Comparing continental and local data: a challenge for wood energy assessment

The JRC's Renewable Energy Unit (REU) is currently undergoing an evaluation of woody biomass suitable for energy uses. For this reason, national forest inventories were carefully analysed and several layers of data were collected in order to attribute resources to areas with different geographical features.
A preliminary result of the data collection and analysis is shown in terms of cubic meters potentially available (see Figure 5). Nevertheless, such an estimate must be carried out considering local features of collection, accessibility and overall sustainability while also needing detailed spatial data on land cover, terrain slope, soil quality, and available roads. For this reason a careful comparison

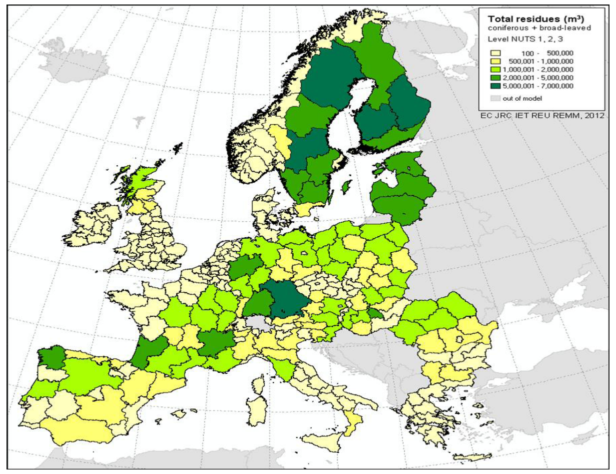
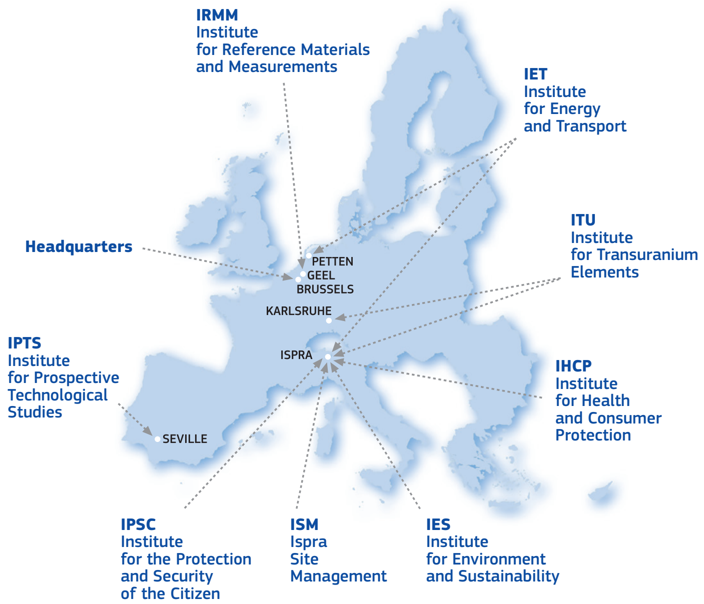


Figure 5. Cubic meters of residuals potentially available in Europe at NUTS-2 level before assessing sustainability and accessibility.



JRC's structure

of the available continental geographical layers with local actual features described by the data themselves should be performed in an attempt to collect «validated» feedback data from the territory.
In an on-going project, an experiment involving the collection of woody material for energy purposes using different machinery is going to be performed in the woods around the Italian village of Entraque. Using this experiment as a first pilot case, the REU has started cooperation with the Entraque municipality in order to compare the «real life» results of such an experiment with the assessment to be subsequently prepared by the JRC.
A very first comparison of the small scale detail of the continental data layers used by the JRC and the local data provided by Entraque municipality has shown a promising consistency in the two data groups, potentially leading to a good overall estimation. Nevertheless, while Entraque could be considered «typical» for an alpine collection site, more data and additional partnerships will have to be included in order to cover areas showing different features.

Mission statement:

As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle. Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new methods, tools and standards, and sharing its know-how with the Member States, the scientific community and international partners. Key policy areas include: environment and climate change; energy and transport; agriculture and food security; health and consumer protection; information society and digital agenda; safety and security, including nuclear; all supported through a cross-cutting and multidisciplinary approach.

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European Commission

Biofuels and Bioenergy: assessing the impacts and availability

Biofuels and Bioenergy: assessing the impacts and availability

The Joint Research Centre (JRC), the European Commission's in-house science service, provides scientific evidence to policy makers on the complex issues of bioenergy and biofuels availability, exploitability and sustainability. The National Renewable Energy Action Plans (NREAPS) presented by the European Union Member States have shown how bioenergy will remain crucial over the next decade in order to reach the renewable energy targets in 2020.
JRC scientific activities on bioenergy and biofuels aim at providing a working platform to address the most relevant and delicate policy questions, and span from analysis and testing of sustainability criteria. These include greenhouse-gas emissions savings for both liquid and solid sources, indirect effects due to land-use change and impact on water resources while not forgetting the overall availability of other primary resources and the most suitable collection and transformation methodologies. Moreover, bioenergy is seen as an integral part of the renewable energy mix and complements other low carbon energy alternatives at different geographical and temporal scales.

Coordinating the assessment of sustainability and technological developments in biofuels

The EU regulatory framework sets ambitious targets for the market uptake of renewable fuels in the transport sector by 2020. Of particular relevance are the Directives on the "Promotion of the Use of Energy from Renewable Sources" (2009/28/EC) RED and the so-called "Fuel Quality Directive" (2009/30/EC) FQD.
The framework sets environmental sustainability criteria for both biofuels and bio-liquids, with a threshold of 35% savings of Greenhouse Gas (GHG) emissions, and excludes the use of specific land-use categories such as primary forest, grassland with high biodiversity, wetlands and peatlands.

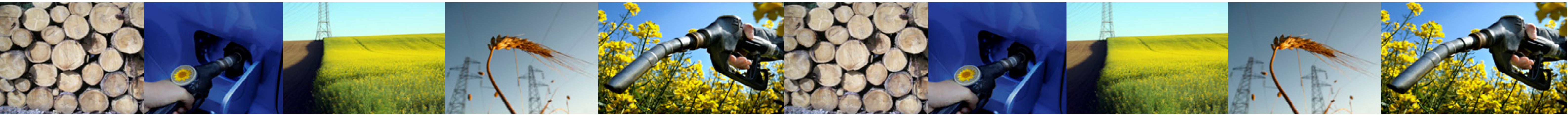
EU law also requires the assessment of GHG emissions from both direct and Indirect Land Use Change (ILUC), N2O emissions, soil carbon stock changes, definition of degraded lands and updating and implementation of new biomass pathways. The sustainability assessment must include topics which may have positive or negative impacts on biofuel policies in tropical countries: including air and soil quality, water footprint, food prices and farm incomes.

An assessment of current and future production of second generation biofuels is also required. Although second (and third) generation biofuels are believed to offer sustained GHG advantages while reducing pressure on natural resources, conversion is both more complicated and more expensive. Research and development on advanced technologies is therefore still necessary.

It is fundamental to tackle policy questions related to the production and use of biofuels from an integrated approach. Thus the JRC coordinates work on:

- Collaboration across several disciplines within JRC institutes,
- Providing independent scientific advice to policy makers, and
- Support to European Commission services in meeting legal obligations with respect to the implementation and reporting.

JRC, the European Commission's in-house science service



Joint Research Centre

Land Use Change due to increased biofuels demand

NREAPs state that about 9% of total transport fuels will be achieved through biofuels (predominantly biodiesel and ethanol) in road fuels. Almost all of this would come from “1st generation” biofuels, which are produced from crops otherwise used for food.

If biofuel crops are grown on uncultivated land, this “direct land use change” will generally result in carbon emissions. However, more frequently, crops for biofuels are diverted from existing food production. This causes a ‘hole’ in the food supply which is filled partly by the expansion of cropland around the world, and it is likely to lead to emissions from “indirect land use change” (ILUC).

Since ILUC cannot be measured directly, global economic models are used to evaluate the impact of increased biofuel demand. However, different models study different mixes of biofuels made in different places, which make it difficult to compare the results. To identify how and why models differ the JRC commissioned several groups to model and examine the same biofuel scenario.

All of the models show that increased biofuel demand would cause ILUC. The estimated crop area increase for one million tonnes of oil equivalent of biofuel ranged from about 100 to 1900 km2 for biodiesel scenarios, and roughly 100 to 900 km2 for ethanol scenarios (Figure 1.).

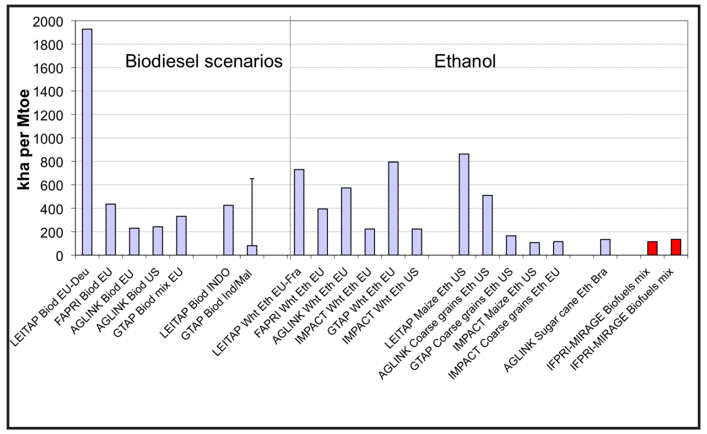


Figure 1: Changes in area for different biofuel scenarios from different models

In all models, the increase in crop demand due to biofuels results in an increase in crop prices. This causes both the supply to increase and the competing demand to decrease. The latter is predominantly a fall in human food consumption due to increased prices, as the effect on animal feed is mostly compensated by the use of biofuel by-products. As demand reduction provides biofuel feedstock without incurring ILUC, ILUC tends to be smaller in models which have the most reduction in food consumption. Models differ also in how much of the increase in supply comes from expansion of crop area and how much price-induced yield increases. Furthermore, the way the models treat crop displacements and “marginal yield” influences their results.

Calculating Emissions from Land Use Change

GHG emissions from land use change arise from:

- loss of standing biomass (which is often burned, or decomposes on site)
- loss by oxidation, of organic matter in the soil in the years following conversion,
- nitrogen in the organic matter released as N2O.

The JRC developed a methodology for estimating these emissions by applying a Spatial Allocation Model (SAM) to estimates of global land use changes, provided by economic models. The model has been applied to the results of several global economic models including the MIRAGE model, run by the International Food and Policy Research Institute (IFPRI) specifically for the European Commission. The scenario considered by IFPRI was based on the estimates of the NREAPs. The JRC estimated that increased biofuels demand will cause ILUC emissions of approximately 36 gCO2/MJ. This includes emissions caused by the drainage of peatlands for oil palm cultivation in Indonesia and Malaysia. These results concur with the emissions calculated by IFPRI’s own land emissions model (Figure 2).

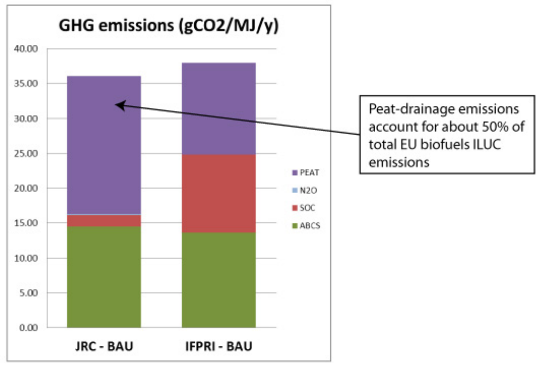


Figure 2: GHG Emissions from global land use change due to increased biofuel demand: JRC and IFPRI results

Feedstock specific calculations indicate that in general ethanol crops have lower ILUC impacts than oilseed/biodiesel crops: emissions for ethanol feedstocks range from approximately 4 to 20 gCO2/MJ, while for biodiesel feedstocks the range is estimated at 36 to 60 gCO2/MJ.

Life-cycle analysis

The JRC calculates the direct emissions from biofuels which are used in the RED and FQD directives, according to a methodology fixed by the European Commission. This is based on an updated database of biofuels pathways continually updated by the JRC. This database is also accessed for updates of the JEC-Well-to-Wheels (WTW) report, which includes more pathways, and is calculated using a different methodology. The JEC is a collaboration between the JRC and the collaborative research associations of the automobile and oil industries. It also analyses alternative roadmaps to achieve the RED and FQD targets for road fuels by 2020

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The JRC also collaborates with biofuels producers and associations in the EU and outside to improve the accuracy of its data used in the WTW, and organises workshops on the subject with national experts. All publications, including raw data used for the analysis, are freely available to download from the JEC website hosted by the European Commission’s JRC at http://iet.jrc.ec.europa.eu/about-jec.

JEC is a collaboration between the JRC’s Institute for Energy and Transport, EUCA - the European Council for Automotive, R&D and CONCAWE - the Oil Companies’ European Organisation for Environment, Health and Safety

GHG emissions accounting in bioenergy pathways

The JRC calculates and updates the emissions from bioenergy pathways to be used in the RED and FQD directives.

Most LCA studies consider the carbon content of any biomass to be neutral in GHG terms because it was sequestered from the atmosphere in the growing season. However, if bioenergy policy encourages the burning of conventional forestry products (timber), more trees are cut immediately, whereas the sequestration happens several decades in the future, as the re-planted forest grows. For the same amount of heat, burning wood releases more carbon than the equivalent fossil fuel. So the immediate effect is a carbon debt, which is not repaid for decades (after which emissions savings become positive). JRC is starting to investigate the accounting of this carbon debt with a literature survey and collaboration with forestry experts.

A similar consideration applies to harvest residues (branches, tops and stumps traditionally left in the forest), except the timing of the debt is determined by the rate of decay of the residues in the forest. Thus, collecting only small-sized residues results in a shorter repayment time of the carbon debt.
In order to maximize the forest sector’s contribution to climate change mitigation, the best strategy would be to combine forest management focused on carbon accumulation in the forest with a steady flow of wood for products and energy. In the long term however, the sequestration capacity limit of the forest will be reached, and the only potential for further mitigation will be regular harvesting, to store the carbon in harvested wood products or to avoid emissions from non renewable materials and energy sources.

Technical availability of straw for energy uses

In 2010, about 62% of renewable energy in the EU27 was generated from biomass and even if this share decreases to 57% in 2020 (as expected), the total contribution of bioenergy to the EU27 mix is expected to increase from 3600 PJ in 2010 to about 5900 PJ in 2020.

Agricultural crop residues are expected to be a relevant source of bioenergy and their use is expected to provide a significant contribution in order to avoid competition for resources and land use between bioenergy and biofuels production, food production and wood. Indeed, agricultural crop residues are already used to a high degree in several EU countries for energy purposes.
The JRC has developed a spatially explicit assessment of agricultural crop residues. Data for straw resources at a regional level have been allocated on the basis of several spatial layers describing for example,. land cover, expected biomass productivity based on soil parameters, climatic zones and topographical conditions to produce an availability map (Figure 3).

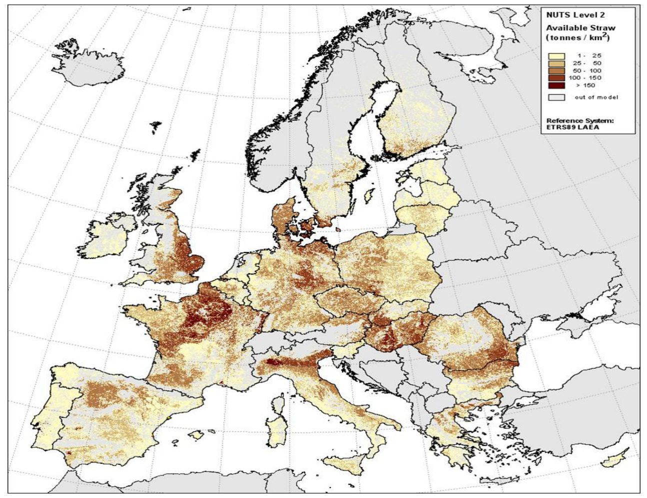

Figure 3. Tonnes of straw and crop residues per km2 potentially available for energy uses in EU27

Moreover, the efficient positioning of «typical» CHP (Combined Heat and Power) straw fed power plants with a capacity of 50 MW of thermal input, leading to a typical straw need of about 100 kt/year, was studied in order to achieve an optimal exploitation of the available resources. Two different procedures were applied to identify the best suitable locations for CHP plants on the straw-availability map: an optimised approach and a (partially) randomised approach (Figure 4).

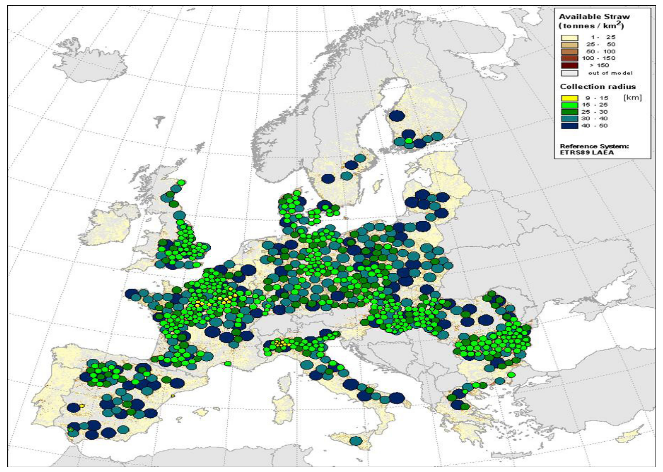

Figure 4: Optimised distribution of modelled power plants in EU-27. Collection radiuses are also shown in actual size.