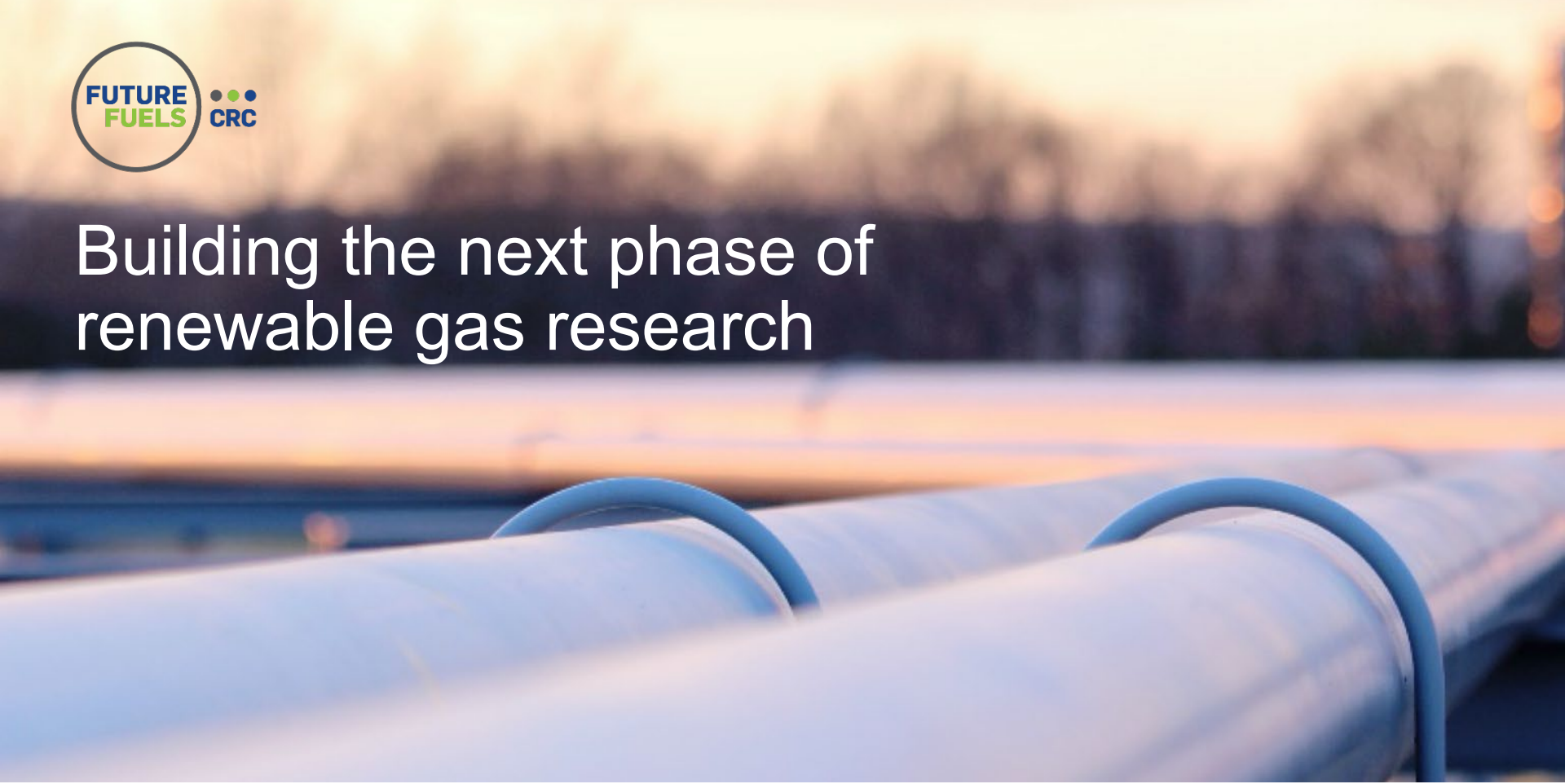

Building the next phase of renewable gas research

APGA Convention 2024 – David Norman - CEO

Future Fuels CRC is action-orientated, industry-led, applied research

118 projects and 50 PhD and Masters scholarships covering Hydrogen and Biomethane:

- **Future Fuel Technologies, Systems and Markets**
- **Social Acceptance, Public Safety, Security of Supply and Policy & Regulatory Changes**
- **Network Lifecycle Management**

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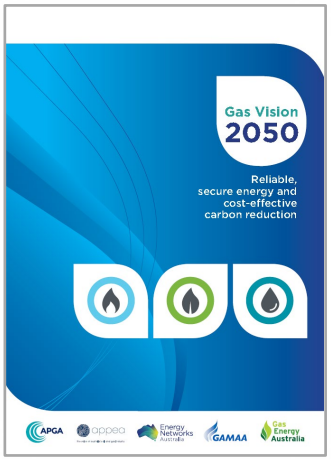
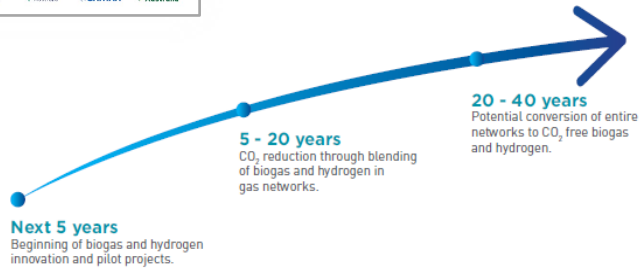
Gas Vision 2050 (from March 2017)





Ongoing work on:
blending in distribution network,
general blending and de-blending,
repurposing assets and new assets for 100% H2 capability,
Biomethane potential and CO2 transportation.

FUTURE FUELS CRC

Future Fuels CRC participants

Long term, industry-led collaboration between 100 industry, all State governments and six academic organisations, co-funded by the National Government

International Collaborations

FUTURE FUELS CRC

Delivering on our mission

Through collaboration and outcome focused research, we will enable Australia's energy sector to adapt its infrastructure to net zero emissions fuels by providing new knowledge and facilitating its use by industry.

People and Communications

- Community of 700
- Communication and engagement methods, seminars, virtual/videoconferences, webinars, research conferences
- Collaboration and spirit during COVID.
- Webinars supporting website
- Three years of Chemeca Hackathon Support
- Total PhD and Masters – 50
- 11 PhD’s completed.
- 6 Masters completed.
- 6 working now in industry / government. Several continuing in post-doc’s
- Ongoing Student Program

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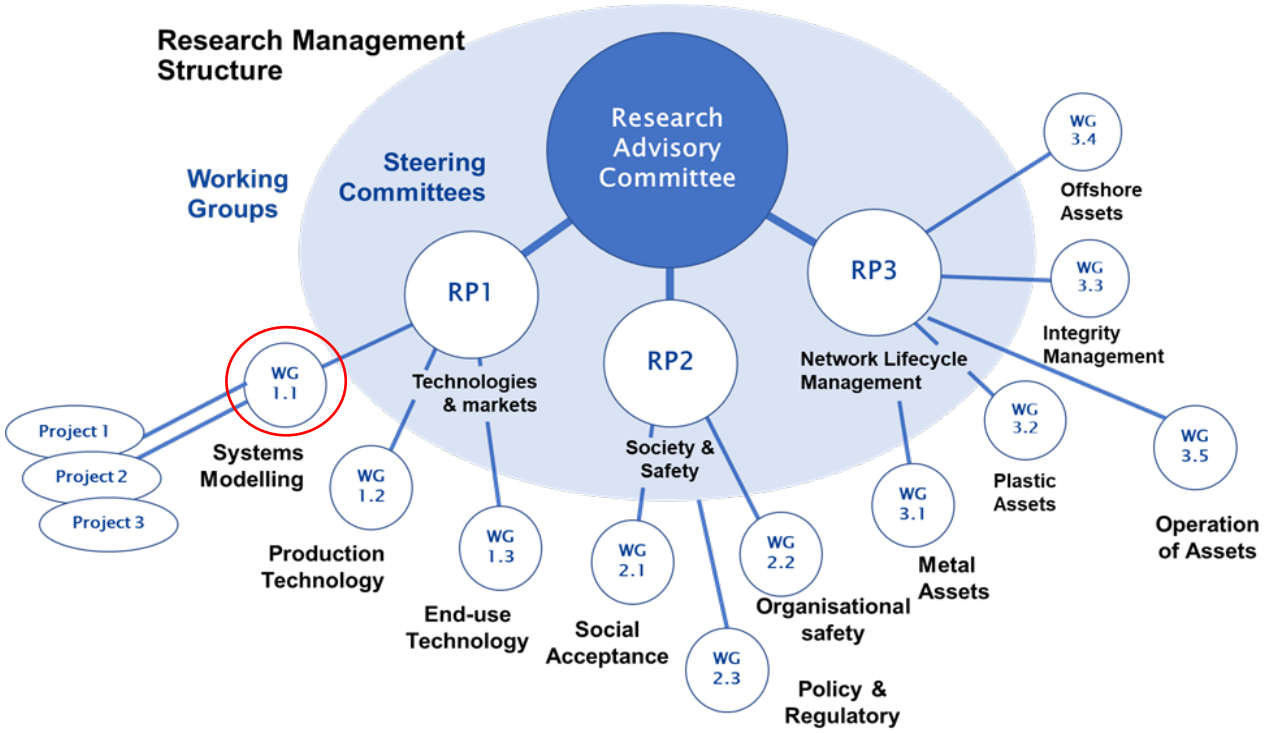

Research Management Structure
Working Groups
Steering Committees
Research Advisory Committee
RP1
RP2
RP3
Technologies & markets
Society & Safety
Network Lifecycle Management
WG 1.1
Systems Modelling
Project 1
Project 2
Project 3
WG 1.2
Production Technology
WG 1.3
End-use Technology
WG 2.1
Social Acceptance
WG 2.2
Organisational safety
WG 2.3
Policy & Regulatory
WG 3.1
Metal Assets
WG 3.2
Plastic Assets
WG 3.3
Integrity Management
WG 3.4
Offshore Assets
WG 3.5
Operation of Assets

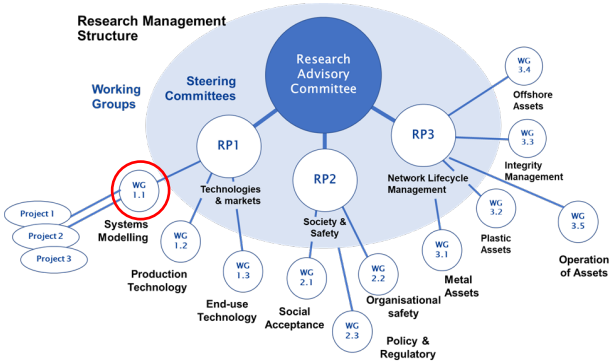
Integrated Systems Modelling

Series of projects to work on integrated of a future gas and electricity system:

RP1.2-01A - Regional Case Studies on multi-energy system integration. Deeper dive on Electrification of Heat

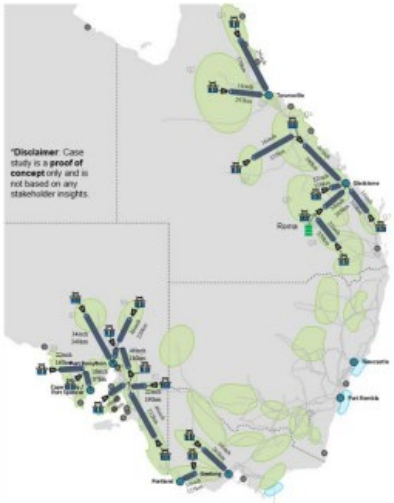
RP1.1.02B - Transport and Storage Options of Future fuels

RP1.1-07 - Integrated electricity-hydrogen: future system and market interactions under different storage considerations”



Optimal integrated transmission and storage infrastructure over a network

a) Without UHS.



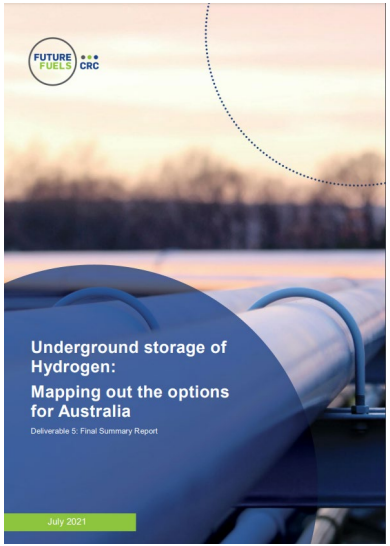
b) With UHS.

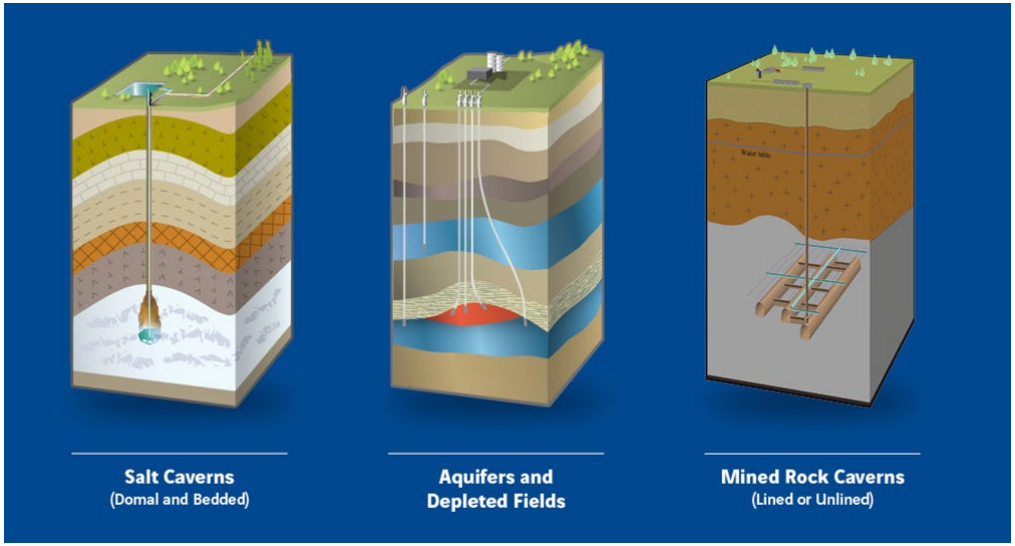
This report introduces a mathematical optimisation framework for finding the optimal greenfield integrated planning of electricity and hydrogen transmission and storage infrastructure and outlines related model outputs for three case studies

Source: project RP1.1-02B Transport and Storage Options for Future Fuels

Underground Hydrogen Storage

We identified a gap in knowledge of the opportunity and options, so delivered early with CSIRO:

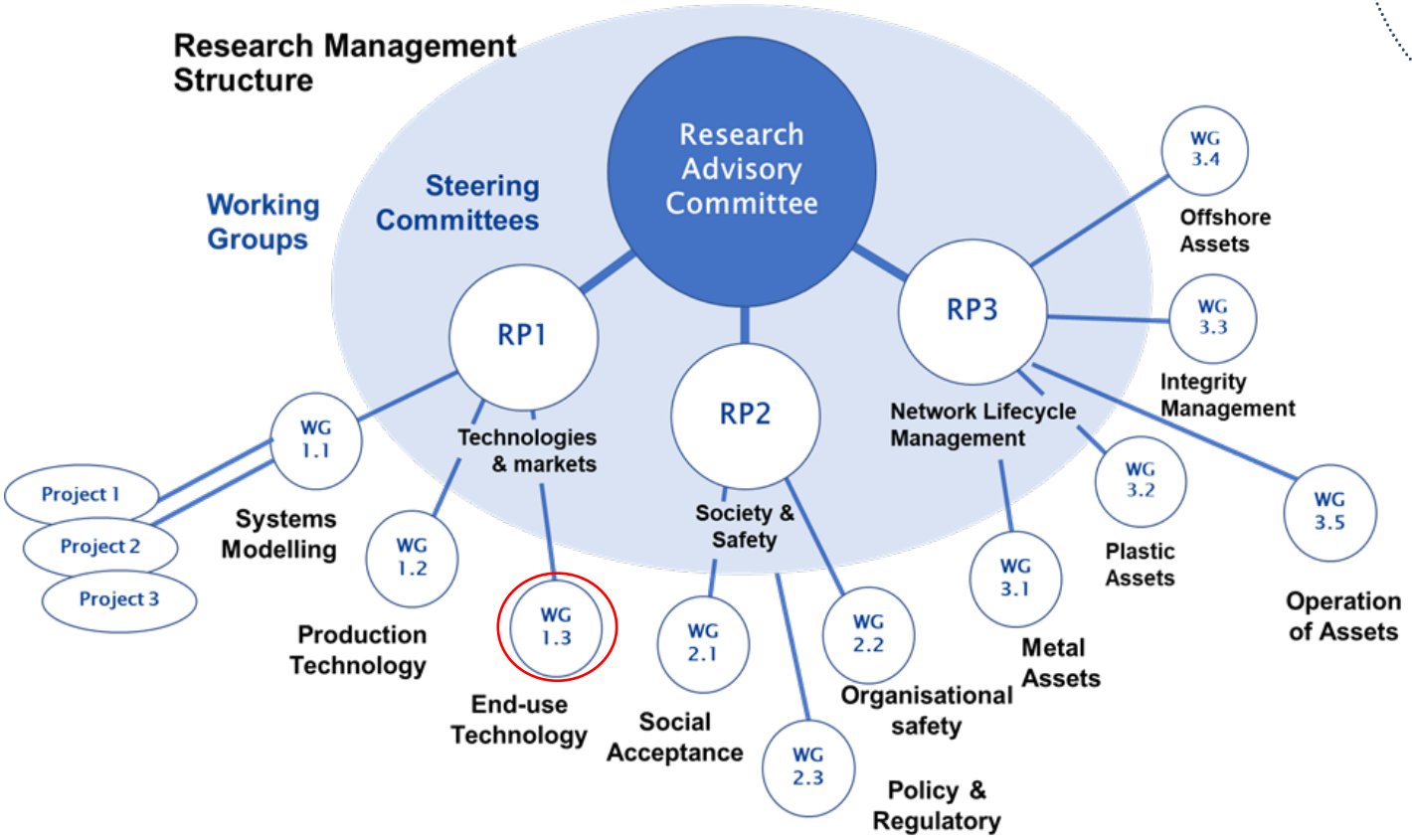




Source: project RP1.1-04 Underground storage of hydrogen

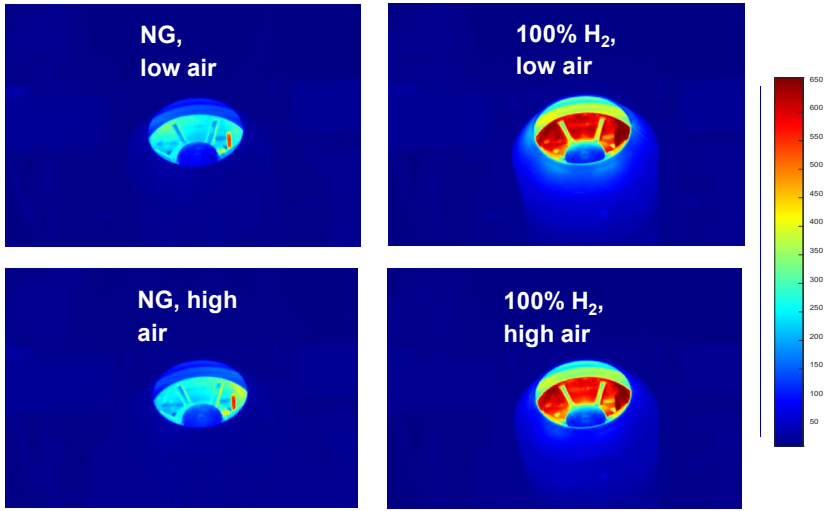
FUTURE FUELS CRC

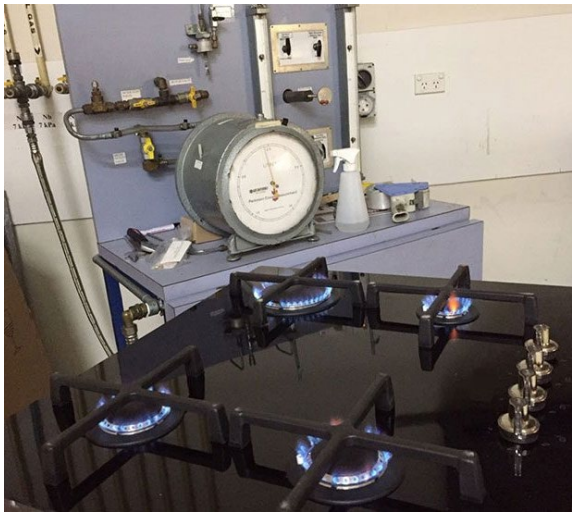
Research Management Structure



Appliance research projects

Supporting long-term safety cases for hydrogen blending and appliance conversion to 100% H_2 in Type A and Type B appliances





Source: projects RP1.4-05, RP1.4-01, RP1.4-08, RP1.4-06 and RP1.4-02

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Hydrogen Park South Australia

Australia's first renewable gas blend supplied to existing customers

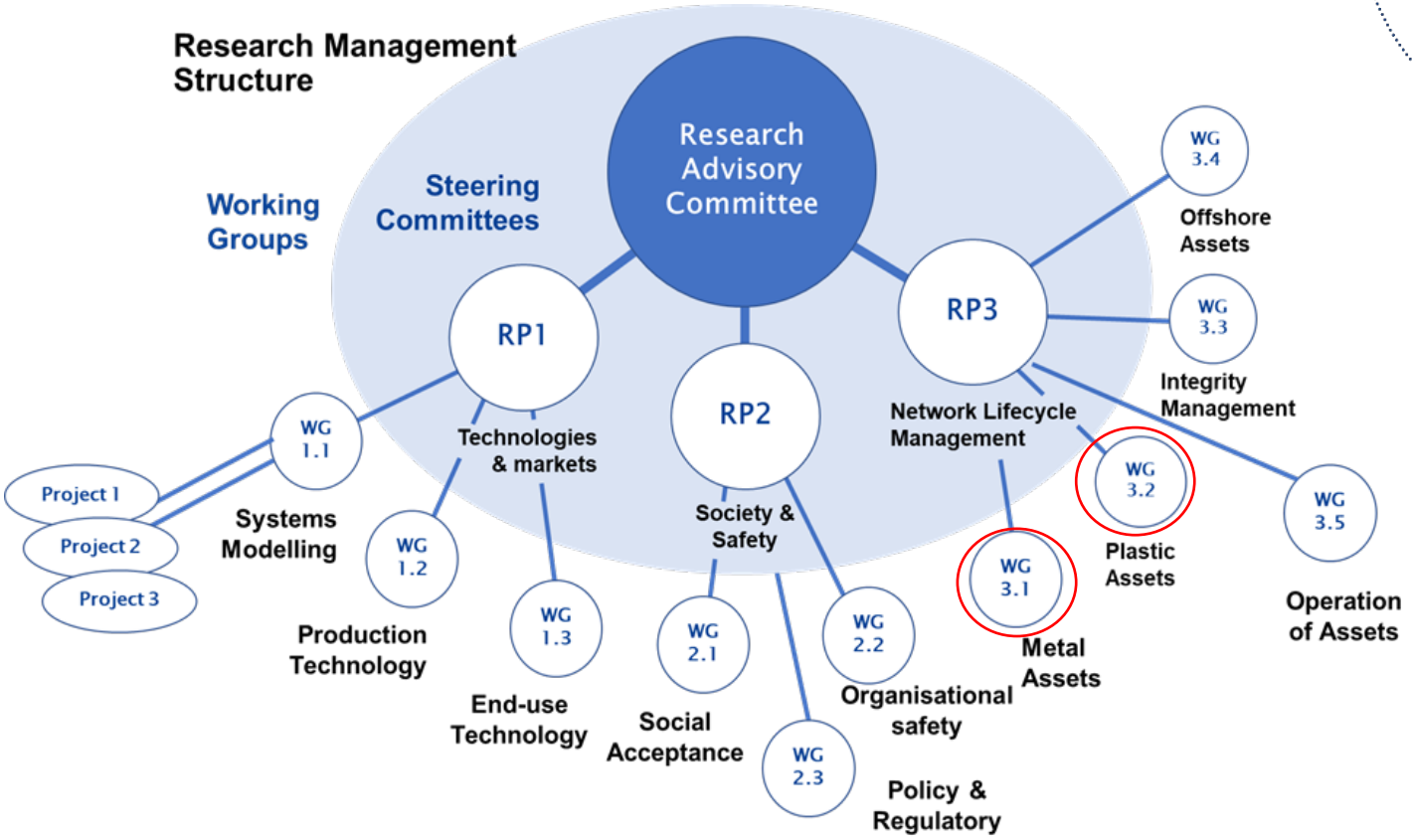
Hydrogen Park South Australia

Hydrogen Park South Australia (HyP SA) is an Australian first to deliver a renewable hydrogen blend to customers on the existing gas network.

FUTURE FUELS CRC

FUTURE FUELS CRC

Research Management Structure



Plastics research at Deakin University

Long-term sandpit environment representing Australian ‘as-installed’ plastics networks

Photo: Deakin long-term plastics sandpit, Warrnambool

FUTURE FUELS CRC

Plastics research at Deakin University

Laboratory testing of plastics and elastomers with hydrogen

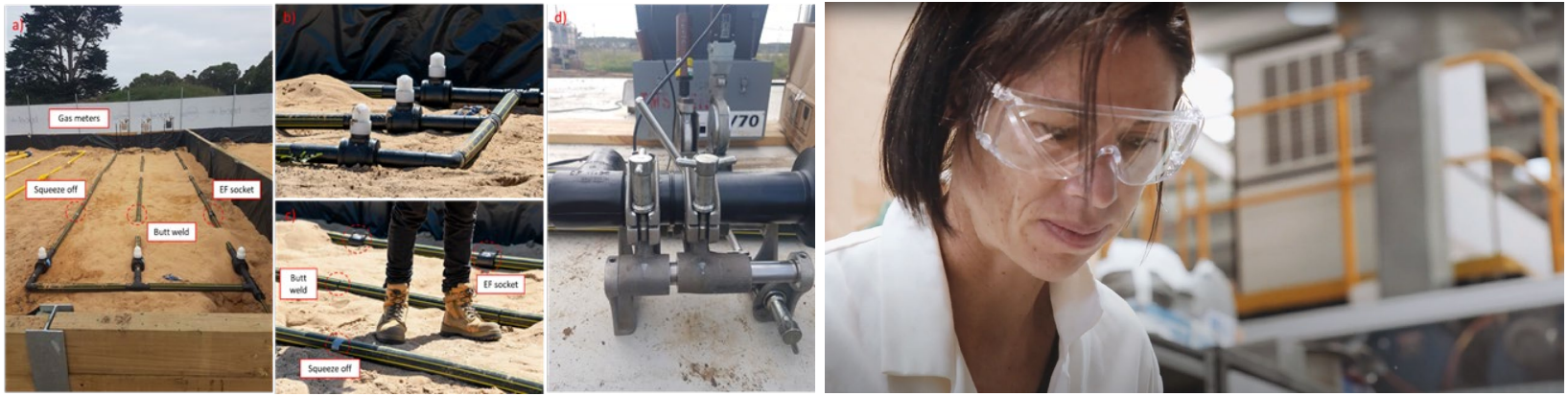


Photo: Deakin long-term plastics sandpit, Warrnambool and laboratories Waurn Ponds

FUTURE FUELS CRC

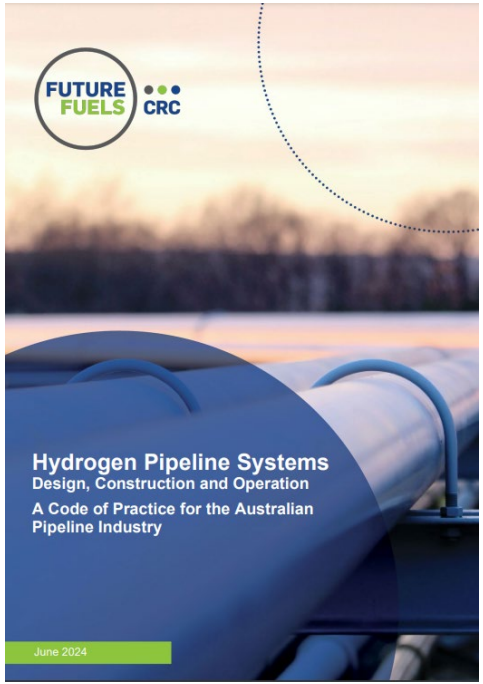
Steels research ongoing focus on fracture mechanics research

- University of Queensland, University of Wollongong and Deakin University.
- Hydrogen embrittlement
- Tensile strain
- Fracture initiation and propagation
- APA Parmelia Gas Pipeline assessment
- Hydrogen Pipeline Code of Practice
- Also corrosion, cathodic protection, coatings, welding, HDD testing, 3rd party interference

Steels: tensile testing in hydrogen

- SafeTi Lab at the University of Wollongong
- Overseas Labs now with testing backlog
- Crucial to ASME B31-12 Option B pathways
- Longer-term commercialisation in progress to provide testing asset for Australian industry
- Partnership now executed between Rosen and UoW

Hydrogen Pipeline Systems Code of Practice

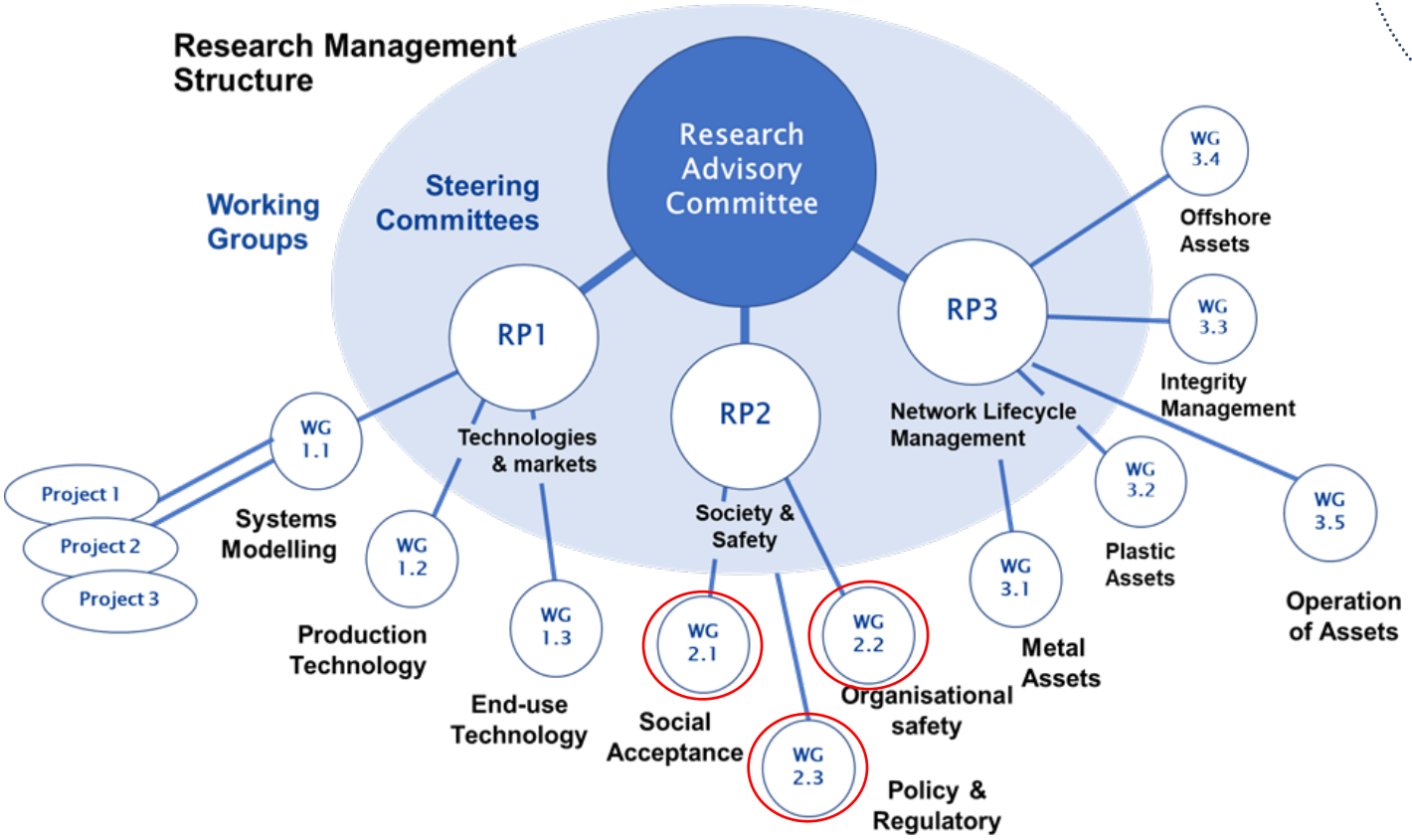


No	CoP Chapter Title	AS 2885 Related Part / Section	Section Scope
Chapter 1	Introduction		Scope, background, scene setting. References research activities and knowledge gaps that remain to be closed
Chapter 2	Background	AS 2885 Part 0	
Chapter 3	Properties of Hydrogen / Process Considerations	N/A – specific to hydrogen fluid	Physical properties of H2 and H2/CH4 blends. Guidance on how different impact process modelling, hydraulic simulation, and Safety in design considerations related to releases
Chapter 4	System Compatibility for H2 Service	AS 2885 Part 1 – Section 3 Pipeline Materials	Outlines impact of H_2 on pipeline system piping materials, components and equipment – and their applicability for H_2 service. Includes hydrogen compatibility reference tables for piping, components, equipment & devices.
Chapter 5	Carbon Steel Linepipe for H2 Service	AS 2885 Part 1 – Section 3 Pipeline Materials	Overview of hydrogen embrittlement, and impact to carbon steel linepipe materials; ductility, fracture initiation toughness, fatigue life / fatigue crack growth rate fracture propagation resistance
Chapter 6	Hydrogen Pipeline Design	AS 2885 Part 1 – Section 5 Pipeline Design	Principles for designing a carbon steel pipeline carrying hydrogen, and associated facilities design considerations

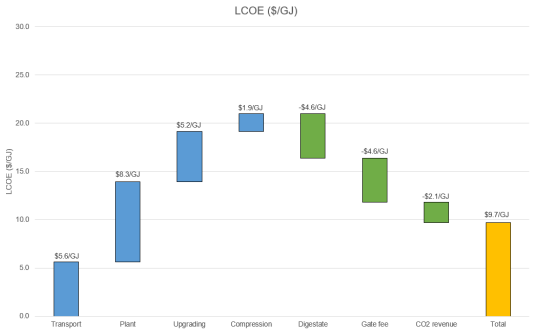
No	CoP Chapter Title	AS 2885 Related Part / Section	Section Scope
Chapter 7	Welding	AS2885 Part 2 Welding	Outlines impacts of hydrogen on the properties of girth welds on carbon steel pipelines and suggests appropriate measures to mitigate these impacts
Chapter 8	Conversion of Existing Pipelines	AS2885 Part 3 – Section 10 Change of operating conditions	Outlines a requalification process – both the linepipe, as well as equipment and components and implications for stations/facilities
Chapter 9	Operations & Maintenance	AS2885 Part 3 O&M	Pipeline system integrity management, pipeline structural integrity and anomaly assessment and defect repair of hydrogen pipelines (new pipelines & conversion of existing assets)
Chapter 10	Composite Pipelines	AS2885 Part 1 - Appendix S Fibreglass Pipe Manufacture	Design principles, fluid service conditions and qualification requirements for high pressure (spoolable) composites that are impacted by hydrogen
Chapter 11	Safety	AS2885 Part 6 – Safety Management	Provides guidance on the safety-related provisions of AS2885 focussed on hydrogen-specific issues that affect: pipeline safety management, process safety applied to facilities, emergency management

FUTURE FUELS CRC

Research Management Structure



Biomethane: viability and impurities



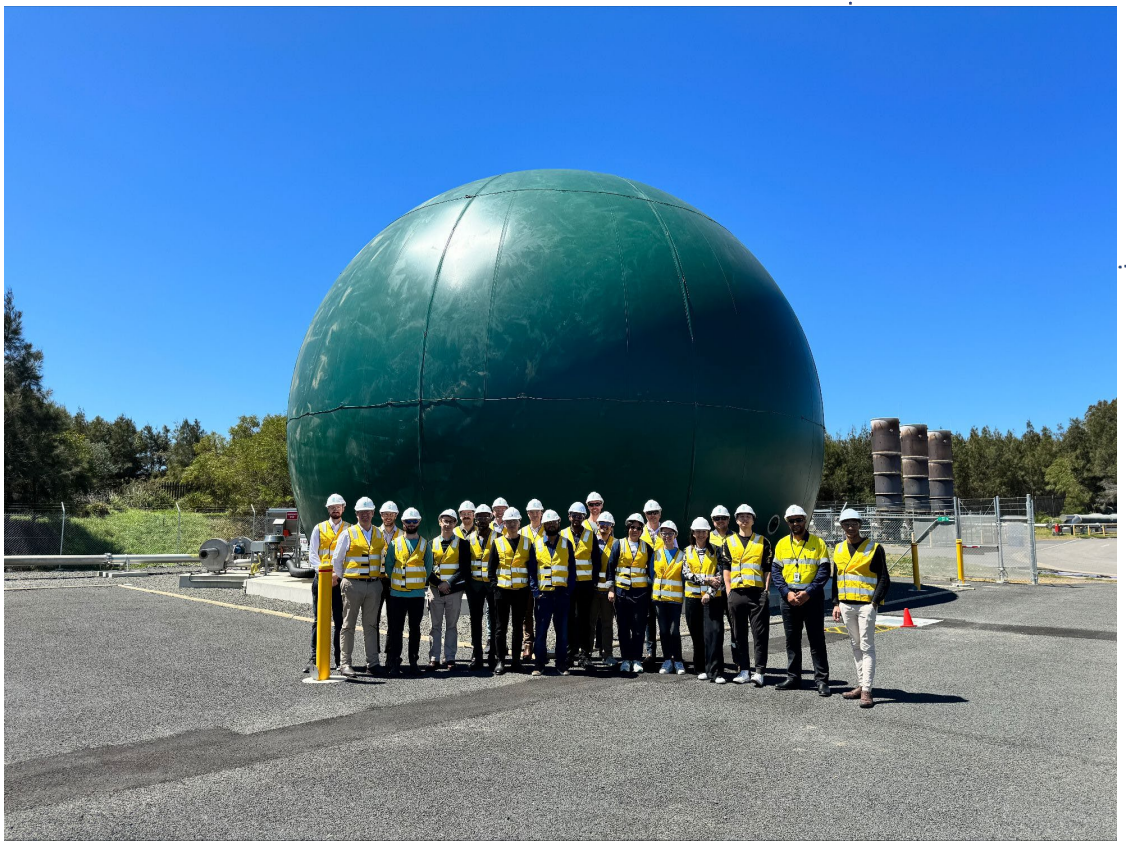


Photo: Our PhD students at Jemena's Malabar Biomethane Project, Sydney

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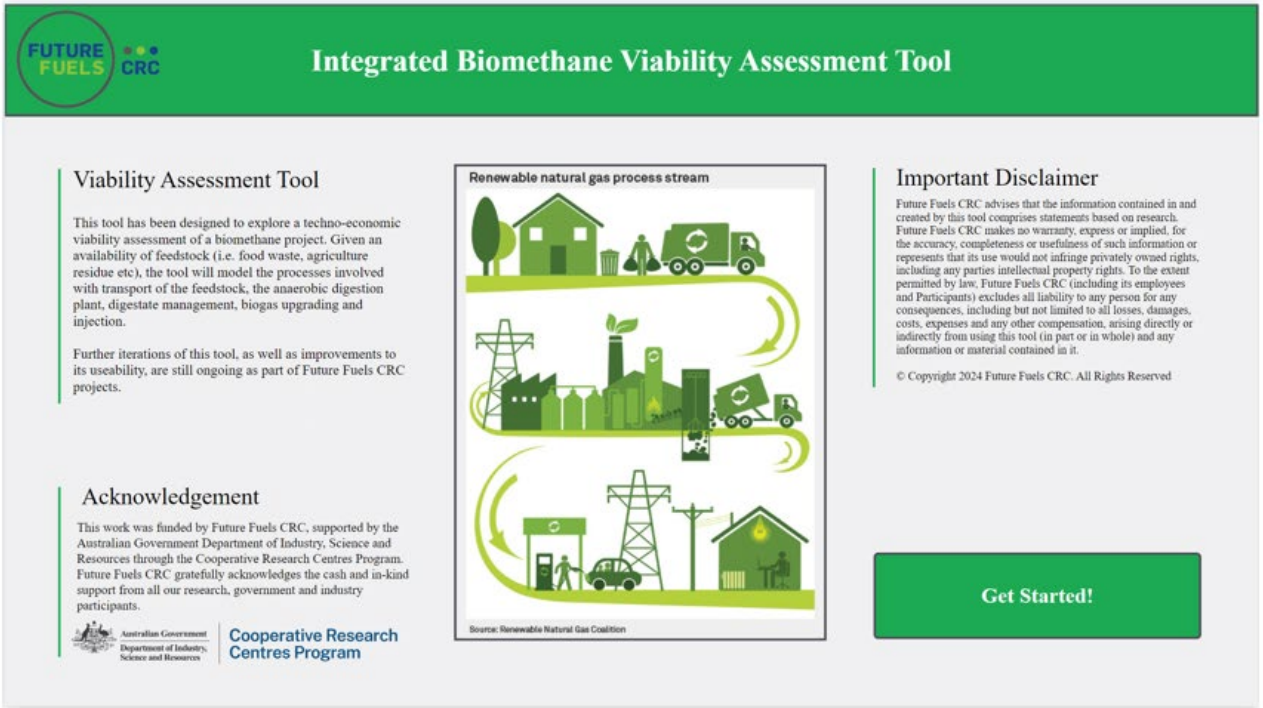
Online tool for project level Biomethane assessment

We have developed an online tool to explore the techno-economic viability of biomethane grid injection projects.



FUTURE FUELS CRC

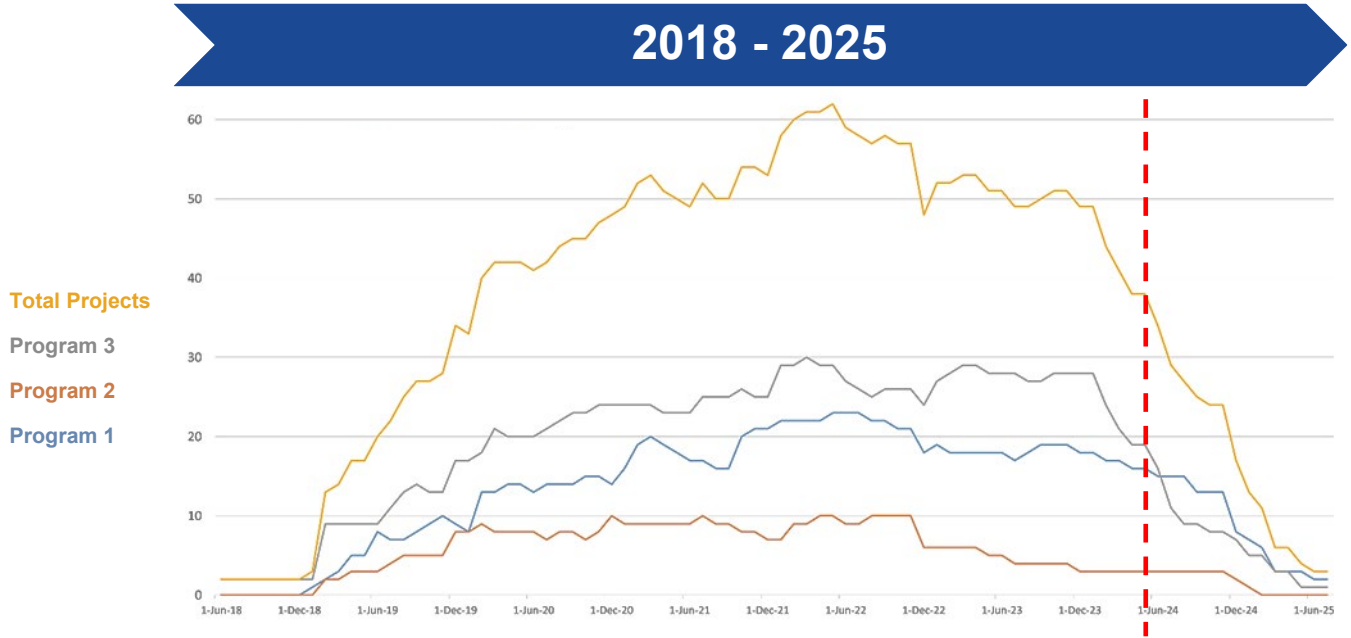
Driving research translation

- Face to face events with industry, seminars and conferences
- Working Groups and Steering Committees
- 30 webinars with more coming
- Members website and email research update to over 700 colleagues
- Over 100 key stakeholder info sharing partners
- Commercialisation and translation of IP to industry

Future research

We are delivering 118 projects

On time and on budget within our seven-year funded term



FUTURE FUELS CRC

Enabling the future of gaseous fuels research

- Transition of Future Fuels CRC in June 2025 and then final wind-up
- Industry has already worked on two possible CRCs:
  - Net Zero Infrastructure CRC
  - Moving Molecules CRC
- Now progressing Australian Gas Infrastructure Research Centre
- Recent CRA report ACIL Allen, need for ongoing research not unique to us and included in their recent decarbonisation support report
- Major transition task is already initiated:
  - Reports, software, IP, information, team changes
- Strongly supported by industry and long-term research collaborators
- Thanks to team, partners and all supporters and participants

FUTURE FUELS CRC

Australian Gas Infrastructure Research Centre

Driving forward collaborative research for meet the future needs of our industry:

- Pipeline research
- Gas network research
- Joint industry-wide research
  - Design and Construction
  - Risk and Safety Management
  - Reliability and Integrity
  - Infrastructure planning and regulation
  - High-pressure Fluid Industry Workspaces

APGA

Energy Networks Australia

FUTURE FUELS CRC

Enabling the decarbonisation of Australia's energy networks

futurefuelscrc

futurefuelscrc.com

Future Fuels CRC is supported through the Australian Government's Cooperative Research Centres Program. We gratefully acknowledge the cash and in-kind support from all our research, government and industry participants.

Australian Government
Department of Industry, Science and Resources

Cooperative Research Centres Program