



## **Shareholder Update: HydroMOR & COHgen development**

**Wednesday 22 Nov 2017:** Environmental Clean Technologies Limited (ASX: ESI) (ECT or Company) is pleased to provide the following update on the progress of its new hydrogen-based technologies, HydroMOR and COHgen.

### **Key points:**

- HydroMOR: Hydrogen-based Metal Oxide Reduction – a low-temperature primary iron making process that utilises abundant, low-cost lignite instead of high-cost coking coal or natural gas
- HydroMOR international patent application filed
- COHgen: Catalytic Organic Hydrogen generation – a new method for deriving hydrogen and other high-value gas streams from low-cost lignite
- COHgen laboratory test data confirms initial hypotheses, yielding high hydrogen and other syngas concentrations – provisional patent application to be lodged in the coming months

### **HydroMOR PCT Application Filed**

Further to previous announcements regarding HydrMOR (24 Nov 2016) and COHgen, HydroMOR has taken the next significant step forward on its commercialisation pathway.

This time last year the Company announced the submission of a new Australian provisional patent application on an improved metal oxide reduction process called HydroMOR.

The submission of the provisional application here in Australia last November provided a 12-month window in which to subsequently submit an international patent application under International Patent Cooperation Treaty (PCT) rules.

The Company is pleased to advise it has filed its PCT application for HydroMOR within the 12-month window.

This outcome increases ECT's confidence to develop this technology commercially.

Further general background on the PCT process is available below.

### **COHgen Strong Results Drive Provisional Patent Process**

On 12 July 2017, the Company announced its research into the potential of hydrogen generation from brown coal.

The Company has continued to research the role that hydrogen plays in chemical reactions involving brown coal, which stems from its deeper understanding garnered via the development of the Matmor and HydroMOR processes.

Recent experimental activity at the Company's R&D facility in Bacchus Marsh, northwest of Melbourne has confirmed initial hypotheses regarding the potential to liberate hydrogen from brown coal via the unique process developed for ECT by its lead scientist, Mr Keith Henley-Smith.

Further research and development is required to confirm scalability and techno-economic feasibility, however sufficient data has been generated to allow the Company to commence preparation of a provisional patent application for submission in coming months.

If successfully commercialised, COHgen has the potential to generate hydrogen from brown coal, delivering a higher value product from a low-cost resource for a market that is expected to grow exponentially in coming decades with the emergence of hydrogen fuel cell vehicles (HFCV's).

### **Background – HydroMOR**

The Company's Matmor process has been the subject of significant activity in the past few years:

1. The purchase of the Matmor Test Plant assets at its Bacchus Marsh facility (Dec 2014)
2. The acquiring of the Matmor intellectual property from the original owners (Dec 2014)
3. Subsequent development work related to the India project opportunity with partners, NLC India and NMDC
4. Upgrade works to the Matmor Test Plant at Bacchus Marsh to ready it for a new period of experimental activity in support of Pilot Plant design works
5. Execution of experimental activity over the past 12 months

The new process, HydroMOR, is an improvement over the existing Matmor process, deriving further advantage from its unique raw material base, especially the hydrocarbon-rich low-rank coals used in the role of reductant.

The process derives its name from the utilisation of hydrogen to enhance the reduction process used to transform metal oxides, such as iron ore, to a metallic state suitable for melting, refining and casting.

The benefits the Company sees in the application of the HydroMOR process include further reductions in plant capital cost due to its ability to achieve the required metal reduction at a lower temperature, and operating savings regarding raw material efficiency improvements, as well as decreased CO<sub>2</sub> intensity. By applying the capital cost savings to carbon offsets, the potential of carbon emission-neutral steel production is brought closer.

### **Background – COHgen**

Investors will understand that the Company is not at liberty to disclose the details regarding COHgen due to the need to secure the intellectual property via the patent process first.

Suffice to say, the invention of the HydroMOR process as an improvement over the Matmor process took the Company's researchers in new and interesting directions, resulting in further hypotheses and a series of inventive steps that led to COHgen.

Mr Keith Henley-Smith, Chief Engineer for COHgen and formerly the Chief Engineer for Matmor and HydroMOR, has again led the breakthroughs for ECT in this field of research resulting in a unique process capable of liberating hydrogen and other valuable gas streams from brown coal. Initial data suggests the process may be more efficient than the current dominant hydrogen production method involving the 'steam reforming' of natural gas.

### **Background – Patent Application Process**

To obtain patent protection, it is ultimately necessary for an application to be filed with a Patent Office in each country where protection is to be sought. However, international conventions exist that enable applications to be initially filed in a single country, with subsequent applications being filed individually in other jurisdictions within a defined time limit.

A single International Patent Cooperation Treaty (PCT) application can be filed, based on an application in a single country such as Australia, covering several contracting states. The PCT application does not ultimately get granted as a patent, but rather allows the filing of national patent applications in individual

countries to be deferred up to a set date, typically 30 months from the filing date of the first patent application, such as the first provisional patent application.

While most countries require a local patent application to be filed, in some cases, regional patent applications can be filed covering a group of individual countries. For example, a European patent application can be filed, which can allow subsequent patents to be granted in up to 38 countries.

Each country will typically perform an independent search and then assess whether the patent application meets the patentability requirements, considering their own local law. Assuming any objections are overcome, the patent application can then be granted allowing this to be subsequently enforced to prevent third parties exploiting the invention.

Patent rights can be assigned or can be licensed on an exclusive or non-exclusive basis.

**For further information, contact:**

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**About ECT**

ECT is in the business of commercialising leading-edge energy and resource technologies, which are capable of delivering financial and environmental benefits.

We are focused on advancing a portfolio of technologies, which have significant market potential globally.

ECT's business plan is to pragmatically commercialise these technologies and secure sustainable, profitable income streams through licensing and other commercial mechanisms.

**About Coldry**

When applied to lignite and some sub-bituminous coals, the Coldry beneficiation process produces a black coal equivalent (BCE) in the form of pellets. Coldry pellets have equal or superior energy value to many black coals and produce lower CO<sub>2</sub> emissions than raw lignite.

**About MATMOR**

The MATMOR process has the potential to revolutionise primary iron making.

MATMOR is a simple, low cost, low emission production technology, utilising the patented MATMOR retort, which enables the use of cheaper feedstocks to produce primary iron.

**About the India R&D Project**

The India project is aimed at advancing the Company's Coldry and Matmor technologies to demonstration and pilot scale, respectively, on the path to commercial deployment.

ECT has partnered with NLC India Limited and NMDC Limited to jointly fund and execute the project.

NLC India Limited is India's national lignite authority, largest lignite miner and largest lignite-based electricity generator.

NMDC Limited is India's national iron ore authority.

**Areas covered in this announcement:**

ECT (ASX:ESI)	ECT Finance	ECT India	India Project	Aust. Project	R&D	HVTF	Business Develop.	Sales
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