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Calix Zero Emission Steel Technology engineering study finds high potential economical green iron solution

Sydney, Australia | 12 February 2024 – Australian environmental technology company Calix Limited (ASX:CXL, Calix) is pleased to announce that it has completed a Front-End Engineering and Design (FFED) study for a 30,000 tonne per annum Zero Emissions Steel Technology (ZESTY) Hydrogen Direct Reduced Iron (H-DRI) demonstration plant. The study was supported with funding from the Australian Renewable Energy Agency (ARENA).

Highlights

- The FEED study estimates ZESTY can produce near-zero emissions hot briquetted iron (HBI) from low grade iron ore for ~AUD$630–800 per tonne of HBI.
- This cost is close to the range of existing, carbon-intensive HBI processing costs[1], before any benefit of emissions reduction is accounted for.
- ZESTY would reduce the emissions intensity of reducing iron ore to metal iron from 1.89 tonnes of CO_2 / tonne of iron to near zero. The reduction of iron ore to metal iron currently accounts for 80-85% of the steel industry's carbon dioxide emissions.[2]
- An expansive ore testing program demonstrated metallisation degrees of commercial grade for a range of ores, including low grade Australian hematite ore.
- ZESTY's low cost of production is driven by efficient hydrogen use, efficient electric heating, and the elimination of additional processing steps.
- Further cost savings are expected as the technology is scaled and refined.
- A Final Investment Decision on a ZESTY HBI Demonstration facility is being progressed and is subject to plant location and commercial agreements currently under negotiation.

The ZESTY FEED study aimed to complete the initial engineering for a 30,000 tonne per annum ZESTY Hydrogen Direct Reduced Iron (H-DRI) demonstration plant and provide an estimate of the levelised cost of producing briquettes of H-DRI using iron ore fines (<6mm) of low-grade hematite or hematite/goethite blends using the ZESTY technology. The study was supported by an expanded ore testing program at Calix's Bacchus Marsh pilot scale facility, covering a large proportion of Australian iron ore sources.

For background information on Calix's Zero Emissions Steel Technology (ZESTY), please refer to Calix's ASX release dated 8 November 2022.[3]

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[1] Simplified levelised cost of competing low-carbon technologies in steel production. IEA. 2020
[2] Climate change and the production of iron and steel. World Steel Association. 2021
[3] Calix awarded ARENA funding for further development of Zero Emissions Steel Technology

ZESTY FEED study results

The FEED study estimates that HBI production from low grade iron ore can be produced for a price of ~AUD$630-$800 / tonne iron using the ZESTY technology at demonstration scale. This value includes the capital cost of the plant and the processing cost. It does not include the cost of land or the cost of transport of the input and output materials.

The estimated cost of HBI production by ZESTY at demonstration scale is close to the range of existing conventional HBI processing costs. This is despite the use of hydrogen as a reductant, and does not take credit for any carbon price, carbon border adjustment mechanism, or other green premium that a near zero emissions iron product may attract. A near zero emissions ZESTY HBI product would enable between 80 to near 100 per cent total reduction in carbon emissions from the final steel product, depending on the processing route used.[4]

ZESTY's potential to achieve a cost of production close to the range of conventional HBI production costs[5] even at small (demonstration) scale is a result of its minimal use of hydrogen, the relative simplicity and efficiency of the electrically heated process, and the elimination of the agglomeration and induration process steps. The total energy requirement of the process is projected to be 4.2-4.6MWh / tonne iron, including the requirements to produce hydrogen. The ZESTY plant's energy requirement excluding hydrogen production is projected to be 0.9-1.3MWh / tonne iron.

The overall capital and operating costs are expected to reduce further as the core technology is scaled and refined. The Calix ZESTY process takes advantage of a short residence time while utilising lightweight materials, resulting in a processing plant that is simple to construct and operate.

Compatible with intermittent and renewable sources of electricity, ZESTY may also be able to provide a versatile load balancing service to the energy grid, due to the technology's potential to match its energy use to the grid's requirements across a wide range. Demand side load balancing – analogous and complementary to supply side energy storage – could support further renewable energy integration into the grid, lower grid balancing costs, and potentially enable more economical industrial energy use.

Expanded ore testing results

The expanded ore testing program demonstrated metallisation degrees (conversion of iron ore to iron) of 70- 95% for a wide range of Australian goethite and hematite ores resulting in a product with an iron content of 66–85%. These results prove the technology can produce sufficient commercial grades at this scale, particularly for blast furnace / basic oxygen furnace (BF/BOF) steelmaking.

Further work is underway to upgrade the iron content of the final briquette and improve the suitability of the product for direct use in Electric Arc Furnaces (EAF), as well as evaluating other post H-DRI purification steps such as Electric Smelting Furnaces (ESF) being developed by the likes of BHP (ASX:BHP), Rio Tinto (ASX:RIO) and BlueScope (ASX:BSL).

[4] Climate change and the production of iron and steel. World Steel Association. 2021

[5] Simplified levelised cost of competing low-carbon technologies in steel production. IEA. 2020

Summary and next steps

The ZESTY H-DRI FEED study and ore testing plan has been highly successful. It has proven the technology at pilot scale and given considerable confidence that at demonstration scale, ZESTY HBI has the potential to be produced at economically attractive costs, even before the cost of carbon is taken into account.

Actual total CAPEX and the preferred site for the ZESTY HBI Demonstration facility remains commercial in confidence while final commercial and financing contracts are negotiated. A Final Investment Decision on the Demonstration Plant is being progressed and is subject to these negotiations.

Study assumptions:

- Total cash cost of iron ore of $54 AUD/ tonne, based on average production prices
- Cost of electricity based on forecast spot market pricing, with an average cost of $36-48 AUD/MWh plus transmission and connection capital costs (included in the Capex analysis).
- Effective levelised cost of hydrogen of AUD$5.5-$6.2/kg H_2 based on electrolyser CAPEX and electricity costs
- Conservative (high) operational costs and other overheads based on averaged numbers from existing similar scale plants.

–ENDS–

This announcement has been authorised for release to the ASX by:

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About Calix

Calix Limited (ASX: CXL) is an environmental technology company solving global challenges in industrial decarbonisation and sustainability, including CO_2 mitigation, sustainable processing, advanced batteries, biotechnology and water treatment.

Calix's patented core platform technology delivers efficient indirect heating of raw materials to enable electrification of industries, efficient capture of unavoidable emissions, and green industrial processing solutions. Its flash heating approach can also produce unique nanoporous materials with enhanced chemical and/or bio-activity.

Leveraging its core platform technology and a global network of research and development collaborations, Calix is urgently developing multiple environmental businesses that deliver positive global impact. Because there's only one Earth.

Mars is for quitters.

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