

# MAGLUE project WP3 case study

## SRC biomass supplied from Europe Version 1

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Biological Sciences is part of the Faculty of Natural Environmental Sciences at the University of Southampton. From global warming to life-threatening infections, the academic unit's world-leading research focuses on today's key challenges in areas of molecular and cellular bioscience, biomedical sciences, ecology and the environment.

## Purpose

The purpose of this document is to specify the research question, purpose, goal and scope for the European short rotation coppice (SRC) case study being undertaken within Work Package 3 of the MAGLUE project.

## Background to research problem

Whilst the UK energy sector has utilised an increasing volume of woody biomass in recent years, the contribution of SRC biomass to this total is currently very limited. However, if the contribution of biomass sources to European energy systems continues to rise then the supply of SRC woody biomass from European sources could increase.

SRC provides a fast-growing second generation biofuel, which can deliver benefits in the way of enhanced farm-scale biodiversity, increased soil carbon content and a reduced need for fertilizers or pesticides. The management of SRC typically operates on a rotational harvest of every 2-4 years. SRC crops often stay in the ground for several rotations.

Interest in the UK in SRC as a potential bioenergy crop has fluctuated over several decades. There have been periods when SRC has been strongly promoted as a significant option for growing biomass for energy<sup>1</sup>. However, these initiatives have not led to significant deployment of SRC crops within the UK and the viability of SRC systems (in terms of levels of productivity and economics) remains debatable<sup>2</sup>. Across the EU the area of land planted with SRC was estimated to not have exceeded 70,000 hectares in 2013 according to one study<sup>3</sup>, although this land area may have increased since then.

It remains important to consider the potential for a contribution from SRC crops to bioenergy supply at a European scale, with the possibility of this resource supporting security of biomass energy supply to Europe and the UK, alongside other biomass sources such as woody biomass from forests. In this context, it should be noted that a recent study undertaken for the European Commission (Matthews *et al.*, 2016) has concluded that achieving a significant contribution to future EU energy supply from biomass sources with low risks of significant associated GHG emissions will most likely involve utilising a balance of forest biomass and agricultural biomass sources.

As such, woody biomass produced from SRC grown in Europe could become an important fuel for the UK energy sector. The aim of this case study is to understand the greenhouse gas (GHG) balances which would be associated with the sourcing of woody biomass from SRC grown in Europe, and to determine to what extent the utilisation of

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<sup>1</sup> e.g [http://www.forestry.gov.uk/pdf/fcpn7.pdf/\\$FILE/fcpn7](http://www.forestry.gov.uk/pdf/fcpn7.pdf/$FILE/fcpn7)

<sup>2</sup> <http://onlinelibrary.wiley.com/doi/10.1111/gcbb.12121/abstract>

<sup>3</sup> LIGNOVIS 'Optimised Fuels for Sustainable Transport', 2013

this woody biomass would contribute to the achievement of net reductions in UK GHG emissions.

## Definition of research question

Following consideration of the maturity of scientific understanding of the GHG balances of SRC grown for bioenergy, as outlined above, a core question has been defined for the European SRC case study, which focuses on impacts on land-based vegetation carbon dynamics and flows of biogenic carbon associated with direct land-use change and land management involved in growing SRC biomass. This is important for determining the scope of the LCA study that will be undertaken. A further supplementary question has been identified regarding the wider environmental impacts of the UK sourcing woody biomass from EU SRC feedstock. This concerns the potential ecosystem service trade-offs associated with SRC, including GHG balances, biodiversity, water usage, and visual impact considerations. For example, what would be the full ecosystem consequences if the UK opted to increase SRC woody biomass imports from the EU as opposed to increasing domestic production of this feedstock?

The core question and supplementary question are stated below.

### Core question

What are the results of characterising land areas within EU countries, or within regions of the Europe, in terms of potential impacts on biogenic carbon emissions, over time horizons up to 2030, 2050 and 2100, that would arise directly from using the specified land area in the EU to grow SRC biomass for the provision of woody biomass to be consumed in the UK, compared with how the land would have been used (or not used) otherwise?

### Supplementary question

What would the wider environmental impacts be if the UK were to increase the contribution of bioenergy to the UK energy sector through increased SRC woody biomass imports from the EU, as opposed to increasing domestic SRC biomass production?

## Definition of research purpose

Based on the more informally stated core research question, the LCA purpose for this case study may be stated as:

To estimate and compare, for policy analysis and to inform general understanding, the environmental performance of SRC biomass sources that may be deployed for energy provision on a national scale in the United Kingdom, involving relevant SRC feedstocks which may be sourced from relevant land areas in Europe, with specific reference to:

- Global climate change resulting from annual and cumulative impacts, over specified time horizons, of total emissions and sequestration of biogenic carbon of biomass potentially grown and harvested from defined areas and types of land, deployed from today on a specified scale, with respect to defined land areas involved and levels of SRC biomass and energy supplied, taking into account any other biomass products supplied, and
- Total GHG emissions arising from direct land management for growing the SRC biomass (e.g. fertiliser application)
- Comparisons between SRC biomass grown in different regions of Europe.

## Definition of research goal

Based on the stated question and purpose for this case study, the LCA research goal is summarised in Table 1. This is based on a checklist developed by Mortimer (2016). The checklist poses relevant questions, presents answers and explains their relevance to the stated LCA question and purpose.

**Table 1 Checklist for the LCA goal of the European case study**

| <b>Question for LCA goal definition</b>            | <b>Answer for this project</b>  | <b>Relevance to LCA question and/or purpose</b>  |
|--|---|--|
| What is the intended application and audience?     | Analysis and general understanding for policy makers and other stakeholders interested in the role of SRC biomass in meeting GHG emissions reductions targets | "...for policy analysis and to inform general understanding..."                            |
| Which environmental impact is under consideration? | Contributions made to global climate change (but not impacts of climate change) by biogenic carbon and inputs to land management (e.g. fertiliser)            | "...environmental performance ... with specific reference to ... Global climate change..." |

**Table 1 (continued) Checklist for the LCA goal of the European SRC biomass case study**

| <b>Question for LCA goal definition</b>  | <b>Answer for this project</b>  | <b>Relevance to LCA question and/or purpose</b>   |
|--|---|---|
| What is the general nature of the product system(s) under consideration?           | Prospective supplies of SRC biomass grown in Europe for consumption as energy in the UK | "...SRC biomass sourced in Europe that may be deployed for energy provision on a national scale in the United Kingdom..." |
| What is the general nature of the scale of these product system(s)?                | National (UK) scale deployment  |   |
| What is the general nature of the system time horizon for these product system(s)? | <i>Ex ante</i> (before the event), specifically from the present time into the future   | "...SRC biomass potentially grown and harvested ... deployed from today ..."  |

## Definition of research scope

As for the LCA research goal, based on the stated question and purpose for this case study, the LCA research scope is summarised in Table 2. This is also based on a checklist developed by Mortimer (2016) and includes questions, answers and relevant explanation, as described for Table 1.

**Table 2 Checklist for the LCA scope of the European SRC biomass case study**

| <b>Question for LCA scope definition</b>                              | <b>Answer for this project</b>   | <b>Relevance to LCA question and/or purpose</b>   |
|---|--|---|
| What specific causes of the environmental impact are being evaluated? | Biogenic carbon exchanges (sequestration and emissions) related to vegetation, litter and soil of land used for growing SRC biomass; also GHG emissions associated with inputs to crop management (e.g. fertilisers) | "...total emissions and sequestration of biogenic carbon of biomass potentially grown and harvested from defined areas and types of land ..."<br><br>"...Total GHG emissions arising from direct land management for growing the SRC biomass (e.g. fertiliser application)" |

**Table 2 (continued) Checklist for the LCA scope of the European SRC biomass case study**

| <b>Question for LCA scope definition</b>  | <b>Answer for this project</b>   | <b>Relevance to LCA question and/or purpose</b>  |
|---|--|--|
| What is the time horizon relevant to the environmental impact?  | Up to 2030, 2050 and 2100  | "...time horizons up to 2030, 2050 and 2100..."<br><br>"...biogenic carbon emissions resulting from different management options, over specified time horizons..."                 |
| What is the specific composition of the product system(s)   | SRC biomass grown within countries or regions of Europe, on land which may have several previous uses, allowing for a range of relevant soil types (see section on land types) | "...SRC biomass feedstocks which may be sourced from relevant land areas in Europe..."<br><br>"...biomass potentially grown and harvested from defined areas and types of land..." |
| What is the relevance of the environmental impact of multiple products (i.e. co-products) and/or services from the product system(s)? | Collective consequences of all outputs (if any) from the specified SRC biomass sources   | "...taking into account any other biomass products supplied..."  |

| Question for LCA scope definition                                       | Answer for this project  | Relevance to LCA question and/or purpose   |
|---|--|--|
| What is the specific spatial system boundary of the product system(s)?  | Global, but covering only biogenic carbon exchanges and direct inputs to crop management in all relevant activities in all relevant locations  | <p>"... arising directly from using a specified area of land ... compared with how the land would have been used (or not used) otherwise"</p> <p>"...emissions and sequestration of biogenic carbon of biomass potentially grown and harvested from defined areas and types of land..."</p> <p>"...Total GHG emissions arising from direct land management..."</p>                   |
| What is the specific temporal system boundary of the product system(s)? | From cultivation, harvesting and production of SRC woody biomass to the time of consumption and beyond (i.e. considering any longer term land-based vegetation, litter and soil responses), up to the end of the specified time horizon(s) | <p>"...time horizons up to 2030, 2050 and 2100..."</p> <p>"...arising directly from using a specified area of land in Europe to grow SRC for the production of woody biomass to be consumed in the UK..."</p> <p>"...annual and cumulative impacts, over specified time horizons, of total emissions and sequestration of biogenic carbon of biomass ... deployed from today..."</p> |
| What is the functional unit?  | <p>Unit (ha) of land area used for growing SRC biomass</p> <p>Unit (odt) of dry biomass output</p> <p>Unit (MWh) of energy output</p>  | <p>"...defined areas and types of land, with respect to specified levels of SRC biomass and energy supplied..."</p>  |
| What is the reporting metric?   | Annual, cumulative and annualised cumulative net biogenic carbon emissions and GHG emissions from inputs to crop cultivation over the specified time   | <p>"...annual and cumulative impacts, over specified time horizons, of total emissions..."</p>   |

|  |   |  |
|--|---|--|
|  | horizon(s), per functional unit (kgCO <sub>2</sub> ha <sup>-1</sup> , kgCO <sub>2</sub> MWh <sup>-1</sup> ) |  |
|--|---|--|

## References

Mortimer, N.D. (2016) Carbon life cycle assessment of bioenergy for policy analysis, formulation and implementation. Norther Energy Associates Briefing Paper. July 2016. North Energy Associates: Sheffield.

Alexander P, Moran D, Smith P, Hastings A, Wang S, Sünnenberg G, Lovett A, Tallis M.J, Casella E, Taylor G, Finch J, Cisowska I (2014) Estimating UK perennial energy crop supply using farm-scale models with spatially disaggregated data. GCB Bioenergy, 6, 142-155.

Tubby I, Armstrong A (2002) Establishment and Management of Short Rotation Coppice. Forestry Commission Practice Note 7, Forestry Commission, Scotland.

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