sg/brunch/charged-up-singapores-journey-to-the-future-of-cars-begins-now>.

²² Tim Ha, *Solar Could Meet 43% of Singapore’s Power Demand During Mid-Day By 2050: Study*, ECO-BUSINESS (May 12, 2020), <https://www.eco-business.com/news/solar-could-meet-43-of-singapores-power-demand-during-mid-day-by-2050-study/>.



PART III - SINGAPORE'S COMPETITIVE ADVANTAGE AS A FUTURE HYDROGEN TRADING HUB

Despite Singapore's relatively small LNG domestic market, it has already positioned itself as Asia's LNG trading hub and could very likely punch above its weight to become Asia's hydrogen trading hub.

Currently, Singapore relies on hydrogen as an industrial input for oil refining and fertiliser production.²⁶ At the same time, Asia's hydrogen gas demand is projected to rise as oil refineries in the region increase their usage of hydrogen as an input to produce IMO 2020 compliant low sulphur marine fuel.²⁷

The demand for hydrogen has grown steadily over the years at a much faster rate than GDP growth....The twin drivers of hydrogen have been sour crude feedstock processing

(at refineries) and environmental regulations.... There are going to be some projects, many of which in Southeast Asia, whereby refiners will be looking to take bottom of the barrel, residue products, and put them through a gasification process to produce hydrogen which can then be used to desulfurize the sulphur particulates. That's how they are going to address IMO 2020[.]²⁸

The CEO of Linde Plc provided the above comment during the groundbreaking ceremony for Linde's US\$1.4 billion gas project on Singapore's Jurong Island in 2019, which will turn heavy residue fuel into hydrogen that will then be used to reduce the sulphur content of fuel produced.²⁹

²⁶ *Supra* note 11.

²⁷ Florence Tan & Shu Zhang, *RPT-Asia's Demand for Low-Sulphur Fuel Drives Hydrogen Gas Consumption – Linde*, YAHOO FINANCE (Aug. 27, 2019), <https://au.finance.yahoo.com/news/rpt-asias-demand-low-sulphur-012504817.html>.

²⁸ *Id.*

²⁹ *Id.*



PART IV - RELEVANT LEGISLATION

Present legislation and regulations do not treat hydrogen as a fuel or energy carrier but only regulate hydrogen as a dangerous substance.

Hydrogen is presently regulated as a flammable material and dangerous substance under the Fire Safety Act (FS Act) and its subsidiary regulations.³⁰ Under the FS Act, the storage, import, transportation, dispensation, and conveyance over pipelines of hydrogen are licensable in Singapore.

Compressed hydrogen, refrigerated liquid hydrogen and hydrogen-methane mixture are defined as “First Schedule dangerous goods” under the Maritime and Port Authority of Singapore (Dangerous Goods, Petroleum and Explosives) Regulations 2005.³¹ Accordingly, vessels carrying compressed hydrogen are subject to certain restrictions on movement, proceeding into certain prescribed areas of a port in Singapore, anchoring and mooring, as well as discharging and loading of compressed hydrogen.

Lastly, under the Workplace Safety and Health (Major Hazard Installations) Regulations 2017 (WSH Regulations), hydrogen is named as a “dangerous substance” under Schedule 1, and any premises where processing, manufacturing or bulk storage by way of trade or for the purpose of gain is carried out in respect of hydrogen is deemed a “major hazard installation.”³² Companies occupying a major hazard installation are required under the WSH Regulations to:

- Take all measures necessary to reduce the risk of major accidents to as low as is reasonably practicable and to limit the consequences of major accidents.
- Keep and maintain a safety case in respect of the major hazard installation, and review and, if necessary, revise the safety case at least once every five years.
- Comply with registration requirements of the major hazard installation.
- Notify and report any process-related incident to the Commissioner for Workplace Safety and Health.

³⁰ Fire Safety Act ch. 109A, 2000 Rev. Ed.

³¹ Maritime and Port Authority of Singapore (Dangerous Goods, Petroleum and Explosives) Regulations 2005.

³² Workplace Safety and Health (Major Hazard Installations) Regulations 2017.

PART V - SINGAPORE HYDROGEN PROJECTS

Project Name	Announced Start Date	Currently Operational (Y/N)	Elaboration
Semakau Island Microgrid Engie	2018	Y	<p>“ENGIE EPS announces to have successfully completed the Site Acceptance Test of the hydrogen-based energy storage system on Semakau Landfill, Singapore. The Semakau project has been developed in a multifluid microgrid under the frame of the program Renewable Energy Integration Demonstrator – Singapore (REIDS-SPORE) by ENGIE Lab Singapore and Nanyang Technological University consisting in the largest hybrid microgrid test and research platform built in a tropical area.”³³</p>
Zero-Emissions Building Powered by Green Hydrogen in Southeast Asia	2019	Y	<p>SP Group (SP) has established the first zero-emission building in Southeast Asia that is powered by green hydrogen. Located at SP’s training centre at Woodleigh Park, the self-sustaining building is 100 per cent powered with renewable energy via an innovative hydrogen energy system (Hydrogen Energy System) and is disconnected from the national electricity grid.</p> <p>The Hydrogen Energy System can mitigate electricity supply fluctuations and intermittency issues—common shortcomings of renewable energy. When there is surplus renewable energy, it can be stored in the form of hydrogen and converted back to electricity when there is a deficit of renewable energy. This ensures that the grid remains stable, even with a greater mix of renewable energy introduced, hence encouraging the use of green energy.</p> <p>SP is working with Marubeni Corporation and Tohoku University on the Hydrogen Energy System, with special metal alloy storage tanks from Japan, to customise and integrate it for use in Singapore.³⁴</p>

³³ Press Release, ENGIE Eps Hydrogen Technology Records a New Achievement in Singapore, ENGIE EPS (Nov. 4, 2020), <https://engie-eps.com/corporate/engie-eps-hydrogen-technology-records-a-new-achievement-in-singapore/>.

³⁴ Media Release, SP Group, SP Group Sets Up First Zero-Emission Building Powered by Green Hydrogen in Southeast Asia (Oct. 30, 2019), <https://www.spgroup.com.sg/wcm/connect/spgrp/c9d8ef18-9a18-4b91-a98b-0e0c0f611b68/%5B20191030%5D+Media+Release+-+SP+Group+Sets+Up+First+Zero-Emission+Building+Powered+By+Green+Hydrogen+In+Southeast+Asia.pdf?MOD=AJPERES&CVID=#:~:text=Singapore%2C%2030%20October%202019%20%E2%80%93%20SP,is%20powered%20by%20green%20hydrogen.&text=The%20Hydrogen%20Energy%20System%20provides,region's%20first%20zero%2Dmission%20building.>

GLOSSARY SINGAPORE

FS Act	Fire Safety Act
GDP	gross domestic product
Keppel DC	Keppel Data Centres Holding
LNG	liquefied natural gas
MOU	memorandums of understanding
REIDS	Renewable Energy Integration Demonstrator - Singapore
SP	SP Group
WSH Regulations	Workplace Safety and Health (Major Hazard Installations) Regulations 2017

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