Sustainable Liquid Biofuels from Biomass Biorefining (SUNLIBB)

Policy Brief #1 March 2012

The SUNLIBB project is funded under the Seventh Framework Programme (FP7) within the Energy theme: Second Generation Biofuels – EU Brazil Coordinated Call. SUNLIBB started on 1st October 2010 for 4 years and collaborates with a parallel project in Brazil, CeProBIO.

Background

First generation biofuels – which are mainly produced from food crops such as grains, sugarcane and vegetable oils – have triggered one of the most highly contentious debates on the current international sustainability agenda, given their links to energy security, transport, trade, food security, land-use impacts and climate change concerns. Developing second generation biofuels has emerged as a more attractive option, as these are manufactured from inedible sources, such as woody crops, energy grasses, or even agricultural and forestry residues.

Residues from sugarcane and biomass from maize, as well as "whole-crop" miscanthus are all potential raw material (called "feedstock") for second generation bioethanol production. Because these three plants are all closely related, processing the biomass from these crops raises common technical challenges, which offers the opportunity for breakthroughs in one species to be rapidly exploited in the others. Despite the potential sustainability benefits of second generation bioethanol, the current inefficiency of production makes it economically uncompetitive. Taking up this challenge, the SUNLIBB consortium's multidisciplinary team of scientists – in cooperation with CeProBIO, our sister project in Brazil – combines European and Brazilian research strengths so as to open the way for environmentally, socially and economically sustainable second generation bioethanol production.

Objectives

In order to realize its ambitious goals, the SUNLIBB consortium aims to achieve the following:

- Unlike the easily processed first-generation biofuels, the complex substances found in the woody or inedible tissues of plants are much harder to "break down" and more complicated to convert to energy with currently available methods, which greatly impedes commercialisation. SUNLIBB aims to use modern crop breeding approaches and cutting-edge plant cell wall research to identify genes that will allow us to modify the cell wall composition of the plants in ways that reduce the cost associated with the conversion process.

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- Upgrade the residues and by-products, as well as produce other value streams from the feedstock, that will further increase the total energy output and profitability of second generation biofuels. Relevant processes will be developed at laboratory scale before being tested in pilot processing plants.

- In order to create biofuels, the feedstock is first broken down into sugars, which are then fermented (converted) to produce bioethanol. SUNLIBB aims to improve the conversion process by which we produce sugars by integrating the feedstock that will emerge from our research, thereby making the process more efficient. Following this, the process of converting the SUNLIBB-produced sugars into second generation bioethanol will be optimized, both at laboratory level and at pilot scale.

- Enhance the economic sustainability of second generation biomass by bringing together in model (or pilot) biorefineries our improved feedstock, added value product extractions, as well as improved conversion processes. Life cycle assessment (LCA) models suited to biorefineries will be developed so as to ensure that our products are sustainable at all stages of the process, and have minimal impacts on local environments, biodiversity and food production or prices.

- Review all pertinent guidelines, policy and regulatory frameworks for sustainable biofuels in both the EU and Brazil in order to take into account any influential developments that could affect the future potential to harness benefits from this work.

First year progress report

This is a four-year FP7 project and much of the first 12 months has been focused on establishing tools, resources and a sense of community amongst the research groups in Europe and Brazil. In terms of progress, we have so far achieved the following:

- In order to improve the biomass-to-biofuels conversion process in our three crop species, our first step has been to identify genes that could enable the cost-effective decomposition of the raw material into sugars. We are taking three broad approaches to this:

  i) Use recently-grown varieties of maize in order to identify suitable genes therein that could potentially be transferred to miscanthus and sugarcane;

  ii) Survey the potential of existing varieties of miscanthus in SUNLIBB, and sugarcane in CeProBIO;

  iii) Use genes shown to assist decomposition into sugars in other plant species, such as Arabidopsis.

Maize silks (Biogemma, France)

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- Through our cell wall deconstruction work package, we are developing a clearer understanding of the composition of cell walls in maize, miscanthus and sugarcane. Subsequently, we are greatly expanding our understanding of the materials that are available for biorefining in these crops, as well as acquiring knowledge that will help inform future processing and crop improvement strategies.

- Work towards developing added value product extractions is well under way, with inventories of the types and quantities of chemicals available from maize, miscanthus and sugarcane being developed. The next steps will be to optimise extraction and scale it up to levels where industrial SUNLIBB partners can assess the utility of the extractives. This aspect of the work will increase in the coming year as our pilot biorefinery facilities come on line.

- Work on the EU policy regulatory framework and LCA aspects of the project has progressed well. A review of biofuels policy and regulation, with respect to sustainability, in the European Union as a whole and in individual Member States, has been undertaken. We have already begun to develop LCA workbooks for calculating greenhouse gas emissions associated with the provision of these feedstocks and the operation of biorefineries. This work will identify emissions "hotspots" and help develop strategies to maximise net greenhouse emissions savings from biorefining.

Outcomes from the project

The knowledge developed within the SUNLIBB project will fall into four categories:

1. Development of novel analytical platforms, such as for separation and characterization of fragments of woody material.
2. Development of biological and genetic material, which will be made freely available through national and international stock centers once any necessary Intellectual Property Rights (IPR) applications have been filed.
3. Knowledge advances in plant biology, plant genetics and biomass value added products, which will lay the foundation for the engineering of plant biomass crops adapted to biorefinery applications.
4. LCA data, as well as analysis of the policy and regulatory context in the EU and Brazil.

Miscanthus (Wageningen Universiteit)

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Impacts from the project

With the improved knowledge as outlined above, this provides the opportunity to deliver impacts in the form of new ways to achieve EU biofuels policy targets, thereby helping the EU to effectively implement the 2009 Renewable Energy Directive.

Project public website address

For public information on the project, please refer to our website: **www.sunlibb.eu**

SUNLIBB Participants

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