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# *BIOMASS FOR ENERGY USES: ASSESSMENT METHODOLOGY FOR FRANCE*

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## Overview

Fossil fuels scarcity and environmental issues are good drivers to question the future limits to the use of these energies and study renewable energies alternatives. Biomass is a credible option either as biofuels incorporated at different rates in the traditional fossil fuels or combustible for large (industry or electricity production) or small scale uses. There is nevertheless real debates on landuse competition for organic resource as well biofuels production routes. The Center for Applied Mathematics is working with the French Petroleum Institute (IFP), the National Institute for Agronomical Research (INRA) and the Fondation for Construction Wood and Furniching (FCBA) to develop a prospective model for biomass valorization as energy in France. The aim of this project is to determine what can be the mix of biomass to use and what can be the potential of biofuel production for France until 2050.

This paper presents the methodology adopted to represent several agricultural and wood products that can be use for combustion and biofuel production on the French available lanfield until 2050. Then with this detailed representation of the resources, all the technological ways of production of biofuel are considered to minimize the total discount cost of meeting given biomass development targets. For this purpose, we implement a bottom-up model that allow us to propose a mix of technologies to fit the bioenergies demands for France.

## Methods

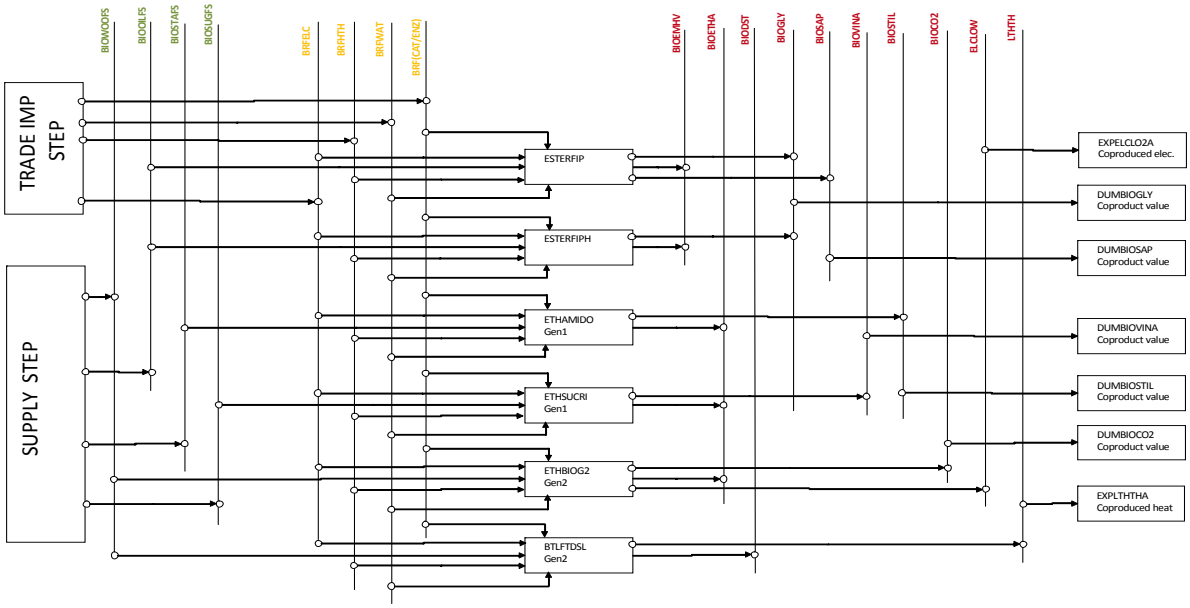
The first important point is to be able to represent the most realistic potential for all agricultural products and wood usable for biofuel production. The country is first divided in several zones that can represent the diversity of the cultures. As biomass is first used for local usages, it is important to represent local potential with different transportation costs' depending of their length that can reduce the potential for a given production site.

The FCBA and INRA, as specialists, provide the most pertinent regional cut-out for all kind of products for France. IFP characterize the most promising biofuel production technologies that can appear during the modelling horizon. Finally we integrate all these specifications in our optimization model representing the biomass chain. Hence, we assess the technological mix able to fit the biofuel demand and give the corresponding agricultural products and wood associated productions in each zone for the studied time horizon.

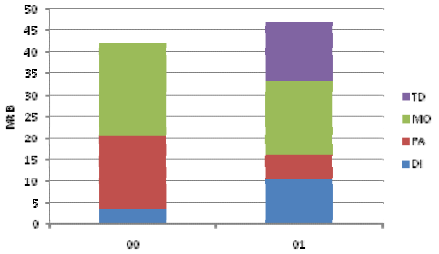
To achieve these simulations, three scenarios have been adopted to represent what will be the demand of biofuel during this time horizon. The first one is the business as usual one and the two other scenarios have been established to assess the limits of what is thinkable.

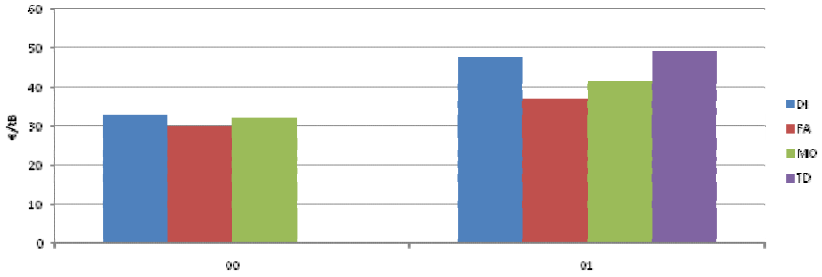
## Results

First, we present the way of representing all the biofuel chain from the lanfiels to the end-use of bifuels. This result is represented in a Reference Energy System (RES) that is the aim of the model. Hereafter is represented one part of this RES concerning the biofuel production step.




All resources, technologies and final uses are represented to be able to see competition between these resources and technologies. One of the results of this approach is the diversity in the kind of resources the model is able to use. In the following figures we can appreciate the diferencies between the actual resource (00) and the reachable resource (01) in term of level of difficulty of accessibility (*TD : Very Difficult, MO :moderately, DI: Difficult, FA : Easy*) for wood. As we can see thestructure of the additional reachable resource is totally different. That imply different cost for production (right figure) which influence the final choice for biofuel production.




## Conclusions

These first results on the diversity of the resources for biofuel production will be a pertinent analyse for determining what can be the future of second generation biofuel taking into account all the specificity of real exploitation of biomass resources available for biofuel production. These results are promising for the analyse of the economical competition between all kinds of biomass for biofuel production. In a second phase we will able to represent some pertinent results for all the biofuel chain for France until 2050.

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