INDUSTRY LEADERS COLLABORATE TO DEVELOP INTEGRATED CARBON CAPTURE, UTILISATION AND SEQUESTRATION AND LOWER CARBON HYDROGEN VALUE CHAINS

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Singapore 110124 — Chevron Singapore Pte Ltd, Keppel, Pan-United Corporation, Surbana Jurong, Air Liquide Singapore, Osaka Gas Singapore, and Pavilion Energy (together Parties) have signed a Memorandum of Understanding (MOU) to collaborate on lower carbon opportunities to support Singapore's aspiration of achieving net-zero emissions by 2050[1].

Collectively known as the Low Carbon Technology Industry Consortium (LCT-IC), the Parties will explore through the advancement of technology, to accelerate the development of cost-effective Carbon Capture, Utilisation and Sequestration (CCUS) as well as the production, transportation, distribution and utilisation of lower carbon hydrogen and its derivatives at scale, with the aim of commercialising new lower carbon technology pathways in Singapore.

This is an extension of a previous MOU signed in July 2020, which aimed to accelerate the development of integrated and energy-efficient CCUS systems that lead to industrially scalable solutions and a lower-carbon economy for Singapore. The MOU also welcomes Air Liquide Singapore, Osaka Gas Singapore, and Pavilion Energy as new members to the LCT-IC.

Under the MOU, the LCT-IC members will seek to partner, exchange ideas, share technical insights and develop lower carbon research, development and demonstration guided by the following framework:

Research in lower carbon technology: Develop research and development projects on lower-carbon energy technology solutions together with various Institutes of Higher Learning (IHLs) and Research Institutes (RIs). Other industry collaborators could also be involved as required.

Technology Translation – Partner technology scale-up platforms to translate and advance lab-scale research and technologies of lower Technology Readiness Levels (TRL) to technology test-beds for scale-up.

[1] Singapore And International Efforts (nccs.gov.sg)

Scalable Solutions -- Establish scalable industrial solutions to realise lower carbon value chains, including first-of-its kind, pre-commercialisation demonstration projects.

As a consortium, members regularly engage with technology startups, academia, and research institutes to keep abreast of developments in lower carbon technology in Singapore, which has the potential to scale into commercially viable solutions. This consortium and its members have participated in earlier relevant research grant calls from government agencies. The consortium has also been invited to contribute towards developing new industry standards related to energy transition e.g. CCUS.

Some notable areas of partnerships since the earlier MOU include:

1) Collaboration with the National University of Singapore (NUS) to propose innovative solutions in combating rising seawater levels as part of a Marine Climate Change Science (MCCS) grant call.

2) Participation in the Low Carbon Energy Research (LCER) Grant Call - Chevron and Surbana Jurong partnered with NUS and Nanyang Technological University (NTU) on the development and validation of novel hollow fiber membranes for carbon dioxide (CO2) capture, a project awarded under the LCER Grant Call.

Encouraged by the progress and fruitful discussions, the seven Parties of the consortium are keen to build on these efforts and broaden the partnership and scope of the MOU to include the following, but not limited to; CCUS and lower carbon hydrogen & its derivatives, in end-to-end value chains.

In the area of Carbon Capture and Utilisation, parties are currently exploring opportunities around CO2 mineralization for use within the build and construction sector.

CO2 sequestered in concrete has the potential to lower the embodied carbon of buildings and other structures where concrete could be utilized. Consortium members are expected to be involved at various points within this value chain to jointly study feedstock availability, potential market demand within Singapore and new product qualification requirements. This could be followed by a techno-economic analysis and product life cycle assessment.

Mr Frederick Chew, CEO of A*STAR, who was the guest-of-honour at the MOU signing ceremony, said: “Efforts by such industry consortiums to develop and commercially deploy low-carbon technologies will contribute towards achieving Singapore’s net zero targets. It is heartening to see the scope of this collaboration being broadened, as innovation through R&D will be crucial in tackling common problem statements and barriers to adoption.”

"Partnerships are critical to advance energy transition. This MOU includes partners from diverse industries but with a shared goal of promoting a vibrant ecosystem that enables technological advancements to thrive and create scalable and affordable lower carbon value chains that industry will adopt. LCT-IC industry partners and I are excited with what this next phase of collaboration may bring, as we transition towards a lower carbon energy future," said Law Tat Win, Chevron Singapore Country Chairman, on behalf of the LCT-IC.

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About Air Liquide Singapore

Air Liquide Singapore (ALSg), a fully owned subsidiary of Air Liquide Group, started its operations in 1911 and now employs close to 800 employees. ALSg operates the largest network of air separation plants and gas production facilities, strategically located on 21 sites in Singapore. ALSg partners with diverse industry players to support the Singapore economy through a unique blend of advanced equipment, processes & systems, supported by a highly engaged and competent workforce. For more information on Air Liquide Singapore, please visit www.sg.airliquide.com .

About Chevron

Chevron is one of the world's leading integrated energy companies. We believe affordable, reliable and ever-cleaner energy is essential to achieving a more prosperous and sustainable world. Chevron produces crude oil and natural gas; manufactures transportation fuels, lubricants, petrochemicals and additives; and develops technologies that enhance our business and the industry. We are focused on lowering the carbon intensity of our operations and seeking to grow lower carbon businesses along with our traditional business lines. More information about Chevron is available at www.chevron.com.

About Keppel

Keppel Ltd. (SGX:BN4) is a global asset manager and operator with strong expertise in sustainability-related solutions spanning the areas of infrastructure, real estate and connectivity. Headquartered in Singapore, Keppel operates in more than 20 countries worldwide, providing critical infrastructure and services for renewables, clean energy, decarbonisation, sustainable urban renewal and digital connectivity. Keppel creates value for investors and stakeholders through its quality investment platforms and diverse asset portfolios, including private funds and listed real estate and business trusts.

About Osaka Gas Singapore

Osaka Gas Singapore Pte. Ltd. (" OGS ") was established in 2013 and wholly owned subsidiary of Osaka Gas Co., Ltd. ("Osaka Gas"). Osaka Gas is the second biggest natural gas provider in Japan. OGS provides energy solutions best suited to customer needs by fully leveraging the global network and expertise of Osaka Gas Co., Ltd.

OGS Group has been in the forefront of the energy business in Asia since 2013, expanding its operations from Singapore to Thailand, Indonesia, the Philippines, Vietnam, and India.

For more information about Osaka Gas Singapore, please visit www.ogs.sg

About Pavilion Energy

Pavilion Energy is a wholly-owned subsidiary of Temasek. Headquartered in Singapore, its global energy business encompasses natural gas supply and marketing activities in South-East Asia and Europe; and global LNG trading, shipping and optimisation; as well as energy hedging and financial solutions.

An advocate for LNG and natural gas as the transition fuel of choice, Pavilion Energy is driving energy transition efforts towards a more sustainable future through the development of LNG bunkering for the maritime industry, promoting accurate greenhouse gas emissions measurement, and helping customers meet their emission targets with the trading of voluntary carbon credits.

For more information about Pavilion Energy, please visit www.pavilionenergy.com.

About Pan-United Corporation

Pan-United Corporation Ltd (Pan-United) is a listed Asia-based technology company (SGX:P52) catalysing change in the ready-mix concrete and logistics space. Through concrete innovation, it has advanced to the global forefront of low-carbon concrete technology. A believer in sustainability for over two decades, Pan-United takes pride in making concrete greener and stronger to decarbonize the world, lowering the world's embodied carbon footprint to create a safer world for future generations.

For more information, please visit: www.panunited.com.sg

About Surbana Jurong Group

Surbana Jurong Group is a diverse collective of problem solvers for the built environment, continually reimagining ways to create a smart and sustainable future.

Headquartered in Singapore, the group has a global talent pool of 16,000 in Surbana Jurong and its member companies AETOS, Atelier Ten, B+H, CHIL, KTP, Prostruct, Robert Bird Group, SAA and SMEC, based in more than 120 offices in over 40 countries. They include architects, designers, planners, engineers, facilities managers and other specialists driven by progressive thinking and creative ideas to shape a better future.

Our technical experts deliver sustainable solutions that cover the entire project life cycle from planning and design, through to delivery and management. We also provide a full suite of multidisciplinary consultancy services across a diverse range of sectors including transportation, water, aviation, healthcare, hospitality, energy, CCUS and industrial decarbonisation.

The Group is #23 in Engineering News-Record's 2023 Top 225 International Design Firms, #13 in World Architecture 100 2023, and Asia Pacific FM Technology Provider of the Year 2022, awarded by International Facility Management Association.

For more information, please visit www.surbanajurong.com.

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