BIOMASS FOR ENERGY USES: ASSESSMENT METHODOLOGY FOR FRANCE

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In collaboration with IFP, FCBA, INRA in the Valerbio Project
Plan of the presentation

- Context
- Objectives
- Tools and assumptions
  - Scenarios
  - Resources analysis
  - Technologies description
- First preliminary results
- Conclusion and perspectives
• Fossil fuel scarcity and environmental concerns are good drivers for renewable alternatives studies
  – How to assume the continuity of liquid fuel?
  – Are biofuels an acceptable and sustainable solution?
  – Which biomass can be use?
  – Which landfield is available without competition with food?
  – Which rate of incorporation as a substitution?
• To answer these questions prospective studies are helpful to policy makers
Objectives

• This study deals with the methodology elaborated to assess the potential of biomass for energy use in France:
  – Using a detailed representation of biomass sources (Agriculture and wood products)
  – Taking into account the spatiality of the resources (the country is separated in several regions)
  – Regarding their economical evolutions (costs of production and transport are forecasted on the time horizon)
  – Having a rich technological database for energy generation with biomass input (1st and 2nd generation)
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Modelling

- French MARKAL/TIMES Bottom up model is used
  - Time horizon is 2000-2050
  - Demand driven (fuels) and given energy prices
  - All sectors represented
- We only deals with available landfield for energy without food competition
  - Base on marginal and useless landfields
- Detailed technology database including the most promising 2\textsuperscript{nd} generation biofuel production (including co products)
Reference Energy System
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Demand scenario

• 3 commodities
  – Fuels: direct use of biomass
  – Liquid fuels: direct use of biofuels
  – Electricity: Use of electricity produced with biomass

• 3 scenarios
  – S1: BAU (Business As Usual)
  – S2: All for energy (biomass mostly use for energy)
  – S3: Dynamic wood (wood is mostly use for non energy applications)

• For each, 2 kinds of prices for biomass (high and low)
Demand for S2

40 Mtoe for end use services, With 20 Mtoe for Transportation

40 Mtoe for end use services, With 10 Mtoe for Transportation
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Studied resources

- **Agriculture**
  - Grains, whole plant, straw for:
    - Corn
    - Wheat
    - Rape
    - Triticale
  - Sugar beet
  - Sunflower
  - Miscanthus
  - Eucalyptus
  - Jatropha, Palm, Poplar...
  - Residu

- **Wood**
  - 3 Types
    - Big
    - Medium
    - Small
  - 4 Accessibilities
    - Easy (FA)
    - Moderately Difficult (MD)
    - Difficult (DI)
    - Very difficult (TD)

SRC : Short Rotation Coppice
Detailed spatiality for landfield

- Pertinent regions for agricultural and wood resources
- Each region has a detailed economic description (cost of production and transport by commodity)
- Realistic evolutions and bounds on region’s potentials
Example for wood resources

- Actual resource (00)
- Reachable resource (01)
- Imply different costs depending on accessibility
- Will influence the final choice for the technologies
Wood potentials

S2:
40 Mtoe for end use services,
With 10 Mtoe for Transportation

Potential repartition for scenario S2

French regions

- REGION MEDITERRANEENNE
- PLAINES DU SUD OUEST
- PLAINES DE L'OUEST
- PLAINES DE NORD EST
- MONTAGNE PYRENEENNE
- MONTAGNE DE L'EST
- MASSIF CENTRAL
- LANDES D'AQUITAINE
- ALPES

Dry Ton

2010 2020 2030 2050

0 100000 200000 300000 400000 500000 600000
Agriculture potentials

S2:
40 Mtoe for end use services,
With 10 Mtoe for Transportation

Potentials repartition for scenario S2

<table>
<thead>
<tr>
<th>Year</th>
<th>Triticale straw</th>
<th>Triticale grains</th>
<th>Agri residus</th>
<th>Corn straw</th>
<th>Rape straw</th>
<th>Sugar beet</th>
<th>Eucalyptus</th>
<th>Miscanthus</th>
<th>Soja</th>
<th>Jatropha</th>
<th>Sunflower</th>
<th>Palm</th>
<th>Sorgho Fibre/Switchgrass</th>
<th>Poplar / Willow</th>
<th>Corn grains</th>
<th>Rape grains</th>
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</table>
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Processes for biofuels production

- Economical values for all of the processes
- Valorization of the production of heat and power
- Valorization of the Co-products

<table>
<thead>
<tr>
<th>Process</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>BTLFTDSL</td>
<td>FT (Fischer-Tropsch)-diesel wood</td>
</tr>
<tr>
<td>BTLFTDSLB</td>
<td>FT-diesel straw</td>
</tr>
<tr>
<td>ESTERFIP</td>
<td>Trans-esterification</td>
</tr>
<tr>
<td>ESTERFIPH</td>
<td>Advanced Trans-esterification</td>
</tr>
<tr>
<td>ETHAMIDO</td>
<td>Ethanol starch (Amidon)</td>
</tr>
<tr>
<td>ETHBOIG2</td>
<td>Ethanol wood</td>
</tr>
<tr>
<td>ETHBOIG2B</td>
<td>Ethanol straw</td>
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<tr>
<td>ETHSUCRI</td>
<td>Ethanol sugar</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Commodities</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>BIODST</td>
<td>FT synthetic diesel</td>
</tr>
<tr>
<td>BIOEMHV</td>
<td>Biodiesel</td>
</tr>
<tr>
<td>BIOETHA</td>
<td>Bioethanol</td>
</tr>
</tbody>
</table>
Biofuels production scheme

TRADE IMP
STEP

SUPPLY STEP

EXPELCLOZA
Coproduced elec.

DUMBIOGLY
Coproduct value

DUMBIOGLY
Coproduct value

DUMBIOGLY
Coproduct value

DUMBIOGLY
Coproduct value

DUMBIOGLY
Coproduct value

EXPLTHHTHA
Coproduced heat

ETHAMIDO
Gen1

ETHSUCRI
Gen1

ETHBIOG2
Gen2

BTLFTDSL
Gen2

ESTERFIP

ESTERFIPH

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A detail of the RES

Energy & other inputs

Biofuels & co products, electricity and heat outputs

Processes
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• **First preliminary results**
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Resources repartition

Wood resources

Agricultural resources

S2: 40 Mtoe for end use services,
With 10 Mtoe for Transportation
Technology path

S2: 40 Mtoe for end use services,  
With 10 Mtoe for Transportation

S2: 40 Mtoe for end use services,  
With 20 Mtoe for Transportation
Electricity production

S2: 40 Mtoe for end use services,
With 10 Mtoe for Transportation

S2: 40 Mtoe for end use services,
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Conclusions & perspectives

- Detailed potentials for biomass with their evolution for each region
  - Permit to assess the future implantation of conversion unit
- Validation of the Implementation of this cutting up in the French model
- A Tool to assess the limits of the French potential of biomass for biofuels is operational
- Preliminary results are promising and are to be discuss with agricultural and forestry experts
- Final results will be available at the end of the year
- Sensitivity analysis will be carried out
- Detailed scenarios can be presented to policy makers
Thank you for your attention