

# VESIHIILI

## Business Opportunities and Use Cases of Biochar

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# Business Opportunities and Use Cases of Biochar

1. What is biochar?
2. Vesihiili development project
3. Business opportunity and use cases of biochar
  - Run-off water purification
  - Growing media
  - Metallurgy
  - Side-stream energy utilization
4. Biochar and circular economy

Source material: barley husk



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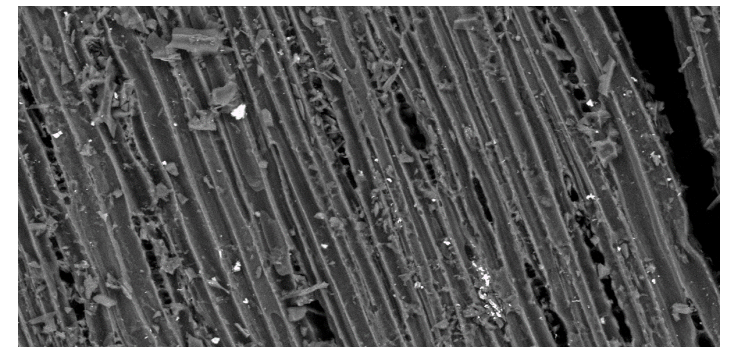
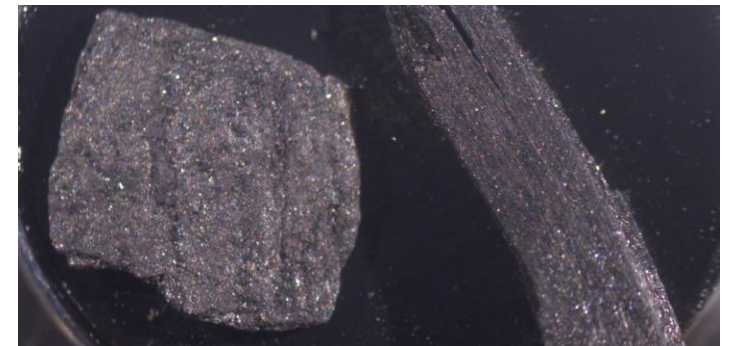
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Photo: Mikko Selenius, 2022

Source material: wood chips (spruce)

# 1. What is biochar?

- Biochar: Porous charcoal made from biomaterial, usually wood
  - The properties of produced biochar are affected by e.g. source material, pyrolysis temperature and time, pre- and post-treatments
- Pyrolysis process: Heating the material in an oxygen-free environment, temperature 350-900°C
  - Solid biochar from slow pyrolysis: 25-40 %
  - Liquids are distilled, and solid components break down and form aerosols and gases → collection or energy



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Photos: Mikko Selenius, 2025

## 2. Vesihiili development project

**Vesihiili development project** (EU JTF, 9/2024-9/2026):

Decentralised production of biochar from various side streams and use in agriculture, water purification and carbon sequestration

- Collecting water samples from agriculture, cities and process industries: nutrient-rich waters
- Water treatment pilots at landfills → Treatment of agricultural run-off water (point sources) in next summer
- Developing and piloting of the use of biochar in berry cultivation and agriculture in general
- Business analysis and development: Profitable and sustainable production and use of biochar



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Photo: Joonas Ruuskanen, 2022



# 3. Biochar business: Costs and price

- The production cost of biochar:
  - Capital investment: 300-550 €/t, size of facility
  - Source material acquisition: 0-80 €/t, waste or new raw material
  - Business operation costs: 200-300 €/t
  - Transportation of source materials and produced biochar, note environment impact also
- There is a lot of variation in the price of biochar: 400-1950 €/t, average 1000 €/t
  - In most use cases, biochar price should be ~600 €/t
  - Potential other revenue streams: Biochar itself and other pyrolysis products e.g. gas as energy (~167 €/t) and carbon sequestration (~300 €/t)



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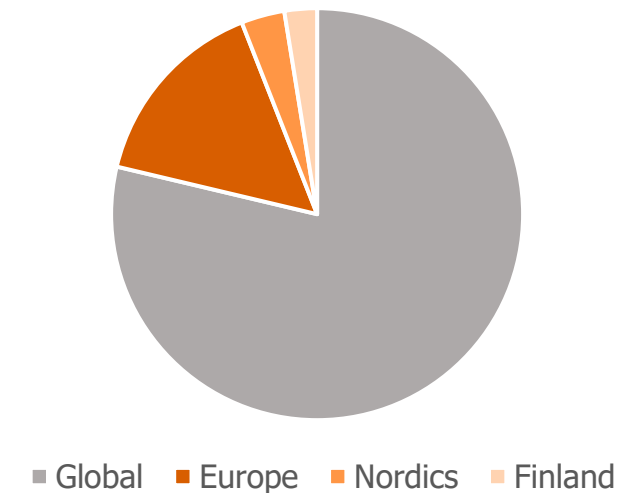
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Based on biochar TEA reports: Sweco, VTT etc.

# 3. Market estimations: Biochar production capacities

Geographical area	Volume in 2023	Volume in 2025
Finland	max. 9 000 t	max. 13 000 t
Nordics	21 000 t	35 000 t
Europe	75 000 t	114 000 t
Global	350 000 t	450 000 t

Production capacities in 2023



- About 200-250 biochar producers in Europe
- Biochar producers in Finland are e.g. Carbofex, GRK, Carbo Culture: 1 000 - 5 000 t/a
  - Joensuu Biocoal, torrefied biomass: 60 000 t/a



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Sources: IBI, Biochar Europe and VTT

# 3. Forest industry side streams: North Savo

Company	Total wood side streams (t)	Biochar (t) 1/3 of the raw material
Iisalmen saha	39 480	13 160
Anaika Wood	29 610	9 870
Lunawood	17 766	5 922
Keitele	78 960	26 320
Iisveden Metsä	31 584	10 528
Stora Enso Varkauden Sawmill	51 324	17 108
Stora Enso Varkauden Containerboard*	21 000	7 000
Mondi Powerflute*	27 300	9 100
<b>Total (~)</b>	<b>297 000</b>	<b>99 000</b>

In addition, straw and farming residues (even 120 000 t biochar), manure and surplus grass are potential



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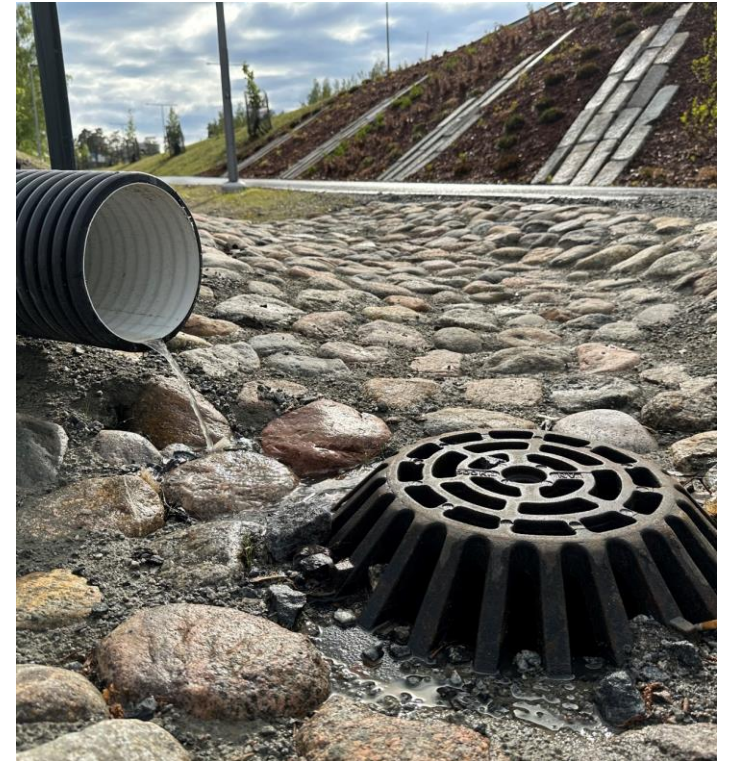


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Based on the public sources of the companies

# 3. Biochar use case for example

- Run-off water treatment: Onsite purification and water quantity management
- Growing media: Improves the conditions for growth and moisture balancing, nutrients remain in the specific area
- Steel industry: As a raw material for stainless steel production, i.e. biocoke
- Carbon sequestration: Biomass carbon can be stored with biochar, up to 3 tons of CO<sub>2</sub> emission



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Photo: Joonas Ruuskanen, 2023



# 3. Use cases:

## Onsite run-off water management

- Run-off water, i.e. storm water, flows on urban surfaces and carries heavy metals, nutrients, microplastics etc. to environment – Biochar as a potential onsite filter solution
- Drivers to improve runoff water management infrastructure:
  - Urbanization and climate change affect quality and quantity of stormwater
  - Increasing environmental awareness and tighter water regulations
- Run-off water potential in Finland for biochar: 180 000 t over several years



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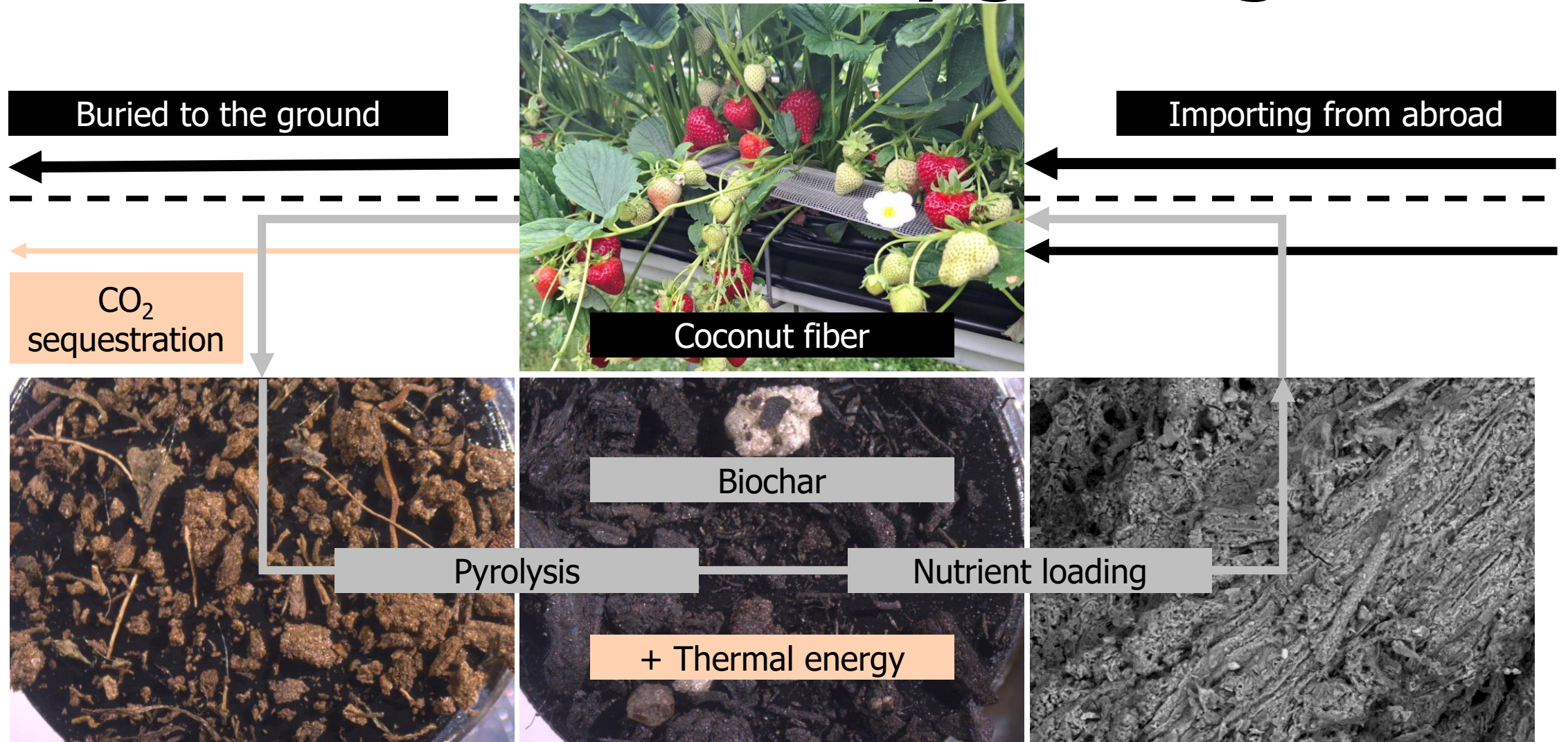
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# 3. Use cases: Strawberry growing media



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# 3. Use cases:

## Metallurgy and steel making

- Biochar can replace fossil coal or energy sources in different stages of stainless-steel production, pelletized/densified biochar i.e. biocoke is specifically used as a reductant in ferrochrome smelting
- High fixed carbon content and low impurities
- Metal industry use potential in Finland for biocoke: 150 000 – 250 000 t/a
  - Outokumpu announced two large investments
    - Rügen (Germany): 15 000 t biochar/biocarbon production starting in 2026
    - Tornio (Finland): 25 000 t biocoke pelletizing facility from biochar, operational from 2025



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Sources: VTT and Outokumpu



# 3. Use cases: Energy/heat production

- As mentioned, pyrolysis process generates heat and gases as side-products
- Requires integration to heating network/energy infrastructure
- 6 500 t/a biochar production facility could generate about 40 GWh heat energy
- Torrefied biomass (e.g. Joensuu Biocoal) as high energy density product for power plants
  - Uniform, low moisture content
  - Easier transport than raw biomass



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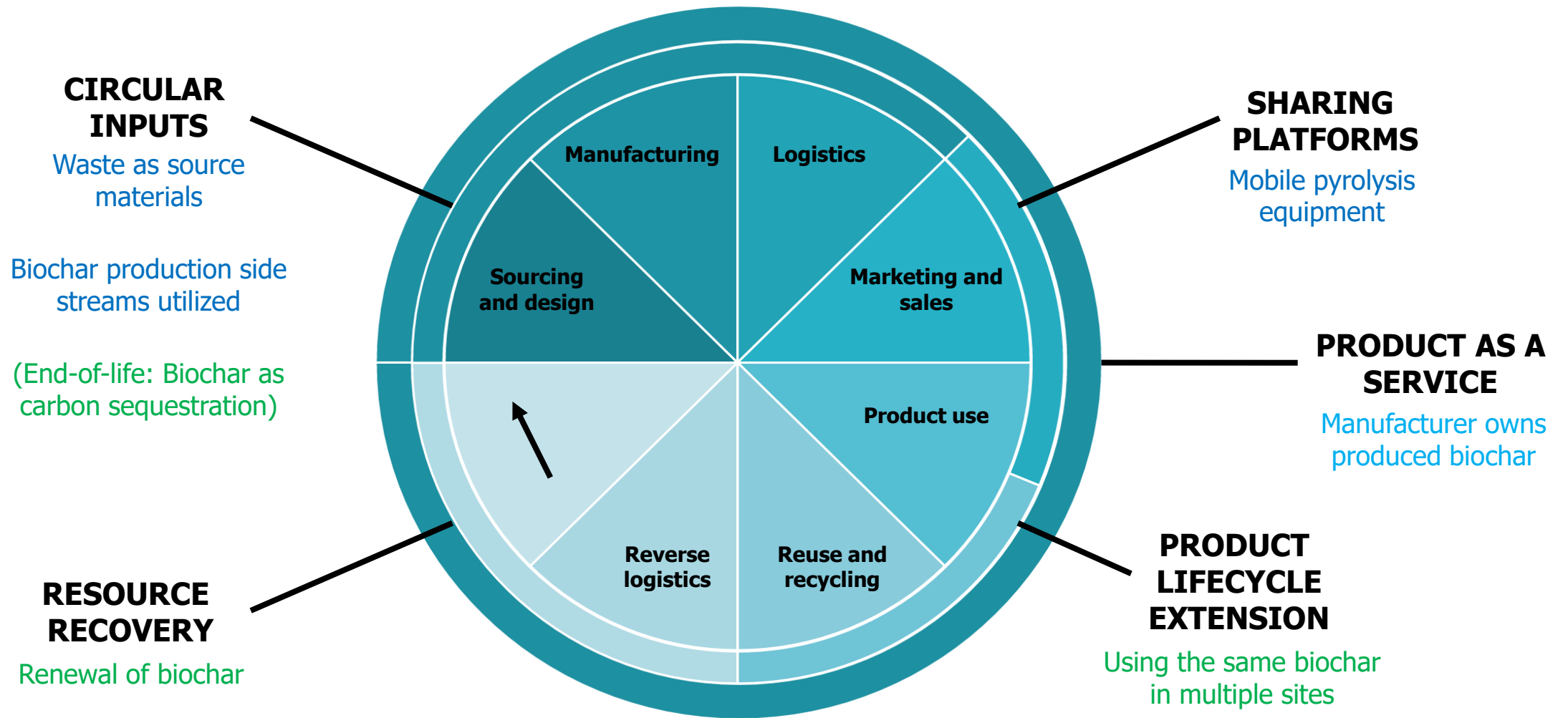
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Source: Sweco



# 4. Biochar and circular economy



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To paraphrase what is presented in Sitra's Handbook on Sustainable Growth from Circular Economy Business Models (2022)

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