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Hydrogen-based ironmaking: MHI Australia and Primetals Technologies join Heavy Industry Low-Carbon Transition Cooperative Research Centre

- **Goal is to conduct research and advance hydrogen-based direct reduction technologies for zero-carbon iron production in Australia**
- **Collaboration involves University of Adelaide, Australian National University and many other companies and academic institutions**
- **Funding for projects includes AUD 175 million in cash and in-kind contributions from partners and AUD 39 million in grants from the federal government of Australia.**

Mitsubishi Heavy Industries (MHI) Australia and Primetals Technologies, a member of Mitsubishi Heavy Industries (MHI) Group, have joined Australia's Heavy Industry Low-Carbon Transition Cooperative Research Centre (HILT CRC) as key partners. The Centre, a not-for-profit entity with significant government funding, aims to develop technologies to decarbonize Australia's heavy industrial sector, leverage the country's natural endowments in mineral and clean energy resources and seize the opportunity of growing export markets for certified low-carbon products. Over the next 10 years, Primetals Technologies and MHI Australia will be contributing financially as well as with their decades-long experience in iron and steel production to this effort. The companies will focus on research and development of hydrogen-based direct reduction of iron ore. This includes the novel HYFOR (hydrogen-based fine-ore reduction) technology currently being piloted by Primetals Technologies in Europe.

Australia has the world's largest iron ore deposits and is the leading exporter of iron ore. Since the iron and steel sector is responsible for 7–10% of greenhouse gas emissions globally, Australia has a key role to play in the decarbonization of the industry—an effort which needs to be accelerated. Switching from traditional coal and coke-based ironmaking processes to hydrogen-based production methods is the only way for the industry to fully decarbonize. Deploying these technologies at scale in Australia could move producers up the value chain and turn the country into a major exporter of low-carbon, direct-reduced

iron. This would help Australia meet its obligations under the Paris Agreement and make it easier for the global iron and steel industry to reach net-zero by 2050.

Primetals Technologies brings an extensive portfolio of iron ore beneficiation, pelletizing, sintering and iron ore reduction technologies to the table. It has been involved in the deployment of one third of the global fleet of MIDREX DRI plants — the now predominant natural gas based direct-reduction technology, which can be operated on 100% hydrogen. Earlier this year, Primetals Technologies commissioned a pilot plant for its novel HYFOR (Hydrogen-based Fine Ore Reduction) technology at a site of Austrian steelmaker voestalpine. The technology builds on the company's extensive experience with the FINMET process, first introduced by Primetals Technologies in Australia (BHP Port Hedland) in the late 1990s. The next step — building an industrial-scale HYFOR prototype — will be decided by the end of the year.

Dr. Alexander Fleischanderl, Technology Officer Upstream and Head of Eco Technologies, Primetals Technologies, said: "Australia has large deposits of iron ore, great potential for green energy, and boasts a dynamic academic and business environment. This puts the country in a unique position in the quest for net-zero by 2050 as a supplier of clean metalics. The HILT-CRC, with its wide range of partners from across the energy, hydrogen, mining, and cement industries, will form a great ecosystem for innovation."

Through MHI Group's advanced technologies and strong collaborations with the Australian government and universities, MHI Australia is an active partner in Australia's sustainable development efforts with a focus on energy and decarbonization. MHI is partnering with the Government of New South Wales to propose a comprehensive development plan for the Western Sydney region. MHI is also working with H2U to support the Front-End Engineering and Design (FEED) study for H2U's Eyre Peninsula Gateway™ project in South Australia, a greenfield development for the production of green hydrogen and ammonia planned to commercially operate from early 2023. It is anticipated that MHI Australia's involvement with the HILT-CRC will expand and evolve over time – further contributing to Australia's industrial development.

Shigeru Nakabayashi, Managing Director, MHI Australia, said: "There is an urgent need to decarbonize the industry sector which is currently responsible for a significant portion of carbon emissions. MHI Group's advanced technologies allows us to partner with Australia – a country where iron ore and iron manufacturing are key industries – in efforts to reduce emissions. We are on track to achieving gas turbines fueled by 100% hydrogen and ammonia by 2025, and we look forward to contributing to HILT-CRC's aim to decarbonize Australia's heavy industry sector with our innovative, low-carbon solutions, including Primetals Technologies' HYFOR technology."

This partnership will contribute to MHI Group's aim to realize a carbon neutral future – one of the most critical challenges faced today – by helping to establish a robust hydrogen solutions ecosystem in Australia and around the world.



Photo of the HYFOR direct reduction pilot plant for iron ore fines developed by Primetals Technologies and located at the voestalpine site in Donawitz, Austria. By joining the Heavy Industry Low-Carbon Transition Cooperative Research Centre, MHI Australia and Primetals Technologies will help Australia's iron and steel sector to decarbonize.

Notes to editors:

HYFOR (Hydrogen-based Fine-Ore Reduction) is a novel direct reduction process for iron ore fines concentrates from ore beneficiation, developed by MHI Group company Primetals Technologies. It builds on fluidized-bed reduction technology, does not require any agglomeration (such as sintering or pelletizing), and uses on 100% hydrogen as a feedstock. This reduces carbon emissions by 90% compared to traditional ironmaking methods. A HYFOR pilot plant was recently started up at a site of Austrian steelmaker voestalpine.

The **MIDREX**[®] process is the world's leading direct-reduction technology for iron ore, developed by MIDREX Technologies, Ltd. The process uses a shaft furnace to reduce

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iron ore to iron using a reforming gas made from natural gas. It can also run on up to 100% hydrogen.

FINMET is a fluidized-bed type technology for iron ore reduction using natural gas. It was developed by Primetals Technologies' predecessor company VAI.

This press release and a press photo are available at www.primetals.com/press/

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MHI Group is one of the world's leading industrial groups, spanning energy, logistics & infrastructure, industrial machinery, aerospace and defense. MHI Group combines cutting-edge technology with deep experience to deliver innovative, integrated solutions that help to realize a carbon neutral world, improve the quality of life and ensure a safer world. For more information, please visit www.mhi.com or follow our insights and stories on www.spectra.mhi.com

Primetals Technologies, Limited, headquartered in London, United Kingdom, is a pioneer and world leader in the fields of engineering, plant building, and the provision of lifecycle services for the metals industry. The company offers a complete technology, product, and services portfolio that includes integrated electrics and automation, digitalization, and environmental solutions. This covers every step of the iron and steel production chain—from the raw materials to the finished product—and includes the latest rolling solutions for the nonferrous metals sector. Primetals Technologies is a joint venture of Mitsubishi Heavy Industries and partners, with around 7,000 employees worldwide. To learn more about Primetals Technologies, visit the company website www.primetals.com.