

The potential and limitations of negative emissions technologies at a small nation scale

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Negative emission technologies (NETs) are any activity that removes carbon from the atmosphere. Examples include bioenergy with carbon capture and storage (BECCS), direct air carbon capture and storage (DACCS), soil carbon management, afforestation and biochar. Each option typically involves the biological or technological capturing of carbon dioxide from the atmosphere and storing the resultant carbon in the biosphere (e.g. In biomass or soil carbon) or geosphere (e.g. In depleted oil gas reservoirs). NETs may have the potential to contribute significantly towards achieving the Paris Agreement temperature goals.

A preliminary assessment of the indigenous NETs carbon removal capacity of Ireland is carried out using a simple model constrained by land area availability. The results find that, under relatively conservative land area availability, there may be significant carbon removal potential across a number of NET options. The highest potential cumulative carbon removal capacities for Ireland are from BECCS and DACCS, neither of which are currently deployment-ready. Lower potential capacities were found for NETs that are deployment-ready in Ireland: afforestation, biochar, and organic soil carbon management. These could provide immediate but saturation-limited and non-permanent carbon removal and storage. We present all these options for Ireland under the categories of relative carbon removal capacity, readiness, cost, vulnerability to re-release of captured carbon, vulnerability to future climate change, biodiversity risk, energy penalty and land pressure. Our findings show NETs deployment may have potential to moderate Irish nett emissions somewhat in the future, however this potential currently remains speculative and uncertain. Hence, near-term emissions reductions must still be prioritised.

Future national research priorities were identified, particularly in relation soil carbon saturation deficits, bioenergy productivity and geological carbon storage potential. Future work will consider the yield potential for two bioenergy crops, *Miscanthus* and willow, under current and possible future Irish climate scenarios using the crop productivity model BioCro.