



MEDIA RELEASE

14 October 2021

New Technology to Boost Energy Efficiency of District Cooling Systems

A new invention that improves the energy efficiency of District Cooling Systems (DCS) has demonstrated that it could improve the energy carrying capacity by up to three times as compared to a conventional chilled water storage system, and yield more than 10% in cost savings annually. The trial, which completed in August 2021, was conducted at one of Keppel Infrastructure's (KI) district cooling plants in Singapore, located at Changi Business Park.

2 This Thermal Energy Storage (TES) technology solution uses a new Phase-Change Material (PCM) that can store and release cold energy as it changes between liquid and solid states. The stored cold energy is gradually released in a district cooling plant to mitigate cooling peak loads in commercial buildings. This solution was jointly designed and developed by the National University of Singapore (NUS) and Keppel DHCS Pte Ltd (KDHCS), a wholly-owned subsidiary of KI. The project was funded by the Energy Market Authority under its Energy Resilience Grant Call in 2018.

3 The NUS research team has also developed a lab-based cold energy recovery system that harnesses cold energy, which is released as a by-product when liquefied natural gas is converted back into its gaseous state for electricity generation. Cold energy recovered can be stored and released, similar to an energy storage system to balance energy demand and supply when needed. An example is the balancing of intermittent output from renewable energy sources like solar so as to maintain the reliability and resilience of Singapore's power grid.

4 Mr Ralph Foong, Deputy Chief Executive of the Energy Planning and Development Division at EMA, said, "The close collaboration between industry, the research community and the Government has enabled the development of this innovative solution to enhance the efficiency and resilience of our energy sector. EMA is pleased to have supported this project which provides a more energy efficient solution to meet the substantial amount of energy use for cooling in Singapore's warm tropical climate. Through such new technologies and innovations, we can build a more sustainable energy future for Singapore."

5 “TES technology can be likened to a battery that can store thermal energy and release it at the desired time. Our new TES system is specifically designed and engineered to bridge the gap between local cold energy supply and energy demand. It enables the redistribution of cold energy such that peak load demands can be met in an energy-efficient manner. Incorporating the new TES technology in KDHCS district cooling plants offers immense potential for the success of low energy designs to meet Singapore’s cooling needs. This innovation marks a significant milestone in our progress towards a sustainable future,” said the project’s Principal Investigator, Associate Professor Ernest Chua from the NUS Department of Mechanical Engineering.

6 Mr Chua Yong Hwee, Executive Director of New Energy at Keppel Infrastructure, said, “We are pleased to have partnered with NUS and EMA in successfully developing this new technology. This is in line with Keppel’s Vision 2030 which places sustainability firmly at the core of the Company’s strategy. The novel TES solution will enhance KDHCS’s ability to meet Singapore’s cooling needs in a more energy efficient manner through a new and better thermal energy storage material, as well as the recovery and use of cold energy which would otherwise have been lost. This innovation can also potentially help to alleviate intermittency in the electrical grid when more renewable sources are integrated.”

7 As part of the Energy Resilience Grant Call by EMA, S\$15 million in grants were awarded in 2018 to seven energy innovations to strengthen the resilience of Singapore’s power system and energy markets. Learn more about these innovative energy projects supported by EMA at: <https://energyinnovation.ema.gov.sg/eishowcase/>

Annex A: Photos of awarded project

Annex B: Infographic on awarded project

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About the Energy Market Authority

The Energy Market Authority (EMA) is a statutory board under the Singapore Ministry of Trade and Industry. Through our work, we seek to forge a progressive energy landscape for sustained growth. We aim to ensure a reliable and secure energy supply, promote effective competition in the energy market and develop a dynamic energy sector in Singapore. Visit www.ema.gov.sg for more information.

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About National University of Singapore (NUS)

The National University of Singapore (NUS) is Singapore's flagship university, which offers a global approach to education, research and entrepreneurship, with a focus on Asian perspectives and expertise. We have 17 faculties across three campuses in Singapore, with more than 40,000 students from 100 countries enriching our vibrant and diverse campus community. We have also established our NUS Overseas Colleges programme in more than 15 cities around the world.

Our multidisciplinary and real-world approach to education, research and entrepreneurship enables us to work closely with industry, governments and academia to address crucial and complex issues relevant to Asia and the world. Researchers in our faculties, 30 university-level research institutes, research centres of excellence and corporate labs focus on themes that include energy; environmental and urban sustainability; treatment and prevention of diseases; active ageing; advanced materials; risk management and resilience of financial systems; Asian studies; and Smart Nation capabilities such as artificial intelligence, data science, operations research and cybersecurity.

For more information on NUS, please visit www.nus.edu.sg.

About Keppel DHCS

Keppel DHCS is the first and largest district cooling systems (DCS) service provider in Singapore, and provides cooling services through the development and operation of DCS at major business parks and retail cooling to selected standalone commercial and industrial buildings.

Incorporated in 1998, Keppel DHCS is a wholly-owned subsidiary of Keppel Infrastructure.

In Singapore, Keppel DHCS services Changi Business Park, one-north (Biopolis, Fusionopolis, Mediapolis) and Woodlands Wafer Fab Park, with a total plant installed capacity that exceeds 65,000 Refrigeration Tons. A district heating and cooling system plant developed by Keppel DHCS's joint venture in the Sino-Singapore Tianjin Eco-City also commenced commercial operation in 2013. Keppel DHCS also provides retail cooling to 10 commercial buildings in Singapore, with a total installed capacity that exceeds 10,000 Refrigeration Tons.

PHOTOS OF AWARDED PROJECT



*The Phase-Change Material thermal energy storage system installed at Keppel DHCS' Changi Business Park District Cooling Systems plant.
Photo credit: Keppel DHCS*



*The Phase-Change Material thermal energy storage tank
Photo credit: Keppel DHCS*

INFOGRAPHIC ON AWARDED PROJECT

New Technology to Boost Energy Efficiency of District Cooling Systems

The new Thermal Energy Storage (TES) technology which uses a novel Phase-Change Material (PCM), can be applied to harness the cold energy by-product from the regasification of Liquefied Natural Gas (LNG), and can be applied to improve the energy carrying capacity of existing District Cooling Systems (DCS) plants by up to three times.

PCM increases energy carrying capacity by **UP TO 3 TIMES**



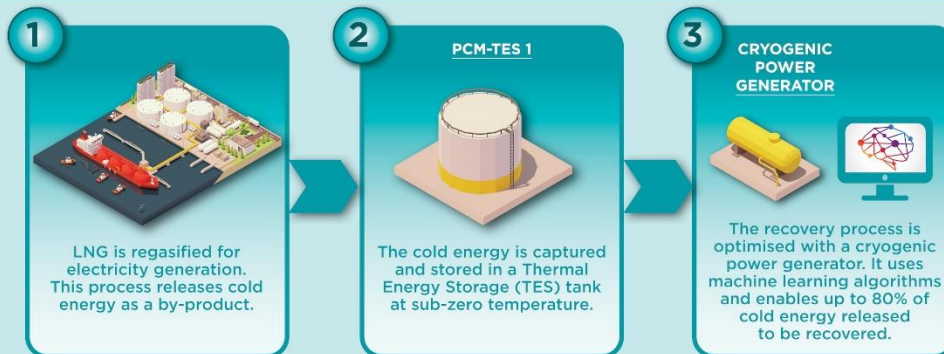
>10% IN ANNUAL COST SAVINGS achieved during trial at DCS plant



Machine learning algorithms enable **UP TO 80%** of cold energy to be recovered



Application for harnessing cold energy from LNG regasification (Concept Test at National University of Singapore)



Cold energy recovered can be used for applications such as district cooling systems. This can be done by transporting the cold energy to another TES tank.

Application for District Cooling Systems (Trial at one of Keppel Infrastructure's district cooling plants in Singapore, located at Changi Business Park)



Photo credit: Keppel DHCS