Northern Territory Low Emission Carbon Capture Storage and Utilisation Hub

Analysing power generation options

CSIRO has been working to build an understanding of the potential range in costs for supplying energy to a Low Emissions Hub in the Northern Territory.

This report has been delivered as part of the Northern Territory Low Emission Carbon Capture Storage and Utilisation (CCUS) Hub Business Case project.

The report builds understanding of the potential range in the costs to supply electricity (or hydrogen as a vector) to the Middle Arm Sustainable Development Precinct (MASDP). The outcomes may help inform the potential emission avoidance technologies that could be implemented in the MASDP and the relative demand that may be expected for CCUS.

The low-emission opportunity in the Northern Territory

The Northern Territory's abundant natural gas, solar resources, and CO_2 storage potential, along with its proximity to international markets, make it a key player in energy exports and decarbonisation in Australia and the region.

The NT Government has adopted a 2050 net-zero emissions target and is seeking ways to rapidly decarbonise existing energy supplies and attract future zero-emission industries.

Capital city Darwin, a gateway to South-East Asia and the location of globally significant liquid natural gas (LNG) export and industrial activity, is the proposed site for a large-scale Low Emission CCUS Hub. Led by CSIRO, a collaboration is underway on a business case project assessing the Hub's viability on the Middle Arm Peninsula.

If realised, the NT CCUS Hub could be one of the world's largest multi-user, multi-access hubs. One of the aims of the business case project is to identify transition pathways for industry in the region by sharing knowledge and experience that will help improve the likelihood of success. By taking a collaborative and regional view, an accelerated and sustainable industry transition can be explored.

The Northern Territory CCUS business case project

- CSIRO is working to identify decarbonisation and transition pathways for existing and potential future industries that may be established in a Low Emissions Hub in the Darwin region of the NT.
- We are working collaboratively with the NT Government and industry on the business case project to assess the viability of a large-scale low-emission CCUS Hub on the Middle Arm of Darwin Harbour.
- This project is also investigating other decarbonisation opportunities as well as CCUS. These include including sector coupling and renewable electrification.
- Task 7 of this project is an analysis of power generation options for the NT Low Emissions Hub.
- The future deployment of renewable electricity in the Northern Territory requires a greater understanding of the potential wind resources in renewable energy zones and the identification of low-cost energy storage technologies.

Exploring options for future energy generation in the NT

To understand how to decarbonise existing industries and develop low-emissions future industries in the Northern Territory, various strategies have been explored.

There is strong potential demand for renewable electrification from existing and future industries. When used in combination with CCUS, renewable sources of electricity and hydrogen could lead to significant reductions in Northern Territory emissions – not only in the power sector but for industrial users of energy.

In order to better understand the costs of potential power generation options, this study focused on three key questions:

1. How does the relative makeup of load type (flat versus variable) impact the least-cost solution for electrical power generation infrastructure and range for the average cost of electricity (ACoE)?
2. How does the constraint on gas generation impact the total cost of the system and the resulting ACoE without CCS?
3. What does the above imply for electrolysis-based hydrogen production in terms of the choice of power system infrastructure, electrolyser sizing and the production cost of hydrogen?

Based on these questions, researchers developed a least-cost optimisation model to explore the mix of generation, locations and associated transmission and pipelines that could meet the industrial electricity demand and the hydrogen production target estimates for the MASDP.

Key findings

Researchers used modelling to develop various cost estimates for a range of power generation scenarios.

The range of costs results from the range in the allowable fraction of gas-based generation, the type of electrical load (flat versus variable), and model inputs such as the wholesale price of gas and the technology cost year.

Additionally, the modelling investigates which aspects of energy infrastructure the cost of supply is most sensitive to.

Key findings were:

- The ACoE ranges from $88/MWh when no constraint is applied to the renewable fraction, to $141–169/MWh for a 50/50 mix of flat and variables loads and a 90% renewable fraction.
- The ACoE cost is most sensitive to how much of the spilled variable renewable electricity can be cost recovered, the capacity factor of onshore wind, and the renewable fraction.
- The Average Cost of Hydrogen at the 90% renewable fraction is almost $9.4/kg with a corresponding ACoE of $144/MWh and an optimal 67% electrolyser capacity factor.
- The cost of hydrogen supply is most sensitive to the assumed electrolyser efficiency, the ability to recover cost for spilled VRE, onshore wind capacity factor and the renewable fraction.

Key needs for the future deployment of renewable electricity in the Northern Territory are the development of a greater understanding of the potential wind resources in REZs and the identification of low-cost energy storage technologies.

The CCUS business case project includes inputs from the wider Northern Territory Low Emissions Hub (NT LEH) collaboration group, whose current members include the Northern Territory Government, Xodus, INPEX, Santos, Woodside Energy, Eni, Total Energies, SK E&S and Tamboran Resources. CSIRO has sought feedback from government and industry on the technical content of the report, CSIRO has sole discretion on including such feedback.

More information

Read the report

Learn more about the NT Low Emission Hub Research

For further information

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