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Technology options for recycling agricultural, forestry and food wastes and residues for sustainable bioenergy and biomaterials

Based on a study by IEEP

12th September 2013

Part of the project 'Technology options for feeding 10 billion people' for the European Parliament (STOA)

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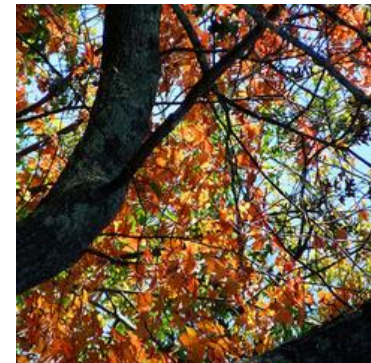
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Outline

- How much material? How easy to mobilise?
- What technology? The state of EU bio-refining
- Sustainability of bio-based products
- Policy options for this sector.

Study scope

- Scope: focus on three feedstocks:
 - **Food waste** (excludes human sewage)
 - **Agricultural crop residues**: (straw, stover, excludes animal manure)
 - **Primary Forestry residues**: from cultivation, harvesting or logging



Waste and residue availability: summary

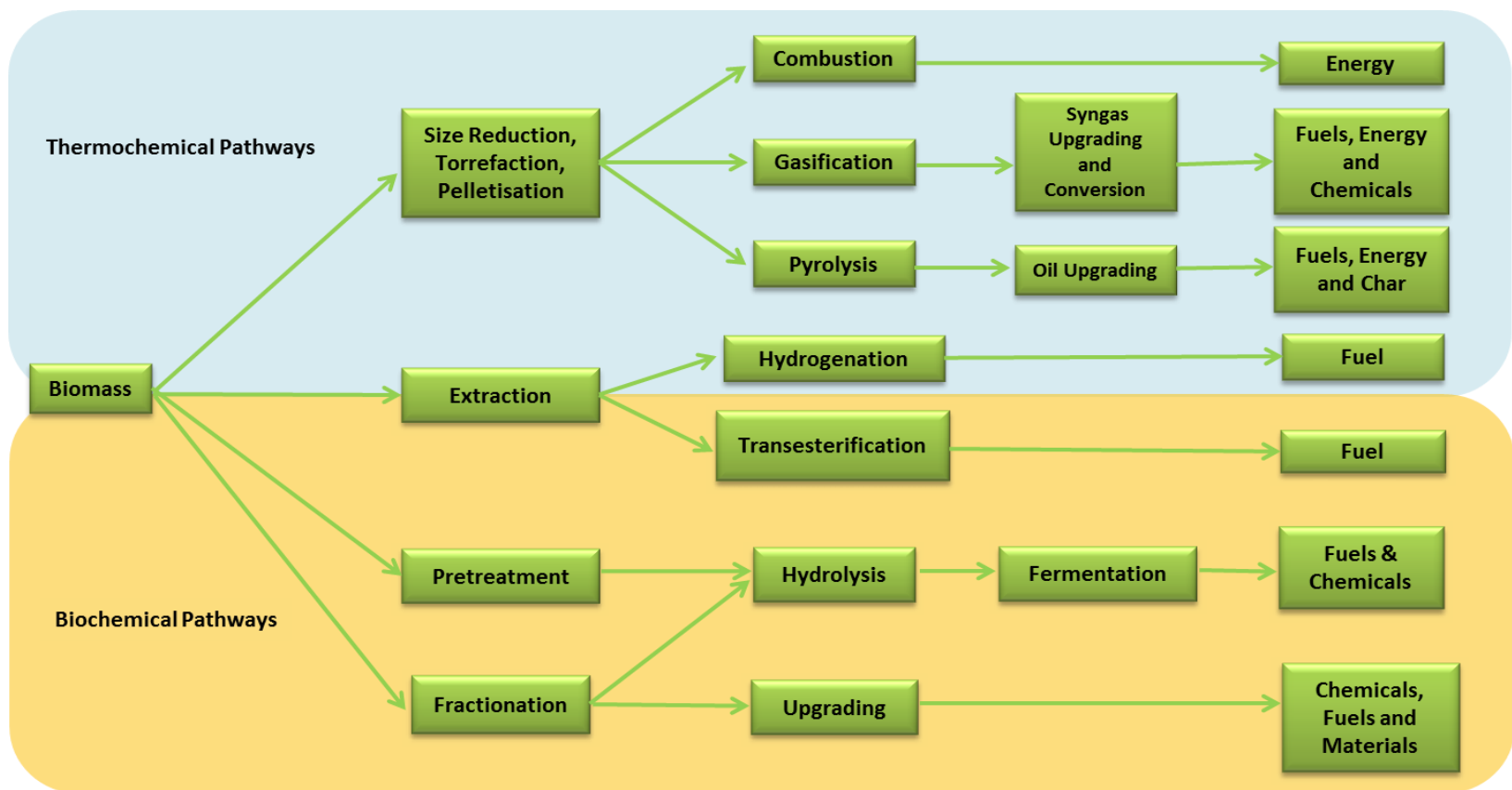
- **Considerable potential :**

– Food waste	0.22 EJ/yr		
– Agricultural crop residues	0.8	to	3.60 EJ/yr
– Primary forest residues	0.8	to	2.70 EJ/yr
– Total	1.82	to	6.52 EJ/yr
– Share of final energy consumption	3.9%	to	14.1%

- **But caution!**

- **Crude estimates** subject to big uncertainty & barriers to mobilisation
- ‘Wastes’ & ‘residues’ **the wrong term?** Many have existing uses.
- New uses by pushing the ‘bioeconomy’ adds to existing demands
- This could worsen the under-production of supporting, regulating and cultural ecosystems services, and biodiversity which underpins these bio-resources.

Technology options for biomass conversion



. Key factors for future development :

- The amount and type of **feedstock available**
- Market or policy driven **demand** for bio-based products
- **investment and production** decisions taken on the ground

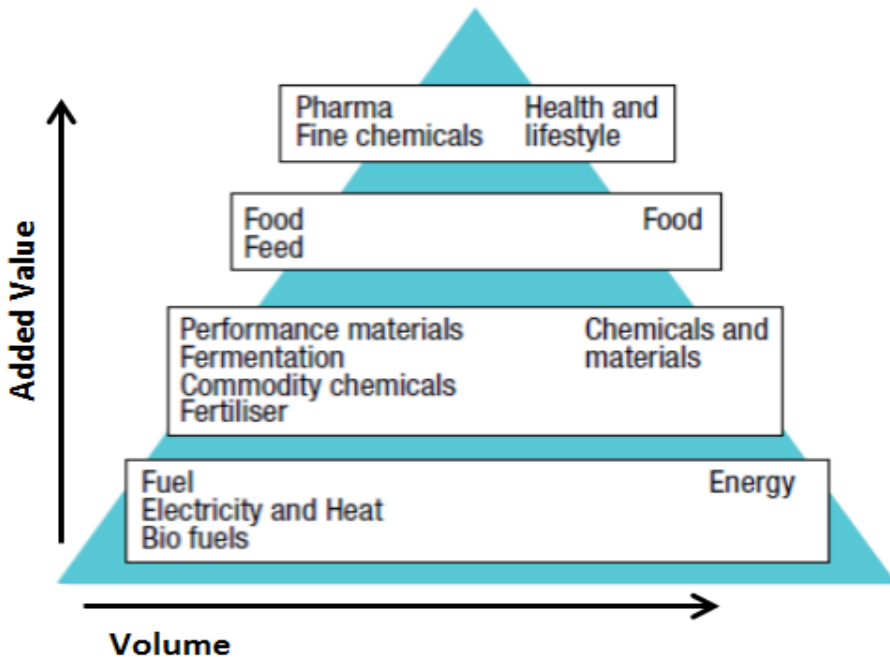
Sustainability of bio-based products

- GHG mitigation and wider environmental benefits must be key for bioeconomy
- Controversy on biofuels means addressing and regulating sustainability upfront
- This must focus on:
 - Life Cycle Analyses (LCAs) of GHG performance
 - Impacts on soil, biodiversity and water



Resource efficient biomass use

The biomass value triangle



Source: Adapted based on Eickhout (2012) and http://www.biobasedeconomy.nl/themas/bioraffinage_v2/

- Non-energy and energy uses for biomass should combine → **Cascading**
- Prioritisation of waste and residue sources based on
 - lifecycle GHG savings per unit of biomass replacing fossil-based feedstocks
 - Availability of low-carbon fuel alternatives
 - Economic considerations: volumes and values

LCAs – Bio-based materials

- Some critical issues in LCAs for bio-based materials:
 - *Fossil fuel comparator*: Not always clear cut as bio-based building blocks can end up in a range of applications
 - *Biogenic carbon storage*: are bio-based products credited for delaying carbon emissions? Depending on product lifetimes.
 - *Energy use*: process energy needs can be large so its choice (eg fossil vs renewable sources) is critical
 - *Efficiency and integration of the biorefinery facility*: how much recycling of process energy & residues, & regeneration of catalysts?

Other significant environmental concerns

- Soil quality:
 - Over-extraction a real danger for soil organic matter
 - All use of W&R implies a breaking of the soil C cycle
- Biodiversity
 - Over removal of crop and forest residues a threat
 - Some potential gains; eg removal of alien invasive spp.
- Water
 - Potential savings if W&R replace crops as feedstock
 - Water consumption in processing can be a concern
- Degradable bio-based materials
 - Positive environmental opportunities here

Options to progress W&R use in bioeconomy

1. Help mobilise waste and residue feedstocks
2. Shift from demonstration to commercialisation
3. Ensure environmental sustainability



Mobilising waste and residue feedstocks

- Make best use of *available support and advice measures* available for land managers (eg under CAP Rural Development Policy)
- Improve *food waste separation and collection* and revisit legislation on its use for anaerobic digestion
- Follow a *regional approach to biomass development* eg in siting of bioenergy or biorefinery plants

Moving from demonstration to commercialisation

- Financing for set-up of large scale demonstration or first-of-its-kind plants (some public money warranted)
- Facilitate market-driven demand for bio-based products through standards and labels for bio-based products
- Ensure a supportive and stable policy framework
 - scale back support for conventional biofuels in particular
 - consider a **Bio-resources Directive** as an integrated set of objectives and principles for the efficient use of biomass for food, energy and material use
 - introduce incentives to use end-of-life biomass for energy
 - phase out EHS for fossil fuels to promote bio-based feedstocks

Ensuring environmental sustainability

Through the introduction of *environmental safeguards*:

- Respect the waste hierarchy, 1st priority is avoid waste
- Avoid depleting soil carbon
 - Standards for biorefinery operators re soils and GHG, direct and indirect
 - Strengthen soil organic matter protection as part of the cross compliance provisions of the CAP
 - Extend the Renewable Energy Directive's GHG accounting framework to include soil carbon stock changes
 - Extend the RED's sustainability criteria to other forms of bioenergy and bio-based products

In conclusion

- Policy encouragement justified but with enhanced transparency and strong sustainability safeguards
- Bioeconomy Observatory can fulfil an important monitoring role
- Greater predictability of the environmental ground rules should be beneficial for attracting investment and ensuring the long-term viability of the sector



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IEEP's Agriculture and Land Management team:

<http://www.ieep.eu/work-areas/agriculture-and-land-management/>

IEEP's work on bioenergy and biofuels:

<http://www.ieep.eu/work-areas/agriculture-and-land-management/bioenergy/>

IEEP's website on the CAP debate:

<http://www.cap2020.ieep.eu/>

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