



JYVÄSKYLÄN YLIOPISTO
UNIVERSITY OF JYVÄSKYLÄ

Process technology development and pyrolysis of building waste

New European Bauhaus event

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Construction and demolition waste

- EU goal by 2020 was to recycle 70 % of construction and demolition waste
- Wood waste in Finland (2018)
 - 3 269 000 tonnes – total
 - 401 000 tonnes – from construction
- Wood waste is barely reused or recycled
 - Over 95% ends up for energy production
 - There is strong demand for efficient solutions to reuse or recycle wood waste





Types of wood waste



- Waste and demolition wood is categorized into A-, B-, C- and D –quality
 - A – Contains clean wood such as wood industry side streams and non-chemically treated demolition wood
 - B - Lightly treated wood e.g. lacquered or painted wood
 - C – Lightly contaminated wood containing e.g. increased levels of heavy metals
 - D – Pressure-treated wood – categorized as hazardous waste
- A, B, and part of C –category woods are seen as the most promising for pyrolysis



Pictures: Annakaisa Elo



Pyrolysis in treating wood and demolition waste

- Reusing/recycling waste wood is major challenge across the globe
- Pyrolysis is highly promising technology in treating wood waste efficiently
- Only small proportion of the waste wood can be reused directly
- In pyrolysis, waste wood is treated in high temperatures (350-1000°C) which removes various contaminants
- Majority of waste wood is only lightly contaminated
- Different stakeholders have already shown high preliminary interest towards this concept



Business opportunities

Establishing new business ecosystem around waste wood

Waste wood



Pyrolysis in static or mobile units

The raw material is heated in the absence of oxygen, producing gas, char and pyrolysis liquid. Pyrolysis is self-sustaining process.



Biochar

Various applications, e.g. soil amendment, water and air filtration.



Closing the loop

Positive C cycle can be created as up to 50% of the carbon in waste wood can be retained in biochar instead of released back to the atmosphere.

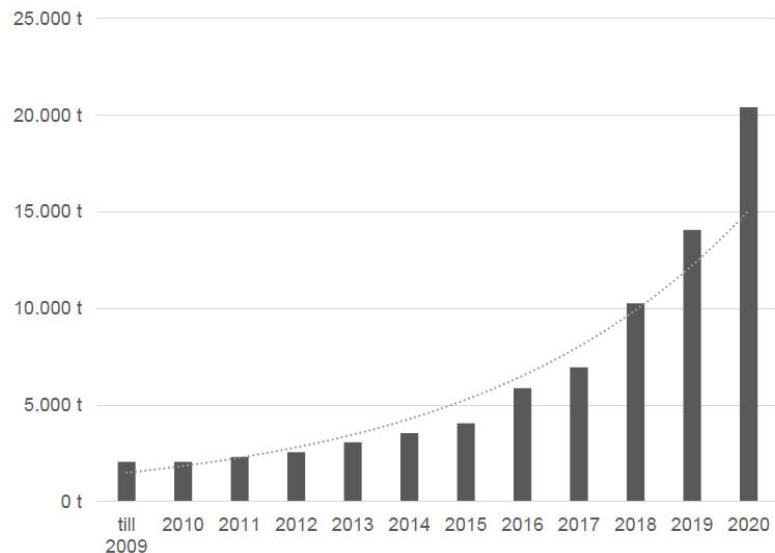




Non-energy biochar markets

Biochar Market growth until 2020

Cumulative biochar production capacity in Europe



- By **end of 2020** dedicated production capacity for biochar was just above **20.000 t**
- Biochar production in **2020** was approximately **17.000 t**
- The **market is growing substantially, and even its growth is growing**
 - Production capacity doubled in only two years from 2018 to 2020
 - Growth rates for cumulative production capacity are increasing:
5y CAGR was **38%**,
3y CAGR was even **43%**

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Source: European Biochar Market Report 2020 - <https://www.biochar-industry.com/market-overview/>



Voluntary Carbon Market (VCM)

- Producing biochar from waste wood can be certified into carbon removal certificates or credits and sold
- Examples of market places:
 - [Puro.earth](https://puro.earth)
 - [CarbonFuture](https://carbonfuture.earth)
- Biochar based carbon removal is highly requested
- Corporations such as Microsoft has purchased and support biochar-based carbon removal
- VCM is highly growing market and essential tool to meet climate goals of Paris agreement

Current market size 300M \$

Estimated to grow 15x by 2030 and 100X by 2050

The screenshot displays a grid of biochar projects from the Puro.earth platform. Each project card includes the project name, location, price, and a brief description. The projects shown are:

- ECHO2** (Australia): 60.00 € / C02e. Described as transforming green waste into high quality biochar and bioenergy. It is the first Puro earth-certified biochar producer outside Europe.
- Carbon cycle** (Germany): 95.00 € / C02e. Described as an innovative and sustainable agriculture company based in south-eastern Germany. The company produces premium quality biochar for modern, sustainable agriculture.
- Carbon Cycle** (Sweden): 0.00 € / C02e. Described as a Swedish biochar producer company awarded the Puro earth certification label. One tonne of biochar produced from pelleted agro-residue blends. Each ton is 78% pure carbon and embodies 2.57 tonnes of C02e, while in manufacturing it emits only 0.05 tonnes of C02e. The biochar is used for soil amendment and environmental remediation.
- ECOERA** (Sweden): 0.00 € / C02e. Described as a Swedish biochar producer company awarded the Puro earth certification label. One tonne of biochar produced from pelleted agro-residue blends. Each ton is 78% pure carbon and embodies 2.57 tonnes of C02e, while in manufacturing it emits only 0.05 tonnes of C02e. The biochar is used for soil amendment and environmental remediation.
- BIOKOL** (Sweden): 150.00 € / C02e. Described as a Hjelmåsen Egendom using a BIOMACON technology to produce biochar from forestry residues that is used for soil amendment and environmental improvement in Sweden. Hjelmåsen Egendom is situated in Lake Västern Archipelago and Mount Växnekuolla UNESCO Biosphere Reserve - a model region for sustainable...
- carbo culture** (United States): 97.09 € / C02e. Described as a Nordic-Californian climate tech startup converting biomass residues into stable carbon which is a synonym for biochar. These carbons stay stable and out of the atmosphere for thousands of years or more. In addition, these biochar are used for environmental remediation.
- CARBOFEX** (Finland): 100.00 € / C02e. Described as a premium grade biochar for the horticulture industry and water filtering applications. One tonne of Carbofex biochar removes 3.1 tonnes of C02 eq. from the atmosphere into long-term storage in the product. The feedstock is spruce thinnings of sustainably managed Finnish PEFC-certified...

The screenshot shows a web browser displaying the CarbonFuture platform. The main navigation bar includes links for carbonfuture, HOW IT WORKS, PARTICIPATE, RESOURCES, FAQ, and ABOUT US. Below the navigation, there are three portfolio cards:

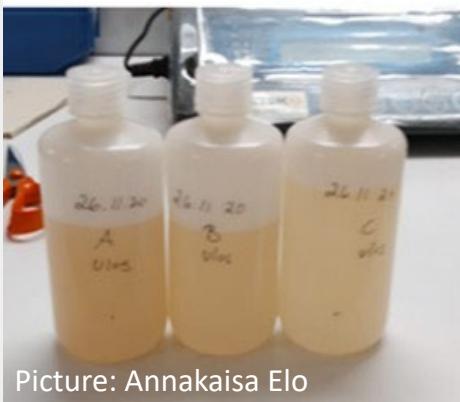
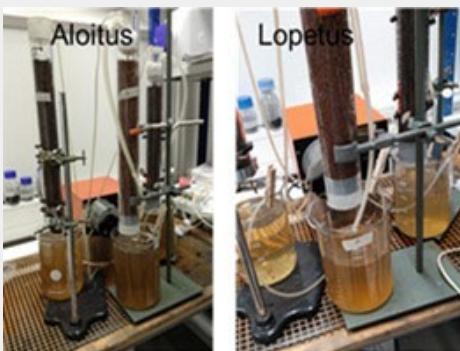
- BIOCHAR Q3 2020**: This C02e portfolio is based on applications of EBC certified biochar in agriculture in Germany and Austria. This includes biochar...
- BIOCHAR Q2 2020**: This C02e portfolio is based on applications of EBC certified biochar in agriculture in Germany, Austria and Switzerland. This...
- PILOT Q1 2020**: This portfolio is based on two deliveries of EBC certified biochar and its application in agriculture in a carbon preserving way. They...

Each portfolio card shows a small image of a forest, the portfolio name, the C02e price (e.g., €116 per 100tC02e), and the amount removed (e.g., 37.19/111.06t C02e, 109.06/109.06t C02e, 4.42/4.42t C02e).



Potential applications for wastewood biochar

- Various potential applications depending on the characteristics, quality and purity of biochar
 - Soil amendment
 - Composting
 - Water filtration



Picture: Annakaisa Elo





Potential applications for wastewood biochar

- Material uses: concrete, composites, asphalt
 - Safe to use with higher impurity levels





Benefits and impacts

- Waste prevention and EU targets
 - Recycling waste wood and solving the problem
- Going up in waste hierarchy
- Creating new and scalable business opportunities
 - R&D of new technological solutions
 - Production and sales of biochar or activated carbon
- Biochar can be used to solve various environmental problems related to air, water and soil
- Carbon removal - biochar in soil can store carbon for hundreds or thousands of years



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