

Opportunities for atmospheric CO₂ removal in Northern Ireland using biochar

Executive Summary

This report summarised the results of an investigation into the potential of biochar-based carbon dioxide removal (CDR) in Northern Ireland. Biochar is one of a number of ways to capture carbon from the atmosphere, but given Northern Ireland's relatively large agricultural sector, offers both a route to reliable and inexpensive CDR and a potential new revenue stream for the country's farmers.

Agriculture has a significant role to play in both low carbon energy generation and CDR in Northern Ireland. Although agriculture contributes significantly to GHG emissions, the sector has potential to be a key part of the decarbonisation solution. If a 'whole system approach' can be introduced through low carbon farming cooperatives, the biogenic carbon captured in agricultural biomass could be removed and stored in biochar for longer term carbon storage and removal. Biochar is a product of gasification of biomass and can be incorporated into soil or added to products such as concrete for carbon storage. This process could integrate into low carbon energy production and contribute to significant decarbonisation in Northern Ireland.

Against this backdrop, the report summarised and evaluated the potential value of CDR in Northern Ireland, through the production of biochar from different biomass sources including grass silage digestate, miscanthus and short rotation coppice (SRC) willow. Biochar quantities, carbon reduction potential and economic return for each of the three biomass to biochar scenarios were modelled and compared to identify what each pathway could deliver for Northern Ireland. The report also detailed what a low carbon farming co-operative could look like in Northern Ireland, as well as summarising the policy and economic levers and barriers for carbon farming.

One of the potential uses of biochar is as a gold standard carbon offset as carbon stored is easily audited and, if stored appropriately, will sequester carbon for hundreds or thousands of years. Currently, carbon offsetting has a dubious reputation although many organisations are striving to improve standards. Many schemes are impossible to verify, and some are demonstrably based on false assumptions and do little to remove carbon from the atmosphere. Establishing an audited, biochar based, gold standard carbon offset industry in NI to address this global market is an option but will offshore the benefits of NI biochar CDR when there are practical uses within NI.

Key findings included:

1. CDR is necessary to meeting carbon targets, as emphasised by multiple reports, including the IPCC.
2. The digestate output from existing anaerobic digestion plants in Northern Ireland is around 110kt of dry matter, equating to 32kt of biochar with a CDR potential of 118 ktCO₂e (around 2% of the current emissions from the agricultural sector in Northern Ireland).
3. 200 kt of biochar could be produced per year if all housed livestock manure and underutilised silage in Northern Ireland was used to produce digestate via anaerobic

digestion (c. 400 ktCO₂e per year of CDR)¹. This is equivalent to 7.1% of the current GHG emissions for the agricultural sector in Northern Ireland (5.6 MtCO₂e per year).

4. Given Northern Ireland's current low level of forestry and the current usage patterns for amenity, nature or existing timber industries including bioenergy via wood chip, forestry was not found to be a realistic route to large scale biochar production. Even if substantial reforestation occurred this would not have significant consequence based on growth achieved by 2050.
5. The Climate Change Committee (CCC) model in Northern Ireland has a target of 36 kha of bioenergy crops by 2050 for decarbonisation. If all the new bioenergy area was taken up by:
 - i. Miscanthus, biochar potential per annum by 2050 is around 123 kt, with a total CO₂ removal potential of 365 ktCO₂e.
 - ii. SRC willow, biochar potential per annum by 2050 is around 145 kt tonnes, with a total CO₂ removal potential of 420 ktCO₂e.
 - iii. Grass silage, biochar potential per annum by 2050 is around 121 kt tonnes, with a total CO₂ removal potential of 246 ktCO₂e. With this scenario other benefits were noted relating to the lower extent of land use transition needed in Northern Ireland and the ability to execute without reducing land for grazing.
6. Biochar produced in Northern Ireland could be a valuable income stream for farming cooperatives and could be directly used by NI's concrete industry to help reduce the carbon footprint of their products.
7. An additional 700 to 800 new jobs could be created in rural communities across Northern Ireland through creation of a CDR industry based on biochar. If this is linked into the production of biomethane via AD then around 2000 jobs could be secured by 2030.
8. Additional revenues of up to £300m are forecast based on biochar-based CDR with syngas and biomethane production. This figure is heavily dependent on price for CO₂ removal certificates and gas prices.

The report covered the current technical and UK/NI policy and regulatory frameworks for biochar. While there has been a rapid increase in interest in biochar as a CDR tool and a growing body of research and demonstration projects world-wide, regulatory frameworks and government policy developments are still to embrace biochar as part of the decarbonisation solution. To put biochar-based CDR on a firm basis in NI a number of steps are recommended. These include:

1. Cross departmental (DfE and DAERA) support for CDR is needed. This should consider both agricultural and carbon balance unintended consequences.
2. Engagement with DESNZ is needed to align new policy with the upcoming UK wide policy.
3. Further research is required:
 - i. To understand implications of GHG removal solutions, including holistic assessments of their feasibility and acceptability.

¹<https://doi.org/10.1016/j.renene.2022.06.115>

- ii. To deliver innovative monitoring, reporting and verification (MRV) tools, technologies and techniques that assess the effectiveness, integrity and longevity of land-based carbon dioxide removal.
 - iii. To work with industrial manufacturers, such as the concrete industry, to determine the best utilisation of CDR products to decarbonise manufactured products whilst also ensuring the long term permanence of the carbon dioxide removal.
 - iv. An investigation of land utilisation to maximise the sustainable biomass output of our land for food, animal feed, bioenergy, bioproducts, timber products and carbon dioxide removal needs.
4. Community and stakeholder engagement is needed to communicate the concept of whole system carbon farming co-operatives. This is due to the general low-level of awareness noted during discussions with stakeholders. If biochar production at scale is to be achieved, then farmers will need to be bought into the concept as they are the main source for feedstock. Communities will also need to accept local bioenergy facilities at a scale larger than current AD plants.