FEnEx CRC News Update

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Dear

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End of year message from FEnEx CRC CEO, Professor Eric May

2024 has been a year of sustained growth, international engagement, and strategic developments for the Future Energy Exports CRC. Over these 12 months, we advanced our core research projects, strengthened our industry collaborations, and participated in national discussions, positioning the CRC at the forefront of energy transition efforts.

Key achievements include securing significant grants, launching new projects, driving collaborative initiatives and furthering our outreach through successful conferences and workshops. Clear signs of the CRC's impact have

emerged over the past year. For example, the Department of Climate Change, Energy, Environment and Water announced updates to the National Greenhouse and Energy Reporting Scheme legislation, with proposed amendments incorporating recommendations made by the FEnEx CRC on how to estimate emissions from flaring. The updated National Science and Research Priorities set “Transitioning to a Net Zero Future” as Priority 1 and quoted the FEnEx CRC’s submission regarding the “challenge, urgency and need for innovation associated with decarbonising Australia’s energy system”.

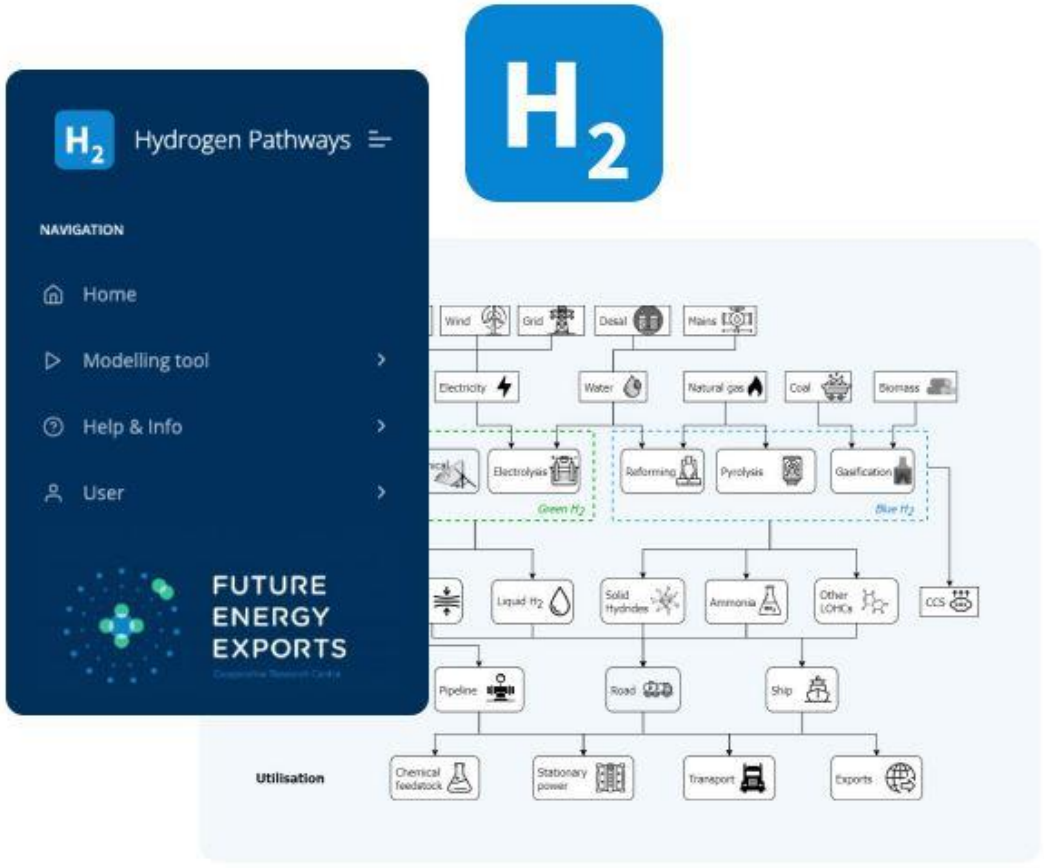
The FEnEx CRC was also invited by the Department of Industry, Science and Resources (DISR) to join the Australian stakeholder group working on the development of an international Measurement Monitoring Reporting and Verification (MMRV) scheme for greenhouse gas emissions being led by the US Department of Energy. And we featured prominently in a report on the value of decarbonisation-focussed activities being undertaken by 13 CRCs, with ACIL Allen estimating it to be worth $4.8 billion in additional economic output for Australia and $3.3 billion in abated CO2 emissions over the period 2017-2032.

The Commonwealth milestone reports have been well received by industry and government; these are available on the website. A major, new project aiming to assess the operational challenges of storing and transporting liquid CO2 under low-pressure, low temperature conditions (7° bar, -49°C) with partners from Japanese and Australian-based organisations and strong research collaboration between The University of Western Australia (UWA), Curtin and Seoul National University (SNU) has been completed.

International and government engagement has also continued at a pace. During WA Premier Roger Cook's visit to Korea, he received a briefing on the liquid CO2 from Austrade’s Trade Commissioner and Counsellor. Laboratory tours to UWA and SNU were also organised for the liquid CO2 project, with Minister King’s Chief of Staff and the Australia Japan Counsel General attending the former. Representatives from the FEnEx CRC were also privileged to visit the successful CO2 injection trial in Dongara WA conducted by Mitsui E&P Australia in February. Our continued support of the SPE Timor Leste Student Chapter has remained steadfast and we continue to participate in DISR’s LNG Fellowship program.

On the hydrogen front, 12 new research projects commenced in Programs 2 and 4, with several having a major focus on hydrogen liquefaction. This included a four-year project titled “Development and demonstration of safe, efficient hydrogen liquefaction through optimized mixed refrigerants and plant design” involving The University of Melbourne, UWA, Woodside, INPEX Holdings Australia Pty Ltd, Baker Hughes and the Queensland Government, which is receiving a $2.1 million grant from ARENA.

I would like to thank our partners, researchers, the Board and head office personnel for their sustained engagement. 2025 is going to be a year of significant advances for Future Energy Exports CRC - watch this space!



The intermittency cost penalty for green hydrogen

The unavoidable and inherent intermittency of upstream solar and wind power will result in fluctuating electrolytic green hydrogen production, which is incompatible with the feedstock requirements of many downstream hydrogen storage and utilisation applications (e.g. manufacture of ammonia). This necessitates some combination of the following: use of batteries to store the renewable energy, firming using either the local grid or a gas turbine, storage of the hydrogen product and/or potential oversizing of the wind/solar and electrolyser capacities. To this end, FEnEx CRC has developed dynamic techno-economic modelling to holistically size such electrolytic hydrogen production systems in their entirety whilst enabling a constant hydrogen output. This minimises the overall cost of hydrogen production (LCOH) whilst ensuring total cradle-to-grave CO2 emissions are adequately constrained. It makes use of local hourly weather data (covering the past decade) and is demonstrated for five locations across Australia frequently touted as potential locations for hydrogen export hubs1.

Interesting observations from this work include:

- The electrolyser capacity is consistently required to be substantially oversized, whilst inclusion of batteries is seldom cost effective.
- Firming with the grid (currently) or with a gas turbine (open cycle) is limited (comfortably less than 10% of the power requirements) in terms of emissions remaining within acceptable limits.
- Many locations favour either solar or wind power, despite some degree of intermittency compensation when they are combined.
- Whilst the resultant total system designs are very location-specific, a design that ensures a 100% usage factor costs approximately 22% more on average than a system design which is optimised for cost alone.

1 Stable electrolytic hydrogen production using renewable energy by Keelan T. O'Neill, Fuyu Jiao, Saif Al Ghafri, Eric F. May, Michael L. Johns

Two new approved projects:

1. **Net Zero Australia Part 2** is an extension of Net Zero Australia Part 1 which received an overwhelming positive response from government, industry and community and is now considered a benchmark study of Australia's net zero transition. In response to the positive encouragement to continue the project, the extension includes how we:

    - track how the Nation is performing relative to what is needed,
    - analyse major aspects of the decarbonisation challenge with sufficient depth and rigour for policy development and planning,
    - make practical recommendations, including policy recommendations, that can achieve deep decarbonisation whilst respecting social and other environmental needs; and
    - translate these recommendations more strongly into policy, planning, investments and, ultimately, operational projects.

2. Highly sensitive, reliable, selective, and innovative hydrogen gas sensing system for renewable energy plants

The project team aim to design and fabricate a proof-of-concept innovative hydrogen gas sensor and supporting system that is able to tackle the grand challenge of effectively detecting hydrogen in operational conditions for safety assurance and hydrogen productivity measurement.

Hydrogen gas sensors rely upon a limited set of physio-chemical interactions to perform sensing, each with associated advantages and drawbacks. Although a range of methods are available for detection and quantisation of hydrogen, commercially available devices tend to focus on those methods that are economic, scalable, and well-established - even if such characteristics come at the cost of sensitivity or selectivity. To meet the demands of a future hydrogen economy however, ongoing research is aimed at continuously improving sensitivity, selectivity, response time and reliability in addition to reducing sensor size, cost and power consumption.

The team will:

- design and development of a proof-of-concept portable sensing system and validation of field-ready hydrogen gas sensors employing novel nanomaterials that have been previously synthesised and tested by the team. Their in-field sensing performance including sensitivity, selectivity, long-term stability and durability and reproducibility will be investigated.
- integrate valid sensors into the developed portable sensing system with performance validated under different conditions and environments in the SUT Sensor Technology laboratory and Hydrogen 4.0 laboratory.
- develop advanced data analytic technique(s) to investigate addressing the accuracy, precision, specificity, and shortcomings of existing hydrogen gas sensors.

Recent Publications

Our research publications and reports are updated on a monthly basis.
Follow the links to see the latest releases:

- Research publications
- Reports

About FEnEx CRC

The Future Energy Exports Cooperative Research Centre (FEnEx CRC) is an Australian non-for-profit organisation established in 2020 to future-proof energy exports through industrial-scale research and innovation. Australia has a long and very profitable heritage as an energy exporter. Now, our country has the opportunity to harness its world-class renewable energy resources and leverage the know-how, capability, infrastructure and supply chains of its existing LNG industry to cultivate a new, sustainable and competitive export industry and remain a leading provider of energy internationally.

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