Land and Agriculture for a Just Transition

November 2019, Rebecca Bell

1 Negative emissions

Combined with carbon capture and storage (CCS), Scotland's land and its food and drink industry have the potential to deliver 'negative emissions', helping Scotland meet its net zero greenhouse gas emissions targets.

Carbon capture and storage is the process of separating carbon dioxide (CO_2) from the flue gases of industrial operations, transporting it, then securely storing it in geological formations deep below the seabed.

CCS is crucial to reducing emissions from industry, where there are few other options for decarbonisation. It can also be used to avoid emissions from power generation using fossil fuels, although this is unlikely to be necessary in Scotland, with its abundant resource for renewable energy generation.

Once it is in place, the infrastructure to transport and store CO_2 should be available to any organisation that can capture its CO_2 - this includes CO_2 from biogenic (non-fossil) sources, which are not counted in the emissions inventory and which therefore would count as 'negative emissions' if they were prevented from reaching the atmosphere, including:

- Biogas combined heat and power (including landfill and sewage treatment)
- Biomethane upgrading
- Biomethane combustion
- Biomass combustion
- Fermentation[1]

Negative emissions should not be seen as a replacement for measures to avoid or reduce greenhouse gases – all parts of the economy will need to do what they can to decarbonise. Negative emissions will be needed to offset emissions that can't be avoided, and by delivering them, Scotland's land and agriculture sector can help the rest of the economy in its transition to net zero.

2 Biogenic CO_2

As plants and trees photosynthesize, they absorb CO_2 from the air and convert it to glucose. Through this process, carbon is taken out of the atmosphere and 'locked up' in the plant.

[1] See Brownsort (2018) *Negative Emission Technology in Scotland: Carbon capture and storage for biogenic CO_2 emissions*: https://www.sccs.org.uk/images/expertise/reports/working-papers/WP_SCCS_2018_08_Negative_Emission_Technology_in_Scotland.pdf

However, this carbon sequestration is not permanent – the CO_2 is released when the plant dies and rots or is eaten or burned.

One way to keep this carbon locked up for a long time is to use timber as a building material, where it will remain inert until the end of the building's life.

Another option is to capture the CO_2 when it is released – for example where wood is burnt for electricity generation or to fuel industrial processes; where organic waste is broken down in landfill or through anaerobic digestion, or where it is incinerated to create energy; or where the sugar is converted to alcohol in the production of whisky and other drinks.

3 Current opportunities for capturing biogenic CO_2 in Scotland[2]

3.1 Food and drink

Scotland has seven grain whisky distilleries, which account for around 0.25 $MtCO_2$ / year as well as hundreds of smaller distilleries and breweries. These fermenting processes give off a concentrated stream of CO_2 as yeast turns sugar to alcohol.

In most cases, it would not be practical to capture this CO_2 because of the small size of the operations - but from the distilleries which operate at an industrial scale, it would be possible and, indeed, has already been done at the North British Distillery in Edinburgh.

3.2 Bioenergy with CCS

Bioenergy with CCS (BECCS) is the most well-developed approach to capturing biogenic emissions, and is currently being trialled at Drax power station in Yorkshire, which burns wood pellets to produce electricity.

Scotland has six major sites where biomass is burned for power generation, heat or both – they account for around 1.4 Mt CO_2/year – in addition to thousands of smaller sites. There is the potential to turn this to negative emissions using CCS.

Overall, research by SCCS found that there is the potential to capture 2.1 Mt CO_2/year of existing biogenic emissions in Scotland, from the 29 of the largest sites in the country.

[2] See Brownsort (2018). This report considered existing sources of biogenic CO_2 in Scotland, including energy from waste, which is less relevant to this evidence session, but nonetheless provides an opportunity for negative emissions. Further work on the greenhouse gas removal potential for energy from waste is being done through the European NEWEST-CCUS project, in which SCCS is a partner.

4 Future opportunities for negative emissions in Scotland

4.1 BECCS

The Committee on Climate Change found that demand for harvested biomass is likely to outstrip supply, so recommends that it "will be used most effectively where it maximises the removal and minimises the release of carbon into the atmosphere"; that is:

- More timber used in buildings
- No new subsidies for large-scale biomass to power plants unless with CCS
- Use biomass to produce hydrogen, electricity or industrial products whilst sequestering carbon with CCS
- Phase out biofuels in cars and vans in the 2030s
- Plan for up to 10% of aviation fuels as biofuel produced with CCS by 2050[3]

It has been estimated that there is the potential for dedicated short rotation coppice plantation on an area of 5,2000 km^2 of land which is described as "marginally suitable for food production", and which accounts for 26.5.% of agricultural land in Scotland. This could remove 5.73-22.9 $MtCO_2$/year[4], although competition with other land uses, and for water and nutrients, means that actual deployment is likely to be less than this.

4.2 Other options

Other options for greenhouse gas removal that could be considered by the land use and agriculture sector include:

- Increasing soil carbon – including peatland restoration and expanding forestry.
- Creating biochar – fixing carbon for long term storage by charring biomass.
- Enhanced geological weathering of rock minerals – intentionally accelerating processes that convert CO_2 in the air to rock.
- Direct capture of CO_2 from the atmosphere for geological storage.[5]

[3] Committee on Climate Change (2018) *Biomass in a low-carbon economy*: https://www.theccc.org.uk/publication/biomass-in-a-low-carbon-economy/
[4] Alcalde et al (2018), cited in Haszeldine et al (2019)
[5] For more detail on these, and their potential capacity for negative emissions in Scotland, see Haszeldine et al (2019) *Greenhouse Gas Removal Technologies – approaches and implementation pathways in Scotland*: https://www.climatexchange.org.uk/media/3749/greenhouse-gas-removal-technologies.pdf