The »Biorefinery Fact Sheet« and its Application to Wood Based Biorefining

Case Studies of IEA Bioenergy Task 42 »Biorefining«

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The IEA Bioenergy Task 42 »Biorefining« with its 11 member countries (A, AUS, CA, DK, G, I, IR, J, NL, NZ, USA) has the following definition on biorefining:

»Biorefining is the sustainable processing of biomass into a spectrum of bio-based products (food, feed, chemicals, and materials) and bioenergy (biofuels, power and/or heat).«

Wood as a renewable and sustainable resource offers great opportunities for a comprehensive product portfolio to satisfy the different needs in a future BioEconomy. Worldwide many different wood based biorefining concepts are investigated and realised, of which the development status and the perspectives for implementation are quite different. Task 42 developed a »Biorefinery Fact Sheet« for the uniform and compact description of the main characteristics of these biorefineries (Part A: »Biorefinery plant«) and their whole value chain (Part B: »Value chain assessment«).

Based on a technical description and the classification scheme the mass and energy balance is calculated for the most reasonable production capacity for each of the selected biorefineries. Then the three dimensions – economic, environmental and social – of sustainability are assessed in a life cycle approach.

The »Biorefinery Fact Sheets« are initially applied for a first selection of interesting biorefinery systems identified by IEA Bioenergy Task 42, of which 6 are based on wood:

- 3-platform (black liquor, pulp, electricity & heat) biorefinery using wood chips for pulp, paper, turpentine, tall oil, bark, electricity and heat
- 2-platform (syngas, electricity & heat) biorefinery using wood chips for FT-Biofuels, electricity, heat and waxes with steam gasification
- 3-platform (pulp, syngas, electricity & heat) biorefinery using wood chips for FT-biofuels, electricity, heat and pulp
- 3-platform (C6 & C5 sugar, lignin, electricity & heat) biorefinery using wood chips for bioethanol, electricity, heat and phenols« (Figure 2)
- 4-platform (hydrogen, biomethane, syngas, electricity & heat) biorefinery using wood chips for biomethane (SNG), hydrogen and carbon dioxide
- 4-platform (C6 & C5 sugar, lignin & C6 sugar, electricity & heat) biorefinery using saw mill residues, wood chips and sulphite liquor for bioethanol, pulp & paper, electricity and heat

The »Biorefinery Fact Sheet« assists various stakeholders in finding their position on wood based biorefining in a future BioEconomy.

An example for a Biorefinery Fact Sheet is given in Figure 1 and Figure 2:

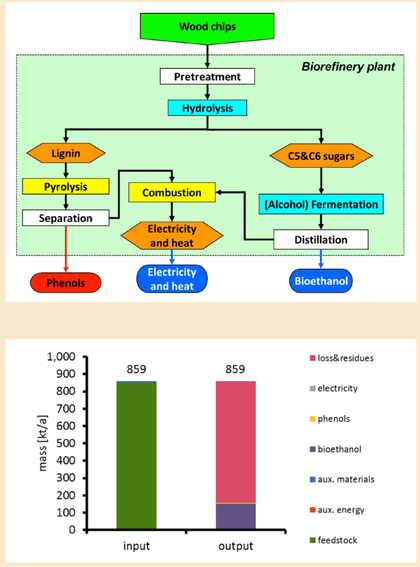
- Part A »Biorefinery plant«: A the key characteristics of the biorefinery plant are described by giving compact information on classification scheme, description of the biorefinery, mass and energy balance, share of costs and revenues.
- Part B »Value chain assessment«: sustainability assessment based on the whole value chain of the biorefinery plant is described by giving compact information on system boundaries, reference system, cumulated primary energy demand, greenhouse gas emissions, costs and revenues.
- In the Annex of the »Biorefinery Fact Sheet« the main data for the sustainability assessment are documented.

Part A: Biorefinery Plant

»3-platform (C6 & C5 sugar, electricity & heat, lignin) biorefinery using wood chips for bioethanol, electricity, heat and phenols«

The wood chips (without bark) are transported to the biorefinery, where the wood chips are pretreated for the hydrolysis to separate the sugars and the lignin. The C5 & C6 sugars are fermented to bioethanol and the lignin is used to produce bio-oil via a pyrolysis step. The phenols from the bio-oil are separated and the residues are combusted to produce electricity and heat.

This biorefinery system is partly demonstrated, the production of bioethanol is demonstrated in Sweden and the pyrolysis of the lignin was tested on laboratory scale. So far the production of bioethanol from hard wood is easier to be developed than from soft wood. Recent R & D results show that the integration of a bioethanol production from wood in a pulp and paper production plant offers promising synergies like handling and logistic of wood, water and waste water treatment, electricity and steam infrastructure and personal. Realising these synergies would enable a commercial bioethanol production from wood by 2025.



Part B: Value Chain Assessment

»3-platform (C6 & C5 sugar, electricity & heat, lignin) biorefinery using wood chips for bioethanol, electricity, heat and phenols«

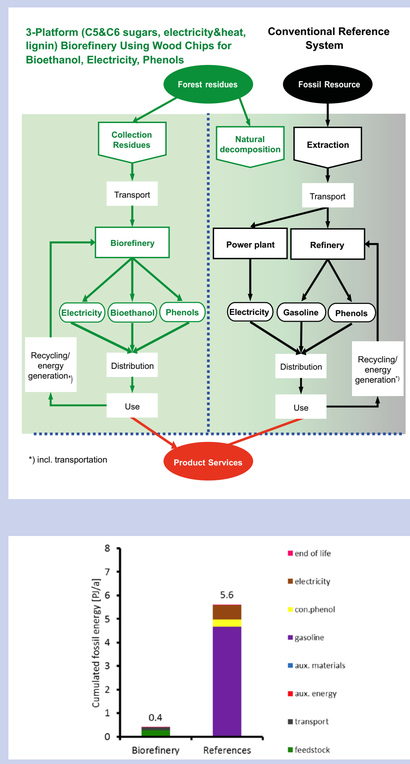


Figure 1: *Part A of the »Biorefinery Fact Sheet«: Biorefinery Plant*

Figure 2: *Part B of the »Biorefinery Fact Sheet«: Value Chain Assessment*

IEA RESEARCH COOPERATION

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Innovation und Technologie

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Acknowledgement

The Austrian participation in Tasks 42 of IEA Bioenergy is financed by the Federal Ministry for Transport, Innovation and Technology / Department for Energy and Environmental Technologies.