19 December 2023

Australian Securities Exchange Limited
10th Floor
20 Bridge Street
SYDNEY NSW 2000

Dear Sir/Madam

CLEAN HYDROGEN TECHNOLOGIES CORP - INVESTMENT UPDATE

At a shareholders' meeting held on 21 June 2022 shareholders voted unanimously to approve an investment in hydrogen technology company, Clean Hydrogen Technologies Corporation (**Clean Hydrogen**) together with BPH's 35.8% investee Advent Energy Ltd (**Advent**), Clean Hydrogen is based in the United States and has established a Centre of Excellence (**CoE**) in India, 6 hours north of Mumbai, for the purposes of research and development of its hydrogen technology.

As previously announced on 27 October 2023, in October 2023, BPH, Advent and Clean Hydrogen entered into a Loan Conversion Agreement whereby BPH and Advent together now have an interest of 19.5% in Clean Hydrogen.

BPH and Advent (together, the **Purchasers**) have been assessing new investment opportunities, where there are ever increasing obligations to provide energy solutions with a responsible management and protection against carbon emissions. In 2019, the International Energy Agency reported that the transitioning from hydrocarbons such as coal and oil to hydrogen, produced with no CO2 emissions, is now presenting real economies and growth globally (report prepared for the G20 held in Japan, titled *The Future of Hydrogen Seizing Today's Opportunities*)[1].

Clean Hydrogen has developed and tested its processing capabilities which have successfully produced hydrogen, with no CO2 emissions, achieving on average above 90% cracking efficiency. Cracking efficiency refers to the percentage of hydrocarbons broken into solid carbon and hydrogen per hour. This high level of cracking efficiency has been consistently achieved across proof-of-concept tests undertaken by Clean Hydrogen in 2022 and 2023.

Clean Hydrogen have tested the performance of a number of catalysts in the period between April 2022 and September 2022 and have determined that several of the catalysts have given methane cracking conversion rate (efficiency) more than 90%, for several hours. To achieve these results, Clean Hydrogen currently uses methane as its feedstock however, in the future, plans to use natural gas as its feedstock through the pyrolysis method (explained further below).

[1] International Energy Agency Global Hydrogen Review Report 2021

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Clean Hydrogen's development activities and testing have shown that, by pyrolysis processing (not burning) methane gas using its catalyst in a modified fluidised bed reactor, it can produce hydrogen with no CO2 emissions. This is referred to as Turquoise Hydrogen, which is hydrogen that is produced using a process called pyrolysis, where the feedstock is natural gas (specifically the hydrocarbons such as acetylene, methane, butane, propane, and others). Pyrolysis is defined as the method of heating solids, liquids, or gases in the absence of oxygen[2]. The pyrolysis process is not new and has been used by the oil industry for many years. What is new, is Clean Hydrogen's success in the efficiency of its cracking the methane into Turquoise Hydrogen with non-CO2 emissions and the quality of the carbon black produced, being majority Carbon Nano-Tubes (**CNTs**), which are highly conductive and used in battery manufacturing.

In Clean Carbon's testing, the majority of the carbon formed (over 80%) from cracking hydrocarbons to date are CNTs. This type of carbon was determined using Scanning Electron Microscopy (**SEM**) analysis, which enables the high-resolution imaging of single nanoparticles with sizes well below 1 nm or micron, as is the case for CNTs. The Clean Hydrogen process is more specifically called a thermos-catalytic pyrolysis, which uses 800-900 degrees heat centigrade in the reactor in the absence of oxygen.

The Company confirms that there are no non-CO2 greenhouse gas emissions that are produced or released as a result of Clean Hydrogen's production process.

Steam Methane Reforming vs Clean Carbon pyrolysis process

Over 80% of the world's hydrogen is produced using a process called Steam Methane Reforming (**SMR**)[3]. The Clean Hydrogen process requires similar energy needs as SMR and at scale, Clean Hydrogen is of the view that it can be produced at a similar price.

Clean Hydrogen's Chief Science Officer, Dr Vivek Nair (PhD material science engineering) has examined research undertaken by Nuria Sánchez-Bastardo, Robert Schlögl, and Holger Ruland published in *Industrial & Engineering Chemistry Research* 2021 60 (32), 11855-11881[4], which shows that the electrical energy required to produce 1kg of hydrogen from SMR is 8.81 kwh, 39.69kwh for electrolysis and 5.24kwh for pyrolysis at the reaction level. As such, the pyrolysis process requires less energy than SMR to achieve cracking and uses the same feedstock, natural gas. This energy analysis is conducted without considering the benefits from the use of a catalyst in the pyrolysis process, such as Clean Hydrogen's catalyst, which implies that pyrolysis at scale can be cheaper than SMR. Further, as the process creates two products, which are hydrogen and CNTs, the combined income source provides a means to produce hydrogen at a cheaper net cost.

Clean Hydrogen

The Clean Hydrogen solution is being built with flexibility to work downstream at heavy transport fuelling hubs currently in use in the USA, mid-stream at steel plants replacing coking coal and upstream where the natural gas is processed into hydrogen, a much higher energy source which can be piped for all uses including the production of electricity. As such the technology being developed by Clean Hydrogen's solution requires very little change and impact to existing infrastructures and supply chains, unlike other solutions.

[2] 'Methane Pyrolysis: hydrogen without CO2 Emissions' www.tno.nl/en/technology-science/technologies/methane-pyrolysis/
[3] Nuria Sánchez-Bastardo, Robert Schlögl, and Holger Ruland *Industrial & Engineering Chemistry Research* **2021** 60 (32), 11855-11881https://pubs.acs.org/doi/10.1021/acs.iecr.1c01679
[4] https://pubs.acs.org/doi/10.1021/acs.iecr.1c01679

Clean Hydrogen has produced hydrogen beyond lab scale tests at the CoE and is now planning to scale up to a commercial production in 2024. There are three (3) stages to Clean Hydrogen scaling to commercial production:

Stage 1 Completed Stage:

Clean Hydrogen has completed work in 2022 / 2023 on how to scale the catalyst production at the CoE. They have also scaled the reactor to 1/3 of the internal diameter of the full scale commercial system reactors planned for use in Stage 3, explained below.

Stage 2 Current Commercial Stage:

Before moving to Stage 3, Clean Hydrogen plans to demonstrate the commercial viability of its two (2) products; Turquoise Hydrogen and solid carbon. This will be performed using a reactor half the internal diameter of the Stage 3 reactor. It will also require Clean Hydrogen to build the end to end process for separating out the hydrogen from the uncracked hydrocarbons and then compressing it into hydrogen bottle storage. Clean Hydrogen will demonstrate the commercial viability of its products by selling a carbon product called carbon composite made from majority based CNTs and Alumina and bottled hydrogen of 99%+ purity. Clean Hydrogen is currently in the final stages of the assembly of the end to end systems for this.

Stage 3 Scale and Commercial:

The Stage 3 system is planned to have two (2) reactors working together, illustrating that Clean Hydrogen can scale several reactors together. Clean Hydrogen's final customer systems are planned to have a network of several reactors working together. Stage 3 is planned for completion in 2024.

David Breeze (Managing Director) authorised the release of this announcement.

David Breeze
Executive Director