FUTURE FUELS CRC

Enabling the decarbonisation of Australia's energy networks

Modelling future fuel options for Australia

Scenario and broad-scale modelling of future energy systems (RP1.1-01)

Project Summary

Developed for Future Fuels Cooperative Research Centre, this project aimed to demonstrate the capacity of a regionalised Computable General Equilibrium (CGE) model to inform the potential for the future role of hydrogen in greenhouse gas emission-reduction strategies. The report provides an overview of initial findings and the capacity of this modelling system.

The four scenarios examined in this research are:

60E – A 60 per cent emission reduction on 2005 levels with more widespread use of electricity as a final fuel ("60 per cent with electrification") but no significant role for hydrogen;

60H – A 60 per cent emission reduction on 2005 levels with the widespread use of electricity and the emergence of hydrogen—both green and blue—as a substantial part of the final energy mix;

100E – A 100 per cent emission reduction on 2005 levels that relies almost entirely on electrification to reduce energy emissions and little use of hydrogen;

100H – A 100 per cent emission reduction on 2005 levels with more widespread use of electricity and the emergence of hydrogen as a substantial part of the final energy mix.

Measured against a 2005 benchmark, the Australian Government is projecting that, by 2030, it will have reduced greenhouse gas emissions to 511 Mt CO_2-e. The government has been adopting a "technologies, not taxes" approach to reducing emissions and released a Technology Investment Roadmap that seeks to position Australia as a global leader in low-emission technology development. Coupling these expectations with the IEA's integrated assessment of demand for energy products if the rest of the world follows a stated-policy development pathway, this report assesses the regional and national implications of the introduction of hydrogen to Australia's energy mix in scenarios achieving a 60% and a 100% reduction in greenhouse gas emissions by 2050.

Results and findings

The most striking finding is that, without change to current policy and/or major technological improvements, attainment of net-zero emissions in Australia by 2050 requires the extraction of massive amounts of CO_2 from the air. Although some offsets from agricultural and other land management (bio-sequestration) are possible, by 2050, this action becomes prohibitively expensive and direct CO_2 extraction from the air becomes necessary.

Extending current policy settings to reach net-zero by 2050 – using either hydrogen or electrification - will require the Government to pay for the extraction of about 160 million tonnes of CO_2 from the air. Using optimistic assumptions, the research estimate that this will end up costing in the vicinity of $15.5 to $16.4 billion per annum.

Surprisingly, if Australia succeeds in reducing the cost of producing hydrogen for local users to $2 per kilogram and for bulk export to $1 per kilogram, the estimated direct extraction offset requirement in 2050 is reduced by only 9 million tonnes per annum.

The regionalised economic model that is developed and documented in the report reveals some important insights into the role of future fuels could play in helping Australia to reduce greenhouse gas emissions.

Conclusions

Three high-level conclusions stand out:

1) If Australia continues with its current suite of policies and continues to rely on the development of technology without introducing any form of market-based signal for greenhouse gas emissions Australia will only be able to meet its 2050 targets, whether they be for 60% reduction or net-zero, by establishing a massive greenhouse gas emission offset program. Moreover, this cannot be affordably achieved via bio-sequestration.

2) The development of the future fuel industry at scale risks being delayed until the late 2030s and only becomes a substantial part of the economy in the 2040s. This is due largely to the current focus on the development of technology coupled with an approach that delays investment until these technologies become cost-competitive. There is merit in carefully examining and, if found appropriate, assisting the case for a different approach.

3) A hypothesis to be tested by further research is that the current stated policy framework favours the development of electrification as a decarbonisation pathway at the expense of future fuels, potentially precluding the substantial role that more timely large-scale deployment could play.

The research also observed that common to all scenarios, neither GDP per capita nor GDP decline in any Australian State or Territory nor in any of 11 regions examined. That is, under all scenarios, no region experiences economic decline defined as an absolute decline in regional income. The reason for this is that, while there is considerable adjustment, every region experiences some population growth. In other words, while some regions benefit more than others, there is no region where the aggregate impact of a 60% reduction in emissions or the elimination of emissions (net-zero) is negative. As a result, the research team concluded that further work on the relationship between greenhouse gas reduction pathways, population and immigration policy options could be justified.

This model can be used to explore the implications of scenarios that involve:

- A global transition to net-zero emissions and an Australian response consistent with the IEA's recent net-zero report and Treasury's recent 2021 *Intergenerational Report*;
- The inclusion of a greenhouse gas emission price signals in the Australian economy;
- Revisions and adjustments that explore the nature of regional impacts of alternative strategies for the development of future fuels in Australia; and
- Examination of detailed transition pathways for the economy as a whole; for transport; for heavy industry; for international trade, for energy use; and for households.

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