SESSION 1: 9:10–9:40

ESTEP
European Steel Technology Platform

ESTEP workshop

SecCarb4Steel

Preparation and use of biogenic and non-biogenic secondary carbon carriers (SCC) in processes for iron and steelmaking

Biochar production plants: Status quo

Daniela Meitner[1]

[1] Next Generation Elements GmbH

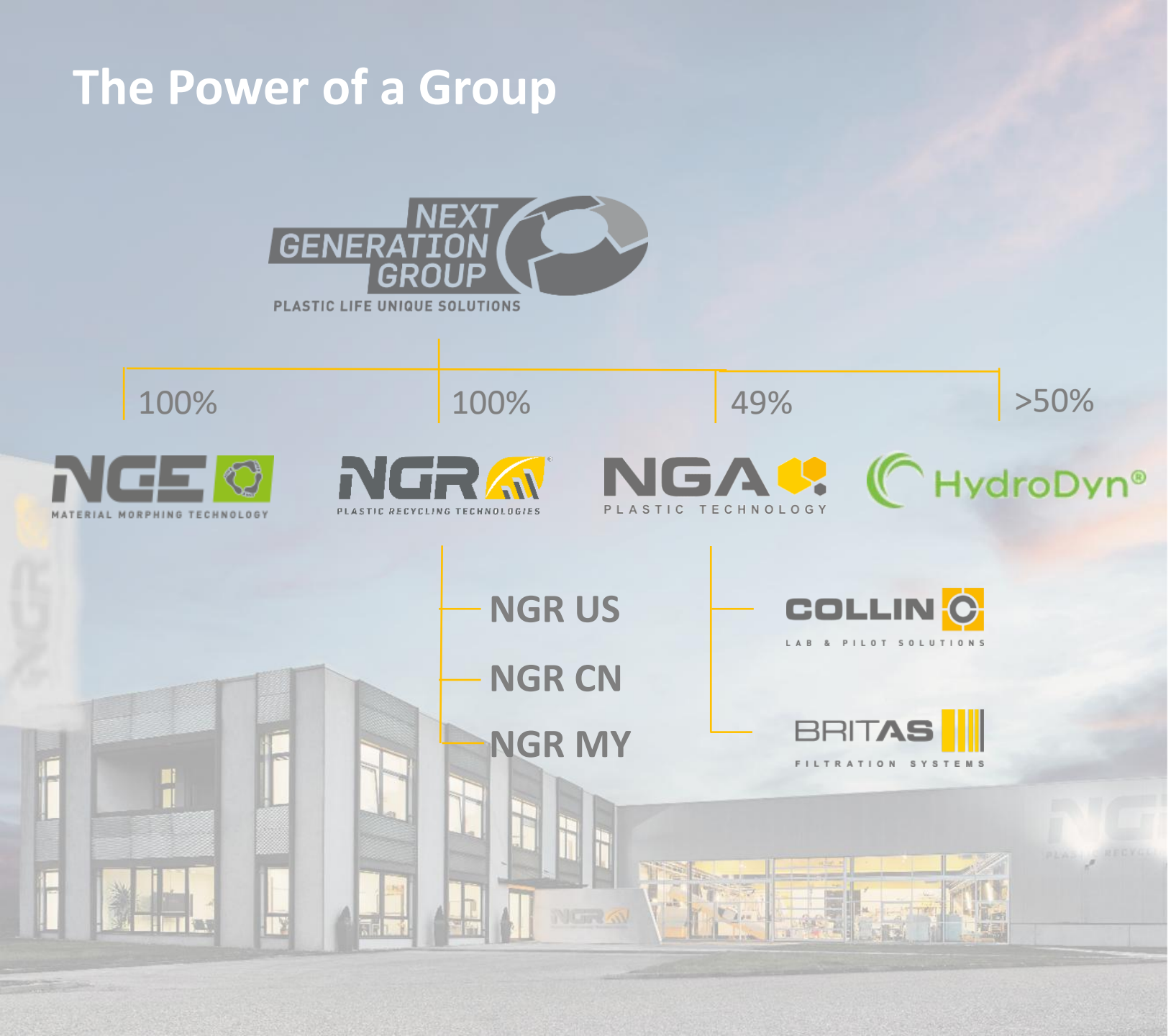
Agenda

- Next Generation Elements GmbH
- Definition Pyrolysis
- T:CRACKER_DH + Technology
- Use CASE
- Market

The Power of a Group

NEXT GENERATION GROUP
PLASTIC LIFE UNIQUE SOLUTIONS

100%	100%	49%	>50%
NGE MATERIAL MORPHING TECHNOLOGY	NGR PLASTIC RECYCLING TECHNOLOGIES	NGA PLASTIC TECHNOLOGY	HydroDyn®
	NGR US NGR CN NGR MY	COLLIN LAB & PILOT SOLUTIONS BRITAS FILTRATION SYSTEMS	



Next Generation Holding GmbH

- Josef Hochreiter
- Gerold Barth
- Ingka Investments

Part of Ingka Group | IKEA

> 200 (FTE)
Mitarbeiter

> 100 Mio. EUR
Umsatz

>100
Ländern vertreten

Next Generation Elements GmbH

> Funding project 2015: **'TC (Thermo-Chemical) Processing'** > Goal: Development of a thermo-chemical reactor for the processing/reuse/recycling of waste

> NGE was founded in 2017

> A test reactor was built at the JKU as part of a research project to sample various input materials

> e.g. different plastics and plastic compounds, wood, sewage sludge, sunflower seeds, plastics, aluminium and much more

How it started !!!

Pyrolysis vs. combustion

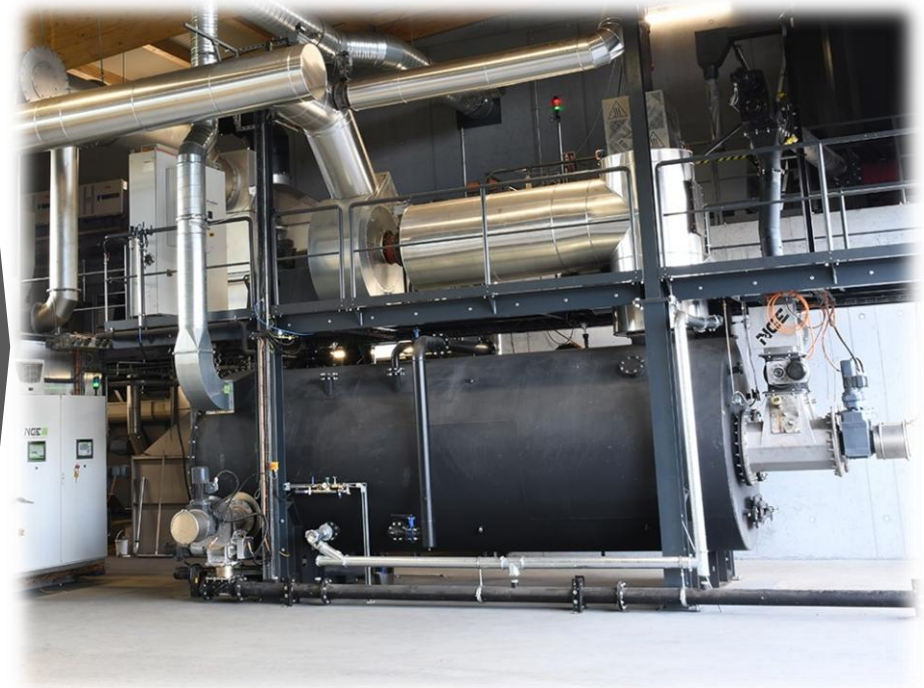
Definition of pyrolysis:

- Combination of the Greek words PYR (fire) and LYSIS (dissolution)

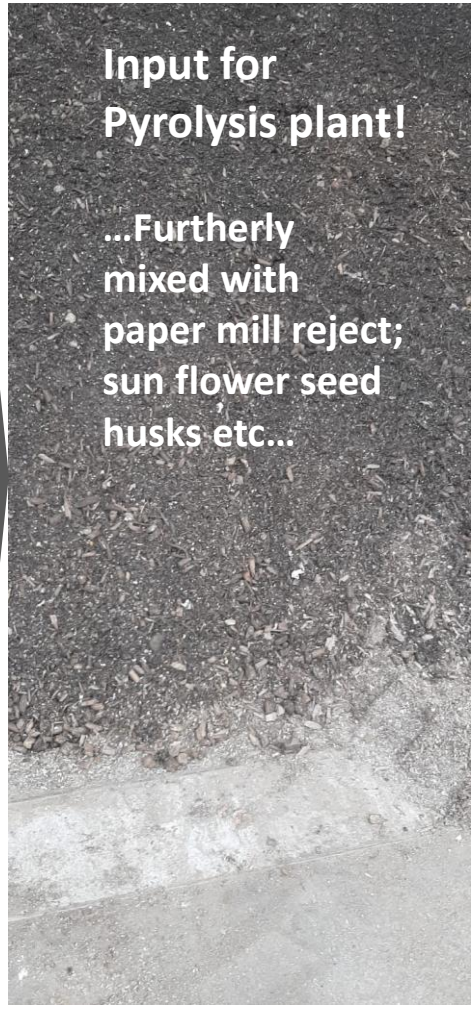
- Describes the thermal decomposition of chemical compounds at high temperatures WITHOUT **THE SUPPLY OF** oxygen (mostly organic substances – plastics, wood, bones)
  Partial conversion of carbon (carbon atoms are retained)

- Combustion: exothermic process **WITH SUPPLY OF** oxygen (e.g. tiled stove, camp fire)
  Complete conversion of carbon (ash)

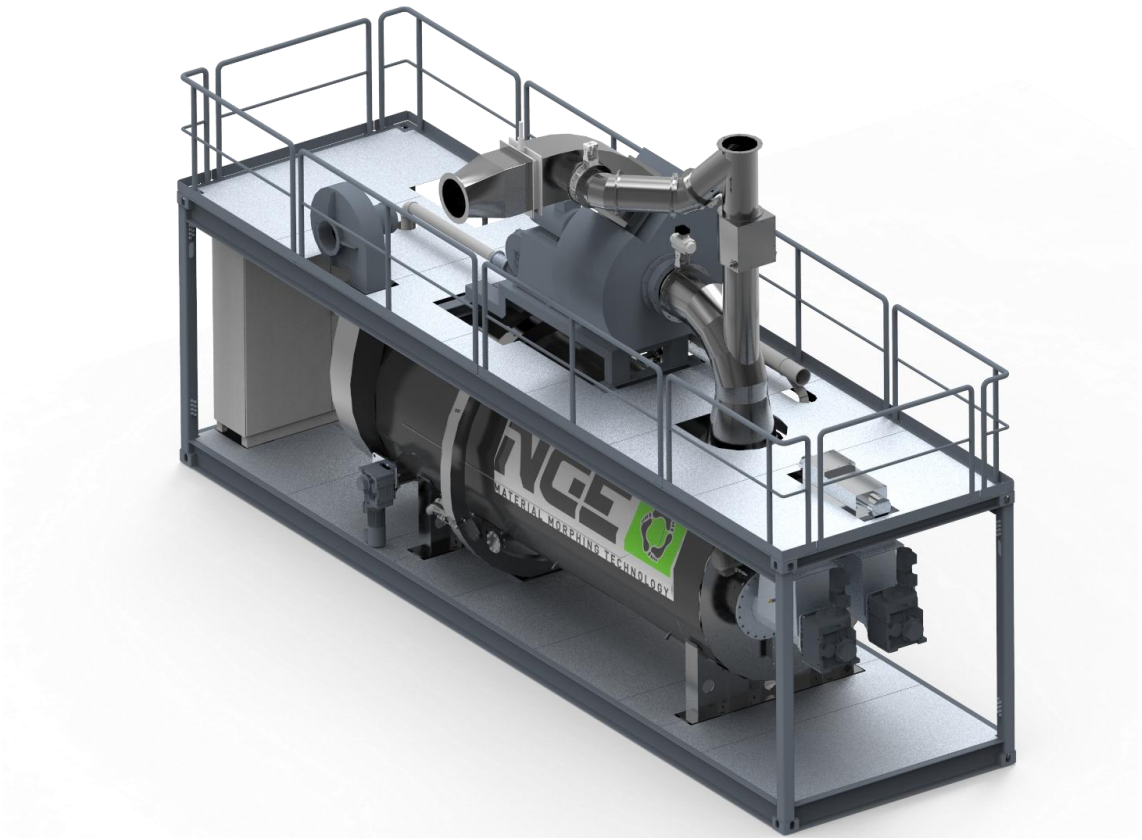
From flexible input to valid material…



Feedstock flexibility



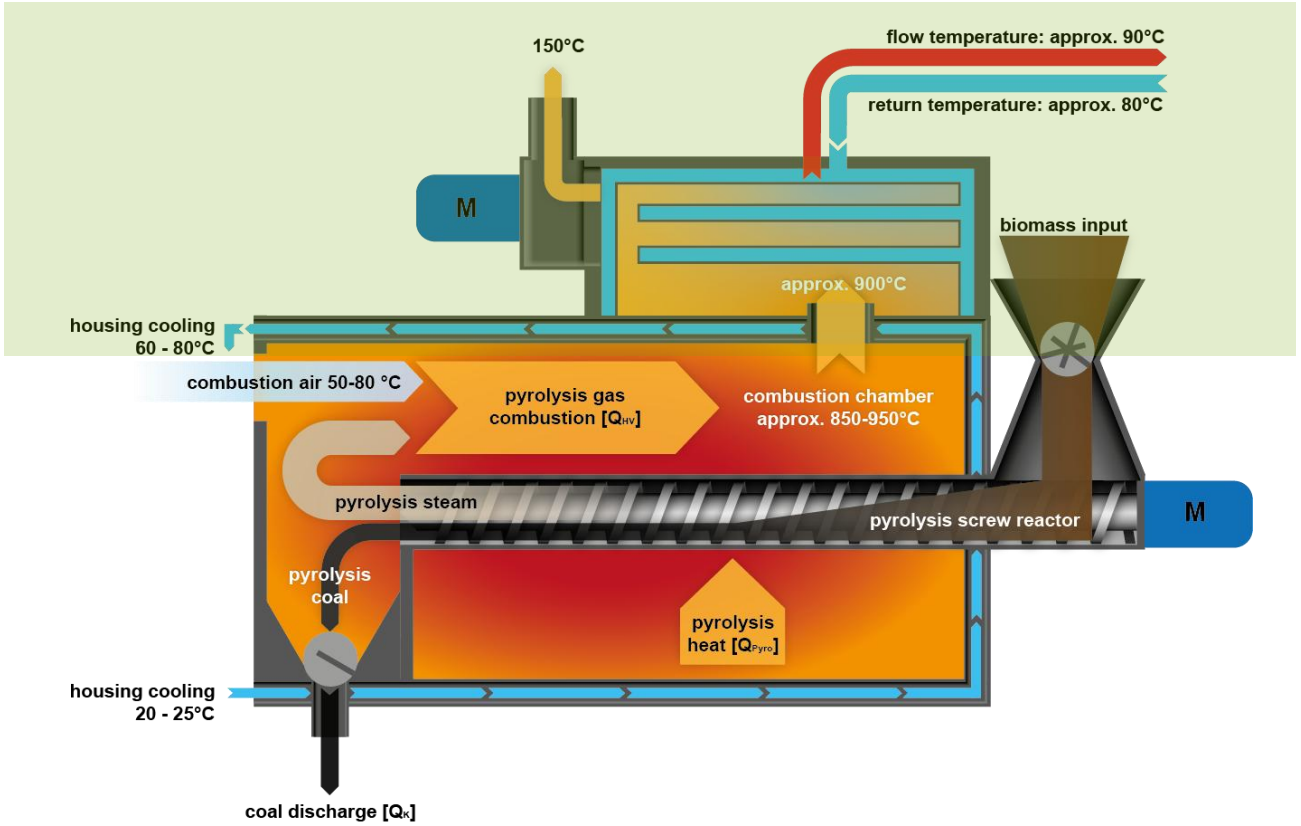
Technology **T:CRACKER_DH**



T:CRACKER®DH (direct heated):

- Thermal decomposition of the input material in the T:CRACKER® screw reactor
- Combustion of the pyrolysis gas in the combustion chamber
- Direct heating of the screw reactor through integration in the combustion chamber.
- Energetically self-sufficient and flexible to several input materials

Technology **Process**



The **PROCESS OF PYROLYSIS** involves the thermal decomposition of organic compounds at a temperature of approximately 700°C in the absence of oxygen.

Two primary fractions are generally produced during the process: **PYROLYSIS VAPOR** and **CARBONISATE**.

The mass and energy distribution of the products are primarily influenced by **THREE PARAMETERS**:

1. **COMPOSITION** of the feedstock material
2. **TEMPERATURE**
3. **RESIDENCE TIME**

Input vs. Biochar






WET BIOMASS (20 – 25 % DRY MATTER)

- Sewage sludge
- Digestate
- Manures (chicken, cow, fish, etc.)
- Papermill rejects
- etc.

T:CRACKER® DH

DRY BIOMASS (75 – 80% DRY MATTER)

- Wood chips
- Yearly crops residues
- Etc.

Input vs. Biochar






WET BIOMASS (20 – 25 % DRY MATTER)

- Lower C – content
- High of micronutrients
- High P – content
- Different Contaminations

BIOCHAR 1 (FROM WET BIOMASS)

- low C – content
- lower BET surface
- high micronutrients
- high P – content

BIOCHAR 2 (FROM DRY BIOMASS)

- Higher C – content
- High BET surface
- Low micronutrients
- Low P – content

DRY BIOMASS (75 – 80% DRY MATTER)

- Higher C – content
- Low micronutrients
- Low P – content

Product biochar applications

Soil and substrate production

- Structure builder/ fertility enhancer (Terra Preta)

Bedding or feed charcoal

- Animal welfare and odor suppression

Biogas additive for process stabilization

- Process stabilization or increase in gas yield

CO2 sink for construction technology products

- e.g. CarbonBeton - CO2-reduced building materials / construction material

CO2-neutral metallurgical coal

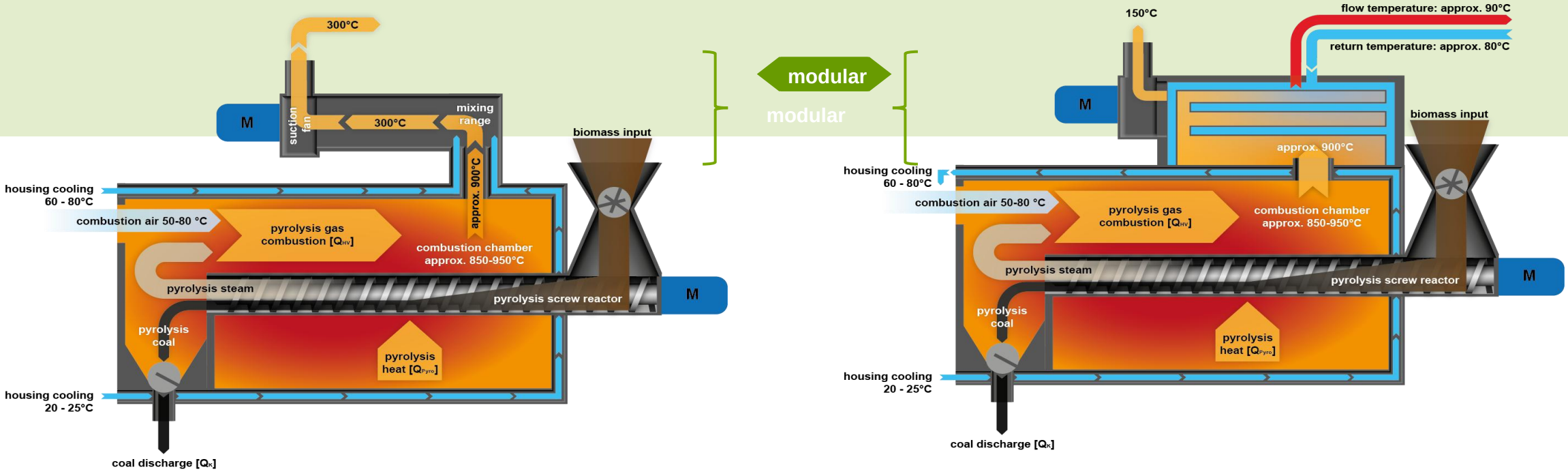
- GreenCarbon - for GreenSteel production

Raw material for phosphorus recycling

- Thermal processes incl. C source

PyroDry and PyroPower

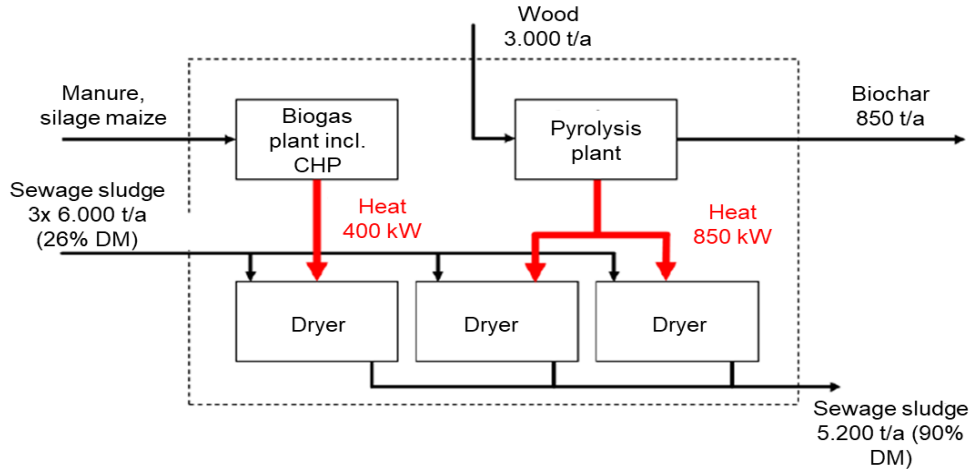
the waste **HEAT UTILIZATION MODULE** can be replaced depending on requirements and application!



ÖKT Offenhausen GmbH / Germany

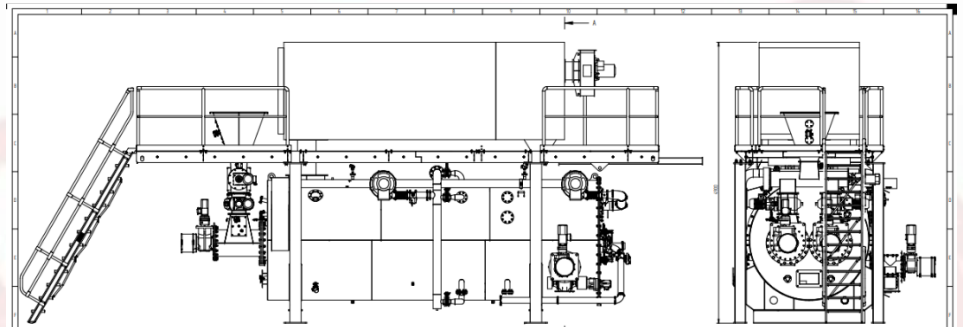
Biomass to Biochar and Drying

- **Description:** Ökologische Klärschlammtrocknung Offenhausen GmbH (ÖKT) decided to switch its drying heat supply from liquified natural gas (LNG) to a biomass-based pyrolysis system in 2022.
- **Location**: Offenhausen, Germany
- **Capacity**:
  - 1 x 450 kW (P5000D) + 1x 150 kW (P3000) ***T:CRACKER*** (NGE)
  - 3x Sewage sludge dryer (Jumbo Group GmbH)
- **Input**: 3.000 t/a wood + 3x 6.000 t/a sewage sludge (26% DM)
- **Output**: 850 t/a Biochar & 850 kW low-temperature heat (300°C hot flue gas) for drying sewage sludge + 5.200 t/a sewage sludge (90% DM)

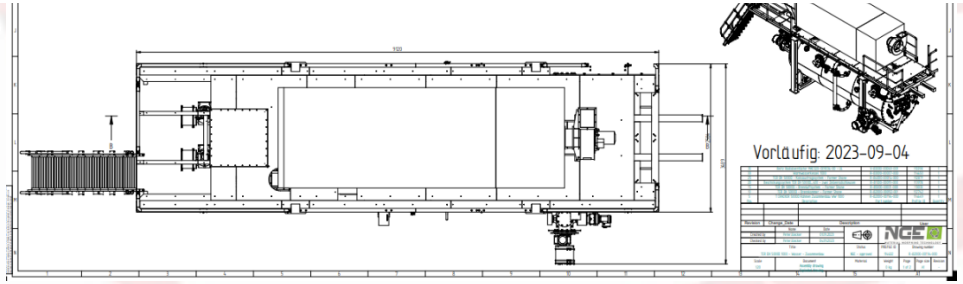


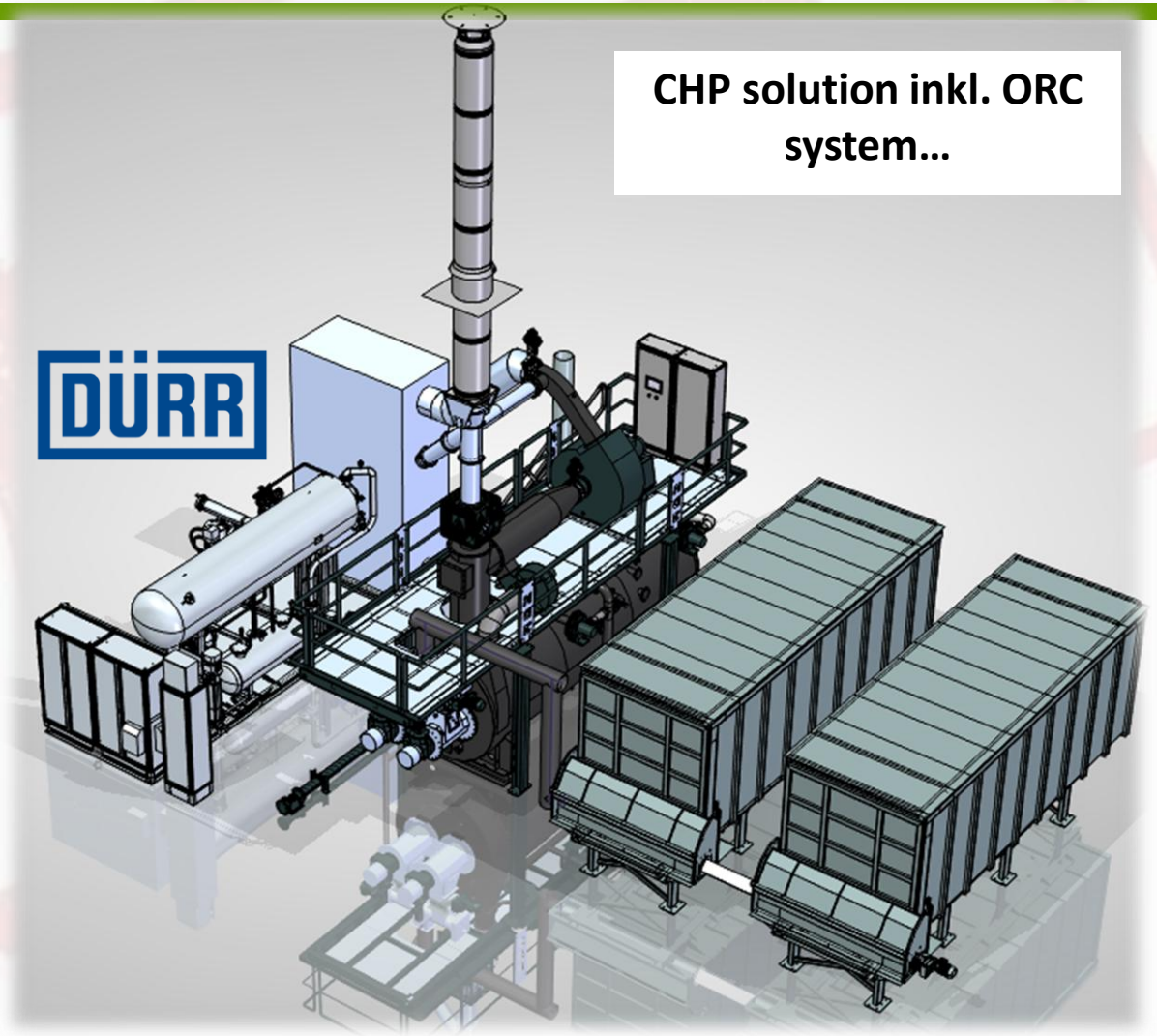
PyroPower

- Biomass → BioChar + CO_2 sink + power/heat
- Single Unit up to 800 kW $_{thermal}$
- CHP singleLine → 120kW$_{el}$ / 600kW$_{therm}$
- CHP multiLine → 500kW$_{el}$ / 2,350kW$_{therm}$



HotWater system e.g. for district heating





CHP solution inkl. ORC system…

“CarboGEO” - lighthouse project at ÖKT site…

Biochar production & decentralized heating

Basic system setup:

- 4 x 750 kW T:CRACKER (NGE)
- 470 kW_{el} + 2,380 kW_{therm} ORC system (DÜRR)

Provision of required **local heating** of **ca. 6,000 MWh/a**

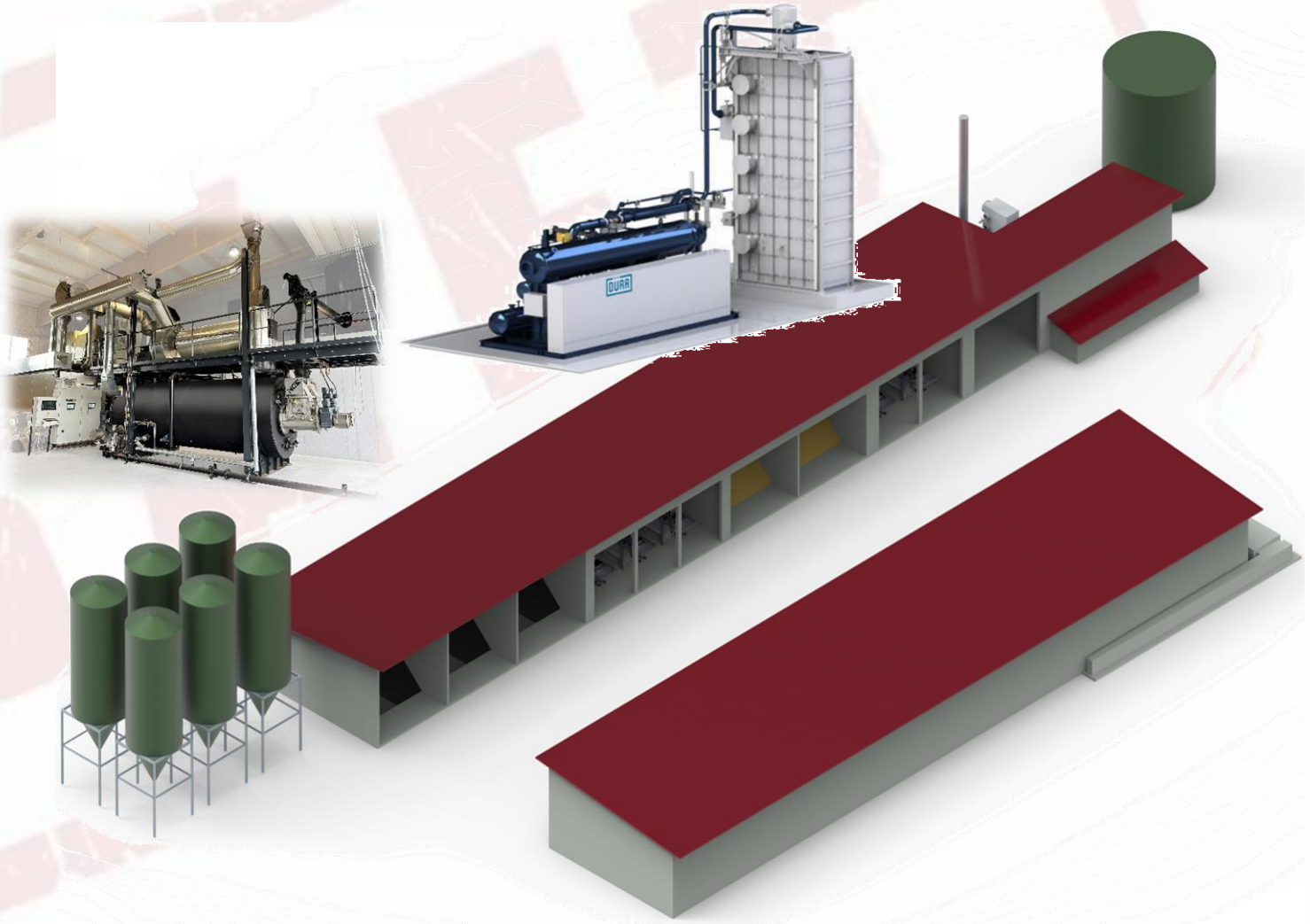
Residual heat utilization via raw material drying / service drying (wood chips, grass, etc.)

Electricity - feed-in of **ca. 3,500 MWh/a**

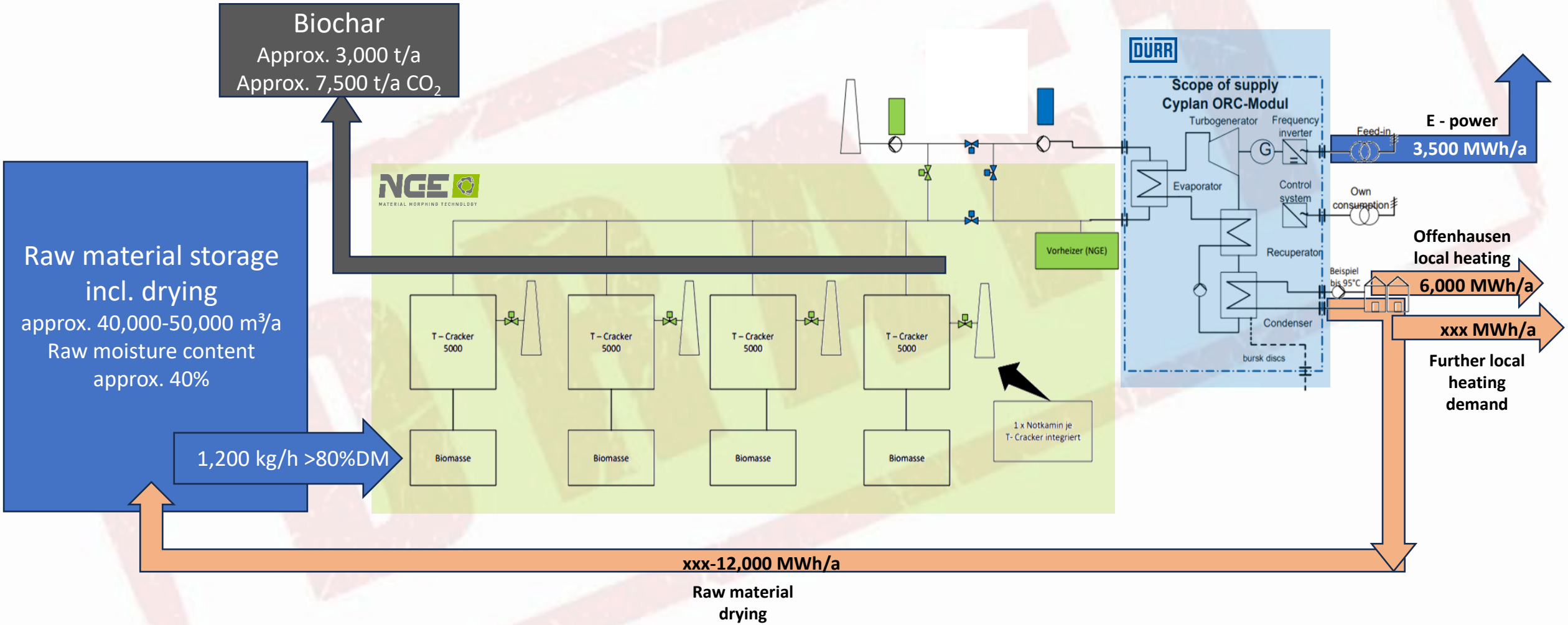
Biochar production - ca. 3,000 t/a | ca. 7,500 t/a CO_2 eq

Total investment: ca. 10 Mio EUR

USPs: take-off agreements already done (Biochar, CO_2, E-power and Heat); top experienced staff; local sourcing of feedstock …



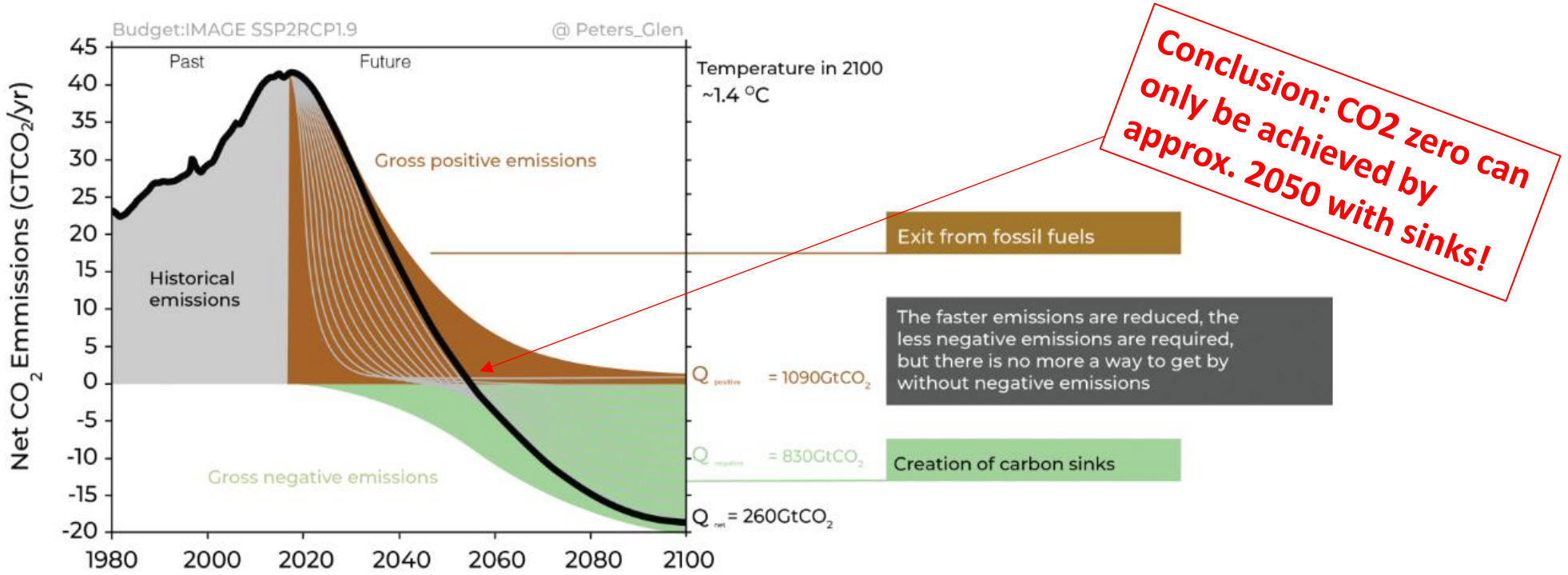
Process overview



Markt

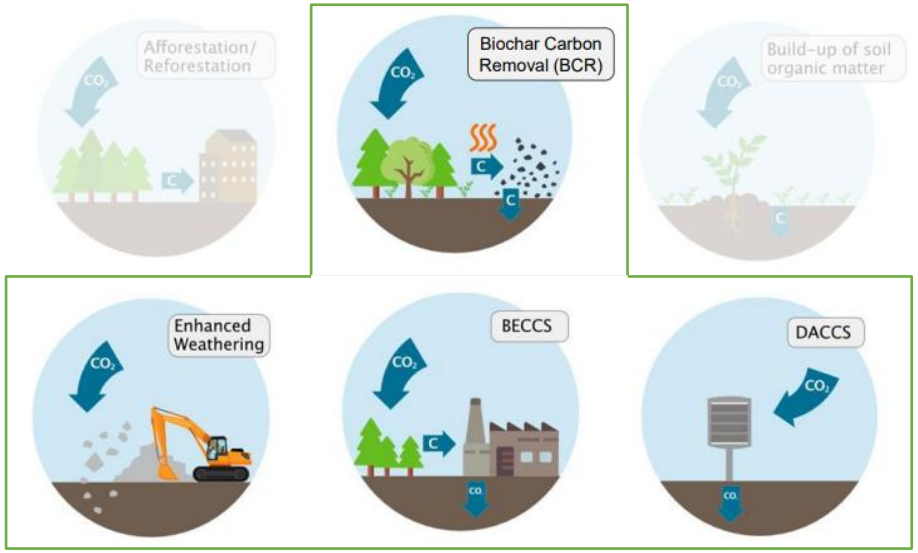
Market Drivers – **NET ZERO TARGET 2050**

In order to achieve the "net zero target" by 2050, companies must not only reduce (decarbonize) emissions, but also offset and thus neutralize the emissions they produce!



Markt

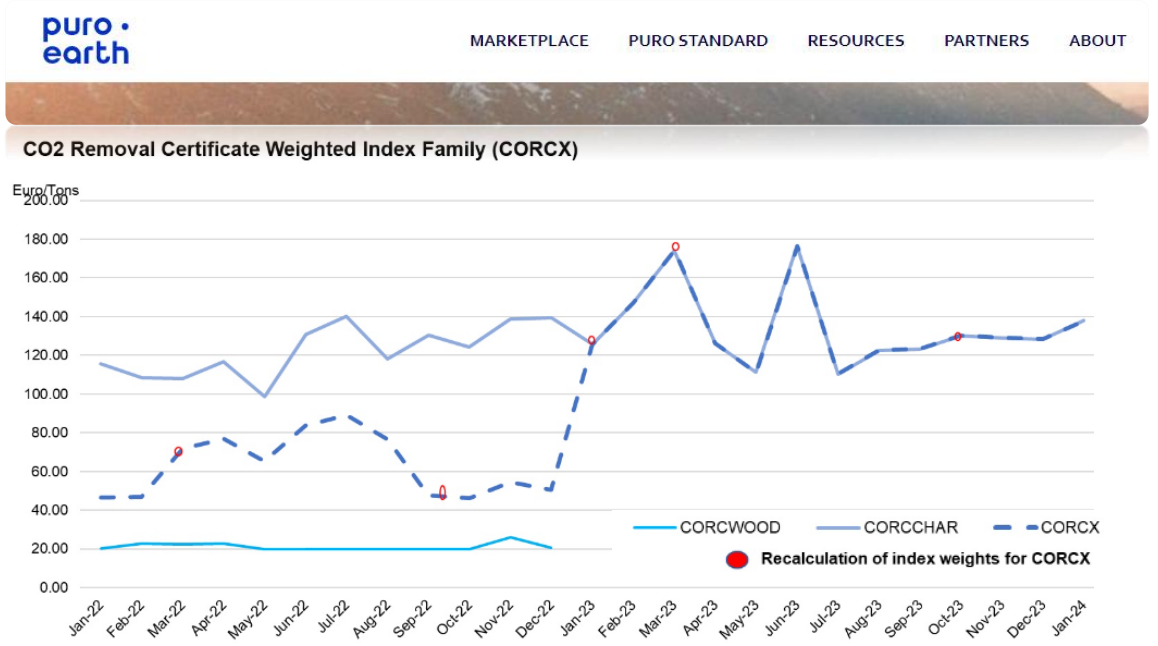
Six highly relevant carbon removal options



Source: European Biochar Market Report 2022/2023

- BioChar is one opportunity to offer C-sinks!

permament carbon removal



Source: http://puro.earth

- Puro.earth (part of Nasdaq the world's leading crediting platform for engineered carbon removal.
- Voluntary Certificate Market (VCM) - certificates in the range of 150 - 200€/t CO_2 and more are traded here.

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Markt

Market Drivers – **OVERVIEW**

Currently several market trends align to create an opportunity for a decentral technology combining waste treatment, energy production and decarbonisation.

+ **Rules and Regulations**
Legal frameworks increasingly impose limitations on disposal options, often increasing costs of existing solutions.

+ **Energy Prices**
It becomes more and more attractive to harvest the energy content, that is available, even in wet biomass.

+ **GHG and Carbon Capture**
Increasing cost of CO2 emissions make it attractive to harvest carbon contained in waste and re-use or store it.

+ **Circularity**
The market looks for solutions capable of bringing every last bit of the waste to a new use, such being zero-discharge.

+ **Decentralisation**
Decentral solutions become more attractive with low-CAPEX solutions, that are easy to operate locally.

Summary

- Inputmaterial: WET or DRY -> What will the requirements of the steel industry be?
  - What is the right input material for the steel industry?
  - Are the properties of the biochar currently on the market sufficient for the steel industry?
  - Can the coals currently on the market be used in the steel industry?
- Technology:
  - The sizes of the systems are currently optimized for the customers and the current demand.
  - Are there new requirements for biochar that can be set in the process?
- Market:
  - The need to save CO_2 is clearly required and biochar is one **possibility.**
  - The regulations are gradually being tightened.

Thank you very much!