Sustainability of bioenergy: from theory to practice. Overview of concepts, policies and case studies

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Bangkok, 23-24 July, 2014
Context: Many Projects and Studies

- **Global Assessments and Guidelines** for Sustainable Liquid Biofuel Production in Developing Countries (FAO/UNEP/UNIDO)

- **Indicators** for Sustainable Bioenergy
  http://www.globalbioenergy.org

- **IEA Bioenergy** Sustainability of certified wood bioenergy feedstock supply chains: Ecological, operational and international policy perspectives. IEA Bio Tasks 40 + 43

- **Joint Workshops on** extending the RED to forest bioenergy
  www.iinas.org/redex.html

- **Sustainable bioenergy in EU28**
  www.biomasspolicies.eu

- **Resource-efficient bioeconomy in Europe**
  www.s2biom.eu

- **Supporting a Sustainable European Bioenergy Trade Strategy** (IEE)
  www.bioenergytrade2020plus.eu

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Competing Uses for Biomass...

Balance needed!

Source: IINAS, IFEU, Shell (2012)
Source: IINAS calculation for 2010 based on IEA (2014) and nova (2012)
Bigger Picture (II)

Current global biomass use for all human activities:
approx. 175 EJ_{eq}

Wood 27 %

Fibers (e.g. textiles) 1%

*materials* 14%

*energy* 13%

*feed from grasslands* 28%

*vegetable oils* 8%

Cereals & rice 36%

Source: IINAS, EFI, JR (2014)

Biomass demand by 2050:
50 - 150 EJ for energy +
50 - 75 EJ_{eq} for materials +
100 - 200 EJ_{eq} for food & feed

Food & Feed 72 %
### Map of selected initiatives related to sustainability of forest bioenergy

<table>
<thead>
<tr>
<th>International</th>
<th>Regional level (EU)</th>
<th>National</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Environment and Climate</strong></td>
<td>NLBI Forests</td>
<td>EU Bioeconomy &amp; Biodiversity Strategy</td>
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<td>UN conventions (e.g. CBD, FCCC)</td>
<td>EU Resource Efficiency Roadmap</td>
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<td><strong>Forestry</strong></td>
<td>Voluntary harvesting guidelines</td>
<td>FLEGT, EU Forest Strategy</td>
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<td>Forest processes C&amp;I</td>
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<td>Several voluntary guidelines</td>
<td>Voluntary forest certification schemes</td>
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<td><strong>Bioenergy</strong></td>
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<tr>
<td>GBEP</td>
<td>Voluntary certification schemes: bioenergy (liquid biofuels and/or woody bioenergy)</td>
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<tr>
<td>FAO-UNEP UN Energy Tool</td>
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<td>ISO</td>
<td>EU RED (for 2G biofuels)</td>
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<td>IDB scorecard</td>
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<tr>
<td>WWF/WB scorecard</td>
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<td>GEF standards</td>
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<tr>
<td><strong>Bioenergy</strong></td>
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<td>FAO woodfuel C&amp;I</td>
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<tr>
<td><strong>Biomaterials (procurement)</strong></td>
<td>Responsible purchasing processes</td>
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<td>Responsible cultivation areas</td>
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<tr>
<td><strong>Financing</strong></td>
<td></td>
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<tr>
<td>Financing institutions safeguards</td>
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</table>

Source: IINAS, EFI, JR (2014)

**Color Key:**
- Voluntary
- Mandatory

**Research sponsored by**
- UNEP
- IEA Bioenergy
- European Environment Agency
- Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
- Umwelt Bundesamt
Selected policies

- **EU**: EU RED for biofuels and bioliquids. For forest bioenergy:
  - **UK**: Demonstrate SFM (Category A: forest certification scheme or Category B: equivalent credible evidence)
  - **NL**: Energy Agreement and negotiated sustainability criteria (NTA8080 and FSC)
  - **US**: RFS (Renewable Fuel Standard 2) + Clean Power Plan. **California**: Low Carbon Fuel Standard
  - **BR**: Agroecological zoning (federal level and state level for various crops e.g. sugarcane)
  - **MZ**: National Biofuels Policy and Strategy (2009)
Sustainable Biomass...

- **Key Criteria (preliminary list):**
  - **Resource** efficiency: make the most out of **limited** resource land (>100 GJ/ha), residues (> 60%), incl. **cascading**
  - GHG emissions savings, including iLUC (**agricultural** crops, incl. SRC) + C stock changes (for **forest** bioenergy and **straw**)
  - **Biodiversity**: high-biodiverse areas and **management** practice (**all** cultivation systems, incl. forestry)
  - Air emissions, water and soil impacts
  - **Food, fuelwood** & **land tenure** security
  - Balance of (rural) **employment & income**
Bioenergy = opportunities, but development needs steering (GBEP Sustainability Indicators www.globalbioenergy.org)

Key role for bioenergy in developing contexts:

- **Agriculture** (often underdeveloped) → bioenergy investment helps improving yields & infrastructure

- In the **forestry sector** → rural development + access to modern energy can reduce deforestation pressure

- **Reducing land competition** → **Intercropping** with food and agroforestry + cultivation of perennial crops on low-carbon and degraded land improves C balance and helps restoring soils
Case: Ethanol in Sierra Leone

• Makieni project (www.addaxbioenergy.com/en/the-makeni-project.php)
• Sugarcane plantation (approx. 10,000 ha) + ethanol refinery (85 Ml/a)
• Biomass power plant (approx. 100,000 MWh) and related infrastructure

• 2,750 employees
• RSB certified
• Germany supports national VGVT implementation project in Sierra Leone (through FAO) → opportunity to mainstream Addax experience!

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Case: Eucalyptus in Uruguay

- Forestal Oriental (UPM, Uruguay) [http://www.upm.com/EN/ABOUT-UPM/Businesses/Pulp/Plantations/Forestal_Oriental/Pages/default.aspx](http://www.upm.com/EN/ABOUT-UPM/Businesses/Pulp/Plantations/Forestal_Oriental/Pages/default.aspx)

- 230,000 ha of land (degraded grassland), 60% eucalyptus approx. → Pulp mill. 2 nurseries

- Fomento: programme that encourages the landowners to diversify their land use with sustainable plantation forestry

- ISO 9001, ISO 14001, OHSAS 18001

- Forest Management and Chain-of-Custody Standards FSC and PEFC

- Part of the New Generation Plantations Project
Final Thoughts

- **Harmonization** of schemes is needed
- **Coherent sustainability requirements** for all bioenergy (electricity, heat, transport) and biomaterials, biorefineries etc. needed
- **Bioeconomy**: not food (or fuelwood) vs. fuel but **land use**
- Opportunities with residues and wastes (cascading) and marginal and degraded land: **yes**, but consider trade-offs
- Address **social** effects (positive and negative)
- **Improve** indicators: C balances, maps for biodiversity and nutrient depletion risk (“go” areas!)
- **Integrated** agro-energy-water and forest-energy projects needed to deliver on synergy opportunities
- **Holistic vision** of sectors, risks and opportunities
More Information

www.iinas.org
Contact: li@iinas.org

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UNEP
IEA Bioenergy
European Environment Agency
Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
Umwelt Bundesamt
GHG accounting of forest bioenergy

- Bioenergy is **C-neutral** in the **long-term**
- **IPCC** budget approach, **but** sub-target of max. 0.1 °C increase per decade meant to protect biodiversity and to limit ocean acidification
- **Differentiation** needed: forest; forest product; material displacement and energy substitution
- Geographical scale: stand level vs. **landscape** level
- Models + simplified approaches: 5-20 years **payback** for most **residues** = nearly C neutral
## Low Climate-Risk Feedstocks?

<table>
<thead>
<tr>
<th>Woody biomass source for energy use</th>
<th>Time horizon for CO₂ emission reduction</th>
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<tbody>
<tr>
<td></td>
<td>short (10 years)</td>
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<tr>
<td></td>
<td>Coal</td>
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<tr>
<td>Boreal, stems final harvest</td>
<td>---</td>
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<tr>
<td>Temperate, stems final harvest</td>
<td>---</td>
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<tr>
<td>Harvest + thinning residues,</td>
<td>+/-</td>
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<tr>
<td>landscape care &amp; salvage wood*</td>
<td></td>
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<tr>
<td>SRC on marginal agricultural land</td>
<td>+++</td>
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<tr>
<td>SRC replacing forest</td>
<td>-</td>
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<tr>
<td>industrial residues, wastes</td>
<td>+++</td>
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</tbody>
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-; --; ---: *bioenergy system emits more* CO₂eq than reference fossil system in given time frame
+/-: GHG emissions of bioenergy and fossil are comparable in given time frame
+; ++; +++: *bioenergy system emits less* CO₂eq than reference fossil system in given time frame

*For harvest/thinning residues & salvage wood, balance depends on alternative use (burning) and decay rates

Source: own compilation based on JRC (2013)