Use of North American woody biomass in UK electricity generation: Assessment of high carbon biomass fuel sourcing scenarios

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I refer to three studies in my presentation, the web links for these are at the end of the presentation.

Content

- Background on why the study was needed
  - BEAC model
  - High carbon scenarios identified using the BEAC model
- Evidence on likelihood of high carbon BEAC scenarios
  - Methodology
  - Challenges and how we overcame them
- Results
- Conclusions

Background: BEAC

- **Biomass Emissions and Counterfactual model**

- Commissioned by DECC in 2014

- Aim: understand the potential impact on carbon emissions of options for sourcing woody biomass from North America for UK power generation plants

- It's a **counterfactual model** – it estimates greenhouse gas intensity of biomass feedstock production by taking into account the counterfactual for the scenario (i.e. what the land or wood would have been used for if it was not used for bioenergy).

- Used by Stephenson and Mackay to estimate additional carbon impact of UK demand for pellets from North America. They examined 55 scenarios.

BEAC Model

- BEAC models the **additional impact** from harvesting of wood for pellets in North America.
  - o It assumes all other demands on the forest will remain the same at landscape level as in the absence of pellet demand. *Other forest products impacts are not modelled.*

- It uses **scenarios paired with counterfactuals**
  - o Each scenario compares the carbon emissions from the supply of pellets to a counterfactual designed to represent what could have happened in the absence of UK pellet demand in forests in North America.
  - o This means that the counterfactuals determine the result and are important
  - o E.g. if the counterfactual is that forest would not be harvested as frequently in the absence of pellet demand BEAC models the carbon impact as the difference compared to a counterfactual of continued forest growth in the absence of the harvest of pellets.

- BEAC also takes factors not included in the Renewable Energy Directive (2009) into account: **carbon debt, changes in average carbon stock, foregone carbon sequestration and indirect impacts**.

Stephenson and Mackay: results and implications

- Identified a number of **low carbon scenarios that had the potential to supply estimated UK demand** were identified.

- Identified **28 potential scenarios that could result in high carbon emissions**.

- There was no information on the likelihood of these scenarios to occur

In 2015 **DECC commissioned a study to examine the likelihood of the high carbon emissions scenarios.**

Assessment of high carbon fuel sourcing scenarios

Aim:

- **Develop an evidence base on the likelihood of the 28 selected BEAC biomass source scenarios associated with the highest greenhouse gas emissions.**

- Provide an assessment of the strength of the data/uncertainty associated with the results of the analysis.

- Eleven additional carbon scenarios that were not considered by Stephenson and Mackay were also included, making 40 in total.

Challenges

- You can't pick up a book that provides the answers
  - The high carbon scenarios are not normal forest practice so the scientific and forestry literature does not allow direct examination of their likelihood.

- These scenarios aren't modelled in available forestry models
  - The nature of the scenarios (particularly potential ones) means that they have not been modelled using forestry economics models
  - The forestry sector in North America use financial models to guide harvesting decisions, but these are proprietary and not available publically

- Only forest owners and forestry experts know what actually happens when the wood is felled and how this might change in response to pellet demand.
  - The relevant information on harvesting methods/rotation lengths lies with the forest sector in North America. They regard much of this information as commercial.

Methodology for likelihood assessment

- 3 phase approach: Literature review; North American stakeholder survey; and modelling of forestry in South-Eastern USA using the Southeast Sub-Regional Timber Supply Model (SRTS).

- Stakeholder survey comprised a questionnaire on the likelihood for each scenario and the factors that influence this.
  - o Used the project's North American experts to recommend a list of candidates who were invited to participate in the study.
  - o Asked participants to provide evidence for their views

- US and Canadian partners:
  - o Dr Jennifer Jenkins of Applied GeoSolutions (Ex Forest LCA expert for the US EPA)
  - o Professor Robert Abt - Professor of Forestry Economics at North Carolina State University, who developed the STRS model
  - o Professor Tat Smith of the University of Toronto, Canada, an internationally renown forest expert.
  - o UK statisticians

Questionnaire

- Part 1 - Experience of participants - context

- Part 2 - Likelihood of the scenarios and counterfactuals and evidence for answers

- Part 3 - Forestry practice relevant to these scenarios (including prices).

- Number of participants completing survey: 56 (*13 pellet producers, 6 NGOs, 6 pellet users, 2 non-bioenergy producers, 14 forest owners/managers, 14 public organisations)*

- Total number of questions: 287 questions

- Time taken for completion: >9 hours for some participants

Headline results

- Most of the high carbon scenarios from BEAC are **unlikely** to occur

- **Four** may be happening or may happen in the future, at limited or uncertain scale.

- **Generally economics drive harvest decisions**: the main value of a tree is in sawtimber, not biomass for wood pellet production.

- It is unlikely that demand for biomass would result in harvesting sooner than for sawtimber, or make foresters switch to supplying wood for bioenergy, but they may increase the intensity with which they manage forests.

High level results

- Unlikely to occur: 15 of the BEAC high carbon scenarios, even at high pellet demand and prices

- No consensus: 20 scenarios, which had a either a wide spread in responses or a high level of 'I don't know' answers. All were considered to only have the potential to occur at low level.

- Likely:

  o 2 scenarios considered likely now and in the future

  o 3 scenarios considered likely or moderately likely now but with less consensus in the future

5 scenarios considered likely or moderately likely

1. 2 scenarios involving removal of coarse residues in SE USA

   Pellet mills and pellet users don't want more than 20% such residues in pellets, but respondents did think that residues are a likely source of fibre in pellets in the future

2. Additional wood could be taken from intensively managed coniferous plantations in Southeast USA

   Not on a shortened rotation

3. Additional harvest from the conversion of naturally regenerated forest in Southeast USA to an intensively managed pine plantation

4. Bringing undermanaged wood into management in SE USA – not designated woodlands, but family owned small scale wood land not subject to a management plan.

Results – general findings

- The counterfactuals were controversial

  - They were considered accurate at least sometimes

  - Some were not thought to be occurring particularly longer rotations.

  - The counterfactuals were considered to be too narrow, as they didn't cover urban expansion, agricultural pressures etc.

- Pellet mills have a ceiling on their ability to pay. Evidence provided suggested that feedstock prices only need to rise 15-20% to make the mills unprofitable.

- There are significant differences between Canada and the USA:

  - Slower tree growth in Canada

  - Provincial regulations in Canada

  - The importance of financial return in SE USA

  - Ownership of timberland in SE USA

Conclusions

- Likely supply strategies are integrated into the supply of high value product chains
  - Primary and secondary manufacturing co-products
  - Forest residues
  - Round wood (when there is no alternative higher value market) and diversion of non-bioenergy pulpwood to pellets
  - (SE USA) intensification of plantation management e.g. planting more trees; taking more thinnings
  - Conversion of naturally regenerated forests to plantations in SE USA

- Identified a need for clearer data on additional harvest is coming from hardwoods in SE USA as a result of pellet demand

- On economics:

  - Fibre price is a major cost in pellet production

  - There is a dynamic between market conditions and pellet fibre availability
    - Pellet fibre availability is relative to saw mill residue availability and pulpwood demand
    - Price of fibre for pellets: insufficient to drive harvest, but most influential near pellet mills
    - The impacts of a number of variables on pellet prices are location-dependent

- Regions:
  - Canada: sawmill residues are important, but in future additional harvest (integrated with harvest for non-bioenergy products) could occur (up to the AAC).
  - SE USA: motivations of small forest owners to harvest determine harvest

Conclusions - general

- It is difficult to turn dynamic forestry practice into carbon scenarios

- Our results showed that in forest carbon modelling assumptions, scenarios, counterfactuals and definitions influence outcomes:
  - Scenarios must be realistic: Pellet production is most likely to be integrated into the management of forests for other forest products
  - It is often difficult to know the true counterfactual. For counterfactual modelling we need involve stakeholders on the ground
  - Definitions must be agreed in advance: for example, residues is defined differently by different stakeholders.
  - Can't extrapolate from one region to another. Canada is very different to SE USA.

- Modelling of forest carbon can identify potential poor practice BUT

- Economics/financial return are pivotal in determining whether a scenario happens. Decisions based on modelling must take this reality into account.

Web sites for reports

- Life Cycle Impacts of Biomass Electricity in 2020 - Scenarios for Assessing the Greenhouse Gas Impacts and Energy Input Requirements of Using North American Woody Biomass for Electricity Generation in the UK" Dr Anna L Stephenson and Professor David J C MacKay FRS 2014
  - https://www.gov.uk/government/publications/life-cycle-impacts-of-biomass-electricity-in-2020
- "Use of North American woody biomass in UK electricity generation: Assessment of high carbon biomass fuel sourcing scenarios" Report for DECC (943/12/2014) 2016 (note there is a summary report and a technical report that contains all of the results).
  - https://www.gov.uk/government/publications/use-of-high-carbon-north-american-woody-biomass-in-uk-electricity-generation

- US SRTS model: see https://research.cnr.ncsu.edu/sofac/