GHG Emissions Assessment & Accounting Frameworks for Bioenergy Systems

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Why are Bioenergy Emissions Important?
Why is the GHG footprint of bioenergy important?

- Energy & emission targets / mandates.
- Bioenergy is firmly on the UK’s roadmap.
- Bioenergy only viable if it provides a low carbon renewable energy pathways.
- Important to maintain focus on GHG performance.

<table>
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<tr>
<th>UK Total Power Generation</th>
<th>UK Total Heat Generation</th>
<th>UK Total (non-air) Transport Energy</th>
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<tbody>
<tr>
<td>13.7% from bioenergy</td>
<td>5.3% from bioenergy</td>
<td>4.2% from bioenergy</td>
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DUKES, 2015
And the Importance of GHG Performance is Growing...

- Growing network of international biomass supply chains.
- Europe consumes 79% of global supply of wood pellets (FAO, 2015).
- The UK the worlds largest consumer 6.8 Mt (FAO, 2015).

| Increased Scale & Complexity of Supply Chains | = | Increased Scrutiny of the GHG Performance |
Our Research Shines a Light on the GHG Performance of Bioenergy
We can show... Bioenergy, is Low Carbon Renewable Energy
Although...

There are Lingering GHG Uncertainties

**UK Generation Heat from Willow SRC – Revised Counterfactual**
Don't Forget:
Geography, Sector and Temporal Framing
We Know...
The Drivers of Bioenergy GHG Variations

- Land and Land Use Change
- Biomass Production Practices
- Bioenergy Feedstocks
- Bioenergy Processes
- Analysis System Boundaries
- Analysis Methodologies
- Temporal/ Spatial Variations
- Counterfactuals

Increasing Uncertainty!
The Importance of Viewing & Analysing Bioenergy as a Whole System
LCA, the Primary Analysis Technique

- Well developed & widely implemented technique for analysing the whole life cycle bioenergy emissions.
- Balance of emissions from all life cycle processes & activities, provide overall GHG performance.
- Explore the influence of counterfactual scenarios.
- Can be applied to analyse the GHG performance of complex supply chains.
- Allows evaluation of the GHG performance of each specific life cycle step – identifying ‘good’ and ‘bad’ processes.
Case Study: Analysing Overall GHG Performance

Generating Heat from UK Miscanthus through Different Resource Production & Bioenergy Conversion Pathways
Case Study: Understanding where GHG are Generated

Breakdown of GHG Emissions Attributed to Processes and Activities within the Bioenergy & Counterfactual Pathways

- Abandoned Arable Land Reverting to Natural Forest System
  - COUNTERFACTUAL PATHWAY

- Case Study Miscanthus Bioenergy Scenarios
  - BIOENERGY PATHWAY
Bioenergy Emissions vs. Emissions Accounting Frameworks
National GHG Inventories

- IPCC developed the methodologies & guidelines universally used for accounting GHG emissions.
- Nations individually account emissions within a series of GHG Inventories.
  - Energy Generation
  - Industrial Processes & Product Use
  - Land-Use, Land-Use Change & Forestry
  - Wastes
- Emissions allocated to inventories based on geography & sector.
- Nations periodically assess and report the emissions from their activities.
Bioenergy vs. National GHG Reporting

UK Bioenergy Generated from Canadian Biomass Pellets

- Forest System
- Biomass Harvest
- Transport
- Pellet Production
- Transport
- Transport Oversees
- Transport
- Bioenergy Conversion
- Waste Management

Emissions Released to the Atmosphere
Emissions Locked Up from the Atmosphere
Does this System Work for Bioenergy?

It does what its supposed to do...

- Mechanism for benching & tracking progress towards emission targets.
- Framework for accounting the overall balance of GHG emissions (assuming sustainability & accurate reporting).
- Framework where policy makers can see how bioenergy reduces GHG inventories.
- Not designed to be tool for analysing the GHG performance of different bioenergy pathways.

It could be improved for bioenergy...

- Can be complicated and hard to see the overall picture.
- Macro-level inventory data.
- No incentive for increased sustainability or efficiency of biomass consumption.
- Annex 1 reporting, non-Annex 1 differences in reporting.
- Big sustainability assumption that bioenergy results in a balance of zero CO\textsubscript{2} emissions.
- LULUCF reporting focuses on afforestation, deforestation & reforestation – changing carbon stocks not explicitly accounted.
Whole Systems Research – Key Messages

- We know what makes a bioenergy pathways good and bad in terms of GHGs
  - we need to shout about the good more!
- Is it time to start picking more bioenergy GHG winners?
- We know what generates bioenergy GHG uncertainties.
  - these need to be addressed through policy and in many cases through development and implementation of best practice.
- Bioenergy is only viable if it provides low carbon energy.
  Understanding how and where bioenergy whole systems emissions are accounted within the National Accounting Frameworks is not always easy.
  - Should we not be focusing on this more?
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