Programme Area: Bioenergy

Project: Biomass to Power with CCS

Title: One Page Summary

Abstract:

Bioenergy production coupled with CCS could provide up to 10% of UK energy in the 2050s and deliver substantial net negative emissions. At the time of writing (2012) Bioenergy with CCS was thought to have the potential to remove 50 - 100 Mt of CO2 from the atmosphere each year by 2050. More recent analysis, published in the Bioenergy Insights papers, suggests that this figure is closer to 55 Mt CO2/yr.
The Biomass to Power with CCS project found that uncertainties in the data resulted in large potential uncertainties in the conclusions, particularly with regard to the looping technologies. This made the comparison of the eight technologies, and drawing definitive conclusions, difficult. The project team recommended further investigation of the data, in particular data relating to chemical looping technologies.

Context:

The Biomass to Power with CCS Phase 1 project consisted of four work packages: WP1: Landscape review of current developments; WP2: High Level Engineering Study (down-selecting from 24 to 8 Biomass to Power with CCS technologies); WP3: Parameterised Sub-System Models development; and WP4: Technology benchmarking and recommendation report. Reports generally follow this coding. We would suggest that you do not read any of the earlier deliverables in isolation as some assumptions in the reports were shown to be invalid. We would recommend that you read the project executive summaries as they provide a good summary of the overall conclusions. This work demonstrated the potential value of Biomass to Power with CCS technologies as a family, but it was clear at the time of the project, that the individual technologies were insufficiently mature to be able to 'pick a winner', due to the uncertainties around cost and performance associated with lower Technology Readiness Levels (TRLs).

Purpose: **Arising IP**
Restrictions: **No additional restrictions**

ETI Programme: Bio Energy

Project Name: Biomass to Power with CCS

Context

[Biomass produced in the UK could provide up to 10% of UK Energy in 2050. The Biomass to Power with CCS Project focussed on developing a detailed understanding of the technical and cost barriers associated with biomass to power with Carbon Capture and Storage (CCS) technologies.

Biomass conversion to heat and/or power combined with CCS could provide the UK with substantial net negative CO2 emissions, with the potential to remove 50 to 100 MT of CO2 from the atmosphere on an annual basis (depending on capture rates) and provide 80 to 120 TWhr of electricity annually. A technology choice that is capable of creating "50 to 100MT of negative carbon" could be compelling, depending on the cost at which this technology option can be developed and deployed.

Project

The objective of this project was to

- develop a techno-economic assessment of the barriers in terms of biomass to power with CCS systems;
- provide an assessment and comparison of various potential biomass to power with CCS configurations (at both small and large scale); and
- provide an assessment and comparison of dedicated biomass/CCS combinations with co-fired biomass/fossil/CCS combinations.

Key Project Findings

1. The uncertainties in the data result in large potential uncertainties in the conclusions, particularly with regard to the looping technologies. This makes the comparison of the eight technologies, and drawing definitive conclusions, difficult.
2. Cost of CO2 capture is less than £190/te, but can be as low as £90/te depending on technology, scale and feedstock price. Increasing the scale of dedicated biomass plants from 50MWe to 250MWe can reduce the cost by around £20/te
3. Dedicated biomass power plants couple with CCS offer the lowest cost negative CO2 emissions, with over 1.4te of negative CO2 emissions per tonne of biomass (odt).
4. Dedicated biomass chemical looping combustion and, to a lesser extent, co-fired carbonate looping came out as two of the more attractive biomass CCS technology combinations for possible development and demonstration in the UK.
5. Chemical looping, due to its higher efficiency and lower specific Capex, appears to offer lowest cost negative CO2 emissions. However better data is required to confirm this conclusion.
6. The chemical looping data needs to be further investigated and sensed checked. There are several technical hurdles to be overcome in the development and scale-up of the two looping technologies, and large uncertainties attached to the cost estimates considered in this study.