IEA Bioenergy
Technology Collaboration Programme

Decarbonizing process heat for industry: the role of biomass

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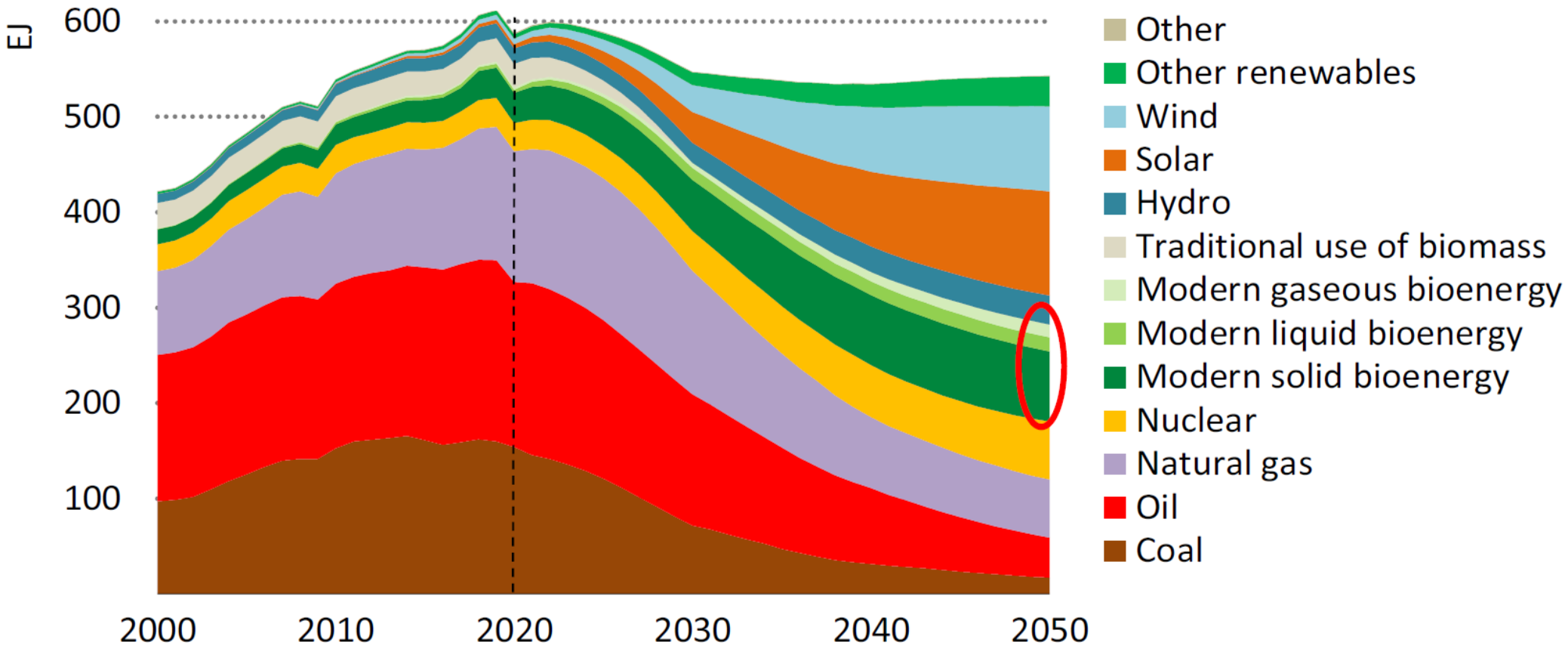
Bioenergy for High Temperature Heat in Industry

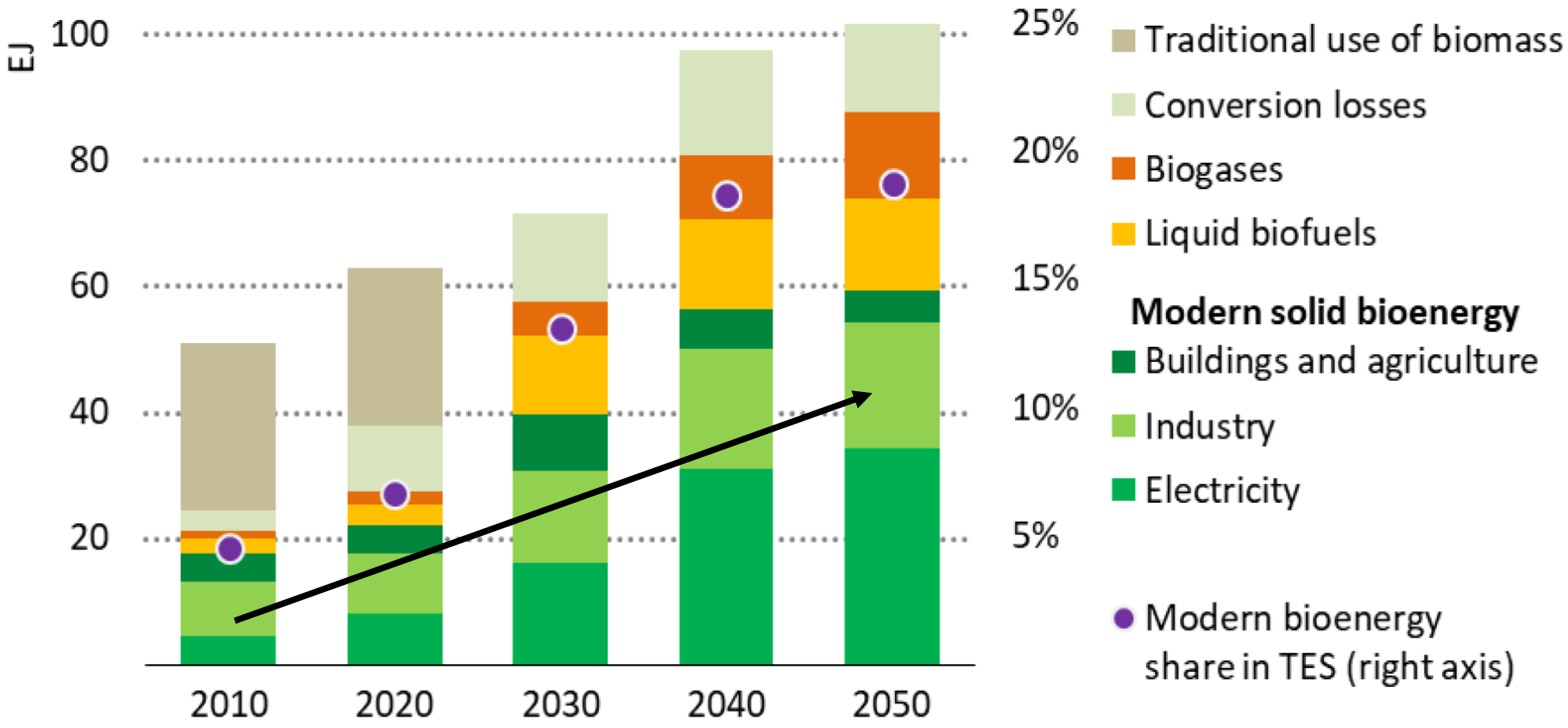
- Task 32 (*Biomass combustion*)
- Task 33 (*Thermal gasification of biomass*)
- Task 34 (*Direct Thermal Liquefaction*)
- Task 36 (*Material and energy valorisation of waste in a circular economy*)
- Task 40 (*Deployment of biobased value chains)*

IEA Net Zero Emissions scenario (max +1.5°C)



Source: IEA

Total bioenergy supply in the Net Zero Emissions scenario

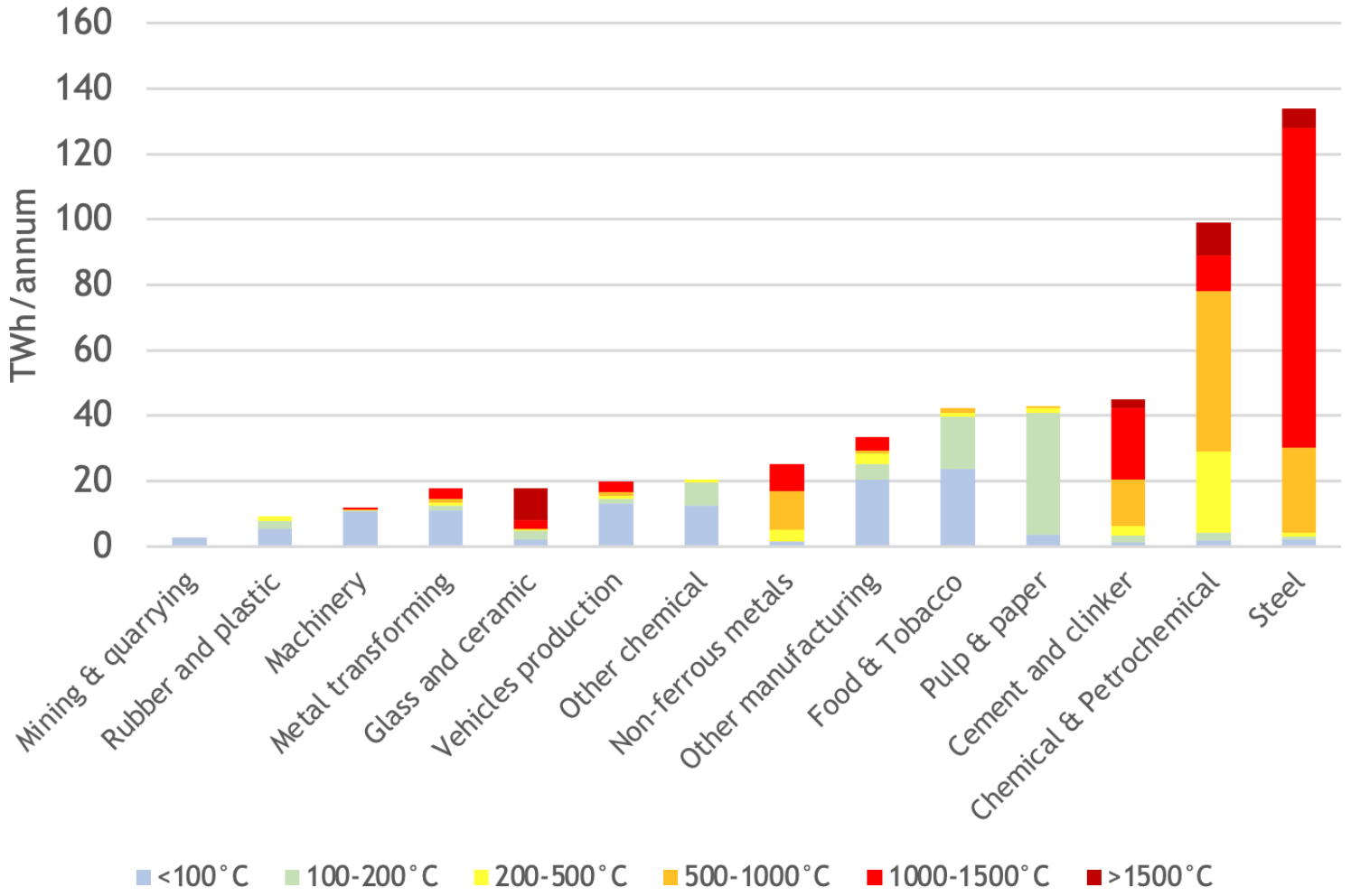


Source: IEA

Industrial heat and CO_2

- Industry is responsible for 30% of global GHG emissions – though not all of it from heat
- EU-ETS and CBAM provide strong market driven incentives for CO_2 reduction in larger industries, smaller industries require other incentives
- Various options (CCS, Electrification, hydrogen, biomass) exist to mitigate CO_2 emissions from fossil fuels

Temperatures needed in industry vary widely

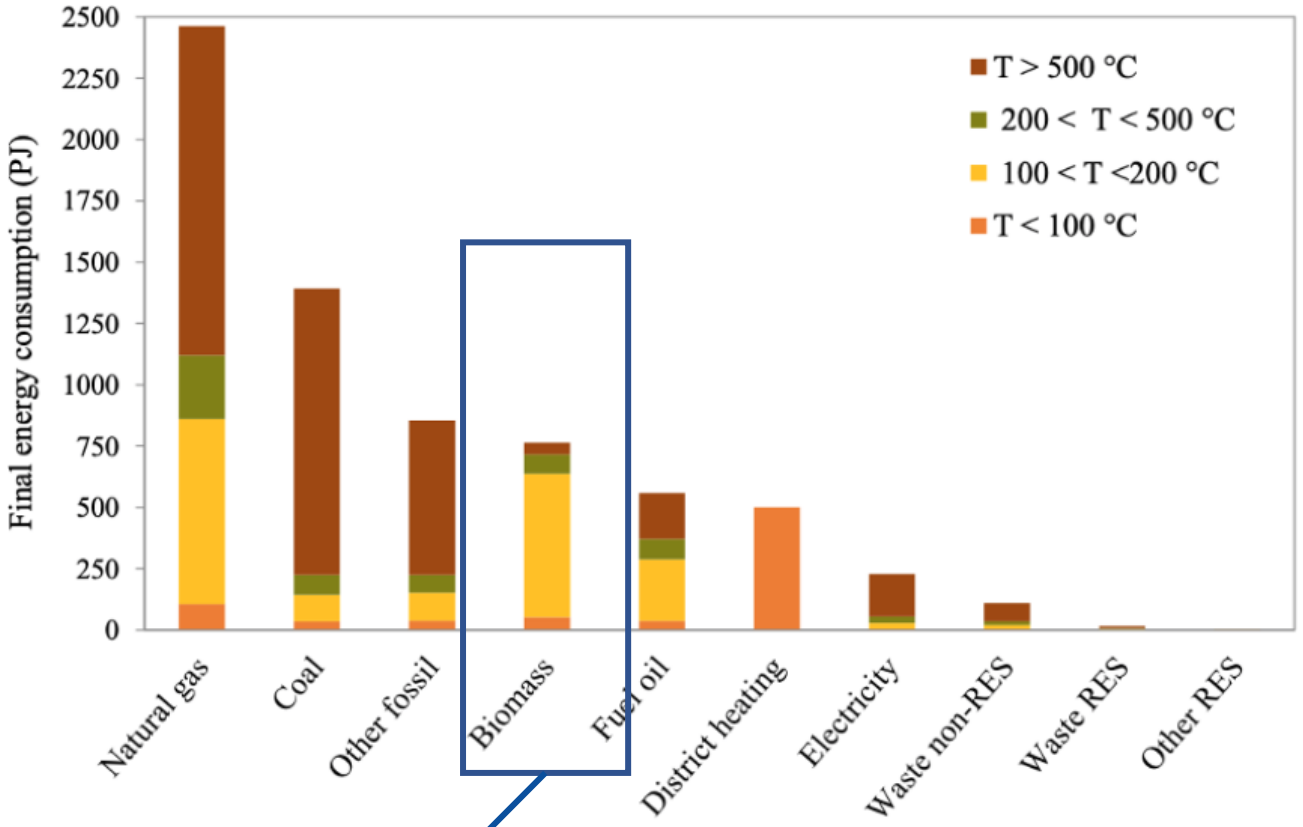


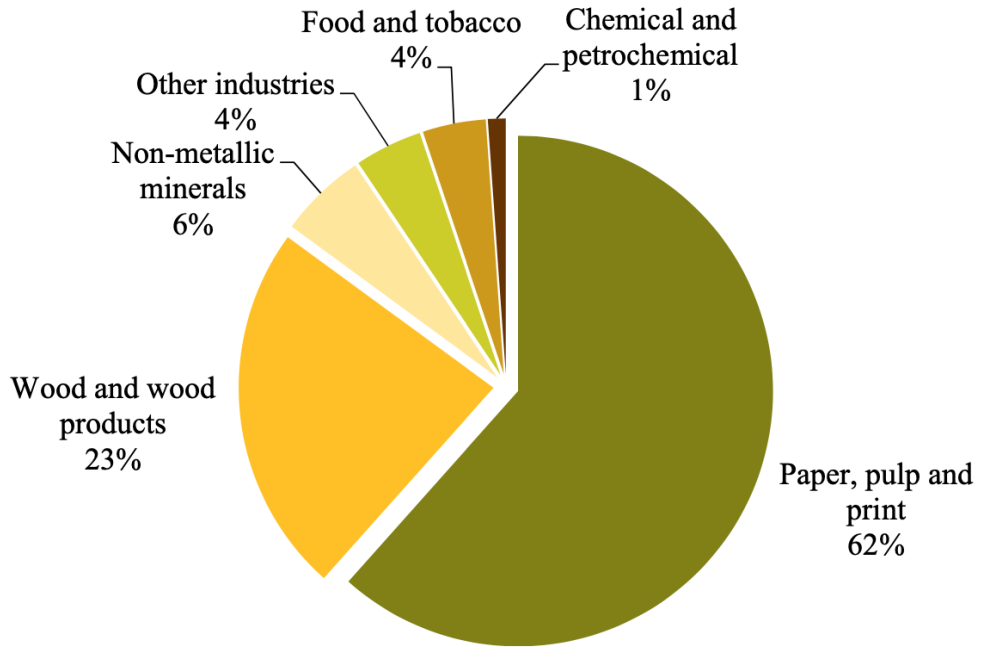
2013 industrial heat use in Germany
(Data from Lenz et al, 2020)

High temperatures (>500°C) especially in metals and minerals processing – direct heating

Lower temperatures (~50-500°C) in wide variety of sectors, indirectly (incl via steam)

Current use of biomass in industrial heat (EU)





Until recently in Europe, industrial biobased heat was mainly for process steam in wood based industries

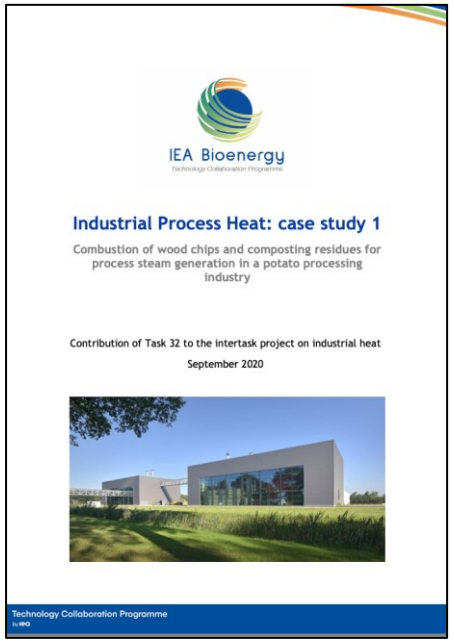
Figures from Malico, I., Pereira, R. N., Gonçalves, A. C. and Sousa, A. M. (2019). Current status and future perspectives for energy production from solid biomass in the European industry. *Renewable and Sustainable Energy Reviews*, 112. 960–77.

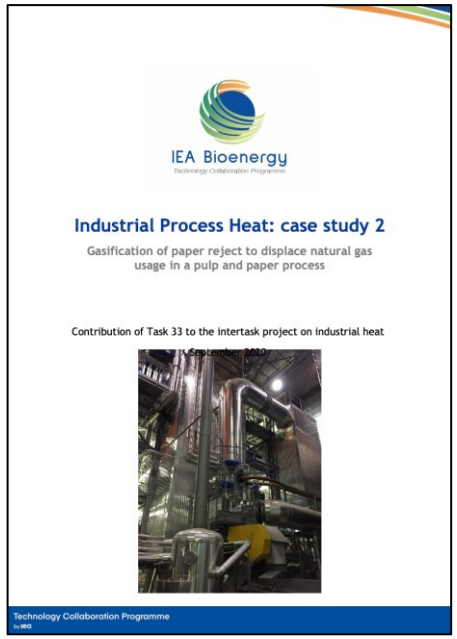
Potential for bioenergy in industrial heat

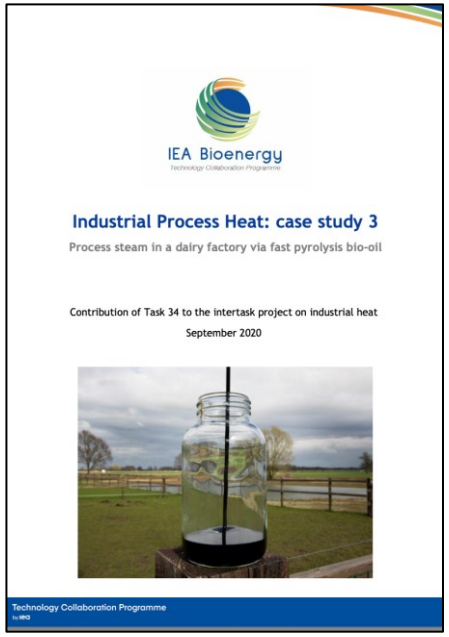
- Why can bioenergy be interesting
  - Comes in many different forms, so can cover most needs currently met by fossil fuels
  - Flexible delivery on demand (in contrast to solar / wind)
  - Retrofits could be relatively small
  - Can enable negative emissions when combined with CCS

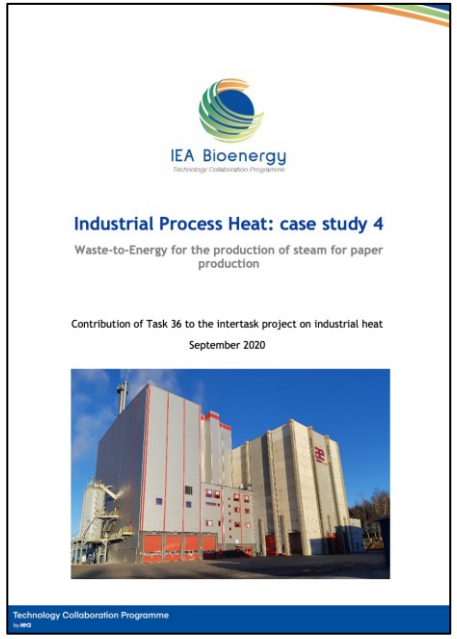
- Tailor made solutions needed
  - Technological maturity varies
  - Local availability and price may vary significantly
  - Larger volumes may cause logistical challenges
  - Available space may be limited

Industrial heat case studies by IEA Bioenergy: existing studies already published





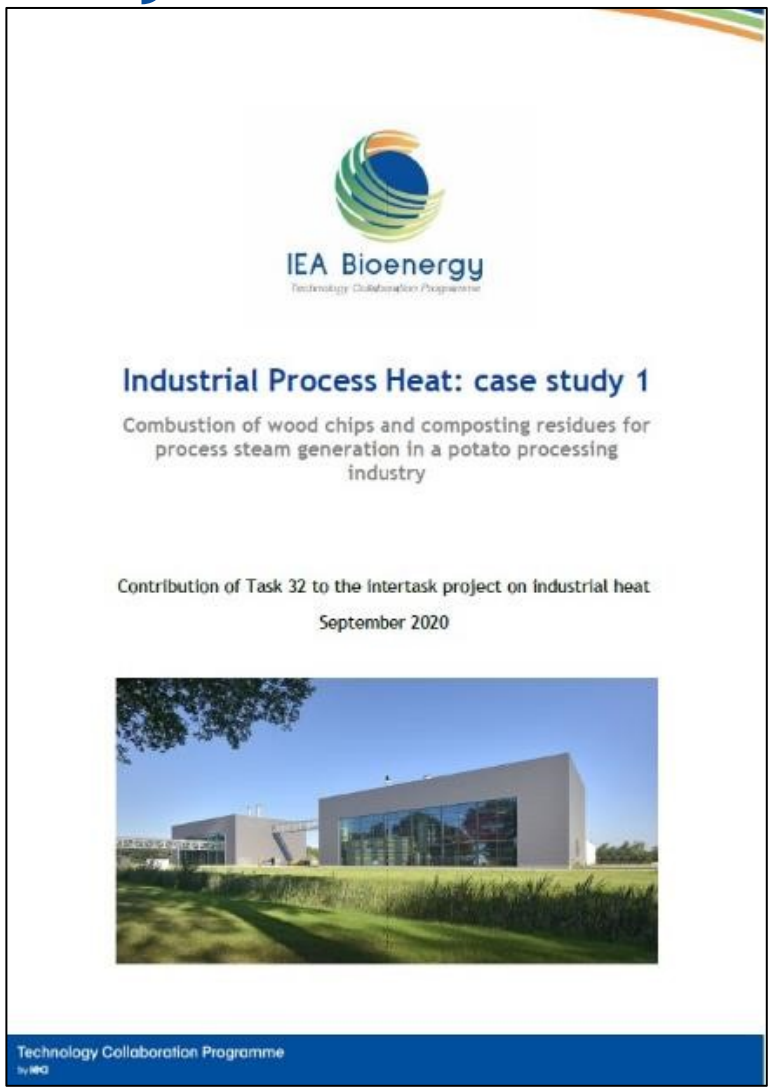




https://itp-hightemperatureheat.ieabioenergy.com/iea-publications/

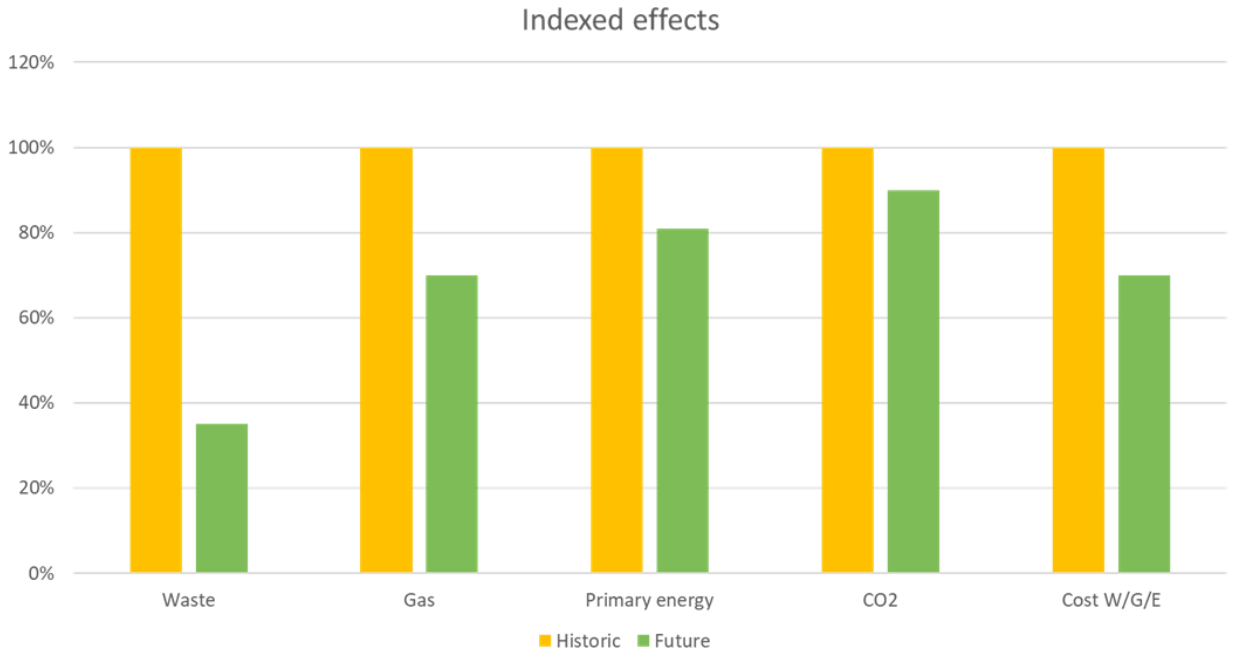
Case study 1 (T32): process steam in a potato processing industry

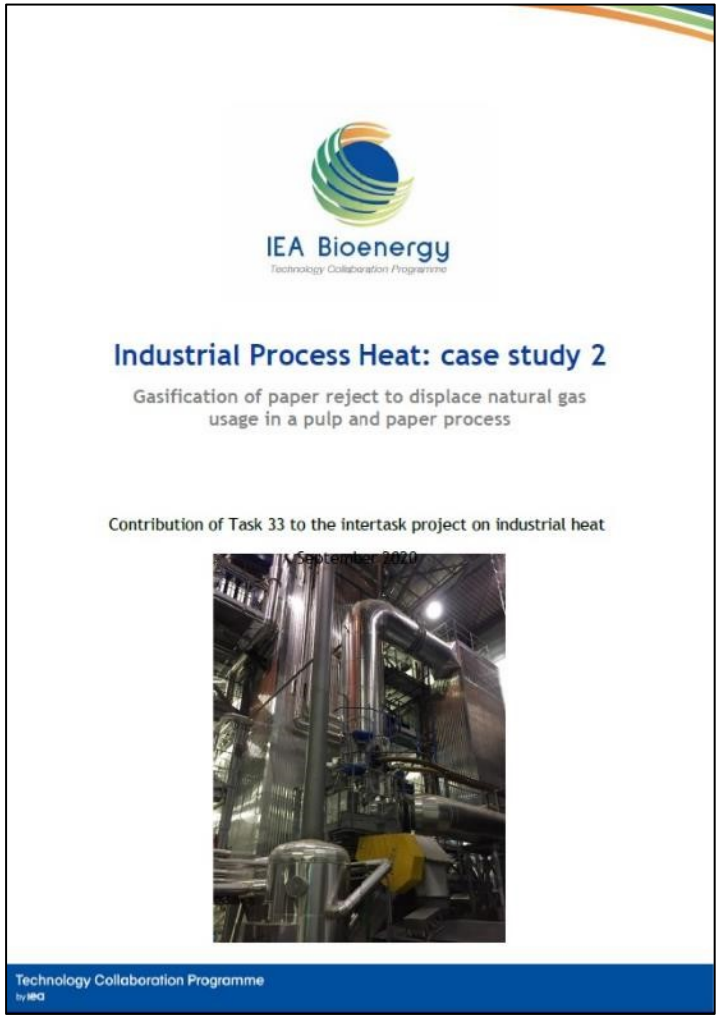
- Waste processing industry Attero builds and operates a 9 MW steam boiler for a potato processing industry
- Optimal sustainability by using very low grade residues from local area
- Optimal economic performance by 7000 full load hours per year



Case study 2 (T33): Gasification of paper reject to displace natural gas usage in a pulp and paper process

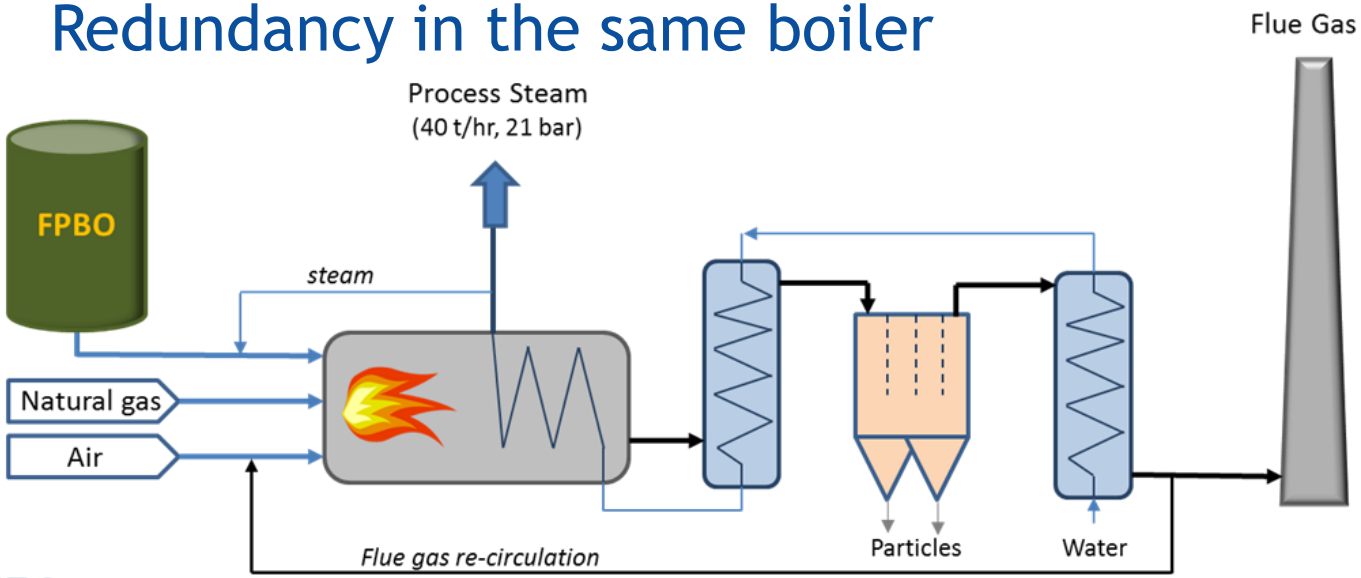
- Use of local paper rejects avoids buying natural gas and saves on transportation and disposal costs

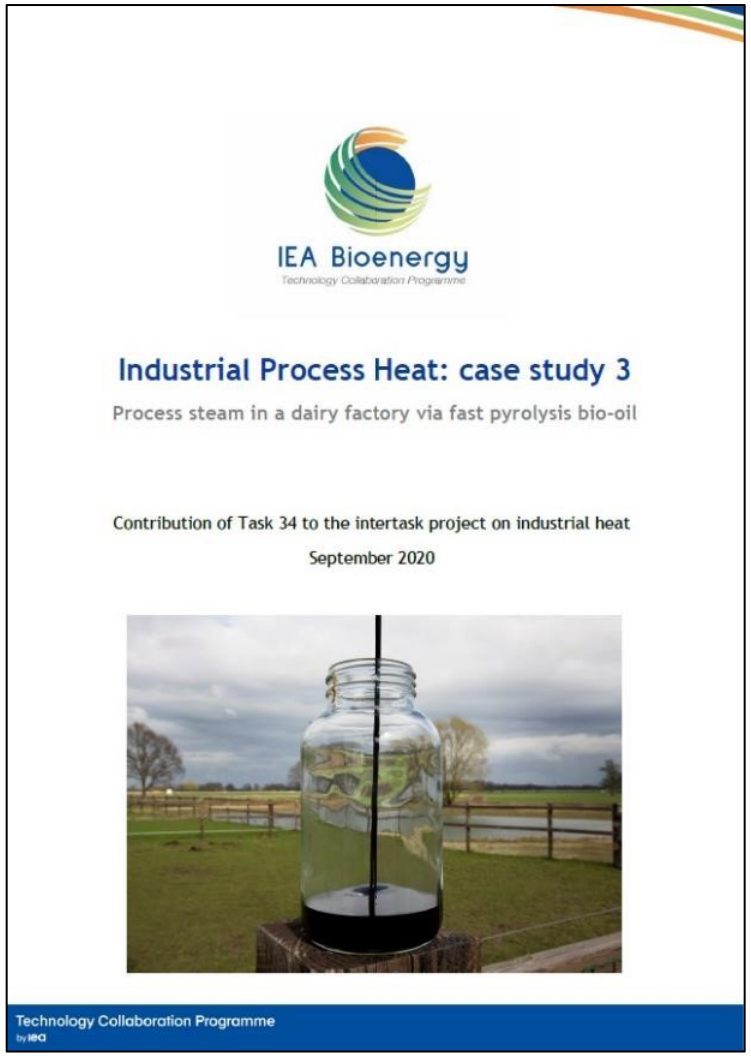




Case study 3 (T34): Process steam in a dairy factory via fast pyrolysis bio-oil

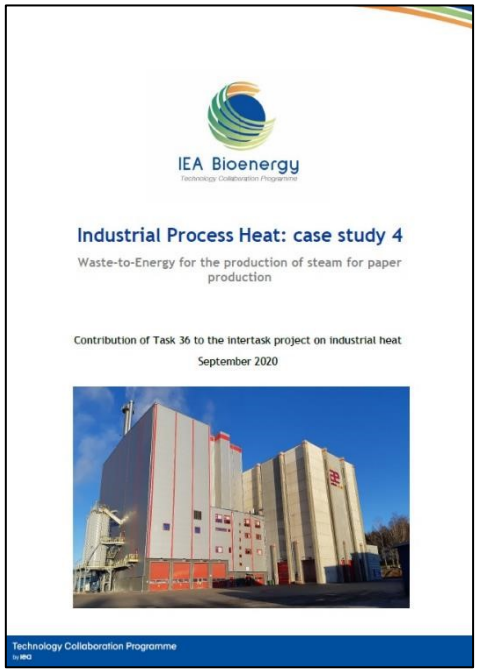
- Space savings at end user
- hygienic aspects
- High OPEX (approx. 18 €/GJ) / low CAPEX at end user (2.5-3.0 M€)
- Peak load possible
- Redundancy in the same boiler





Case study 4 (T36): Waste-to-Energy for the production of steam for paper production

- Waste from neighbouring municipalities and eastern Norway is burned for steam generation to pulp and paper factory
- Reduced carbon dioxide emission
- Reduced emissions and improves air quality in the village due to the expansion of district heating
- Reducing waste to landfill



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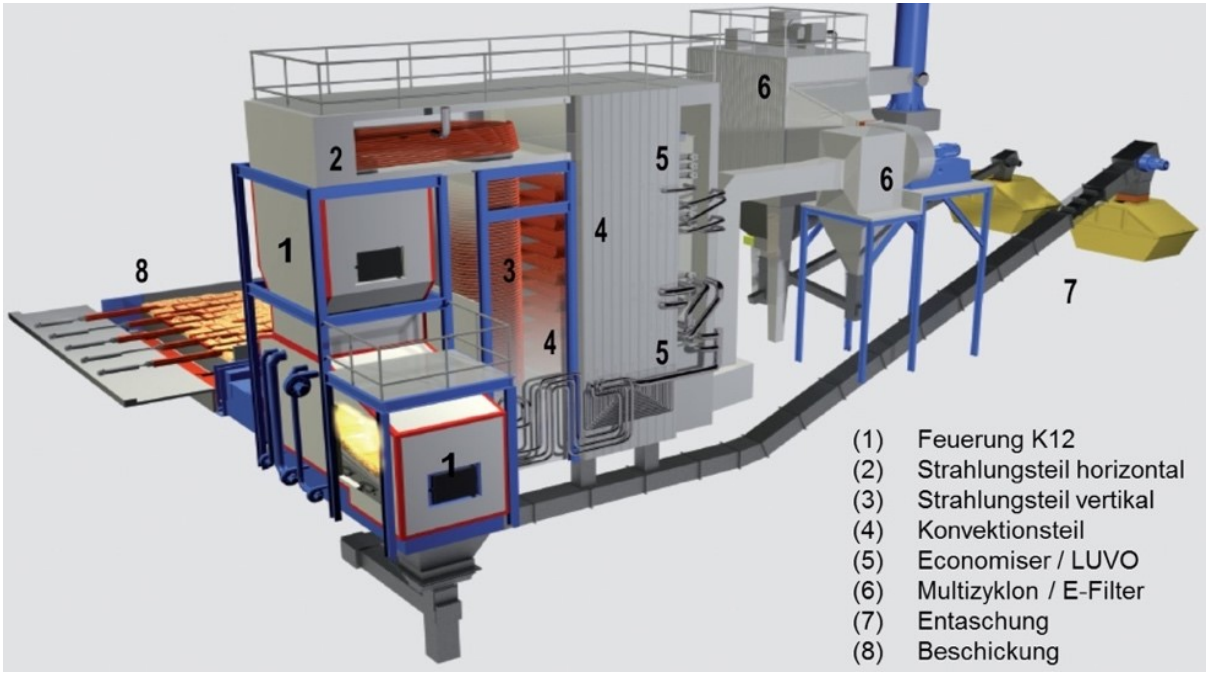
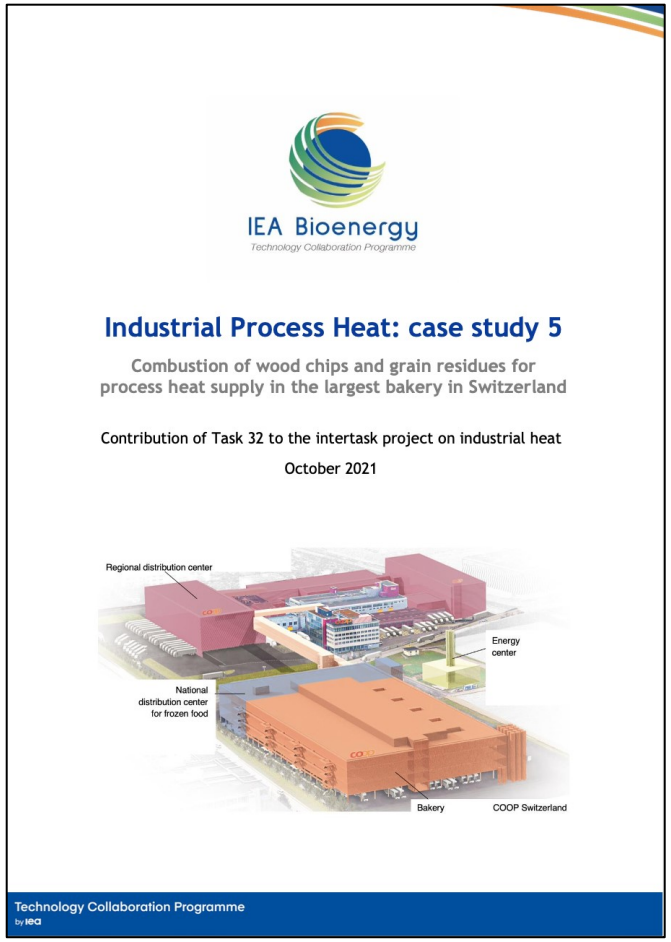
Case study 5 (T32): Combustion of wood chips and grain residues for process heat supply in the largest bakery in Switzerland

- Wood residues and locally avaible grain residues are used as fuels
- This causes some ash related issues
- Thermal oil is produced to heat the baking ovens





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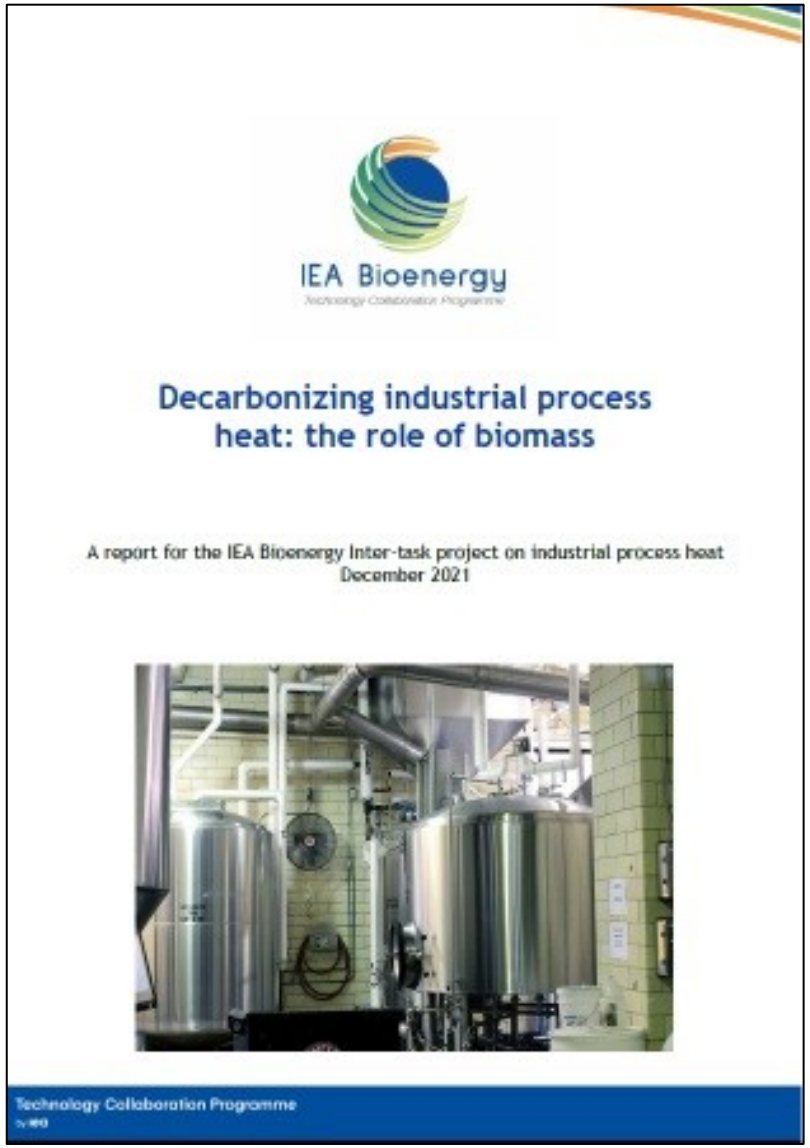
Take away messages

- Several fuel/technology combinations are commercially available for producing biobased heat in industry
- There are many succesful examples of biobased industrial heat
- The potential is not limited to energy intensive industries (steel, cement etc), process industries also represent a large potential
- The annual amount of fuel needed to cover an industrial heat demand can in many cases be sourced locally
- The optimal combination is very site specific and needs to be carefully assessed



Three additional combustion based case studies to be published shortly

- Combustion of waste wood for kiln drying and gelatine processing in the Netherlands
- Combustion of wood chips in a dairy industry in Denmark
- Process heat from forest residues for battery industry in Austria

Thank you!

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https://itp-hightemperatureheat.ieabioenergy.com

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