Institut für Energetik und Umwelt
Institute for Energy and Environment

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Synthetic Biofuels, Techniques, Potentials, Perspectives

# Mobilisation and Logistics of Solid Biofuels

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## Agenda

1. Introduction
2. Overall system of logistics for BtL-production
3. Logistic concepts
4. Economic assessment
5. Conclusions

# Introduction

***Requirements for BtL production***

- Large-scale plants based on thermo-chemical gasification that are technical efficient (i.e. high conversion rates) and economic efficient (i.e. competitive costs)
- Primarily lignocelluloses biomass with high potentials (EU-25: ~6.1 EJ/a) as feedstock
- Mobilisation of required biomass preliminary to operation start of BtL plant, i.e time for cultivation and harvesting particularly in case of energy crops as feedstock (e.g. approx. 3 years for short rotation coppice)

***Requirements for biomass logistics***

- Integration of existing technical biomass potentials in a BtL production system under national conditions (i.e. contribution to regional added value)
- Energy and cost efficient logistic concepts

***Key questions of biomass logistics***

- What are the important logistic parameters for energetic purposes?
- Which general logistic options are relevant in terms of practical application?
- Which economic effects are associated with these options?

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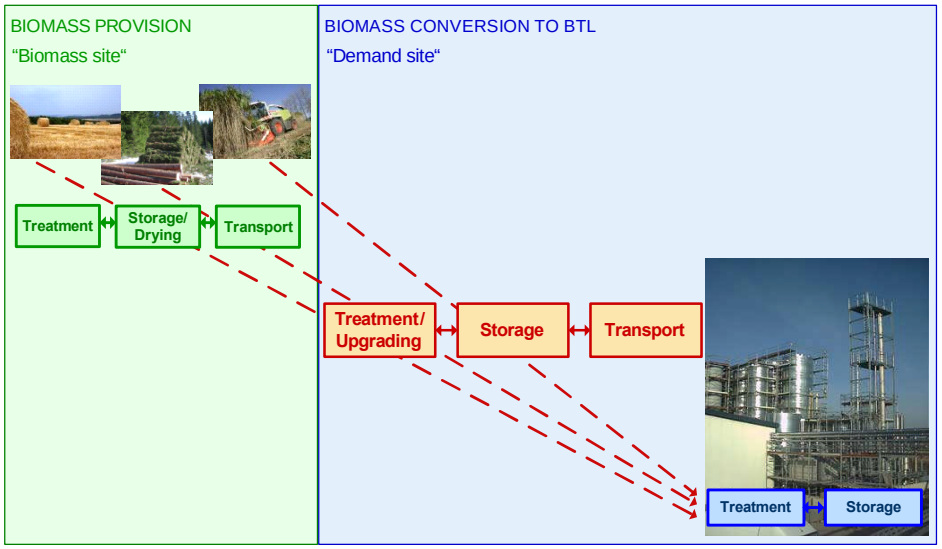
# Overall system of logistics for BtL-production

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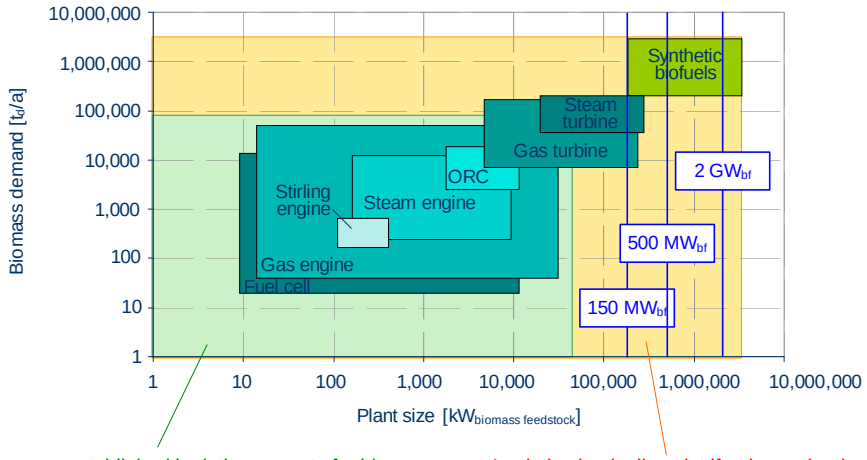
# Overall system of logistics for BtL-production
## - Characteristics of BtL-processes: Scale -




- established logistic concepts for biomass provision for energetic use

- Logistics basically exist if only mechanical or thermal treatment is required
- R&D stage for thermo-chemical treatment (pyrolysis + transport of pyrolysis product)

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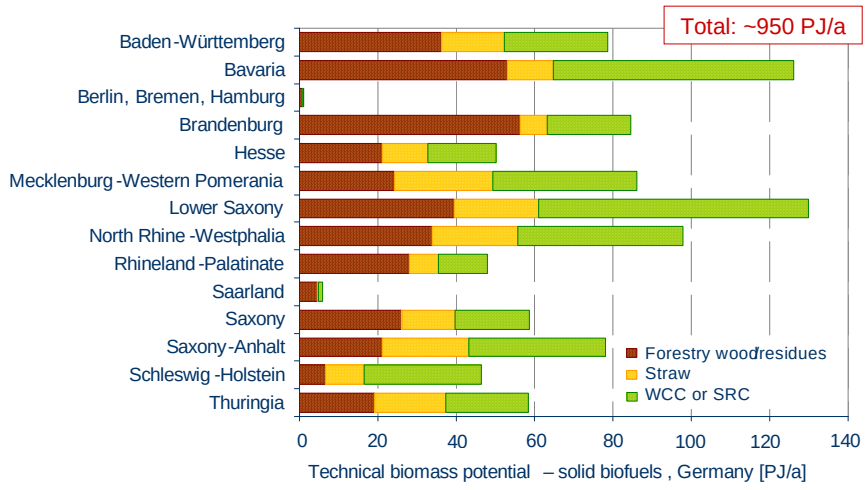
# Overall system of logistic for BtL-production
## - Technical potentials of solid biofuels -

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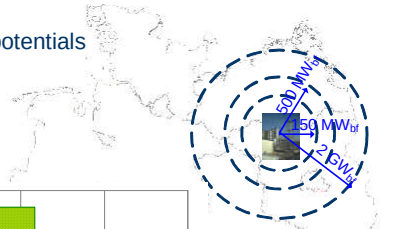
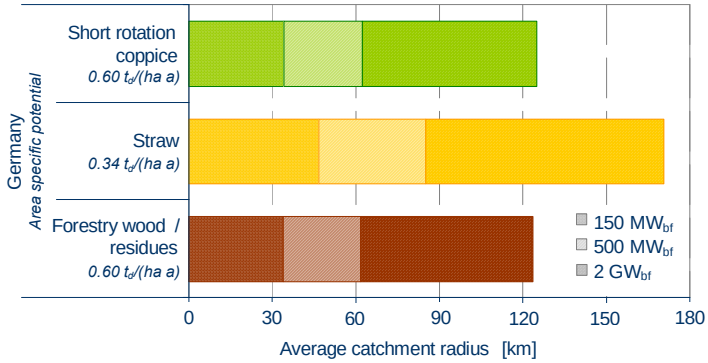
# Overall system of logistic for BtL-production
## - Catchment radius -

- Based on total area land different area specific potentials
- Larger scale and lower energy value of biomass assortment result in increasing catchment area

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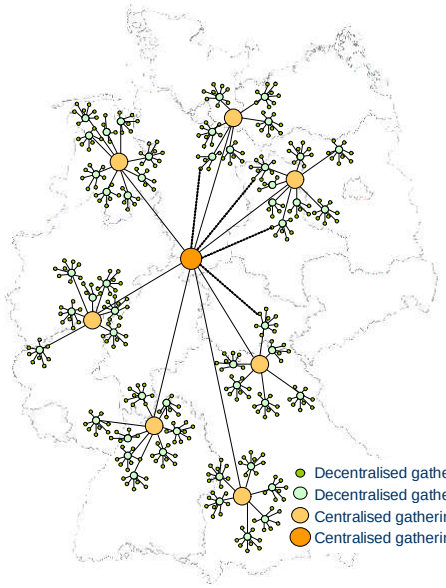
# Parameters of biomass logistics




- Biomass assortment
- Biomass demand
- Area specific potentials
- Biomass treatment
- Means of transportation
- Transportation distances
- Storage technologies
- Storage demand
- Plant location
- Existing infrastructure

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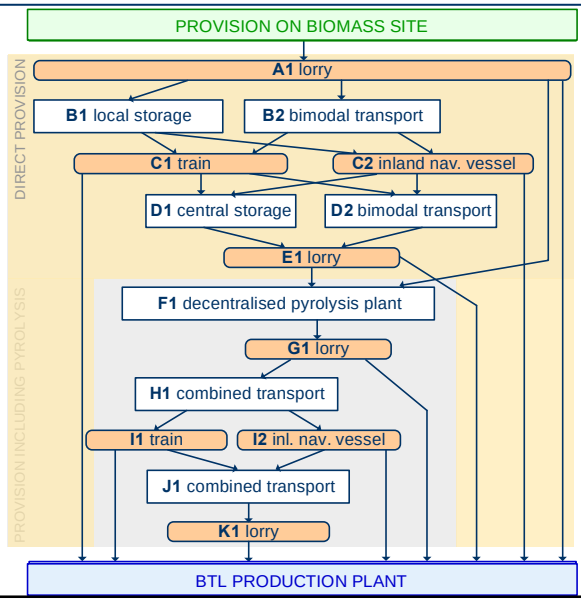
# Logistic concepts
## - General options -

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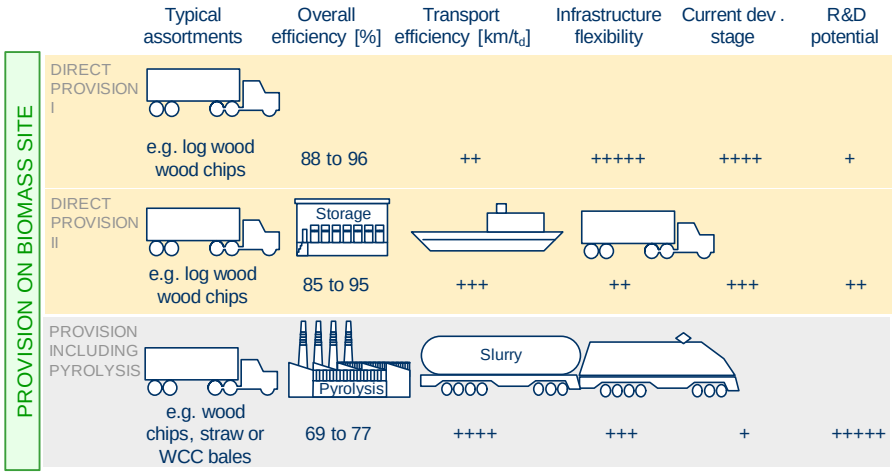
# Logistic concepts
## - Examples and their characteristics -




*Legend: + less promising, +++ promising, +++++ very promising*

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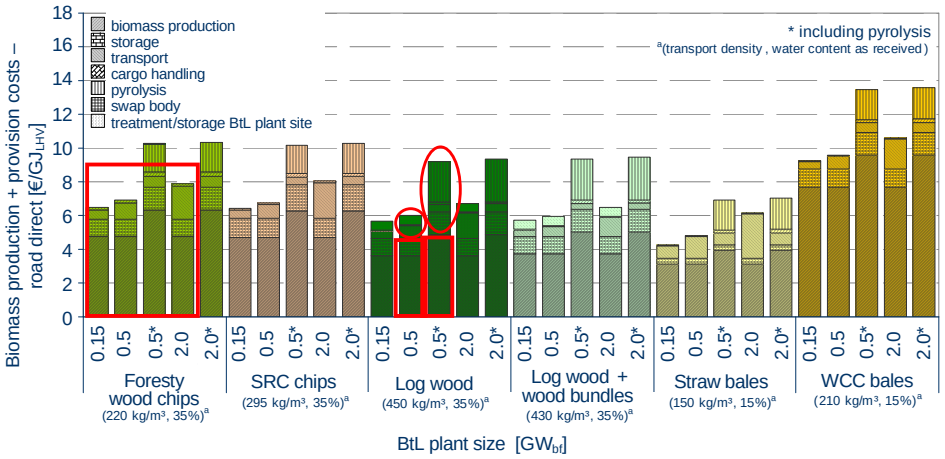
# Economic assessment
## - Different biomass assortments -




- Biomass production costs dominant; energy crops provision promises no economic benefit
- Increasing total provision costs with increasing BtL plant size; dominated by transport
- Higher biomass production costs due to conversion efficiency of pyrolysis; favourable transport costs vs. high production costs of pyrolsis slurry

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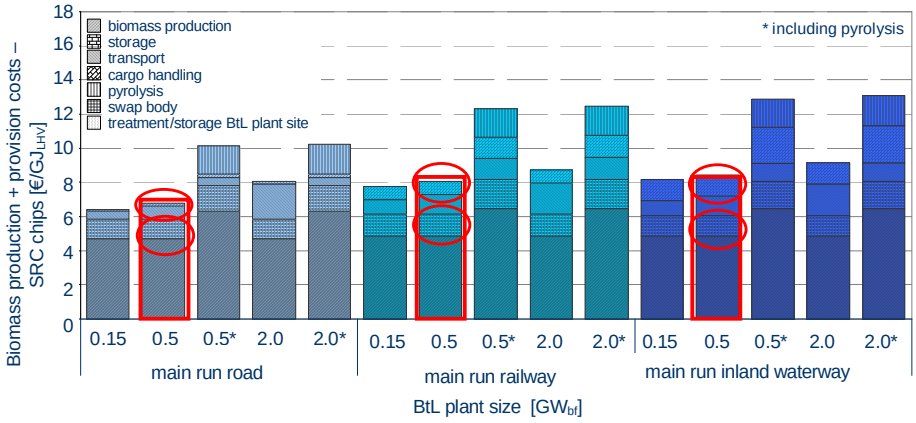
# Economic assessment
## - Means of transportation -




- Principially, road transport most favourable regarding economics
- Decreasing share of biomass production costs at increasing costs for storage, cargo loading when biomass is transported by train or inland navigation vessel (increasing technical demand)

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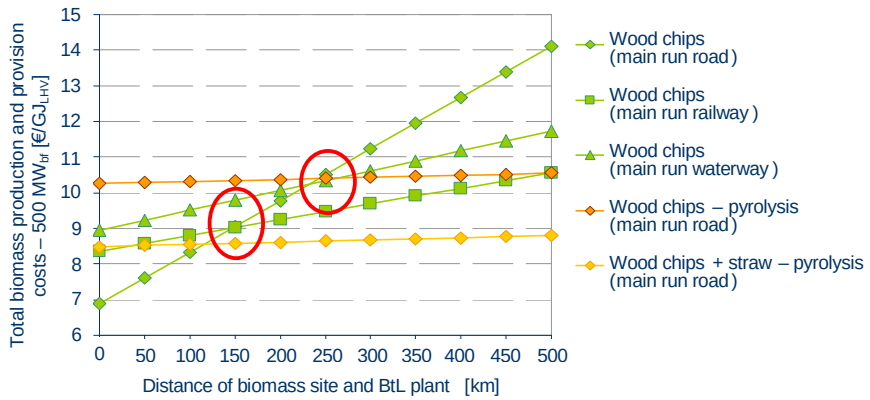
# Economic assessment
## - Influence of transport distance to provision costs -




- Linear progression of distance of biomass production site and BtL plant
  - ⇨ high for direct road transport
  - ⇨ low for pyrolysis
- Marginal distance at 150 km for train and pyrolysis slurry based on biomass mix; 250 km for inland navigation vessel and provision including biomass pyrolysis based on wood

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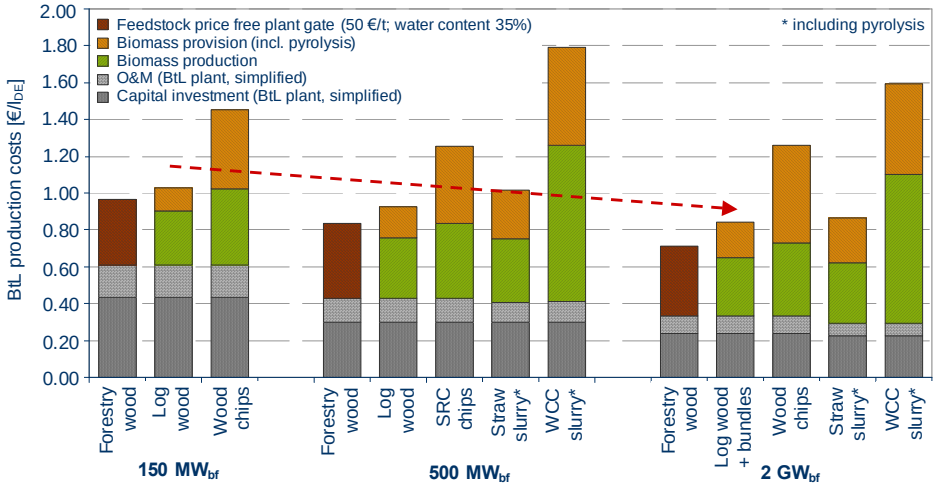
# Economic assessment
## - BtL production costs -




- Effect of economy of scale compensates biomass transport costs
- Biomass production and provision costs of most importance for BtL production costs
  - ⇨ to reduce BtL cost, reduction of biomass production will be one of the main challenges

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## Conclusions I

- Bascially, techno-economic bottlenecks regarding efficiency for large-scale BtL productions plants have to be overcome in the medium-term
- Biomass logistics for large-scale BtL: basically available concepts only for mechanical or thermal treatment, pyrolysis and transport of pyrolysis slurry at R&D stage
- Depending on area specific potentials, under ideal national conditions typical catchment radius in the range of approx. 35 km for 150 $MW_{bf}$ to 170 km for 2 $GW_{bf}$
- Various and also complex options for provision of solid biofuels to BtL plants
  ⇨ different characteristics concerning efficiencies, flexibility, status of development
- Effects from logistic view point:
  - Increasing provision expenditure with increasing BtL plant size (4.30 to 15.60 €/$GJ_{LHV}$)
    ⇨ provision costs highly correlate to technical complexity of provision chains
    ⇨ storage and cargo handling should be limited
  - Energy crops promise no benefits with regard to biomass provision
  - For provision of pyrolysis slurry significantly higher expenditures, benefits only in few cases (e.g. slurry based on a biomass mix, lower total provision costs in spite of slurry production costs, at very long distances)
  - Road transport generally the most favourable at typical conditions
  - Rail and inland waterway transport promising at very long distances between biomass site and BtL plant

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## Conclusions II

- Impact of biomass production and provision expenditures to BtL production
  - From energetic viewpoint: low for direct provision (85 to 96%), comparibly higher for provision including pyrolysis (66 to 77%)
  - From economic viewpoint: crucial (40 to 81% of total BtL production costs), but the effect of economy of scale compensates biomass provision costs

⇩

In terms of integration under national conditions and with regard to regional added value, BtL plant location should be selected by criteria as

- Area specific potential of the required biomass assortment
- In time mobilisation of required biomass demand (particularly for energy crops)
- Distance of biomass site and plant location
- Multi-modal infrastructure

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