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Studiengänge

Burgenland

Bildung im
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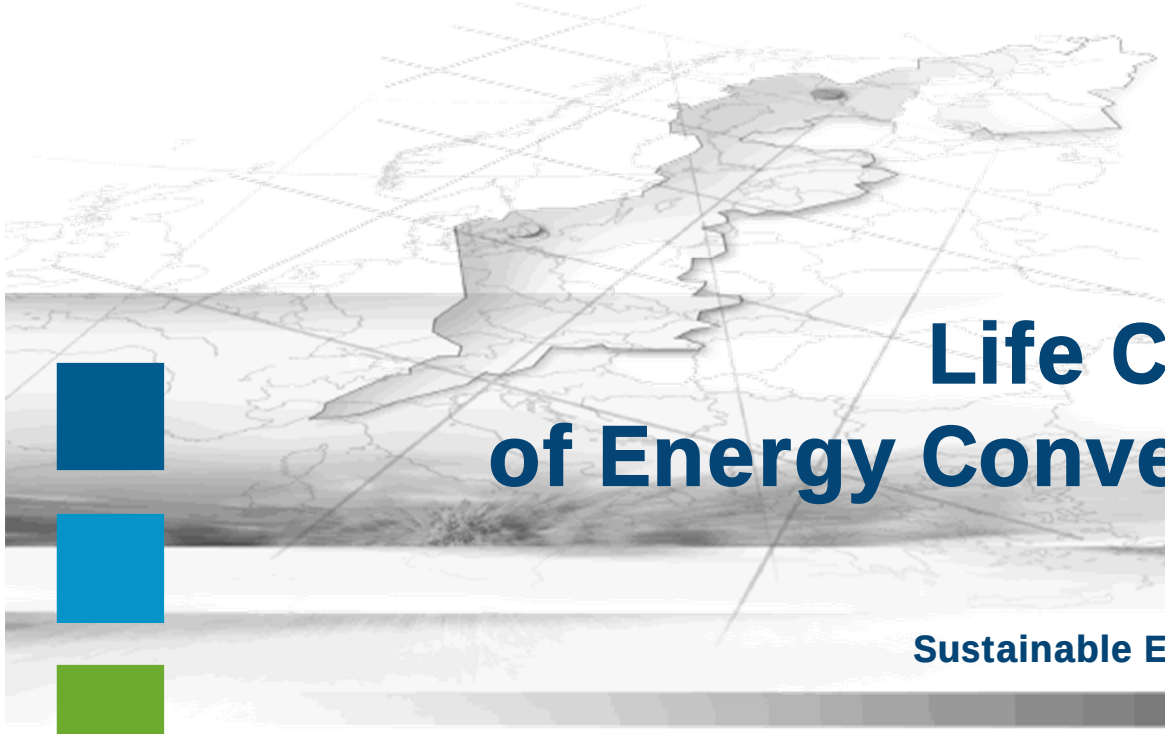

Life Cycle Assessment of Energy Conversion from Reed

ENEREED
Sustainable Energy Conversion from Reed Biomass

Reed as a Renewable Resource 2013, Greifswald

Introduction

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ENEREED (Sustainable Energy Conversion from Reed Biomass)

- Research project to investigate harvesting, processing technologies and thermal utilization possibilities for reed
- Technology investigation was done for harvesting (1st step)

  ⇨ see presentation Georg Beckmann “Harvesting technologies for reeds in Austria”
- Technology investigation was done for pelletising, combustion (2nd step)

  ⇨ see presentation Jürgen Krail “Sustainable energy conversion from reed biomass overview of laboratory and field test results”
- **Ecologic** and economic evaluation (3rd step)

Objective

- Reed from the Lake Neusiedl in Austria is examined as energy source for thermal utilization

- Evaluation of different harvesting technologies, treatments, supply chains and conversation possibilities

⇨ **Which is the best ecologic application scenario?**

⇨ **Compare this to wood and fossil reference (fuel oil and natural gas)**

Method

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Environmental life-cycle assessment:

- Complies largely with the ISO 14000 series of LCA standards (EN ISO 14040, 2006 and EN ISO 14044, 2006)
- System function: energy supply of 1 MJ thermal energy from reed as a renewable fuel
- System boundaries:
  - Include upstream processes to manufacture technical devices, infrastructure for storage and transportation devices, transportation between the supply steps
  - CO_2 from biomass GWP = neutral
- Impact assessment, use of CML and ReCiPe methodology
  - Human toxicity (HTP), stratospheric ozone depletion (ODP), global warming potential (GWP 100), acidification potential (AP) and fine particulate matter emissions (PM)

Method, cont'd

- Data source:
  - Foreground data based on **field tests and own measurements** (harvesting, combustion)
  - Background data (infrastructure) & foreground data (transportation, fossil fuel systems, ash disposure) from the ecoinvent database version 2.1 (Swiss Centre for Life Cycle Inventories, St. Gallen, Switzerland)
- Data used:
  - Austrian or German origin
  - Background processes European and worldwide
  - Most data used are more recent than 2005

System description - application scenarios

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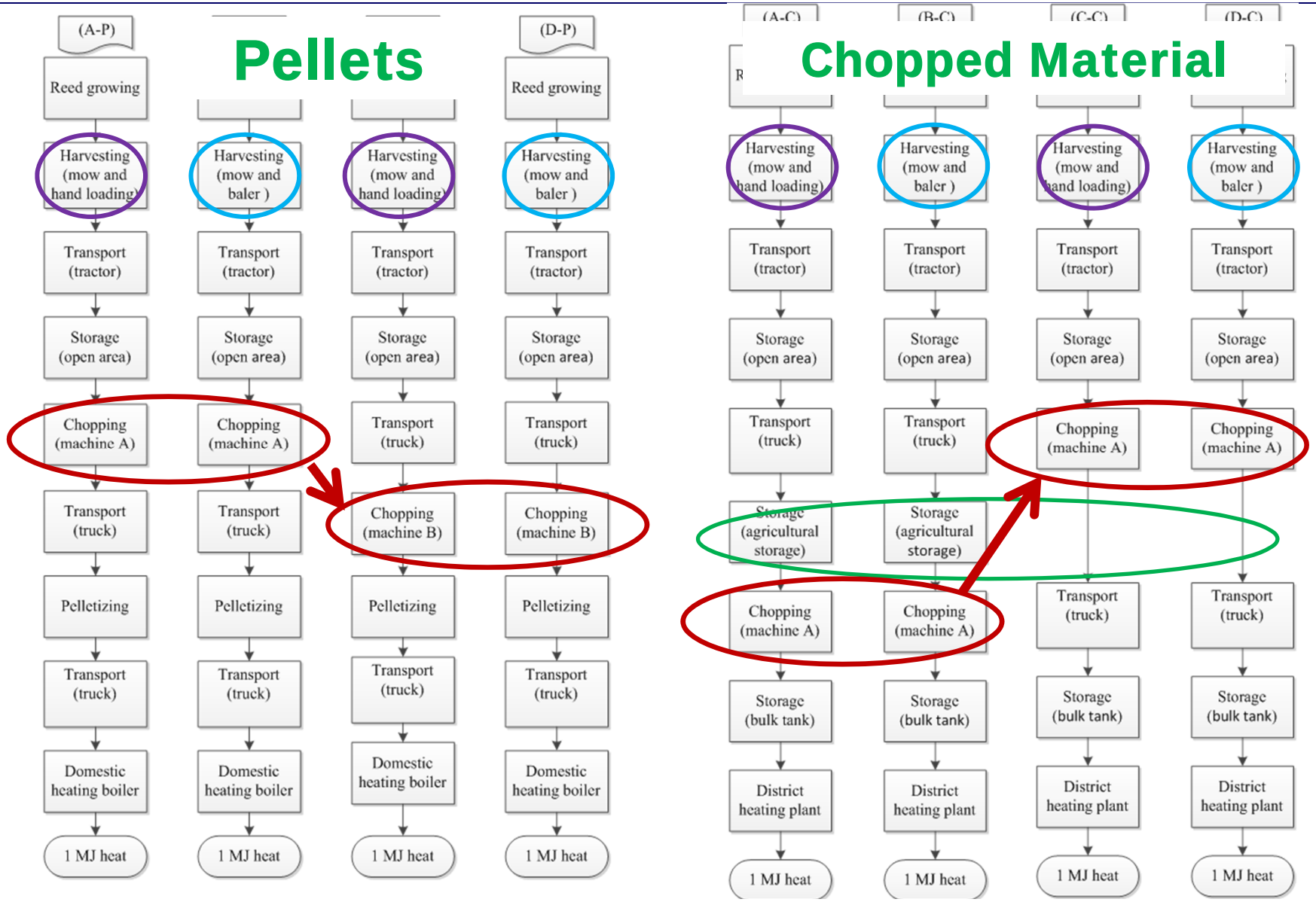
- Two references using 100% wood (pellets and chips)
- Two references using 100% fossil fuel (oil and natural gas)
- 8 different application scenarios using 100% reed

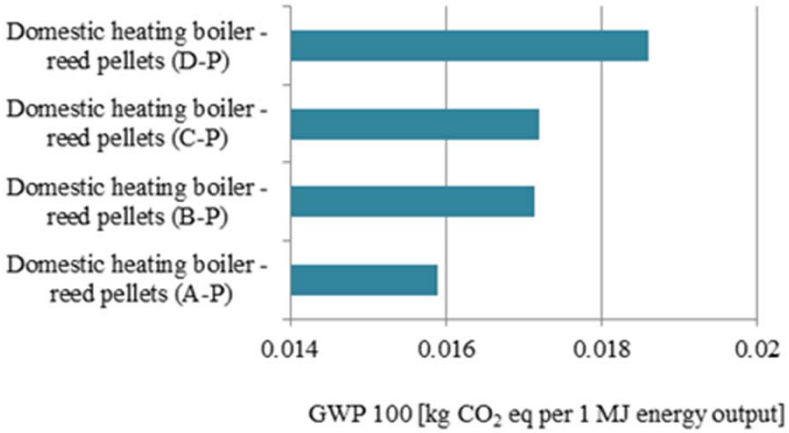
↳ Can be differed in 2 particular cases:

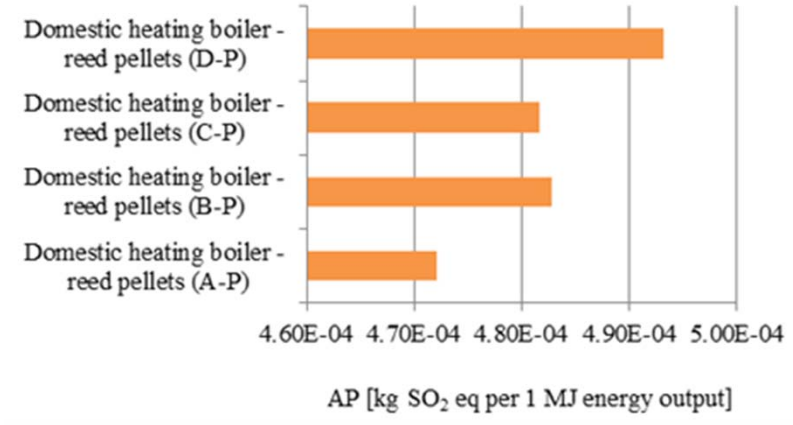
  - 4 use reed in district heating plants (chips)
  - 4 use reed in domestic heating boilers (pellets)

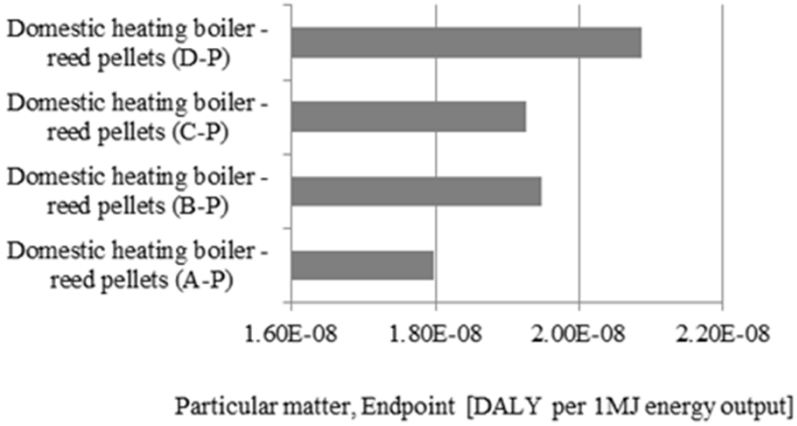
Supply chains – reed pellets, chopped reed



Results, first operation run - application scenario (pellets)

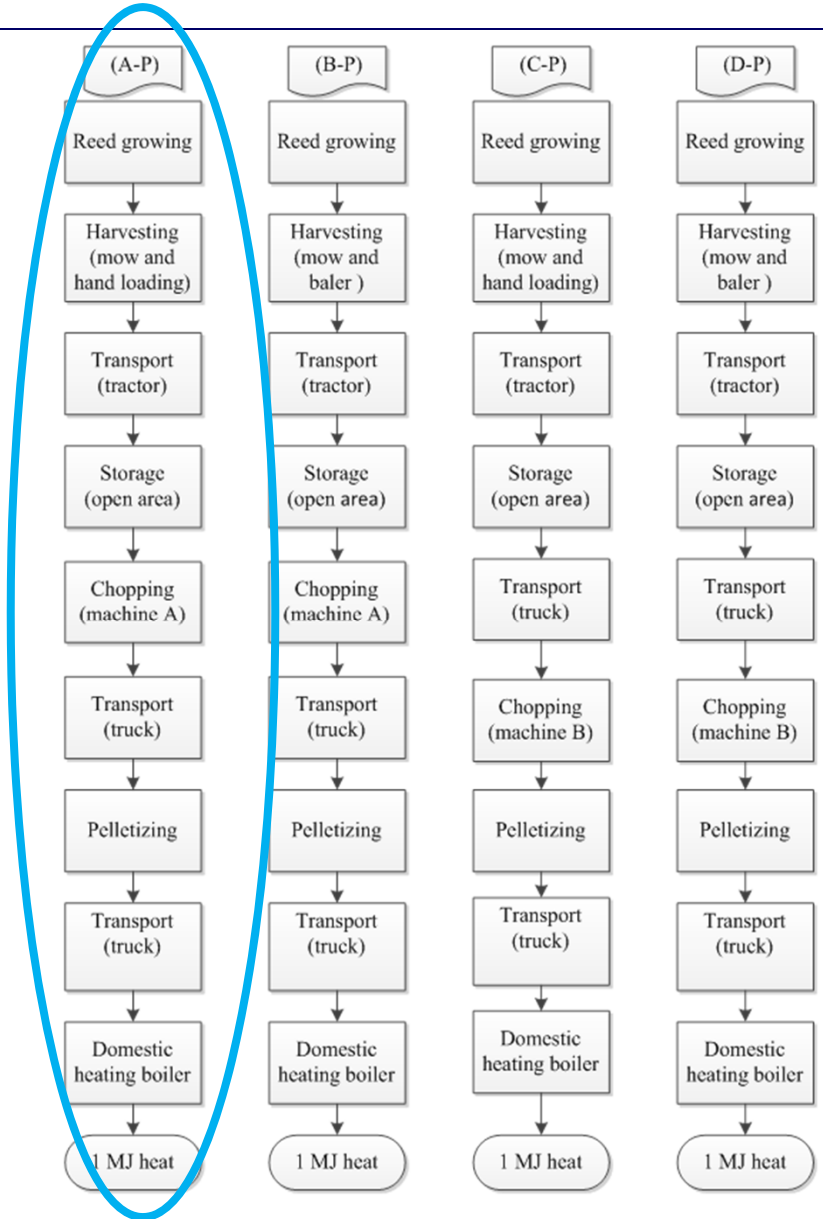




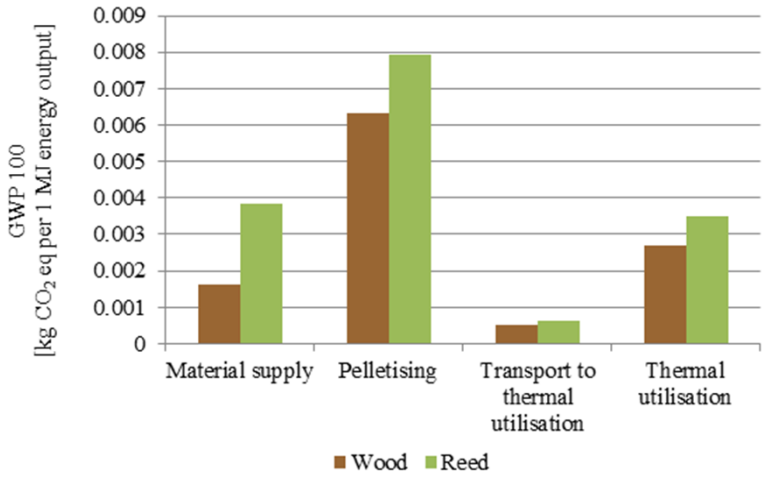


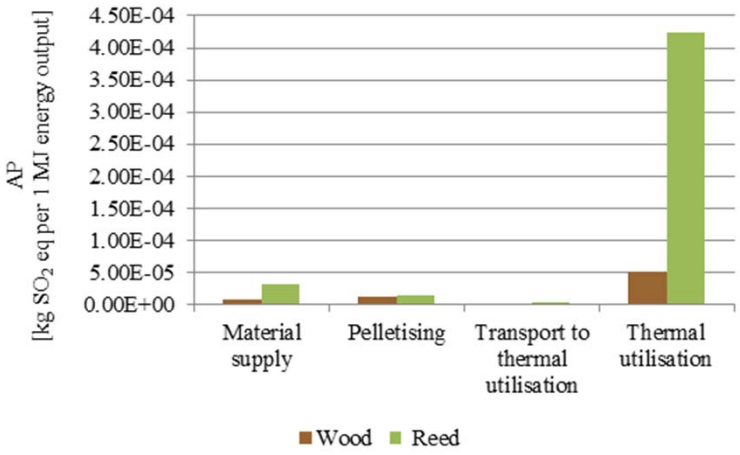
- Results are within less than +/- 10% of the arithmetic average in each category
- Differences are caused by the chosen harvesting and chopping technology
- Different result if transport takes place before or after chopping (bulk density)

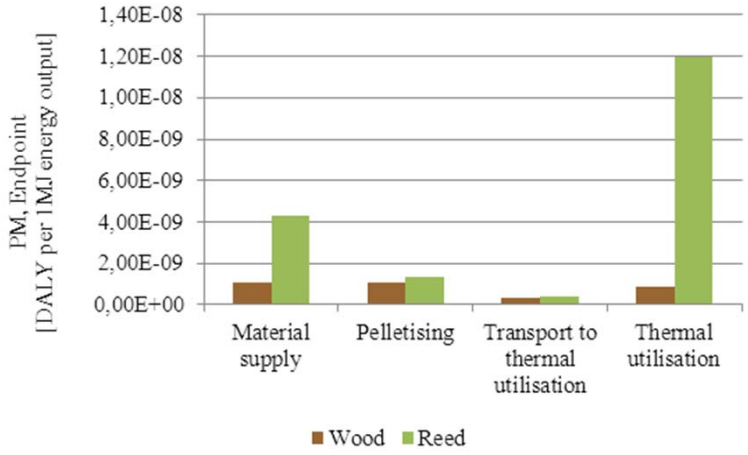
Supply chains – reed pellets



Best scenarios reed pellets compared to wood pellets

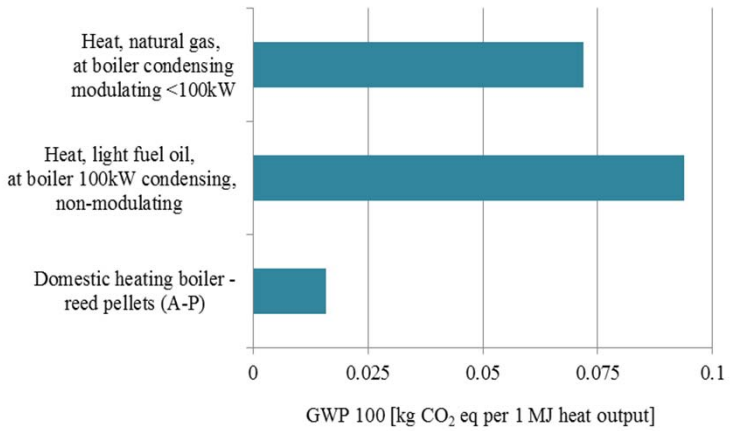


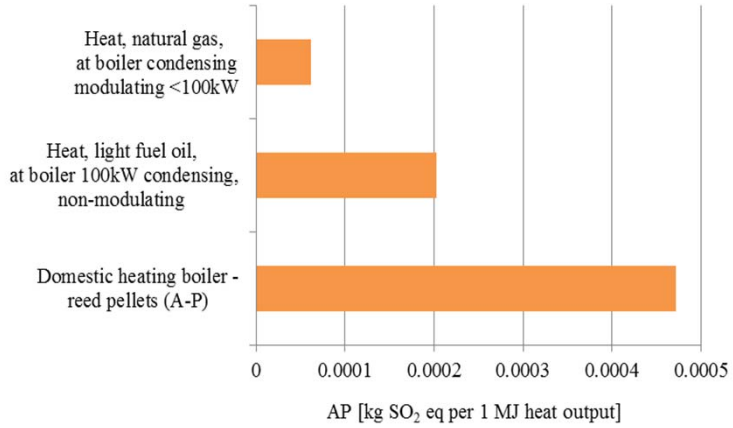


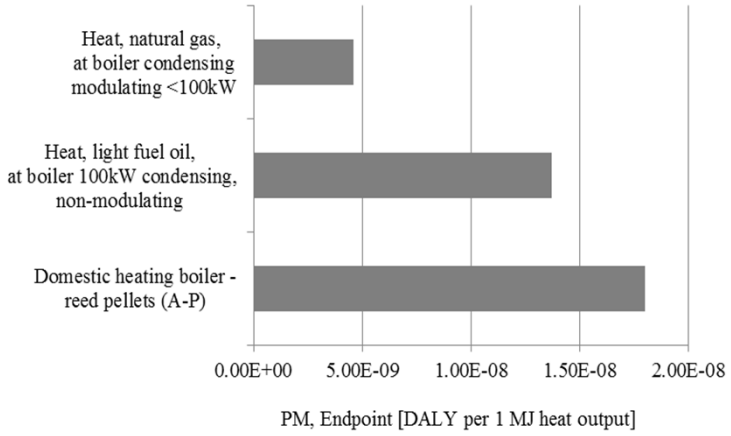


- Wood pellets harvesting of timber is not included ⇨ waste wood from timber industry (material supply)
- Wood has a higher energy density per mass (pelletising, transport)
- Reed pellets have a higher sulphur content - AP and PM (thermal utilisation)

Best scenario reed pellets compared to fossil

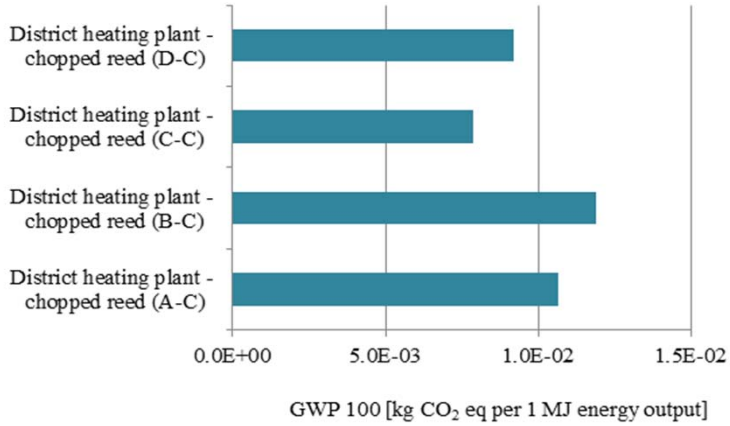


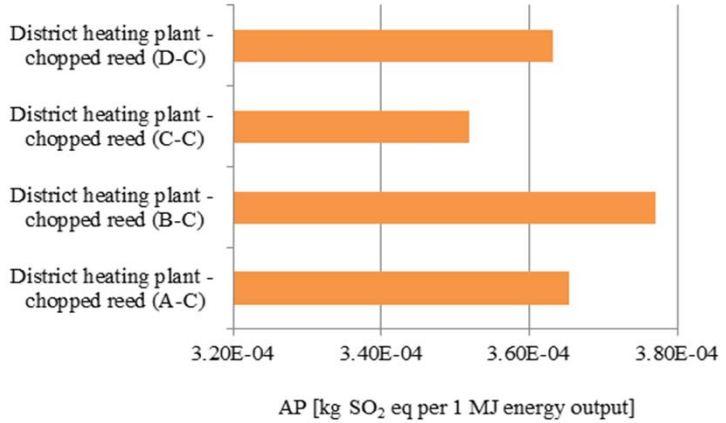


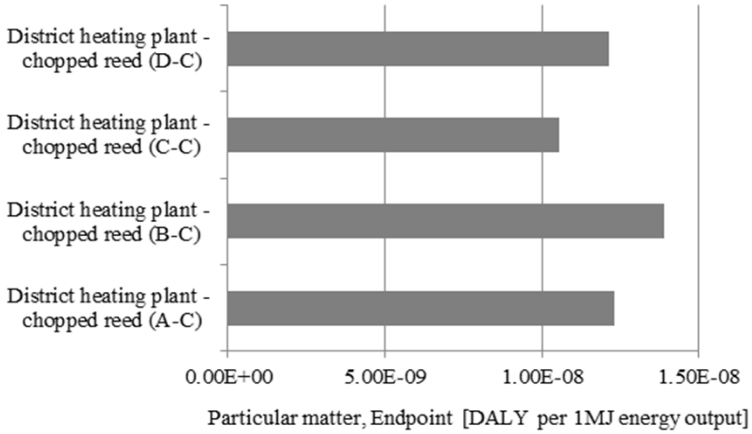


- Reed scenario has the lowest overall specific GWP 100
- High ratio of sulphur (reed) results in high values for AP and PM

Results, first operation run - application scenario (chopped reed)

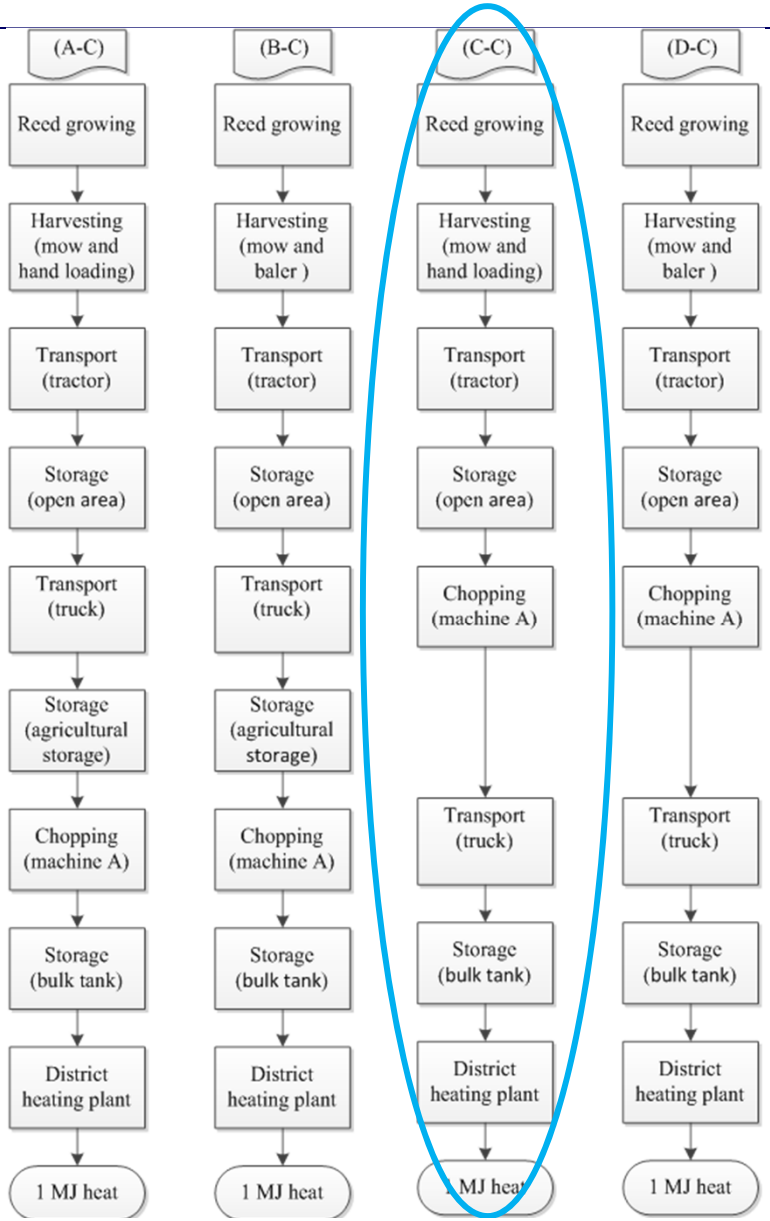




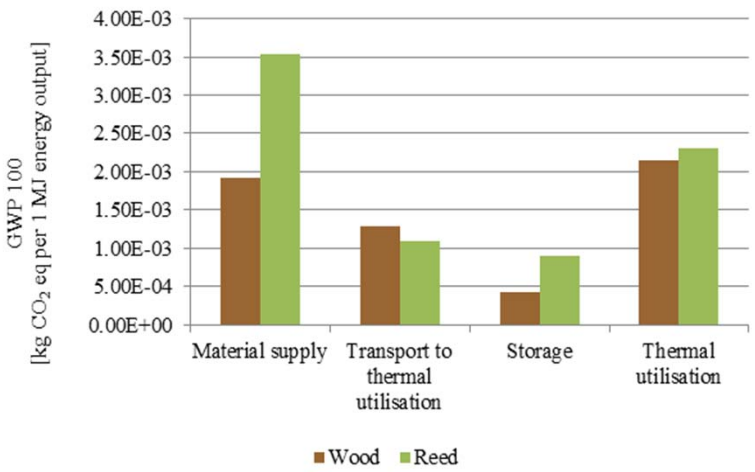


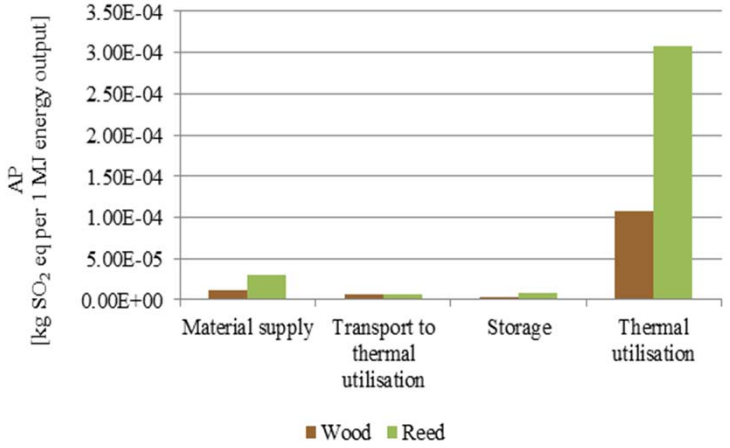
- Results are within about +/- 25% of the arithmetic average in each category
- Difference because of varying structure of the supply chains ⇨ A-C and B-C - extra storage hall
- Differences because of harvesting technology and if transport takes place before or after chopping

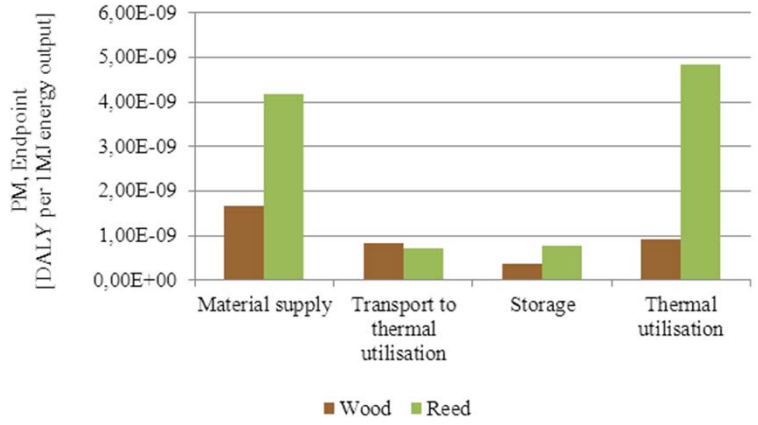
Supply chains – chopped reed



Best scenarios chopped reed compared to wood chips

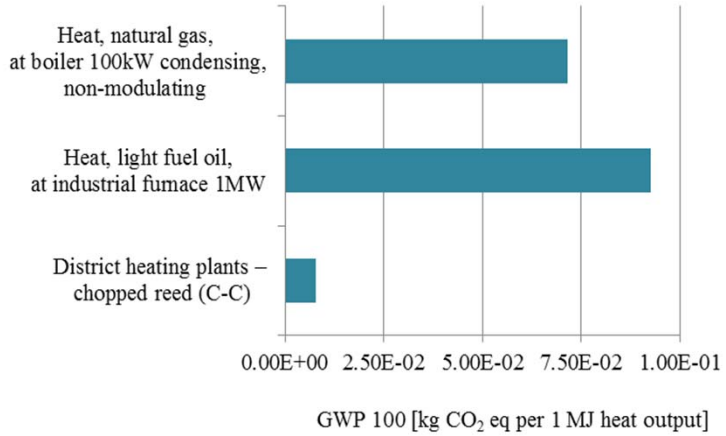


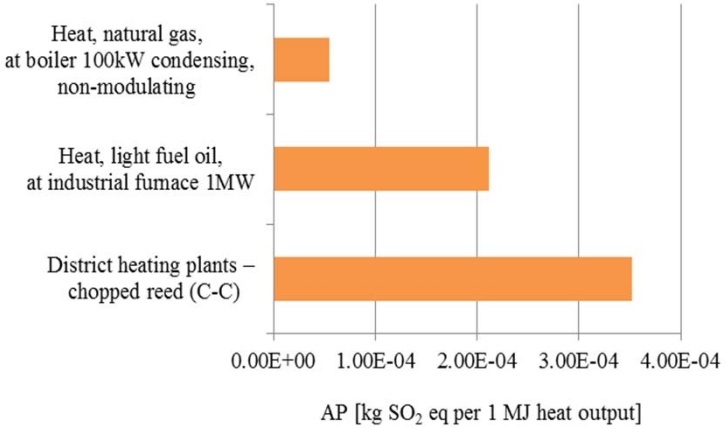


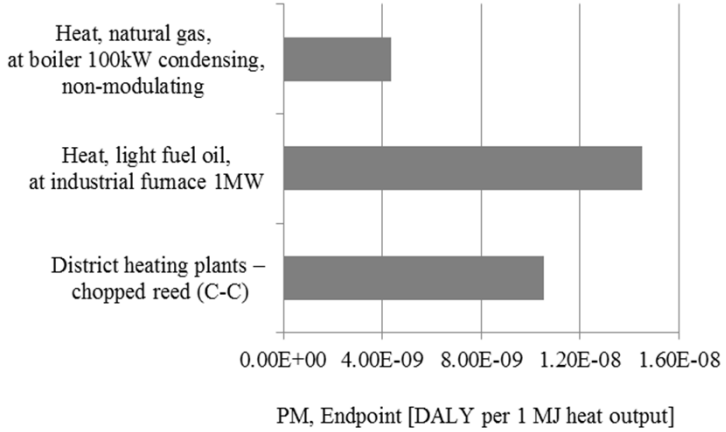


- Harvesting reed - no state of the art techniques, lower energy amount for harvesting wood
- Wood chips have a much higher bulk density than reed ⇨ important for transportation; not so storage (volume)
- Combustion ⇨ much higher PM and sulphur emissions were measured for burning reed

Best scenario chopped reed compared to fossil







- Reed has the lowest overall specific GWP
- High ratio of sulphur (reed) ⇨ AP
- PM are much higher for the oil-fired scenario ⇨ caused by particles, sulphur dioxide and nitrogen oxides

Conclusion

- Using reed as a renewable fuel makes sense ⇨ regional resource
- Harvesting reed is more complex than harvesting wood ⇨ higher emissions (chopped material scenarios)
- Transportation – less burdens when transporting chopped material than bales or bundles
- Supply chains reed scenarios: chopped material ⇨ lowest GWP 100
- Compared to wood, reed has lower GWP 100
- Compared to wood, reed has higher AP and PM

  ⇨ is caused by its higher sulphur content ⇨ sulphur dioxide
- Compared to fossil fuels ⇨ much lower values in the impact category GWP 100

Acknowledgment

Thanks to all our research partners!

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Project Management
Industrial Conversion
Thermal Conversion Small Scale

TU WIEN Technische Universität Wien / Vienna University of Technology

Inst. f. Verfahrenstechnik, Umwelttechnik und Techn. Biowissenschaften

Thermal Conversion Large Scale

Technisches Büro für Maschinenbau und Energietechnik Dr. Georg Beckmann

Harvesting Technology

Amt der Burgenländischen Landesregierung

Cultivation,
Fuel Supply

Esterházy

Land Owner,
Cultivation

WWF

Environmental Protection,
Sustainable Cultivation

LAFARGE ZEMENT

Industrial Conversion

Herz

Thermal Conversion
Small Scale Plant

BIOMASSE FERNHEIZWERK GUSSING

Thermal Conversion
Large Scale Plant

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