Biobased economy:
how to maximize its contribution to sustainable development

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Contents

1. Biomass as a resource: potential and quantities
2. Biomass versus other resources
3. Guiding principles for sustainable utilization
4. Case studies
1. Biomass as a resource: potential and quantities
Global flows of biomass in 2000:

Recent estimates for 2050:

- potential for primary (non-food): 3.4 – 9.1 Gt/yr
- Potential waste/residues biomass: 3.0 – 6.9 Gt/yr

Source: Dewulf et al., 2016
Potential for new applications of biomass, e.g.:

Source: Dewulf et al., 2016
2. Biomass versus other resources
Biomass versus fossils as a resource:

Technical characteristics:
- High level of (chemical) diversity and complexity
- Higher level of hetero-elements: source of energy and nutrients

→ NEED OF DIVERSE AND INTEGRATED VALORISATION:
  feed and food and energy and materials

The surrounding conditions:
- Product: wide range of applications
  → food/feed/fuel/material competition
- End-of-life: biogenic carbon
  → Coping with Global Warming
- Land requirement: land footprint
  → Land use change
Biomass versus other renewables as a resource:

- Emissions: all renewables more carbon neutral than fossils

-Biomass: only renewable with energy and mass character
  - Advantage: Material applications and storage of energy (↔ flows)
  - Disadvantage: no ‘dematerialisation’ in energy context

-Resource requirements: land versus advanced materials/specialty metals
3. Guiding principles for sustainable utilization
A. Guiding at the process level:
Assess the thermodynamic efficiency: exergy analysis

Exergy\textsubscript{in} → Resources → Exergetic efficiency → Product → Exergy\textsubscript{out}

Entropy prod.
Waste
Product

Economic sustainability and Environmental sustainability

Source: Dewulf et al., 2008
B. Guiding beyond the process level: sustainability

Brundtland, 1987 (UNEP):
‘Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs’

Elkington, 1997:
Triple bottom line/ 3Ps:
People (social)
Profit (economics)
Planet (environment)
Make use of the Sustainability Assessment Toolbox today:

- Key input: data
- Key advantage: avoiding burden shifting

Source: Dewulf et al., 2016
4. Case studies
Case studies in collaboration with industry in Belgium

Organic Waste Systems

OLEON

SOLVAY

Colruyt

Tereos

Trotec
Illustration 1: consequences of bioethanol production

Introduction of biofuel into product portfolio of food/feed biorefinery:

- Fossil fuel substituted:
  → reduction of fossil demand
  → reduction in fossil CO$_2$ emission

- Less feedstock left for food/feed → need for other sourcing:

Crude oil saving of 1kg

Mineral use of 0.077kg
Water use of 35.90L
Land use of 9.78m$^2$.year

Source: De Meester et al., 2011
Illustration 2: biobased PVC

Values normalized to the maximum result of each category.

- Bioethanol-based PVC
- Fossil-based PVC

Bar chart showing various environmental impacts compared between bioethanol-based PVC and fossil-based PVC.
Quantification and substantiation of sustainability claims → Stakeholders communication

“Sustainability standards”: see EU Horizon 2020

Source: Dewulf et al., 2016
THANK YOU

Background information: