



CARBOFEX

Carbon Negative Heating and Cooling with Carbofex Pyrolysis Technology

CEO Sampo Tukiainen
August 28th 2010
Tampere

CARBOFEX Inc - THE MAKER OF CARBON

- Est. 2016
- CEO Sampo Tukiainen, carbonization and biorefining since 1995
- Carbonizer technology developed in 2008-2011, supporting technologies 2003-2007
- Carbofex was established as a biochar producer
- Largest EBC-certified producer in Europe - the only one in the Nordics
- Now offers biochar production technology

COMPANY



- Located in Tampere, Finland (back office in Espoo)
- Has built and successfully operates the largest continuously operating biochar plant in Europe
- Revenue from biochar & energy in 2018 was 250.000 euros
- Budgeted revenue for 2019:
 - 600.000 euros from biochar and energy
 - 300.000 euros as down payment for first equipment delivery

Business idea

- We turn biomass and organic waste into high value (biochar) products.
- Produce clean energy and permanently remove CO₂.

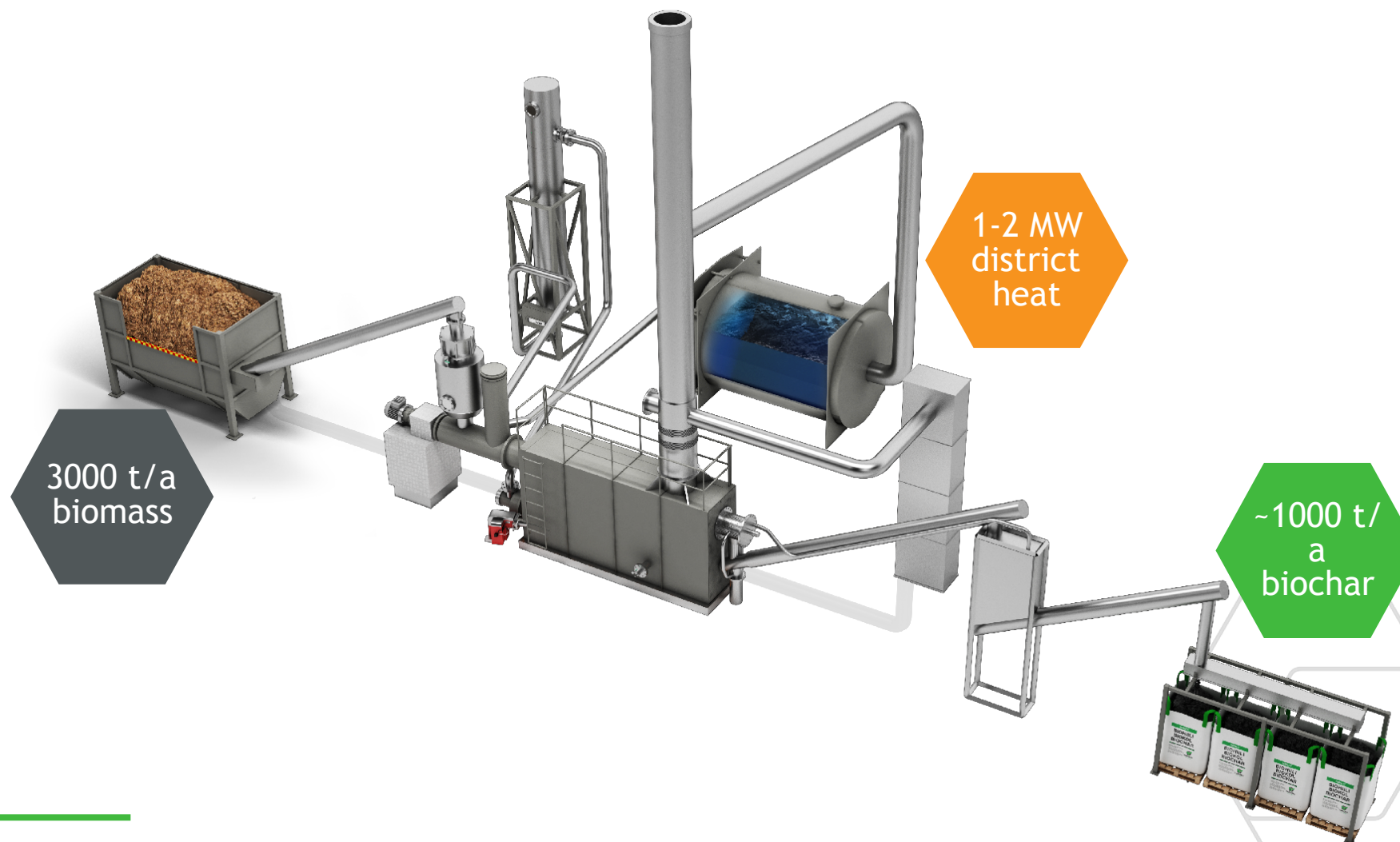


VISION

To be the leading
biochar technology
supplier in 2025 with
100+ MEUR
revenue.



ADVANCED BIOCHAR TECHNOLOGY



CARBOFEX SOLUTION

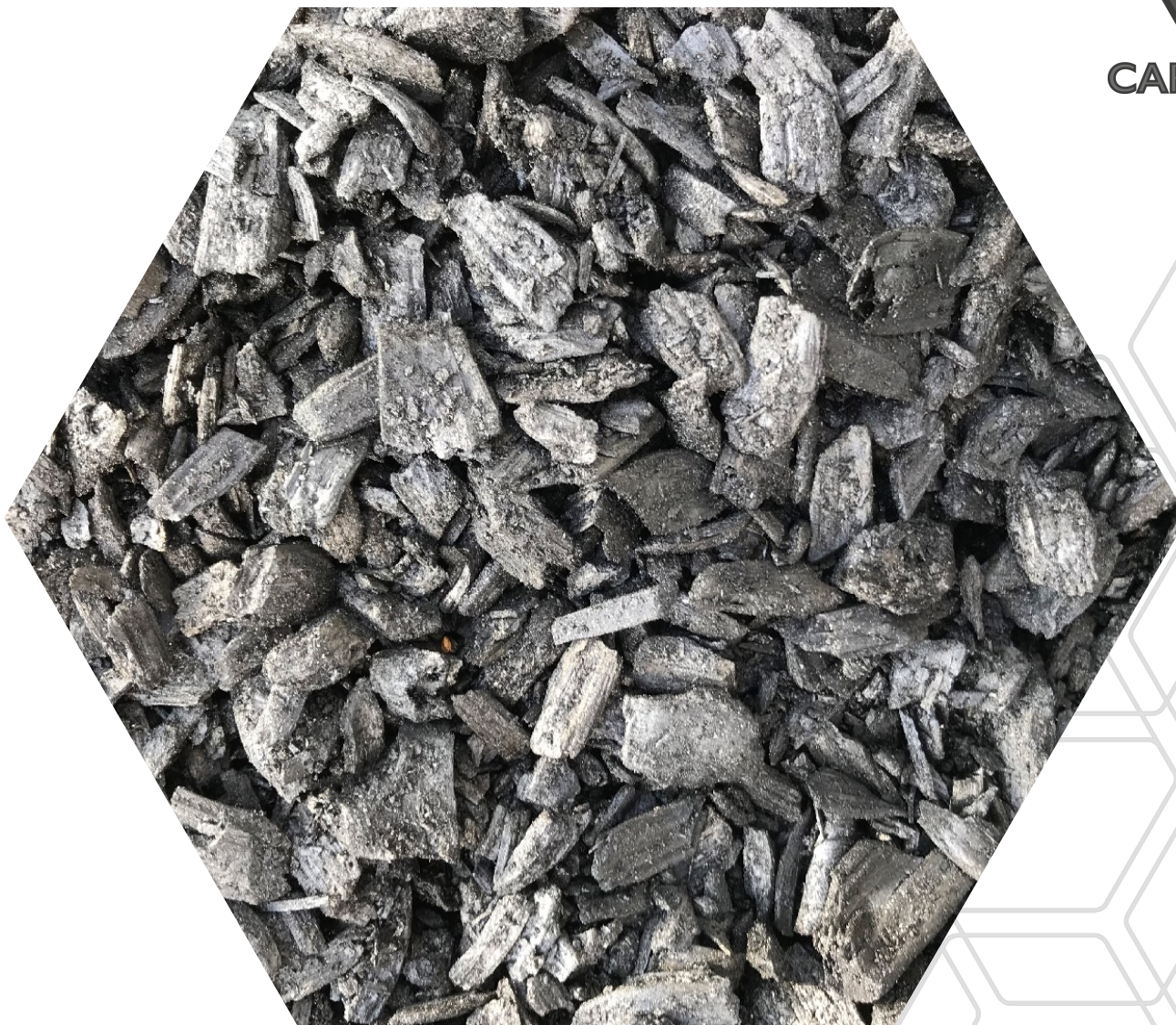
- Creates new value from unutilised resources (waste materials)
- Captures carbon – biomass converted into biochar locks in CO₂
- Provides clean energy
- Reduces air and water pollution – removes nutrients and pollutants
- Creates CO₂ removal certificates

CARBOFEX SOLUTION

- High capacity 500 kg / h
- Competitive pricing
- Highest product quality – First Nordic producer with EBC certificate
- Low emissions and high efficiency – 90 % utilisation rate
- Very low polycyclic aromatic hydrocarbons (PAH) in the biochar
- CO2 negative technology – one of the few existing solutions for removing carbon from the atmosphere (NET-negative emissions technology)
- Flexibility – use released energy for heating/cooling or to desalinate water

Carbofex Biochar

- Is made by processing biomass at 600-700 °C in an air free environment
- Residence time 5-10 min
- Surface area >500 m²/g
- Ash 1-3%
- Fixed carbon 90-95%



Specs

ANALYTICAL METHOD		RESULT	ACCREDITED	METHOD
Ash content (550 °C)	A	1,6 %, d	x	SFS-EN ISO 18122, SFS-EN 15403
Volatile matter	Vol	3,7 %, d	x	SFS-EN ISO 18123, SFS-EN 15402, ISO 562
Sulphur content	S	<0.01 %, d	x	ASTM D 4239 (mod), SFS-EN ISO 16994
CHN	C	94,1 %, d	x	SFS-EN ISO 16948, SFS-EN 15407, ISO 29541
	H	1,3 %, d	x	
	N	0,61 %, d	x	SFS-EN ISO 16948, SFS-EN 15407, ISO 29541
Oxygen content (calculated)	O	2,4 %, d		SFS-EN ISO 16993
Fixed carbon (calculated)	FC	94,8 %, d		
Volume weight and dry bulk density	Volume weight	295 g/l	x	SFS-EN 13040
	Bulk density	142 g/l	x	SFS-EN 13040
Moisture	M	51,7 %	x	SFS-EN 13040
ICP-OES measurement	Ca	787 mg/kg, d	x	SFS-EN ISO 11885
	Mg	10 mg/kg, d	x	SFS-EN ISO 11885
	Na	42 mg/kg, d	x	SFS-EN ISO 11885
	K	1120 mg/kg, d	x	SFS-EN ISO 11885

MAIN USES OF OUR BIOCHAR

- Removal of nutrients (phosphorous, nitrogen) from industrial and municipal effluents, ponds and lakes
- Growing media
- Building – biochar concrete building materials, vacuum insulation



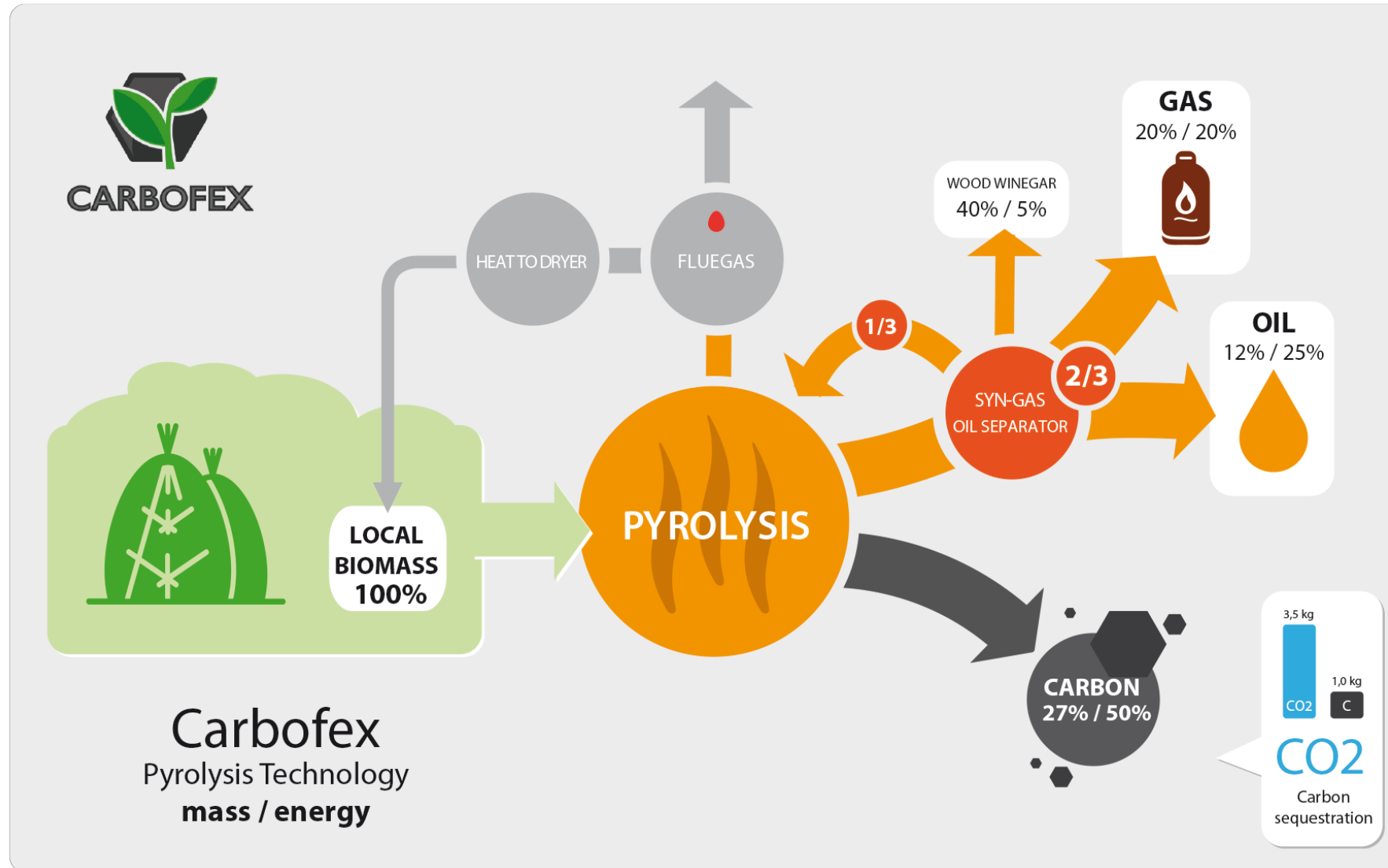
INTEGRATED THERMAL GENERATION

- The carbonizer can co-generate
 - Bio-oil
 - wood vinegar (currently not recovered)
 - Clean CO₂ and pyrolysis gas
- Flue gas is ultra clean, good for greenhouse applications
- Low-NO_x, 30-40 ppm
- CO below 1 ppm (normally not detectable)
- Particle emissions > 1 mg m³

INTEGRATED ENERGY PRODUCTION

- Annual maximum production of current unit:
- 700-1000 tons of biochar - 7000-8000 m³
- 600 tons of oil (300 t during summer)
- Max 7000 MWh thermal output
- Wood chip input 15.000 m³ per year
- Unit scalable to 5 x capacity, modular design

MASS & ENERGY BALANCE



INTEGRATED THERMAL CONTINUED

- Carbonizer can be integrated for production of process or district heat (hot water or steam).
- Heat can also be used to run a chiller or multiple effect evaporator.
- Ag residues suitable in a shredded or pelletised form.
- With high nitrogen feedstocks the control of NO_x is easy and the EU waste incineration directive is fulfilled in terms of temperature and residence time. 850 C, 2 s

INTEGRATED THERMAL GENERATION

- Pyrolysis oil can be separated and stored for later use.
- Thermal output can be minimised when there is no heat load.
- The bio-oil is easy to draw from a tank for peak and auxiliary use, during highest energy demand.



Future plans

- Carbofex and Tampere electric utility have agreed to build a large combined biochar / peak district heating station with total value of 20 million euros.
- The unit will initially produce 60.000 m³ of biochar and have a peak heating capacity of 30 MW. Start up is scheduled for mid 2021.
- The project will be one of the first industrial scale biochar production schemes, with reservations to expand to 240.000 m³.

THANK YOU.



CARBOFEX

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