
Centre for
Energy
Technology
Institute for
Mineral and
Energy Resources
INNOVATIVE
TECHNOLOGIES
IN HEAT, POWER AND
FUELS FOR INDUSTRY
TRANSFORMATION.
Hydrogen, batteries, networks,
mineral processing, waste to energy
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HYDROGEN FOR INDUSTRY

Working with our global partners to produce and use green hydrogen for energy, chemicals and metallurgy

WHY FAST TRACK HYDROGEN TECHNOLOGIES?

Hydrogen can be made relatively easily with renewable energy

Green hydrogen could be cost-competitive with fossil fuels by 2030

Global hydrogen production is almost entirely fossil fuel based, and stable at ~55 million tonnes (6,600 PJ) pa

Hydrogen for energy is currently only ~1–2 per cent of consumption, with significant scope to grow

When it comes to energy or metallurgy, hydrogen can do everything that coal or gas can do, sometimes better, but with zero emissions

WHAT WE'RE DOING

Integrating hydrogen production into industrial processes together with Concentrated Solar Thermal energy

Innovative technologies spanning lab-scale to pilot-scale demonstration to integrate the production of solar thermal energy with industrial by-products to co-produce hydrogen, oxygen and products such as sulphuric acid.

Photocatalysis for hydrogen production and CO_2 regeneration

Novel reactors from innovative materials to perform 'artificial photosynthesis'. These convert water to hydrogen and oxygen using just sunlight and a catalyst, at room temperature. No electricity is needed. The technology can also split CO_2, and convert it, with hydrogen, into hydrocarbon fuels.

Hydrogen as a met-coal replacement in steel making

Innovative technologies to lower the cost of hydrogen production with a view to replacing met-coke for the blast furnace. This technology will use concentrated solar thermal energy to convert methane (from natural gas or bio-gas) into hydrogen and solid carbon, including pet-coke substitutes.

DLR · CSIRO · ASTRI · The University Of Queensland AUSTRALIA · FUTURE FUELS CRC

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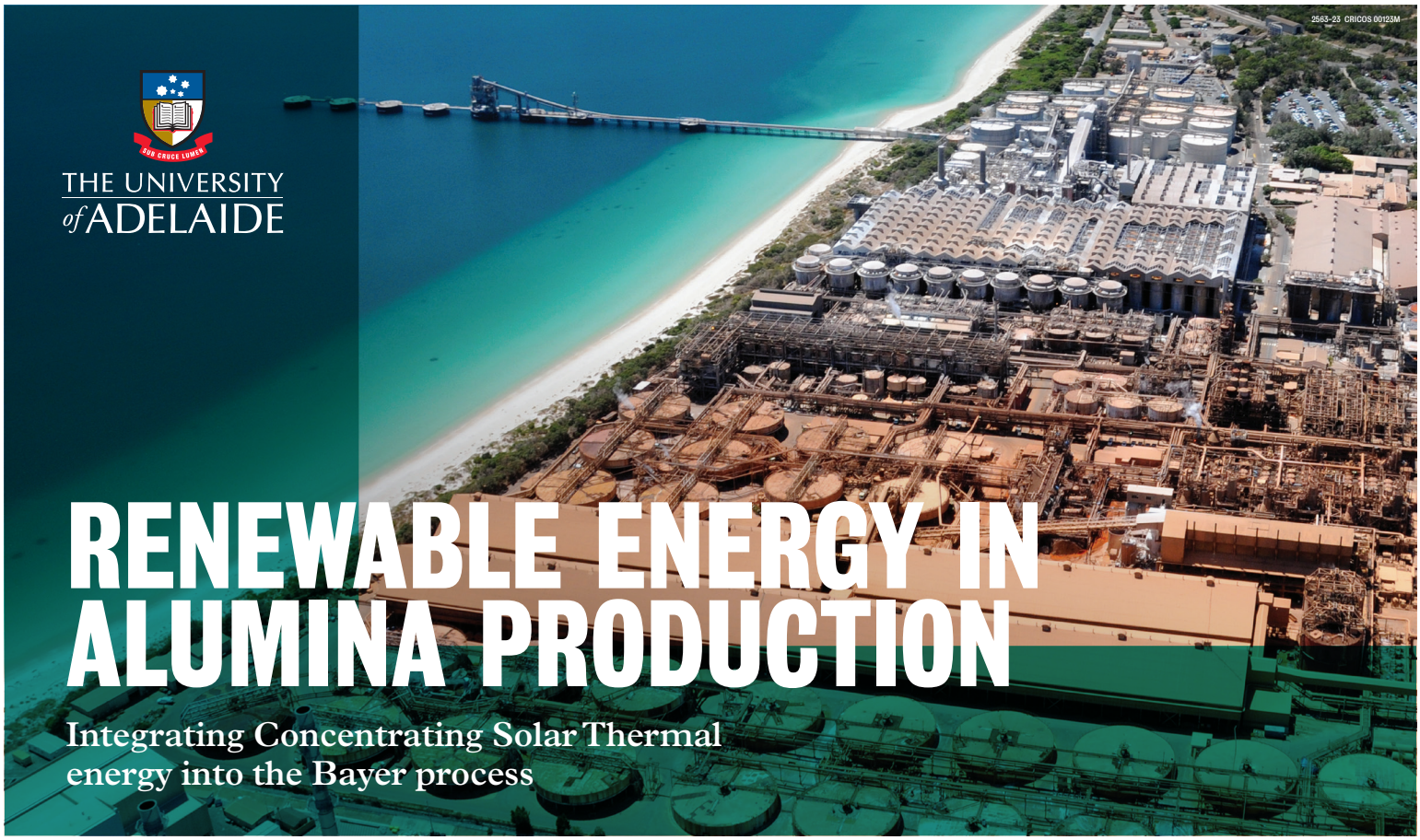

RENEWABLE ENERGY IN ALUMINA PRODUCTION

Integrating Concentrating Solar Thermal energy into the Bayer process

$15.1M project, including $4.5M from the Australian Renewable Energy Agency (ARENA)

3 research organisations

3 industry partners

Integrating low and high temperature Concentrating Solar Thermal (CST), solar reforming and energy storage into the energy-intensive Bayer process

Developing a pathway to reduce natural gas use by up to 45%

Developing disruptive technologies with the potential to enable a 29% – 45% solar share with minimal disruption to the current refinery process

THREE CONCURRENT RESEARCH PROJECTS TO EVALUATE

Low temperature CST is commercially available but not yet for process heat

Solar reforming and syngas storage is available at pilot scale

We are assessing viability for commercial application

High temperature CST process heat for calcination

Digestion Process

Calcination Process

PROGRESS TO DATE

Low Temperature Process Heat

- Energy flow models for the low temperature stages of the Bayer process
- Models of low temperature CST technologies for the Bayer process
- Techno-economics of low temperature CST technologies into the Bayer process

Solar Reforming of Natural Gas

- Process models of solar reformed gas for the Bayer process.
- Assessment of syngas and thermal storage options
- Techno-economics of a solar reforming of natural gas into the Bayer process

High Temperature Calcination

- Energy flow models for the alumina calcination stage of the Bayer process
- First stage models of a Bayer process hybrid calciner
- Techno-economics of a hybrid calciner in the Bayer process

ARENA Australian Government Australian Renewable Energy Agency · Alcoa · CSIRO · HATCH · itp · UNSW SYDNEY

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COMBINED HEAT AND POWER FOR MINERALS PROCESSING

Energy for industry from renewable sources, hybridised with fossil fuels to ensure continuous reliable supply.

HYBRID SOLAR COMBUSTION TECHNOLOGY

Capitalise on the co-location of gas and solar to provide firm energy supply to industry.

Three modes

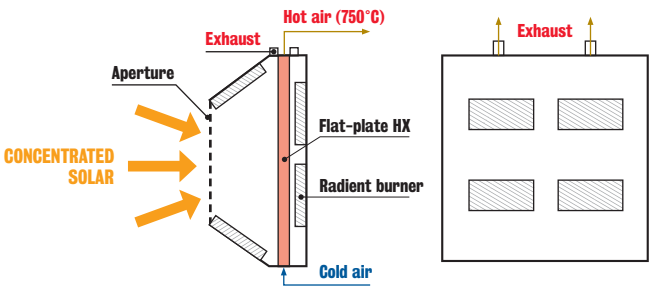
- Solar only
- Combustion only
- Combined Solar and Combustion

Advantages

- Increase solar share while reducing heat losses and trace heating
- Fast response to solar transients (one second)
- Hybrid design brings reduced thermal stresses
- Thermal energy for mineral processing (hot air or steam)

Benefits

- Up to 45% reduction in fuel consumption
- 24% reduction in levelised cost of electricity (LCOE)
- 51% reduction in overall energy plant capital cost compared to a system with standalone solar and combustion units



MAGALDI STEM

- Beam-down solar thermal concentrating system
- Thermal energy storage system with 40 MWh capacity and 700°C steam
- Sand is the storage medium, not salt; steam or hot air the only fluids

Advantages

- Safe, reliable and robust solar thermal system (ideal for remote sites)
- Capacity to deliver steam or hot air to a process for industrial heat and/or power
- Relatively easy to hybridise in an efficient manner

Applications

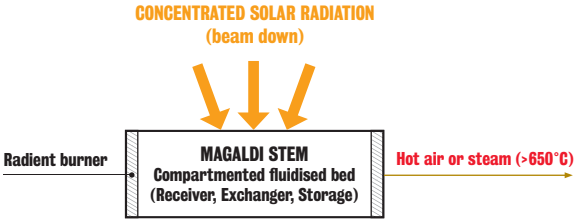
Well suited to a range of Australian industry applications eg:

- Copper concentrate production (steam at ~180°C and a typical power of ~10MWth)
- Combined heat and power
- Possible direct heat for rock crushing

HYBRID MAGALDI STEM WITH RADIANT BURNER TECHNOLOGY

Additional benefits

- Potential to provide continuous reliable thermal supply 24/7
- Can operate with many fuels (e.g. natural gas, hydrogen)
- Operation flexibility - temperature control and thermal output



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MAGALDI® Dependable technologies

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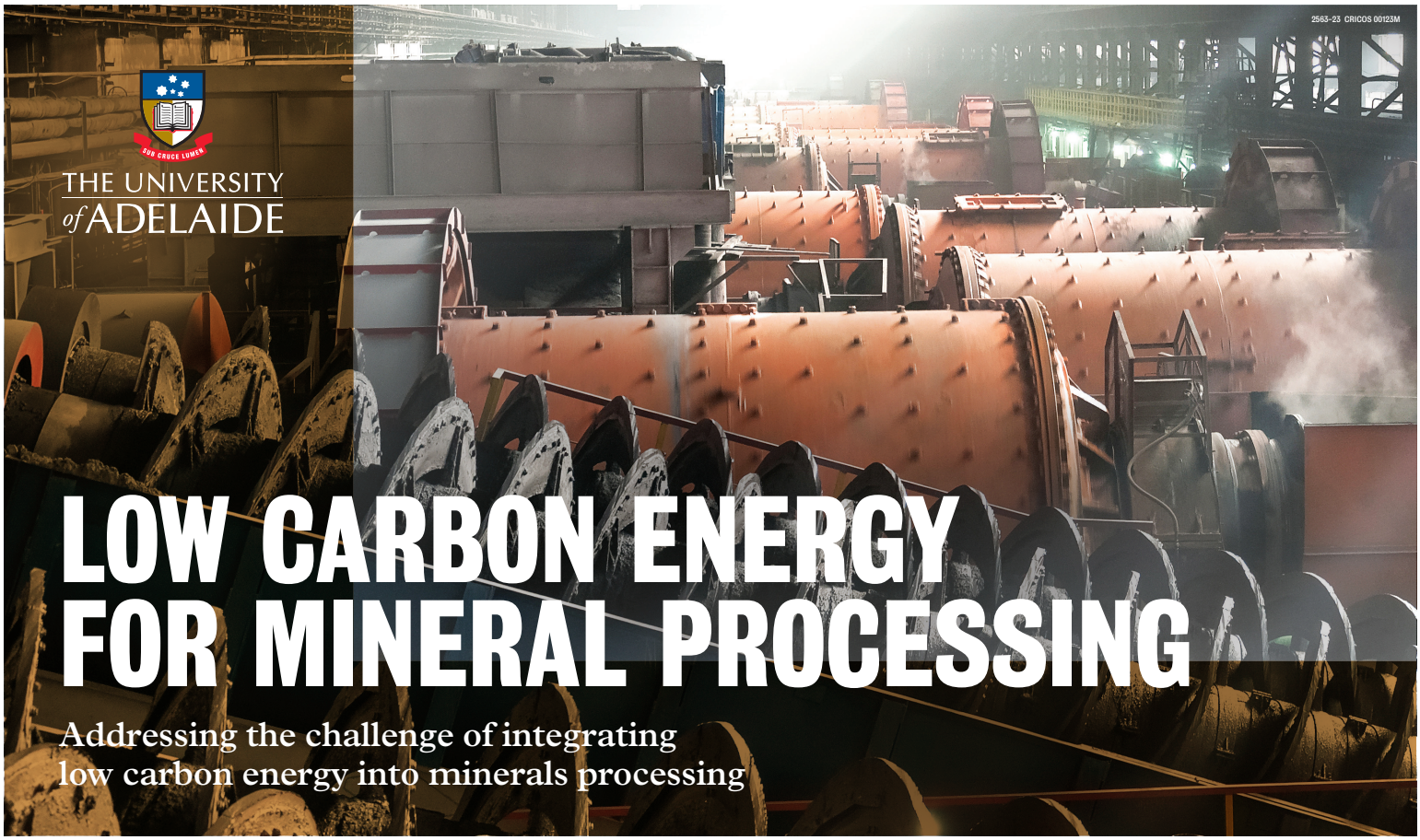

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LOW CARBON ENERGY FOR MINERAL PROCESSING

Addressing the challenge of integrating low carbon energy into minerals processing

MANUFACTURING AND MINING IN AUSTRALIA

- Accounts for half of Australia's natural gas use
- Requires heat, fuels and power
- Is vulnerable to increases in price for both gas and electricity

Thermal calcining of limestone, magnesia, alumina

Processes for calcination using concentrated solar thermal energy, with strong potential to compete with natural gas.

Direct heat for minerals processing

- Stored thermal heat for calcination
- Steam for ore concentration
- Hot air for grinding and drying
- Integration in mining and high temperature processing

Producing chemicals for industrial processes

- H_2SO_4 production for use in concentrate leach and tails leach (copper)
- O_2 for smelting and refining
- H_2 for metallurgy, heat, power and mobility

Thermally assisted crushing and grinding (comminution)

- Thermal shock – heating and quenching to promote fractuing to lower comminution energy requirements
- Potential to lower crushing and grinding costs dramatically

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THE SECOND INTERNATIONAL FORUM ON ZERO CARBON HIGH TEMPERATURE MINERAL PROCESSING

Monday 16 – Wednesday 18 March, 2020
National Wine Centre, Adelaide, South Australia

The HiTeMP-2 Forum will bring together global leaders from industry, research, investors, non-government agencies and policy makers to chart the pathway to transition heavy industry toward net-zero-CO2 emissions, addressing the need for heat, chemicals and electricity.

Processes to be reviewed:

- Iron/steel
- Alumina/cement
- Copper
- Other mineral processes

Topics to be addressed:

- Drivers and opportunities
- Emerging technologies
- Industry exemplars
- The path forward

The forum will build on the outcomes from HiTeMP-1 to synthesise multi-stakeholder perspectives, identify high value opportunities and guide investors, policy makers and researchers in this sector.

REGISTER YOUR INTEREST OR DOWNLOAD THE REPORT FROM THE FIRST FORUM:

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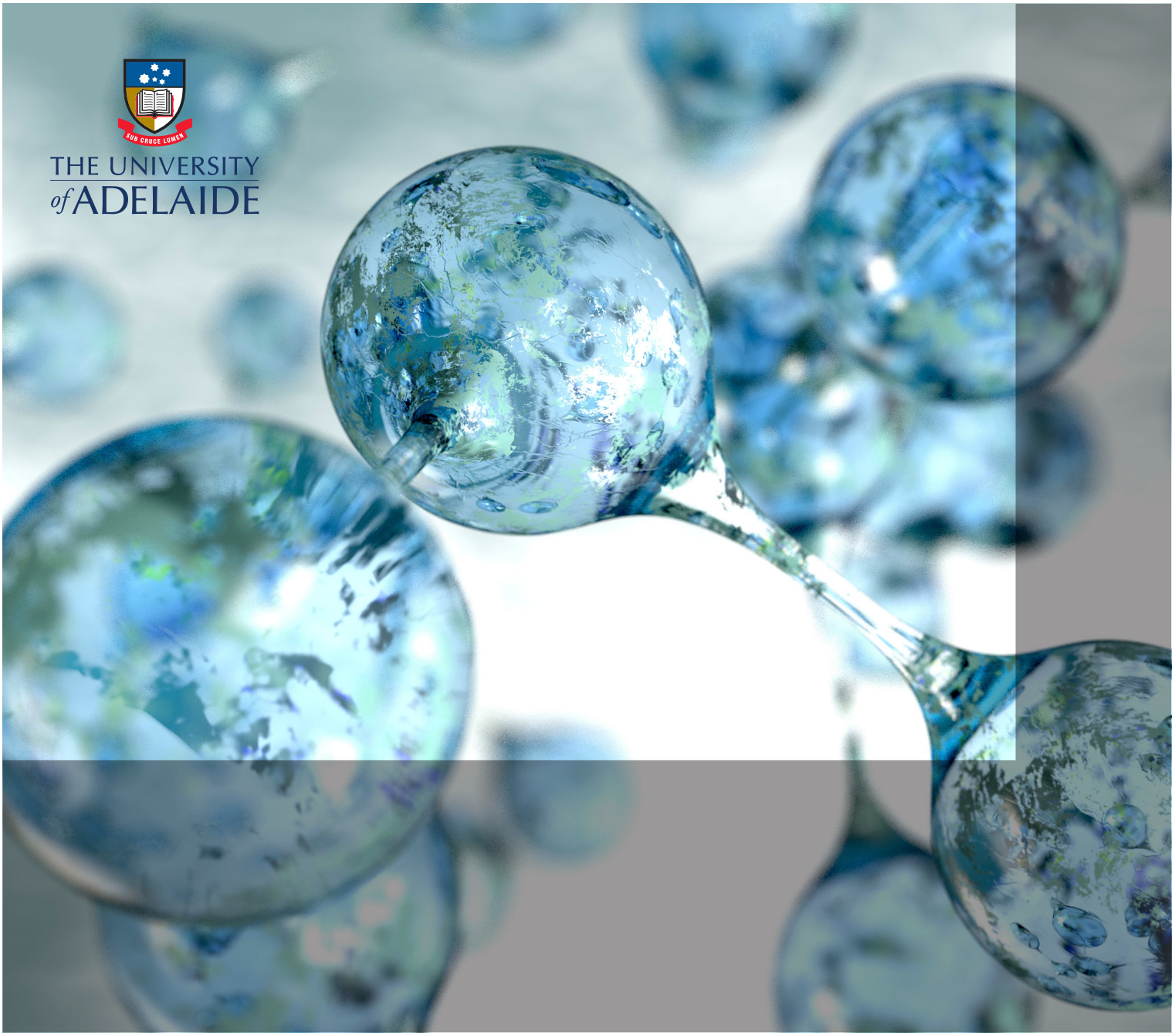

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HyPT | Innovation in Hydrogen Production Technologies

Monday 23 September 2019
Sanctuary Function Centre, Adelaide Zoo, Australia

The International Forum on Hydrogen Production Technologies (HyPT) 2019 will bring together stakeholders from around the world to compare the relative merits of alternative CO_2-free hydrogen technologies.

Governments, the transport and energy industries, and researchers have recognised the potential that hydrogen offers. To accelerate the transition to a hydrogen economy, cost effective hydrogen production is needed so it can compete with current energy sources and fuels.

Forum Themes

- **State of Affairs.** What is the current state of hydrogen production technologies globally? And what is their future potential?
- **Green Hydrogen Technologies.** What is the current state of technologies that use renewable energy? How widely are they being researched, and where? We'll discuss their readiness levels (TRLs), scalability, costs and future potential.
- **Blue Hydrogen Technologies.** What is the current state of technologies that use natural and other gases? Are they being used by industry? What are their TRLs, scalability, costs and carbon footprints?

About HyPT

The forum will explore, through expert opinion and discussion, the future of hydrogen technologies, including:

- drivers, barriers and opportunities for a thriving hydrogen production industry in Australia
- envisioning what success would look like in progressively expanding, cost-competitive Hydrogen markets
- ways in which emerging technologies could drive costs down in CO_2-free Hydrogen production
- key barriers to further cost reduction of CO_2-free hydrogen
- roles that government, researchers and industry could play in enabling the pathway to cost-competitive hydrogen.

The forum is organised by the University of Adelaide's Centre for Energy Technology and is supported by the South Australian Government.

Speakers include:

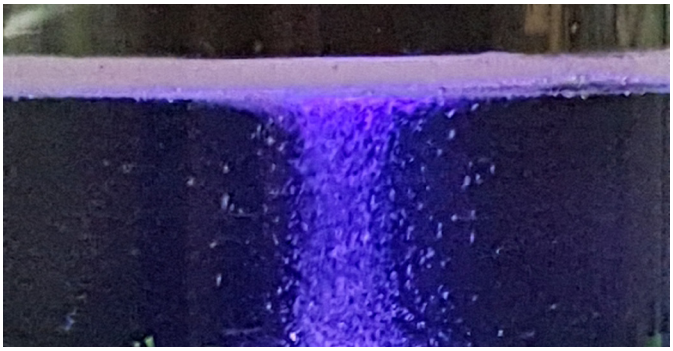
- Mr Richard Day, South Australian Government Hydrogen Plan, Department for Energy and Mining (Theme: State of Affairs)
- Prof Piero Salatino, University of Naples (Blue Technologies)
- Prof Christian Sattler, German Aerospace, DLR (Green Technologies)
- Prof Kazunari Domen, Tokyo University (Green Technologies)

Who should attend:

- Hydrogen production industry
- Clean technology providers
- Researchers in hydrogen production
- Clean energy investors
- Policy and decision makers.

University of Adelaide

The University of Adelaide is one of Australia's leading research-intensive universities and is consistently ranked among the top 1% of universities in the world. Established in 1874, it is Australia's third oldest university with a strong reputation for research and teaching excellence, and producing graduates that make an impact on the world.



In action: production of solar hydrogen (and oxygen) from water using a photocatalyst sheet.

Centre for Energy Technology

Hydrogen technology research is led by the Centre for Energy Technology (CET), the University of Adelaide's research and technology development hub for clean, reliable, affordable energy.

Our aim is to reduce energy costs and CO_2 emissions, and accelerate society's transition to carbon neutrality. We work with industry to reduce emissions now, by retro-fitting innovative technologies to existing systems, and by developing new carbon neutral and carbon negative technologies to replace existing heat, power and fuel production systems.

About Adelaide

Adelaide is South Australia's capital city. It combines exceptional food and wine, art, shopping, a bustling bar scene, beaches and world-class events. No matter what season you visit, Adelaide and its regions allow you to sample the best of Australia.

Why fast track hydrogen technologies?

- Hydrogen can be made relatively easily with renewable energy sources.
- Hydrogen could be cost-competitive with fossil fuels between 2025 and 2050 (University of Amsterdam 2018).
- Global hydrogen production is currently almost entirely fossil fuel based, and stable at ~55 million tonnes (6,600 PJ) pa.
- Hydrogen for energy is currently only ~1-2 per cent of consumption (ACIL Allen Consulting for ARENA 2018), so there is significant scope to increase this.

Registration

Register now

adelaide.edu.au/cet/seminars-events/hypt

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