Australian Government
Australian Renewable Energy Agency

ARENA

Media Release

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Boosting research into exporting renewable hydrogen

On behalf of the Australian Government, the Australian Renewable Energy Agency (ARENA) today announced it has awarded $22.1 million in funding to 16 research projects to propel innovation in exporting renewable hydrogen to the world.

The funding has been offered to research teams from nine Australian universities and research organisations including the Australian National University, Macquarie University, Monash University, Queensland University of Technology, RMIT University, The University of Melbourne, University of New South Wales, The University of Western Australia and the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

In December 2017, ARENA announced the funding round into hydrogen R&D. It is the first time ARENA had sought to fund research into the hydrogen energy supply chain.

The early stage research projects cover a diverse range of renewable solutions, with at least one project from each point in the supply chain - production, hydrogen carrier and end use. The projects include the development of a wide range of hydrogen-related technologies including concentrating solar thermal, electrolysis, biotechnology, carrier synthesis, thermochemical processes, fuel cell development and energy generation.

Hydrogen - or carriers like ammonia - are potentially ways for Australia to export renewable energy. Electrical energy can readily be converted into hydrogen via electrolysis. Renewable or green hydrogen involves producing hydrogen from renewable sources for example via electrolysers powered by solar and wind.

Hydrogen is poised to play a larger role, as the world moves to a low carbon economy. Hydrogen can potentially be used as a way for Australia to export renewable energy to other countries, particularly in Asia with demand expected to increase.

Earlier this month, ARENA also released a report that identified opportunities for Australia to export hydrogen as global demand for hydrogen increases in the next decade.

The report, prepared by ACIL Allen Consulting for ARENA, found there could be a significant increase in demand globally for hydrogen exports as other countries - such as

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0410 724 227
media@arena.gov.au

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Japan and the Republic of Korea - looked to transition to renewable energy. With the right conditions, hydrogen exports could be worth $1.7 billion annually and could generate 2,800 jobs in Australia by 2030.

ARENA is also part of the Hydrogen Strategy Group, led by Chief Scientist Dr Alan Finkel AO, which prepared a briefing paper on hydrogen for the COAG Energy Council.

ARENA CEO Darren Miller said the $22.1 million funding boost would help to maximise Australia's opportunities in developing a cost-effective hydrogen export supply chain.

"Exporting renewable energy, such as by the use of hydrogen, involves developing and integrating emerging technologies. This funding will help bolster the research efforts of Australian scientists to drive innovation for what could become the next big export industry.

"Hydrogen is poised to play a big role in the world's low carbon economy. Already, Japan and South Korea have committed to becoming major import markets for renewable hydrogen but as yet there are no exporters," Mr Miller said.

"With its abundance of sun and wind, and experience as one of the world's largest LNG exporters, Australia is ideally placed to become a global superpower in exporting renewable energy, and this work will help position us as leaders in this field," he said.

FULL LIST OF RENEWABLE HYDROGEN FOR EXPORT R&D FUNDING RECIPIENTS

Project name by Institution	**ARENA funding ($AUD)**	**Research Focus**
Australian National University		
ANU Hydrogen Generation by Electro-Catalytic Systems	$615,682	This project will use biologically inspired catalysts with gas permeable electrode surfaces to develop a simpler and more efficient hydrogen electrolysis technology than any known to operate. Inputs are pure water and renewably sourced electricity.
ANU Direct Water Electrolysis	$1,235,407	The aim of ANU's project is to demonstrate the concepts required to develop highly efficient direct solar-to-hydrogen conversion for economical hydrogen production.

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ANU Solar Hydrogen Generation	$1,637,303	ANU aims to design, fabricate and integrate low-cost semiconductors and earth abundant catalysts to address one of the most significant challenges for hydrogen production: the development of efficient, stable and cheap solar water splitting systems.
CSIRO		
CSIRO Solar Thermochemical Hydrogen	$2,007,676	This project will demonstrate Australia's first solar thermal beam down system, concentrating solar energy from a heliostat field in order to heat a fluidised bed on the ground to 1300 °C. Water added to this bed will be split into hydrogen and oxygen using a two-step chemical process. Additional research will examine the conversion of the produced hydrogen into methanol that can be used as a hydrogen carrier to export markets such as Japan.
CSIRO Hydrogen to Ammonia	$1,175,000	CSIRO aims to develop an ammonia production process with 25% less energy input per tonne of ammonia than the conventional Haber-Bosch process and does not contribute to any greenhouse gas emissions. A prototype ammonia producing reactor will be built to demonstrate the operation with electricity supplied by a solar PV, thus showcasing the technology potential for export of Australia's vast renewable sources of energy.
CSIRO Methane Fuel Carrier	$1,085,553	CSIRO's project will investigate the production of synthetic methane as a readily exportable, renewable fuel, derived from atmospheric carbon dioxide and hydrogen produced from renewable sources.
CSIRO Liquid Fuel Carrier	$1,010,021	This project proposes technology for conversion of solar energy to liquid fuels. Both solar heat and solar PV electricity will be used to drive a solid oxide electrolyser device for a production of hydrogen and syngas which then can be converted onsite into transportable liquid fuels enabling large-scale energy export and storage.

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Macquarie		
Macquarie Biological hydrogen production using genetically engineered microorganisms	$1,148,455	The project will produce a bacterial strain that is optimised for converting glucose and other carbohydrates to hydrogen gas. The bacterial strains will also be optimised to produce the gas rapidly such that both rates and yields of hydrogen production are commercially viable. To move towards commercial scale the project will also develop a 2 L scale culture system that can produce and collect hydrogen gas in a safe and effective way.
Monash University		
Monash Low-cost, robust, high-activity water splitting electrodes	$1,054,209	Monash University and ANU will develop scalable methods for the fabrication of efficient, low-cost and robust electrodes for hydrogen production from renewable sources via electrochemical water splitting.
Monash Ammonia production from renewables at ambient temperature and pressure. Developing a process for reduction of nitrogen to ammonia	$915,848	Monash University will develop high-performing electrodes for direct electrochemical conversion of atmospheric nitrogen to ammonia – a readily exportable carrier of renewable energy.
Queensland University of Technology		
QUT Hydrogen Process	$3,350,000	The QUT project aims to develops a scalable and systematic process to evaluate the viability of decentralised and regional-scale renewable energy hybrid systems to generate hydrogen from sustainable resources.
RMIT University		
RMIT A proton flow reactor system for electrical energy storage and bulk export of hydrogenated carbon- based material	$805,026	The aim of this project is to develop an integrated system for storage of electricity from renewable energy and export the stored energy as hydrogen within hydrogenated carbon-based material.
The University of Melbourne		
UOM Enabling efficient, affordable and robust use of renewable hydrogen in transport and power generation	$2,594,747	This project will demonstrate the performance and the value of highly efficient, reciprocating engines operating

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		on renewable hydrogen. These engines are intended to be the most efficient, hydrogen fuelled engines ever developed. Analysis will be undertaken to assess how these engines would become part of different, economically optimal, integrated systems that generate, transport or use renewable hydrogen.
University of New South Wales		
UNSW Highly efficient and low cost photovoltaic-electrolysis (PVE) system to generate hydrogen by harvesting the full spectrum of sunlight	$1,319,105	The aim of this project is to lower the cost of renewable hydrogen produced via photovoltaic electrolysis (PVE) by improving the energy efficiency of transition metal-based alkaline water electrolysers and the overall solar to hydrogen (STH) conversion efficiency of PVE systems. This approach is anticipated to lead to the development of an integrated PVE system demonstrating an overall solar-to hydrogen (STH) conversion efficiency >30%.
UNSW Waste Biomass to Renewable Hydrogen	$1,045,770	UNSW will develop a biomass reforming system capable of extracting hydrogen and/or hydrogen-carriers - such as bio-alcohols and bio-acids - from biomass. The biomass reforming system will comprise a biomass pre-conditioning reactor (BPR) coupled with a flow electrolyser cell (FEC) to produce renewable hydrogen without any carbon dioxide emissions.
The University of Western Australia		
UWA Methanol from Syngas	$1,079,875	The project aims to develop an innovative, miniaturised process for the synthesis of renewable methanol as hydrogen carrier from biomass pyrolysis syngas. This will be demonstrated in a laboratory-scale pilot plant. The benefit of miniaturisation is that plants could potentially be geographically dispersed and be located near or close to biomass feedstock.
TOTAL ARENA FUNDING	**$22,079,677**	

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