Slovenia

Outlook of lignocellulosic biomass and relevant policies for a bio-based economy in 2030
What types of lignocellulosic biomass are included in the analysis?

Lignocellulosic biomass in this analysis includes:

- Forest biomass from primary forestry productions (fellings), primary field residues and secondary forest industry residues;
- Agricultural biomass from primary field activities;
- Biowastes and post consumer wood;
- Dedicated perennial crops.
Context

S2Biom provides data and evidence relating to:

- indigenous, sustainable lignocellulosic biomass feedstock potentials at national/regional/local levels;
- resource and energy efficient value chains which are expected to be implemented at scale by 2030;
- policies that can facilitate uptake of indigenous lignocellulosic biomass.
Key questions, addressed by S2Biom

- Where is biomass found?
- What is estimated sustainable potential by 2030?
- What are the sustainable potentials by biomass type and where can they be found?
- Which value chains have high resource and energy efficiency?
- What is the national policy landscape?
- What future policy interventions can be considered based on good practice?
Where is biomass found?

- The following slide presents a map with total sustainable* occurrence of lignocellulosic biomass by region, measured in ‘000 dry tonnes per year.

* The estimated potentials include sustainability criteria as required by the Renewable Energy Directive.
Total lignocellulosic biomass by region

Supply in kton DM per region (2030, BASE)
What is the availability per biomass type?

- Sustainable potential from residues, dedicated perennial crops, biowastes and post consumer wood totals 1.8m dry tonnes / year.
- Primary forestry production accounts for an additional 4.2m dry tonnes / year.
- The following slide presents a graph of potential available lignocellulosic biomass by source, excluding primary forestry production.
Lignocellulosic biomass availability by source by 2030 (‘000 dry tonnes)
What are the sustainable potentials by biomass type and where can they be found?

- The following slides present maps of estimated sustainable potential lignocellulosic biomass by region and by main source, namely:
  - Forest (primary forestry production, field residues and secondary agricultural residues)
  - Agriculture (primary field residues and tree prunings)
  - Biowastes and post consumer wood
  - Dedicated perennial crops
Forest

- Estimated sustainable potential can reach up to 5.3m dry tonnes/year
Agriculture

- Estimated sustainable potential can reach up to 0.7m dry tonnes/year
Biowastes and post consumer wood

- Estimated sustainable potential can reach up to 0.32m dry tonnes/ year
Dedicated perennial crops

- Estimated sustainable potential can reach up to 63,000 dry tonnes/ year
Which value chains have high resource and energy efficiency?

- The following show value chains with relatively high efficiency in the following aspects:
  - Energy efficiency
  - Greenhouse gas emissions
  - Air quality
  - Technological maturity
## Value chains: forest and agriculture

<table>
<thead>
<tr>
<th>Energy efficiency</th>
<th>Greenhouse gases</th>
<th>Air quality</th>
<th>Technological maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Combustion at small scale including households</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Strength</strong></td>
<td>High conversion efficiency with modern technology</td>
<td>Low fossil input in the value chain</td>
<td>-</td>
</tr>
<tr>
<td><strong>Weakness</strong></td>
<td>Older stoves have low conversion efficiency. Heat not always efficiently used.</td>
<td>-</td>
<td>High emissions from older wood stoves.</td>
</tr>
<tr>
<td><strong>Combustion at small-medium scale including buildings</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Strength</strong></td>
<td>High conversion efficiency</td>
<td>Low fossil input in the chain</td>
<td>-</td>
</tr>
<tr>
<td><strong>Weakness</strong></td>
<td>-</td>
<td>-</td>
<td>Emissions better than smaller scale but higher than natural gas.</td>
</tr>
<tr>
<td><strong>Combustion at medium scale, heat led</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Strength</strong></td>
<td>High conversion efficiency</td>
<td>Low input of fossil fuels; high GHG savings especially for Combined Heat and Power</td>
<td>Better control options for emissions</td>
</tr>
<tr>
<td><strong>Weakness</strong></td>
<td>-</td>
<td>-</td>
<td>Higher emissions than natural gas combustion.</td>
</tr>
<tr>
<td><strong>Biochemical - lignocell. hydrolysis and fermentation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Strength</strong></td>
<td>-</td>
<td>High GHG savings in case of process integration and limited fossil input.</td>
<td>Ethanol has low emissions as transport fuel.</td>
</tr>
<tr>
<td><strong>Weakness</strong></td>
<td>Around 50% conversion efficiency</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
### Value chains: wastes

<table>
<thead>
<tr>
<th></th>
<th>Energy efficiency</th>
<th>Greenhouse gases</th>
<th>Air quality</th>
<th>Technological maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Waste incineration and energy recovery</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Strength</strong></td>
<td>Adding energy recovery to waste management improves its pathway; high efficiency if CHP</td>
<td>High GHG benefit, particularly compared to landfill (avoided methane emissions); energy recovery substitutes fossil fuels</td>
<td>If landfill is avoided, lower air emissions.</td>
<td>Fully commercial</td>
</tr>
<tr>
<td><strong>Weakness</strong></td>
<td>Relatively low net energy output; auxiliary fuel may be required due to low calorific value of fuel</td>
<td>-</td>
<td>Issues in terms of emissions of waste incineration. Emission control is circa one third of project cost.</td>
<td>-</td>
</tr>
<tr>
<td><strong>Combustion at medium scale, heat driven</strong></td>
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</tr>
<tr>
<td><strong>Strength</strong></td>
<td>&gt;85% conversion efficiency in case of heat only; 65-85% efficiency for CHP installations.</td>
<td>Low input of fossil fuels; especially in case of CHP GHG savings can be high</td>
<td>Better control options for PM emissions compared to small scale installations.</td>
<td>Fully commercial</td>
</tr>
<tr>
<td><strong>Weakness</strong></td>
<td>-</td>
<td>-</td>
<td>Still higher PM emissions than natural gas combustion.</td>
<td>-</td>
</tr>
<tr>
<td><strong>Gasification &amp; CHP at medium scale - heat driven</strong></td>
<td></td>
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</tr>
<tr>
<td><strong>Strength</strong></td>
<td>Up to 80% conversion efficiency, depending on heat only or CHP installations.</td>
<td>Low/no input of fossil fuels; especially in case of CHP GHG savings can be high</td>
<td>Low emissions of gas engine or turbine</td>
<td>(Early) commercial</td>
</tr>
</tbody>
</table>
What is the national policy landscape?

- The following slides provide diagrams to illustrate how existing policies / measures support one or more of the following:
  - Biomass supply
  - Logistics
  - Conversion
  - Distribution
  - End use
- Policies / measures are categorised as: (1) Regulation, (2) Financing and (3) Information

* Policy mapping and respective recommendations are the result of intensive review but as the field is dynamic the authors appreciate there may be missing elements.
Current policy: forest

Biomass Supply
- SL Forest Act
- SL National Forest Plan
- SL_DGPP: Environmental requirements
- SL-RDP: Investment subsidies

Logistics

Conversion
- SL-NEEAP: Energy Efficiency Action Plan
- SL-NREAP: Renewable Energy Action Plan
- SL-ReNEP: Renewable Energy Action Plan
- SL- EA: Requirements, Substitution Obligation, Permitting, Zoning

Distribution
- SL_DESFC: Subsidies

End Use
- Decree on Renewable Electricity support & SL-EPA: Feed in tariffs
- Excise Duties Act

Regulations

Financing

Information
Current policy: agriculture & dedicated crops

Biomass Supply
- CAP: Slovenian Rural Development Programmes

Logistics

Conversion
- SL-NEEAP: Energy Efficiency Action Plan
- SL-NREAP: Renewable Energy Action Plan
- SL-ReNEP: Renewable Energy Action Plan
- SL- EA: Requirements, Substitution Obligation, Permitting, Zoning
- Act on Sustainable Biofuels
- SL- RTFO: Substitution Obligation
- SL_DESFC: Subsidies

Distribution

End Use
- Decree on Renewable Electricity support
- SL- EPA: Feed in tariffs
- Excise Duties Act

Regulations
- Financing
- Information
Current policy: wastes

Biomass Supply
- SL-DOW: Requirements for waste energy
- SL_DRNHW: Requirements for waste energy
- SL_OPW: Strategy for wastes

Logistics

Conversion
- SL-NEEAP: Energy Efficiency Action Plan
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- SL-ReNEP: Renewable Energy Action Plan
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Distribution

End Use
- Decree on Renewable Electricity support & SL-EPA: Feed in tariffs
- Excise Duties Act

Regulations

Financing

Information
What improvements can be made based on good practice?

- The following slides illustrate selected policies from Member States that have had significant positive impact in promoting the use of lignocellulosic biomass
- Based on this Good Practice, recommended new policies are shown (shaded boxes) to complement existing policies

* Policy mapping and respective recommendations are the result of intensive review but as the field is dynamic the authors appreciate there may be missing elements.
Good Practice- Feedstocks

Biomass sourcing

- AT: Waste management & Regulation on recycling of waste wood
- DE: Kreislaufwirtschaftsgesetz-KrWG- Waste disposal
- NL: strategic initiative for anaerobic digestion of MSW- organics
- FI: private forest owners
- FI: forest certification
- BE: Subsidies for afforestation and forest management
- AT: ÖPUL – Austrian Agri-environmental Programme: Tailored investment support with market sector focus
- DE: EEG- Feedstock bonus for plants using straw
- DE: ÖPUL – “Gemeinschaftsaufgabe Agrarstruktur und Küstenschutz” provides farmers with financial support for the cultivation of short rotation coppices.

Logistics

- BE: VLAREM- collecting & treatment
- DE: Kreislaufwirtschaftsgesetz-KrWG- Waste disposal
- NL: strategic initiative for anaerobic digestion of MSW- organics
- FI: private forest owners
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High impact
Moderate impact
Good Practice- End use sectors

- **Heat**
  - UK: Renewable Heat Initiatives (RHI)
  - AT: Climate and Energy Fund-Subsidy scheme wood heating.
  - NL: Energy Investment Allowance (EIA), tax reductions for boilers
  - DE: repayment bonus from market program (MAP) and soft loans with low interest rates public sector bank KfW
  - AT: Green Electricity Act & CHP Act: refines scales of applications and target specific sectors and biomass resource types and end uses.
  - DE: Renewable Energy Sources Act 2014 - Act (EEG 2014); Market premium (in EEG § 35); Flexibility premium for existing installations (EEG, § 54)
  - UK: Renewables Obligation (RO) scheme, based on green certificates favouring certain technologies
  - DE: Federal Immission Control Act (BImSchG)
  - FI: Act of Excise Duty on Liquid Fuels, a taxation system, in which each component of a liquid fuel is taxed separately, based on its energy content and carbon dioxide emission, meaning reduced taxation for biofuels

- **CHP**
  - AT: Green Electricity Act & CHP Act: refines scales of applications and target specific sectors and biomass resource types and end uses.
  - DE: Renewable Energy Sources Act 2014 - Act (EEG 2014); Market premium (in EEG § 35); Flexibility premium for existing installations (EEG, § 54)
  - UK: Renewables Obligation (RO) scheme, based on green certificates favouring certain technologies

- **Transport biofuels**
  - UK: Renewable Transport Fuel Obligation (RTFO) and certification system
  - DE: Energy Tax Act (EnergieStG) : It accounts for transport biofuels

- **Biobased products**
  - DE: National Bioeconomy Strategy
  - DE: National Bioeconomy Strategy
  - SE: Swedish Research and Innovation Strategy for a Bio-based Economy
Recommended new policy*: forest

**Biomass Supply**
- SL Forest Act
- SL National Forest Plan
- SL_DGPP: Environmental requirements
- SL-RDP: Investment subsidies

**Logistics**

**Conversion**
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- SL-ReNEP: Renewable Energy Action Plan
- SL- EA: Requirements, Substitution Obligation, Permitting, Zoning
- SL_DESFC: Subsidies

**Distribution**
- Decree on Renewable Electricity support & SL-EPA: Feed in tariffs
- Excise Duties Act

**End Use**
- Climate & Energy Fund: Subsidy scheme wood heating

**Forest Certification**

**Regulations**

**Financing**

**Information**

*Shaded boxes show recommended new measures*
Recommended new policy: agriculture & dedicated crops

Biomass Supply
- CAP: Slovenian Rural Development Programmes

Logistics

Conversion
- SL-NEEAP: Energy Efficiency Action Plan
- SL-NREAP: Renewable Energy Action Plan
- SL-ReNEP: Renewable Energy Action Plan
- SL-RTFO: Substitution Obligation
- SL-EA: Requirements, Substitution Obligation, Permitting, Zoning
- SL_DESFC: Subsidies

Distribution
- Decree on Renewable Electricity support
- SL-EPA: Feed in tariffs
- & SL-EPA: Feed in tariffs

End Use

Climate & Energy Fund: Subsidy scheme heating with agricultural residues, pellets from crops

Standards for agricultural biomass

Combined Heat and Power Act
- Act on promoted energy sources: Feed in tariffs
- introduce premiums for agricultural residues & dedicated crops

Regulation on agricultural raw materials for biofuels and bioliquids

Regulations
Financing
Information
Recommended new policy: wastes

**Biomass Supply**
- SL-DOW: Requirements for waste energy
- SL_DRNHW: Requirements for waste energy
- SL_OPW: Strategy for wastes

**Logistics**

**Conversion**
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**Distribution**
- Decree on Renewable Electricity support & SL-EPA: Feed in tariffs
- Excise Duties Act

**End Use**

**Standards for biowastes**

**Regulations**

**Financing**

**Information**

**Feed in tariffs**
- introduce premiums for biowastes

**Combined Heat and Power Act**

**Fixed premiums**

**Biomethane injection**
Conclusions

- Slovenian national lignocellulosic biomass potential is substantial at around 1.5m dry tonnes / year (excluding primary forest harvest), with forestry being the main source.
- The existing policy framework forms a foundation for future support measures to be introduced.
- The study has recommended a number of new targeted laws, regulations, standards and finance mechanisms to help Slovenia realise its potential to contribute to a bio-based economy by 2030.
More information on: [http://s2biom.alterra.wur.nl/](http://s2biom.alterra.wur.nl/)

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