CRT Flexi-Fuel Ammonia Fuel Cell

Clean, Modular Power
Enabling the Future of Decarbonized Energy

Cavendish Renewable Technology

Dr. Ani Kulkarni, CEO
June 2025

Funding Acknowledgement

The project gratefully received funding from the Australian Renewable Energy Agency (ARENA) as part of ARENA's Hydrogen Research and Development Funding Round, awarded to Cavendish Renewable Technology Pty Ltd for the project titled Efficient, Scalable, and Modular Ammonia to Hydrogen/Electricity Conversion System.

The views expressed herein are not necessarily the views of the Australian Government, and the Australian Government does not accept responsibility for any information or advice contained herein

Company Snapshot

About

- **Australian Cleantech Company based in Melbourne, 4 years in operation**
- **Focused on hydrogen electrolyser, natural gas/ammonia fuel cells and carbon recycling technologies**

Key Stats

120Yrs+
Team Experience

A$7M
Invested in R&D

Multimillion +
in non-dilutive development funding

30M+
potential royalty streams

Current Focus

- Advancing pilot for ceramic tech
- Commercialization of already scaled and proven AEM electrolyser technology

Core Technologies

Two core technology domains:

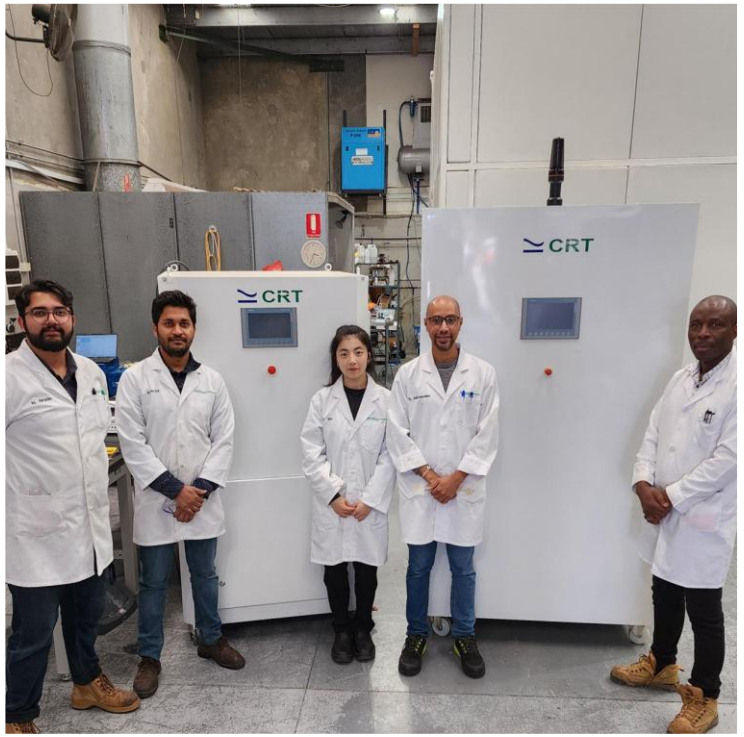
- ***Polymer Electrochemistry -AEM Electrolyser***– scalable, cost-effective green hydrogen/derivatives , proven at industrial scale and out of lab. Licensed to multinational and more JV/Licensing discussions
- ***Ceramic Electrochemistry*** – next-generation electrolyser C-Cell (highest efficiency without external heat), ammonia/NG fuel cells and CO_2 recycling for clean steel

Team and Partnerships

•**Collaboration ecosystem**: Partnerships with leading US/Australian universities and global multibillion dollar industrial powerhouse
•**Facilities & Team**: 11 scientists/engineers, 2 workshops in Melbourne, industrial scale electrolyser test platform
•**Governance**: Board with strong techno-commercial expertise and startup ecosystem

Track Record of Innovation – From Lab to Market

- **Delivered industrial-scale hydrogen electrolyser to partner** as part of a multi-million-dollar development and licensing agreement, with ongoing royalties for Indian production.
- **Scaled proprietary electrode coating and stack technology** over four years, demonstrating commercial readiness and manufacturing capability.
- **Now focused on Ammonia fuel cells and CO_2 recycling** , leveraging dedicated, state-of-the-art facilities in Rowville, including CRT's in-house workshop and state of the art CO_2 recycling testing labs



CRT designed and built system ready for deployment at various scales

Collaborations/ Partners/ Commercial Contracts

Ammonia Utilisation Challenges & Opportunities

Challenges

Poor Combustion
Low flame speed and high NO_x emissions

Cracking Requirements
Needs high-temperature reactors and catalysts

Costly Purification
Traditional H_2 systems rely on palladium membranes

Integration Complexity
Hard to use with conventional engines or variable loads

Opportunities

Carbon-Free & Renewable
Burns or cracks without producing CO_2. Enables deep decarbonisation using renewable electricity.

High Energy Density & Storage
High volumetric energy density and easier to store than hydrogen (liquefies under moderate pressure or cooling).

Established Infrastructure & Scalable Export
Compatible with existing global transport and storage systems. Suitable for large-scale energy export (e.g. Australia to Asia).

Versatile & Cost-Effective
Usable in combustion engines, fuel cells, or for hydrogen production. Supported by mature industrial processes and a wide global supply.

Ammonia Efficiency

Application	Net Energy Output(MWh per ton NH_3)	Net Efficiency(% of energy input)
PEMFC – Residential Power (CHP)	2.9 – 4.5	29% – 45%
PEMFC – Automotive Power/Grid	1.4 – 2.3	14% – 23%
SOFC – Residential Power (CHP)/Grid	3.7 – 5.2	37% – 54%
Gas Turbine – Combined Cycle (Stationary)	2.6 – 3.4	33% – 64%
Internal Combustion Engine – Automotive	1.8 – 2.5	18% – 25%
Maritime Propulsion (Engine or Fuel Cell)	2.1 – 3.4	40% – 65%
Industrial Heating / High-Temp Processes	4.2 – 4.6	81% – 90%

Why This Technology Is Needed

Rapid global electrification is increasing demand for distributed, reliable power
Conventional solutions are **expensive**, **emission-heavy**, or **fuel-restricted**

Our Solution

High Efficiency
Direct chemical-to-electrical conversion with minimal losses

Internal Ammonia Cracking
SOFCs use waste heat to efficiently crack ammonia

Zero Combustion
No flame = no NO_x emissions

Fuel Flexibility
Accepts ammonia, hydrogen, or natural gas

Modular & Scalable
Ideal for data centres, remote power, and backup

Silent Operation
No moving parts = low noise

Challenges with Existing Energy Solutions

Technology	Limitation
Diesel Generators	High emissions & maintenance
Batteries	Limited duration; poor scalability
Palladium Membranes	Expensive & impurity-sensitive

CRT

Our Technology

Fuel cell with
internal reformer

Ammonia

Natural Gas

Green H_2

Electricity

Modular

Flexi-Fuels

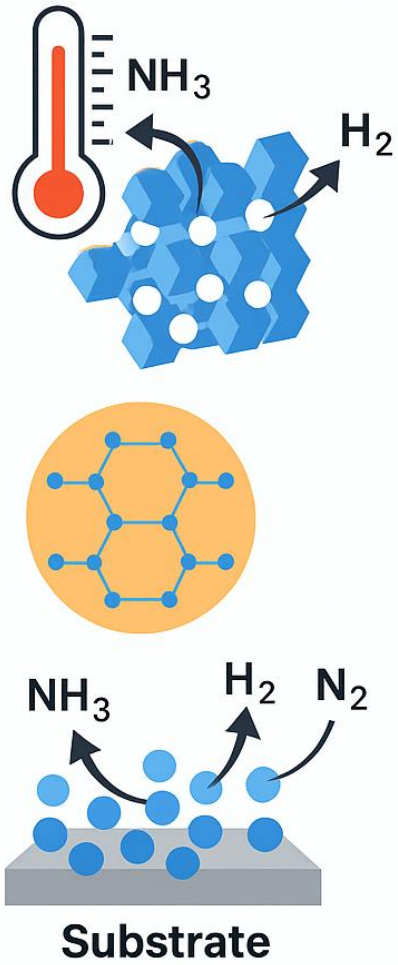
High Efficiency

Novelty

- **High Conversion Efficiency at Moderate Temperatures**: CRT's patented oxide catalysts (CRT-CAT-1 to CAT-3) consistently achieve >99.9% ammonia conversion at 400 °-450 °C without relying on palladium/metal membranes, enabling SOFC integration at lower thermal loads.

- **Advanced Nano-Engineered Structure**: The catalysts feature high surface area, and mesoporous architecture (~4 nm pores), enhancing gas diffusion and active site exposure for superior catalytic performance.

- **Dual-Function Integration with Substrate**: When supported on CRT's micro-engineered substrates, the catalysts not only crack ammonia but also partially purify the gas stream, selectively filtering nitrogen and delivering hydrogen suitable for direct SOFC or PEM use—eliminating the need for costly external separator



NH_3 10 kW Test System

Key Features

- Fuel Compatibility: 100% anhydrous ammonia, natural gas or hydrogen
- Flexible Configuration: Supports multiple unit formats (SOFC stacks, reactors, reformers)
- Thermal Control: Precision temperature regulation up to 850°C
- Gas Monitoring: Integrated mass flow controllers and sampling ports

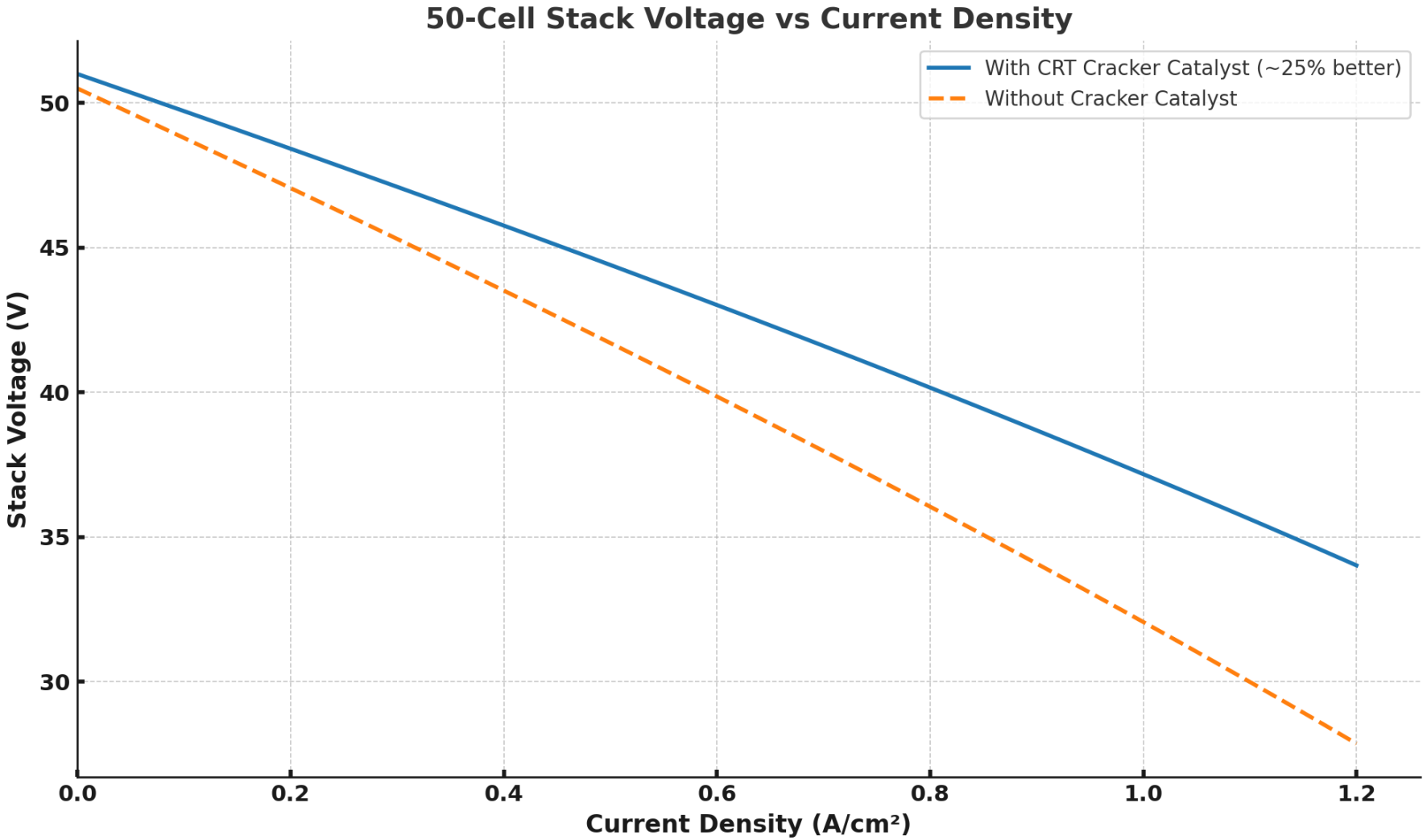
System Capabilities

- Power Support: Up to 10 kW unit testing
- Cycle Testing: Automated thermal/electrical cycling
- Safety Systems: NH_3 detectors, automatic shutdown, exhaust handling

Applications

- SOFC system validation
- Ammonia cracker development
- Long-term durability trials
- Start-stop and transient testing

Data: 50 cell stack



CRT Flexi Fuel : Ammonia, Natural gas

Natural gas, ammonia, or green hydrogen to electricity

54% efficiency

CRT's novel design ensures maximum conversion, while reducing costs by avoiding the use of expensive critical materials such as Palladium

$1.7m from ARENA for fundamental R&D

Modular design

Thank you

Contact:

Email: apkulkarni@cavendishrenewable.com.au

Website: www.cavendishrenewable.com.au