Future Energy Development

Carbon Dioxide Capture, Utilisation and Storage Consultation 2024: Ara Ake proposal

5 August 2024

Ara Ake is the national future energy development centre, with the purpose to enable the acceleration, commercialisation, and deployment of energy innovation to support Aotearoa New Zealand's transition to a more sustainable, resilient, and equitable energy future. We welcome the opportunity to submit on the Government's discussion paper "Carbon Dioxide Capture, Utilisation and Storage."

Regarding Carbon Capture, Utilisation and Storage (CCUS), Ara Ake published the report *Carbon Dioxide Removal and Utilisation in Aotearoa New Zealand* (here) in 2022 to promote fresh discussion and inquiry about its use as one of the elements in New Zealand's decarbonisation efforts.

We support the introduction of a CCUS regime that will reduce net emissions, though we hold to the view that reducing gross emissions is the gold standard of mitigation. Added to that, we also hold to the view that the overall CCUS regime proposed by the Government would benefit with a stronger emphasis on the CCU (utilisation) component of the regime, as the Government's discussion document principally focuses on geological storage.

Benefits of Carbon Capture and Utilisation

We recognise the importance of renewable CO_2 as a key component in future low or zero emission fuels such as Renewable Methanol and Sustainable Aviation Fuel (eSAF).[1]

Low or zero emission fuels

Low or zero emission liquid fossil fuel alternatives, such as those described above, will require utilisation of carbon as an essential component of their production. For these fuels to be considered net-zero upon combustion, the carbon utilised needs to be extracted from non-fossil sources (such as biomass) or from the atmosphere through direct air capture technologies.

With respect to the demand of renewable carbon in New Zealand, Ara Ake's recent publication, *Transitioning to low emissions domestic aviation in New Zealand: A detailed technical options analysis*, specified that to meet future domestic aviation demand through the production of eSAF, close to 1,500 kilotonne (kt) of renewable CO_2 would be required as a feedstock to replace fossil jet fuel. Domestic aviation represents only 10% of New Zealand's projected liquid fuel demand (according to the Climate Change Commission's demonstration pathway),[2] suggesting that future demand for renewable carbon to produce liquid e-fuels is well in excess of 10,000 kt annually, before accounting for other areas of the economy (renewable natural gas, CO_2 for food and beverage, chemicals production etc.). A principal way of supplying this demand will be through CCUS technologies.

[1] eSAF is a type of sustainable aviation fuel produced through combining green hydrogen with direct air-captured carbon dioxide (CO2).

[2] Climate Change Commission. (2021). Ināia tonu nei: a low emissions future for Aotearoa

CCS with bioenergy

Carbon capture and storage (CCS) can generate negative emissions when combined with bioenergy. The concept of bioenergy is growing biomass for energy purposes. As it grows, the biomass absorbs atmospheric CO_2 through photosynthesis. The biomass is then processed into a fuel form, often pellets. As the fuel combusts, it produces biogenic CO_2. Bioenergy with carbon capture and storage is known as BECCS.

BECCS enables carbon removal because biomass absorbs CO_2 as it grows, and this CO_2 is not re-released when it is burned. Instead, it is captured and injected into deep geological formations, removing it from the natural carbon cycle.[3]

Carbon Dioxide's importance to the New Zealand economy

CO2 has important uses in our society including food and beverage production as well as the production of iron, steel, methanol, fertiliser and synthetic natural gas production. Medical grade CO2 is used as a pure gas or in specialised mixtures with other gases in stimulating breathing, anaesthesia and sterilisation of equipment. In New Zealand, the highest demand for CO2 currently is the horticulture and food/beverage industries. Utilising CO2 extracted from the atmosphere would make these uses carbon neutral.

Innovation is creating more uses for CO2 in our economy, some of the most significant being:

- Construction aggregates such as steel
- Concrete
- Fertiliser
- Renewable-Methanol
- Sustainable Aviation Fuel

Ara Ake is working with innovators in New Zealand developing CCUS technologies

In our 2022 report *Carbon Dioxide Removal and Utilisation in Aotearoa New Zealand* we brought focus to emerging technologies in carbon capture and utilisation, and since then Ara Ake has been working with the following innovators on CCUS initiatives that have a strong focus on carbon utilisation.

Aspiring Materials

Aspiring Materials focuses on carbon sequestration as well as by-product utilisation. Their team has developed carbon removal technology that utilises commonly found ultramafic rocks in their process to manufacture Magnesium Hydroxide that rapidly captures carbon dioxide. From that process, iron, silica and hydrogen are also extracted, creating low-emission ingredients to be used in products such

[3] Going carbon negative: What are the technology options? – Analysis - IEA

as cement. A tonne of ground ultramafic rock can abate and absorb up to 1.6 tonnes of atmospheric CO_2.

Capture6

Their direct air capture (DAC) technology can provide sustainable CO2, support high-quality carbon credits, and produce freshwater and green industrial byproducts (e.g. hydrogen). All this while also reducing point-source emissions and supporting the extraction of lithium from geothermal brine. This technology can produce food-grade and eSAF compliant CO2.

Hot Lime Labs

Their CO2 capture system converts wood waste biomass into clean CO2 for commercial greenhouses, increasing crop productivity and growth by up to 25% and will support transition to sustainable CO2 use for a hard-to-abate sector.

Captivate Technology

Originally formed at Massey University, Captivate Technology has developed a low-cost process to capture emissions at their source. Its core technology is a solid-state adsorbent, Metal Organic Framework (MOF) that sieves CO_2 from emissions to produce a pure stream of CO_2 that can be used or stored.

Conclusion

CCUS can play a crucial role in reducing net greenhouse gas emissions in the short-term, and in offsetting residual emissions from hard-to-transition sectors. However, we believe we must pursue innovation that enables CO_2 utilisation in the first instance. We support the introduction of a CCUS regime that will reduce net emissions, though we hold to the view that reducing gross emissions is the gold standard of mitigation. The Boston Consulting Group's white paper *Carbon capture and utilisation as a decarbonisation lever* states "CCU will account for 10% to 33% of total captured carbon by 2050, according to some estimates."

They go on to say "that the amount of captured carbon required to achieve net zero far exceeds the potential of CCU. As a result, CCS will remain the dominant decarbonization lever."

While we acknowledge this, we emphasise that storage should not be the first recourse for captured CO2 - utilisation should be. CO2 utilisation is an essential component to decarbonising a number of hard-to-transition essential industries within our economy. Having a stronger focus for utilisation of CO2 in New Zealand's proposed CCUS regime, will be of value and importance to the country.