Market potential and applications for CHP systems

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EnerecO

EUBCE 2023

Tuesday 6 June 2023

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 815284

BLAZE objective

The technology is developed for a **CHP capacity** range from **small (25-100 kWe)** to **medium (0.1-5 MWe)** scale

Parameter	Current	BLAZE (target)
Overall efficiency	≈ 65%	≈ 90%
electrical efficiency	≈ 25%	≈ 50%
investment cost	≈ 10,000 €/kWe	≈ 4,000 €/kWe
operating cost	≈ 0.10 €/kWhe	≈ 0.05 €/kWhe
electricity production cost	≈ 0.20 €/kWh	≈ 0.10 €/kWh
Negligible gaseous and particulate matter emissions		

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WP2- D2.1 Biomass selection & Characterization

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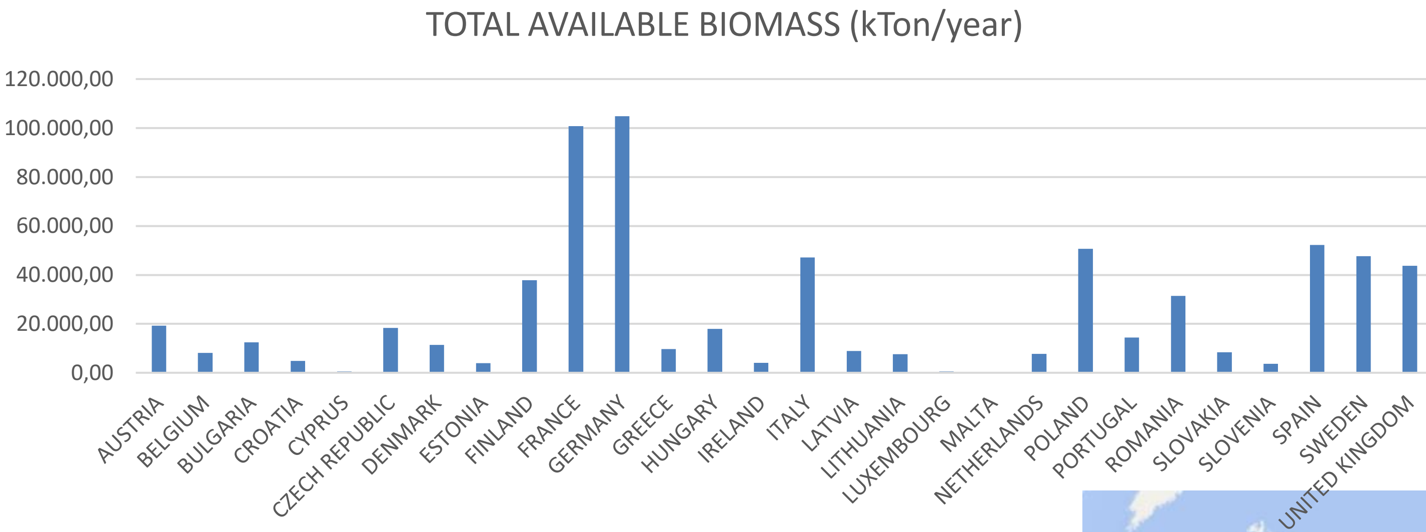
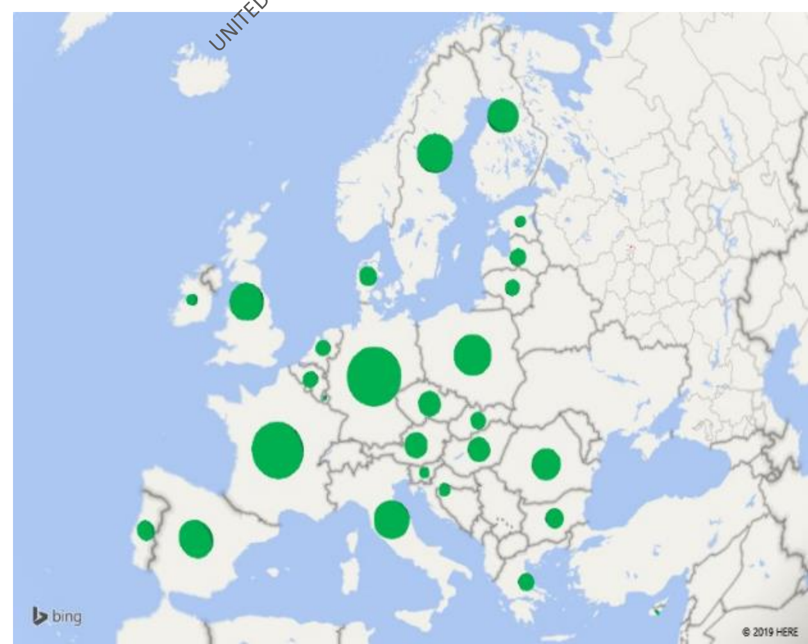
TASK 2.1 - Determination of the actual potential of residual biomass feedstocks



Total biomass availability and map distribution in EU28 (kton/year)



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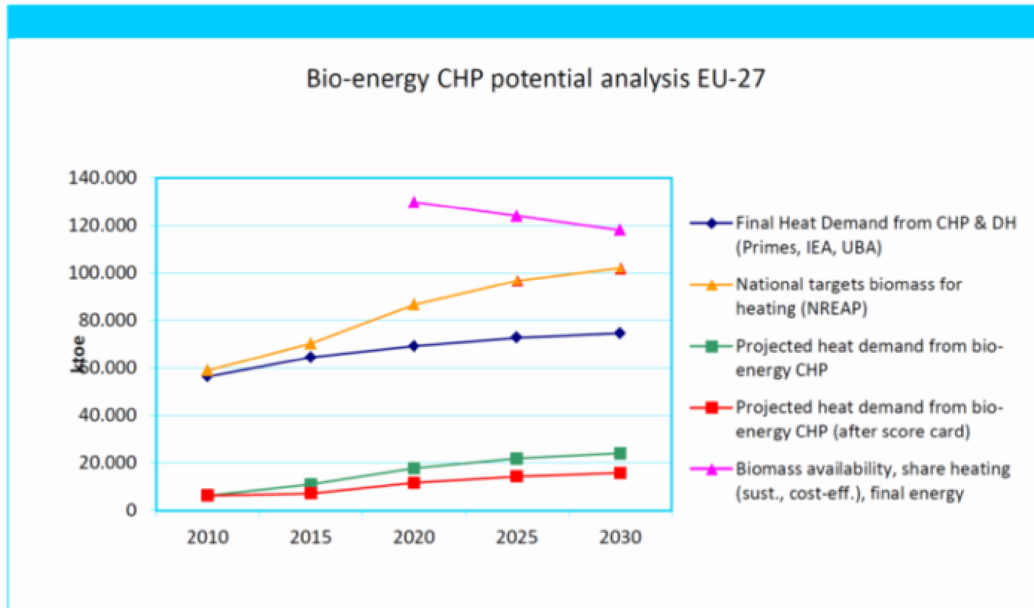
TASK 2.1 - Determination of the actual potential of residual biomass feedstocks

It was considered theoretical potential for applying BLAZE technology as 100% fuel switch to bio-fuels in existing CHP systems – in district heating (DH) as well as in industry.

(Projected) Heat demand from bio-energy CHP and DH in 2030 is equal to 17.664 ktoe or 205.432 GWhth. (According to "European report on potential of BIO-ENERGY CHP in EU27") *to be updated with latest report*

Figures (projections)	2010	2020	2030
Final heat demand from CHP and DH (PRIMES, IEA, UBA), ktoe	56.233	69.056	74.465
(Projected) heat demand from bio-energy CHP and DH (after score card), ktoe	10.967	14.015	17.664
Bio-energy penetration rate in CHP markets (2009: EEA, Eurostat)	19,5% (2009)	20,3%	23,7%
Biomass availability, share heating (sust., cost-eff.), final energy (Biom. Futures), ktoe		129.756	117.868



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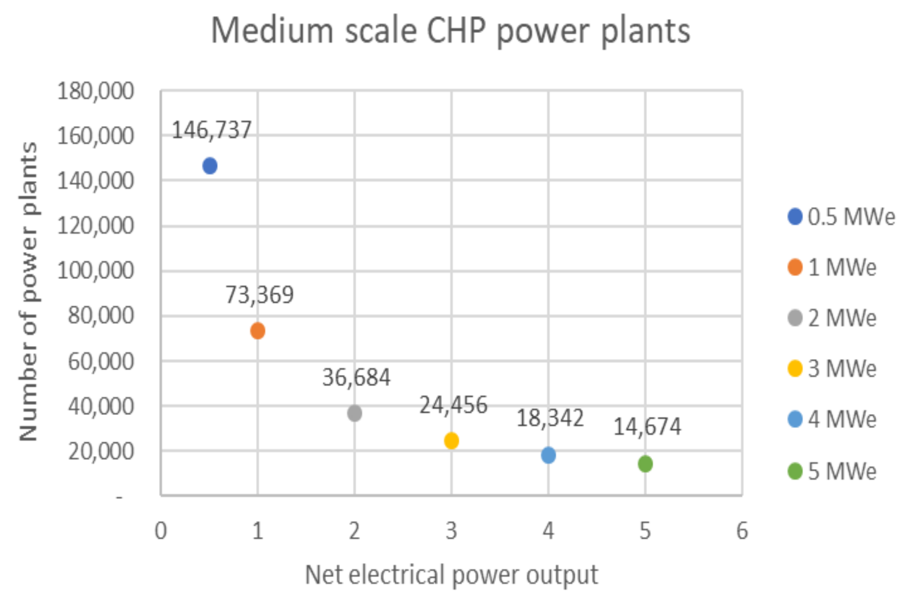
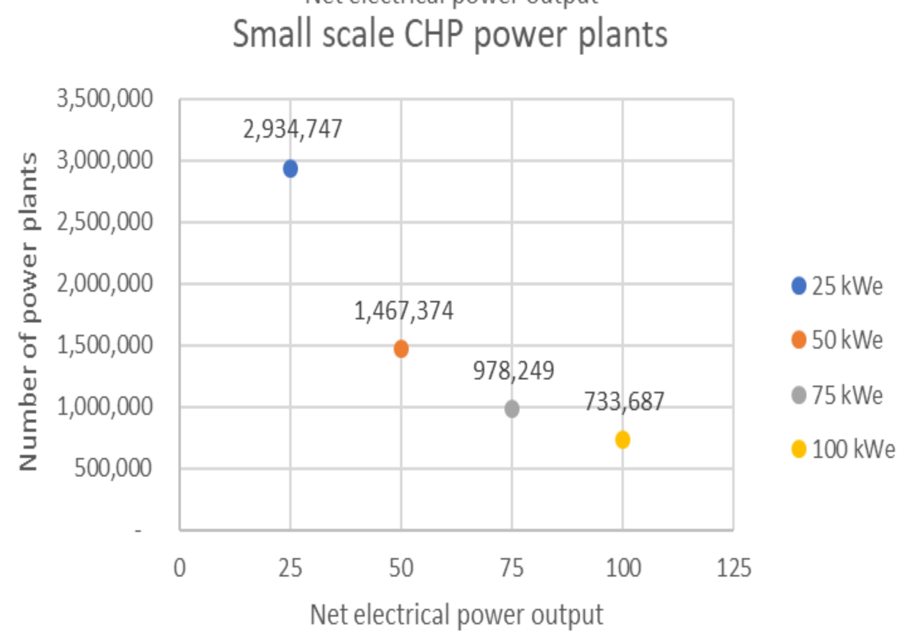
TASK 2.1 - Determination of the actual potential of residual biomass feedstocks

Assuming Blaze technology thermal conversion efficiency equal to 40% and a medium value of 3.500 working hours of the plant we estimated the number of CHP power plants based on BLAZE technology for different capacity range and scale

REPowerEU foresees measures to drastically reduce Russian gas imports from its 2021 level of 155 billion m3 (bcm) to 0 bcm in 8 years.

Taking the specific energy content from EU biomass resources is equal to 179% of the above-mentioned energy in the 155 bcm gas





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BIOMASS CONCLUSION
MARKET ANALYSIS STARTING POINT

Biomass Potential

Considering the technical and economic aspects (availability and costs), the following biomasses have been selected for testing :

- Agricultural residues: Arundo Donax or similar.
- Primary residues from forest: Sawmill, Wood Chips.
- Secondary residues from wood industry: Sawdust.
- Secondary residues of industry utilizing agricultural products: almond shell or similar.
- Waste from wood: Wood Chips.

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BIOMASS CONCLUSION
MARKET ANALYSIS STARTING POINT

Biomass Caractherization

- ENEA analyzed a wide selection of Biomass residues to find the most suited fuel for a BLAZE type plant.
- With exception made for corn cobs, black liquor and digestate, **all the feedstocks analyzed** (woody or herbaceous) **present no special issues with regards to their use as feedstocks** in a process of gasification in a BFB reactor.
- The only issue would be the release of relatively high content of S and Cl that could be noxious to any catalytic downstream equipment and to the SOFC unit. However, this can be fixed with utilization of specific chemical solutions.
- These results confirm the high fuel flexibility of BLAZE, thus making it suitable for a wider geographical application. The same study, based on the results of previous

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BLAZE TECHNOLOGY OUTCOMES

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General outcomes of BLAZE pilot plant design:

- increased complexity of the system arisen during the project mainly due to high purity of syngas required by SOFC
- Custom made equipment for pilot scale since not available on the market at small scale

These outcomes could lead to an increase of CAPEX and also OPEX that may become critical for small CHP capacity (25-100 kWe).

Hence **BLAZE concept is more likely to be economically viable for medium CHP capacity (0.5-5 MWe)** more focused to **small/medium industries** and **large public/commercial areas, o**ff course in regions where the identified category of biomass is available.

Anyway, **economic viability for small scale CHP** can be still realistic with a simplification of plant scheme by implementing some **optimization learned from BLAZE implementation**, like rationalization of the gas cleaning limited to removal of S and heavy tars

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Techno-economic results

The technology is developed for a **CHP capacity** range from **small (25-100 kWe)** to **medium (0.1-5 MWe)** scale

Parameter	Current	BLAZE (target)	BLAZE (Future)
Overall efficiency	≈ 65%	≈ 90%	≈ 80%
electrical efficiency	≈ 25%	≈ 50%	≈ 45%
investment cost	≈ 10,000 €/kWe	≈ 4,000 €/kWe	≈ 7,000 €/kWe
operating cost	≈ 0.10 €/kWh	≈ 0.05 €/kWh	≈ 0.10 €/kWh
electricity production cost	≈ 0.20 €/kWh	≈ 0.10 €/kWh	≈ 0.27 €/kWh
Negligible gaseous and particulate matter emissions			

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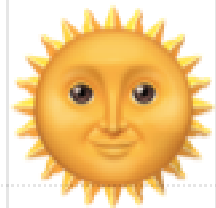
BLAZE SWOT ANALYSIS

Strengths

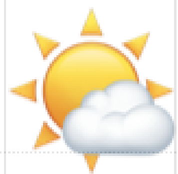


- CHP is energy efficient
- Storage
- Blaze has good Bio CHP characteristics
- Smaller size

Weaknesses

- Complex plant (leading also to higher CAPEX and O&M costs)
- Limited no. of operational hours leading reliability
- Biomass supply

Opportunities



- Global energy crisis
- Local autonomy is trendy
- Climate change increasingly actual

Threats

- Objections of decision-makers
- CAPEX of standard CHP

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Value Proposition Canvas

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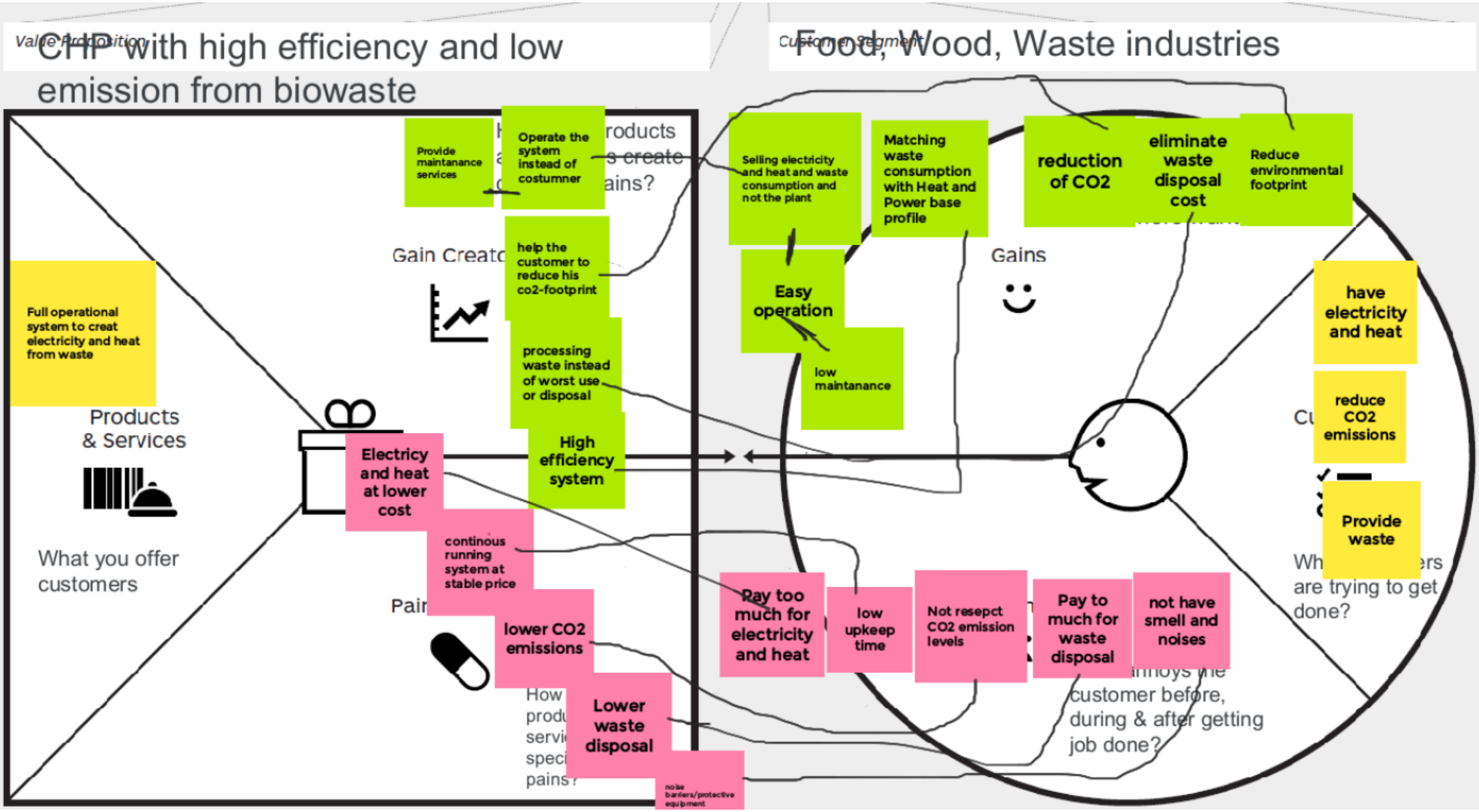

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Value Proposition Canvas

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Characteristic of ideal customer

- Simultaneous need of Heat and Power along the whole year that has relevant cost for the production
- Availability of low cost biomass residues or wastes to be disposed from Client or in the surrounding area
- Motivation to reduce emissions and increas renewables
- Skilled internal Operation&Maintenance or Energy and facility management outsourced

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Identified Client

Conclusions

Business Model

- **Model 1:** skilled industry: technology handed over to customer, only maintenance support from the technology provider
- **Model 2: Energy Service Company:** build a SPV that take over the wastes/biomass residues and provide energy and heat at stabilized costs.

Technology roadmap

- Reduce the plant and single equipment costs
- Optimize the overall plant cost defining a modular standard size
- Cumulate operational manhours for increasing reliability and availability

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