Combining BCR + BECC(S)

at a fully integrated 500 kWel Bioenergy CHP plant in Austria.

Marcel Huber, CEO SYNCRAFT

SYNCRAFT®
Climate Positive Solutions.

BRIGHT

Agenda.

SYNCRAFT Climate Positive Solutions.

- SYNCRAFT Company
- Technology
- #ReversePowerPlants
- Biochar / BCR
- BECCS Technology
- Let's Work Together

SYNCRAFT Climate Positive Solutions.

Syncraft Company.

COMPANY.
Facts & Figures

SYNCRAFT®
Climate Positive Solutions.

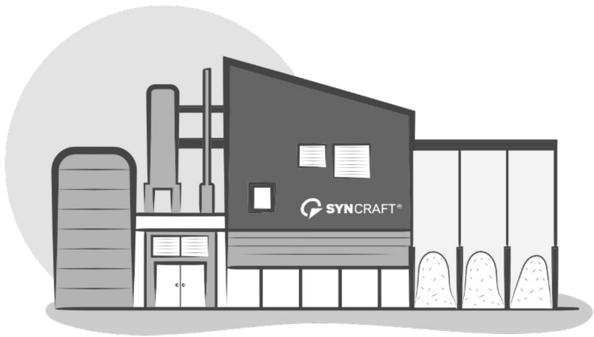
- Greentech company based in **Tyrol** / Austria
- Founded in 2009 as an **MCI university spin-off**
- Revenue 2022 roughly: **20 million euro**
- More than **50 employees** form **#teamSYNCRAFT**
- We pursue the mutual goal of **combating climate change**

Company.

Business

SYNCRAFT #Reversepowerplants

Our power plants only use woody residues to generate bioenergy and negative emissions. They are featured with patented floating fixed bed gasification technology.



Heat

Power

Biochar

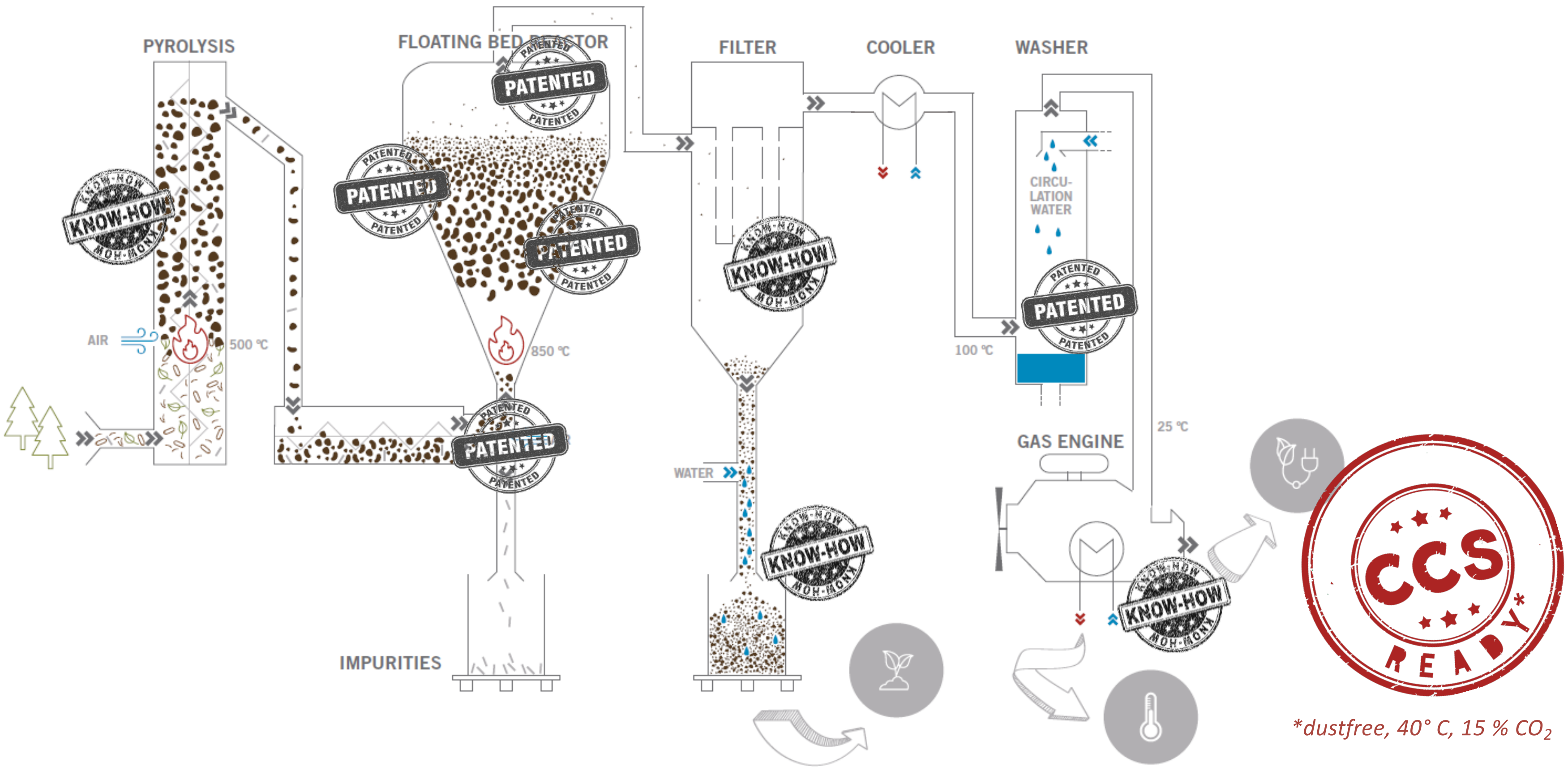
BCR

SYNCRAFT ®
Climate Positive Solutions.

SYNCRAFT TECHNOLOGY.

SYNCRAFT Technology.

Unique and multiple patented



*dustfree, 40° C, 15 % CO_2

SYNCRAFT® Climate Positive Solutions.

SYNCRAFT
#Reversepowerplants

SYNCRAFT #REVERSEPOWERPLANTS.

Systems Overview.

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	CW1200-400	CW1800-500	CW1800x2-1000
Electrical power	400 kW	500 kW	1,000 kW
Thermal power 90 °C	572 kW	740 kW	1,404 kW
Thermal power ~50 °C	227 kW	250 kW	500 kW
Fuel heat capacity	1,429 kW	1,808 kW	3,527 kW
Fuel demand (dry)	286 kg/h	362 kg/h	705 kg/h
Specific fuel demand (dry)	0.71 kg/kWh el	0.72 kg/kWh el	0.71 kg/kWh el
Premium charcoal	3.5 m³/d	4.5 m³/d	9 m³/d
Space required by gas generator	ca. 120 m²	ca. 120 m²	145 m²
Space required by engine	ca. 55 m²	ca. 55 m²	65 m²
Space required for bunker (week's supply)	278 m³	418 m³	480 m³

SYNCRAFT #REVERSEPOWERPLANTS.

References

2023

NAWARO ENERGIE
Perg / AUSTRIA

CW1800-500 x 2
1,000kW
- 3,000 t/a CO2 eq.

SYNCRAFT #REVERSEPOWERPLANTS.

References

SYNCRAFT®
Climate Positive Solutions.

2022

BIOENERGIE FRAUENFELD
Frauenfeld /CH

CW1800 x 2-1000x4
4 000kW
- 12 000 t/a CO_2 eq.

BIOENERGIE
FRAUENFELD

SYNCRAFT #REVERSEPOWERPLANTS.

References

2020

FOREST ENERGY
Shingu / JAPAN

CW1800-400x4
1,600kW
- 6,000 t/a CO2 eq.

SYNCRAFT #REVERSEPOWERPLANTS.

References

2020

TERSA

Osijek / CROATIA

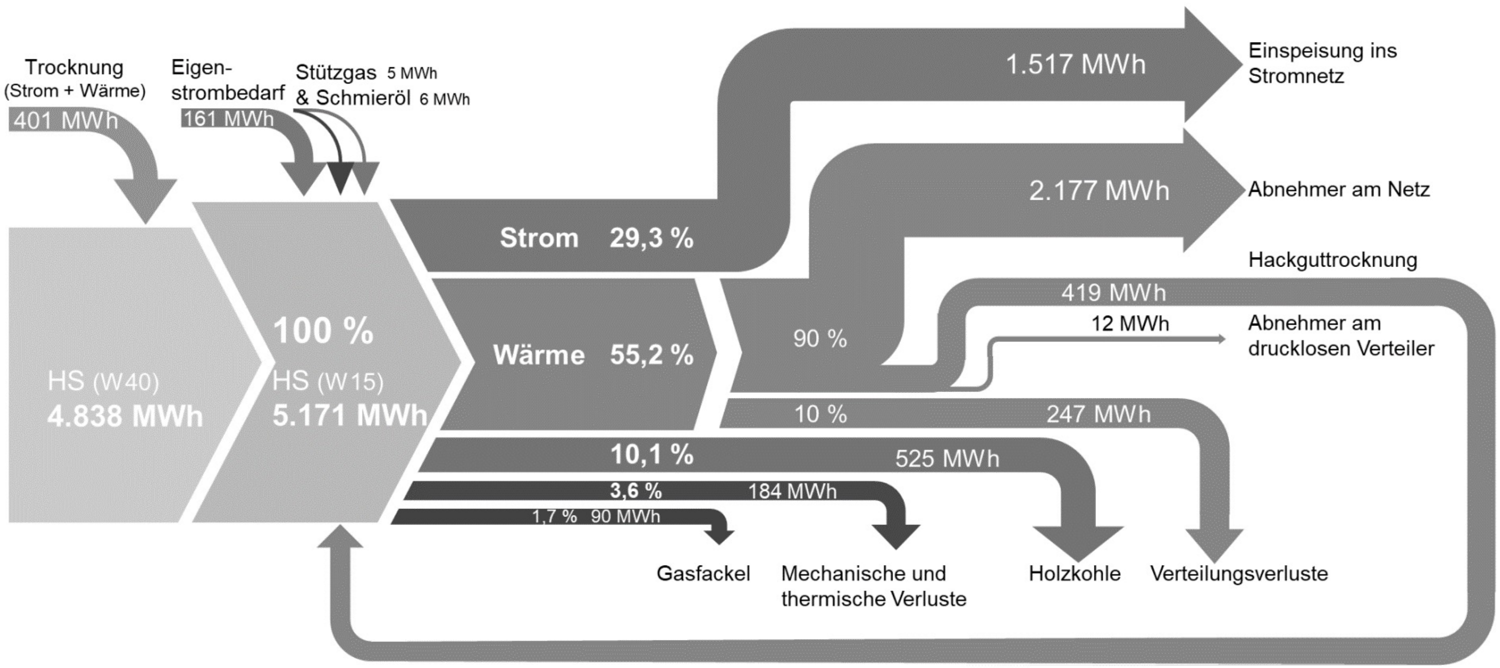
CW1800-400

400 kW

- 1,200 t/a CO2 eq.

SYNCRAFT #REVERSEPOWERPLANTS.

Typical Energy Flow Chart



Käppler, Elena (2017): Lebenszyklusanalyse der Strom- und Wärmeerzeugung einer Holzvergasungsanlage inklusive Nahwärmenetz Am Beispiel des Schwebefestbettvergasers des Energiewerk Ilg, unveröffentlichte Masterarbeit, Energietechnik und Energiewirtschaft, Dornbirn: Fachhochschule Dornbirn, S. 12

SYNCRAFT #REVERSEPOWERPLANTS.

Profitability

Investment	+ 6 cent/kWh
Financing	+ 1 cent/kWh
Operation & maintainance	+ 4 cent/kWh
Fuel	+ 7 cent/kWh
Revenue heat	- 6 cent/kWh
Revenue biochar	- 1 cent/kWh
Energy costs	+ 11 cent/kWh*

* Based on plant type CW 1800-500 incl. infrastructure, 7,500 hours per year, 90 €/t fuel, 4 cents/kWh heat revenue; Revenue from charcoal 200 €/t

Let's Return To Combining BCR + BECC(S)

SYNCRAFT #REVERSEPOWERPLANTS.

SYNCRAFT Reverse Power Plant in Stöcken / AUSTRIA

2019

EnergieWerk Ilg
Dornbirn Stöcken/
AUSTRIA

CW1800-500
500 kW
- 1,500 t/a CO2 eq.

SYNCRAFT #REVERSEPOWERPLANTS.

SYNCRAFT Reverse Power Plant in Stöcken / AUSTRIA

SYNCRAFT
Climate Positive Solutions.

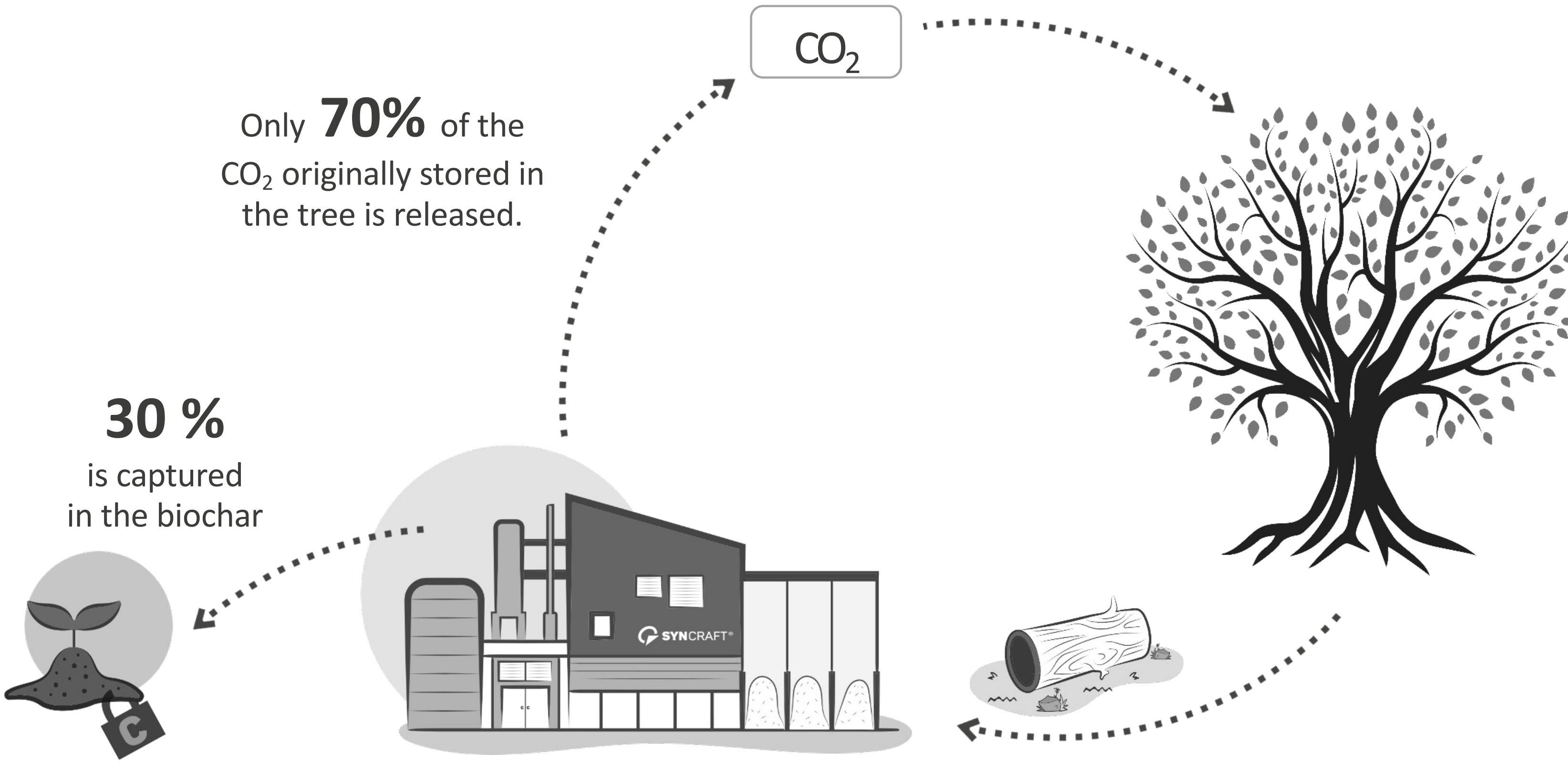
– Investment:	ca. 3.5 Mio. €
– Construction time:	7 months
– Electrical power:	500 kW
– District heating 90°C	740 kW
– Annual operating hours	> 8,000 h
– Total operation hours:	> 35,000 h
– Total efficiency :	93,1% incl. Biochar
– Biochar usage:	EBC sink + EBC feed

EBC
PYROGENIC CARBON SINKS
EUROPEAN BIOCHAR CERTIFICATE (EBC)

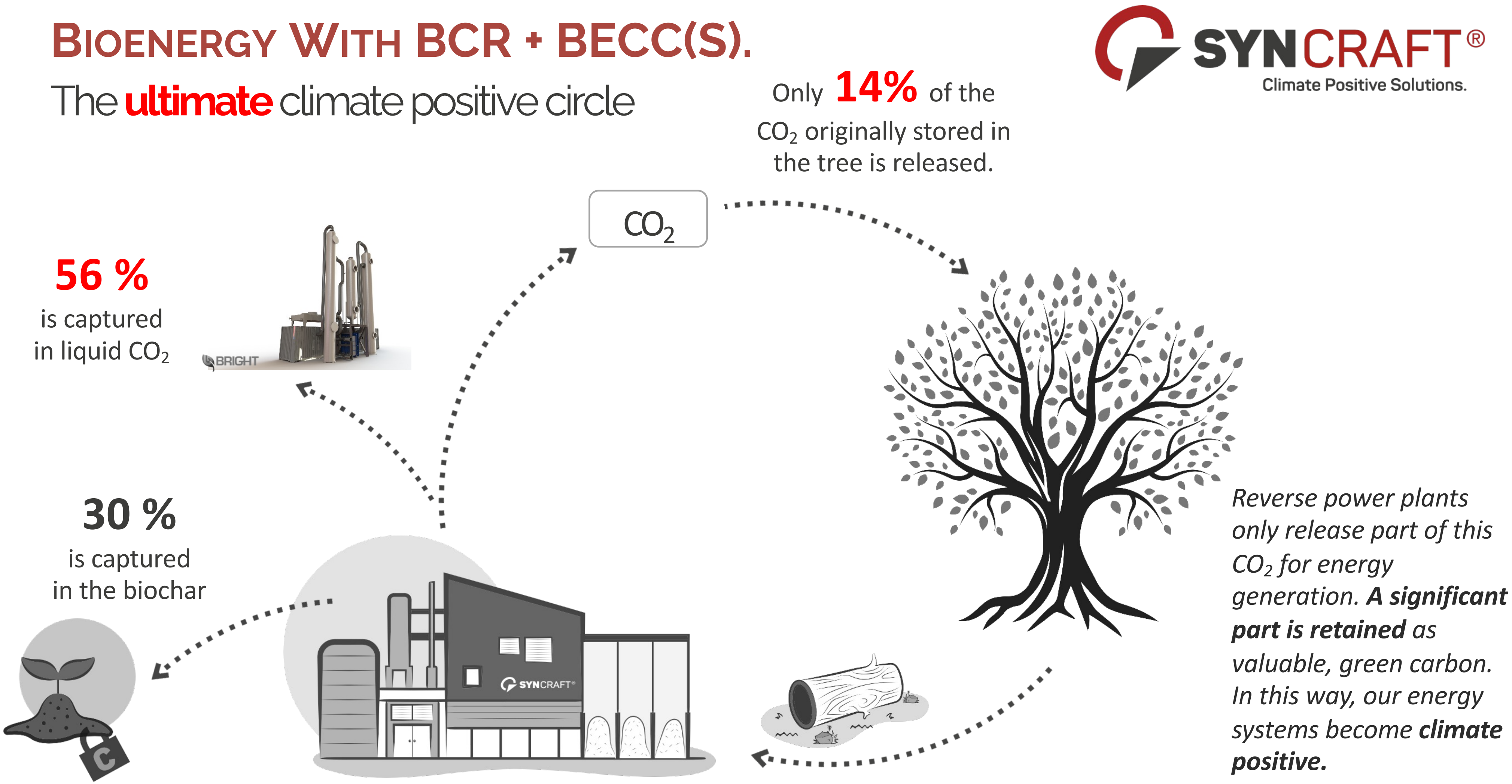
Bioenergy With BCR

The climate positive circle

SYNCRAFT®
Climate Positive Solutions.



Reverse power plants only release part of this CO_2 for energy generation. ***A significant part is retained*** *as valuable, green carbon. In this way, our energy systems become* ***climate positive.***


BIOENERGY WITH BCR + BECC(S).
The ultimate climate positive circle
SYNCRAFT®
Climate Positive Solutions.
Only 14% of the
CO₂ originally stored in
the tree is released.
CO₂
56 %
is captured
in liquid CO₂
BRIGHT
30 %
is captured
in the biochar
SYNCRAFT®
Reverse power plants only release part of this CO₂ for energy generation. A significant part is retained as valuable, green carbon. In this way, our energy systems become climate positive.

SYNCRAFT
BIOCHAR / BCR.

SYNCRAFT BIOCHAR.

High quality raw material

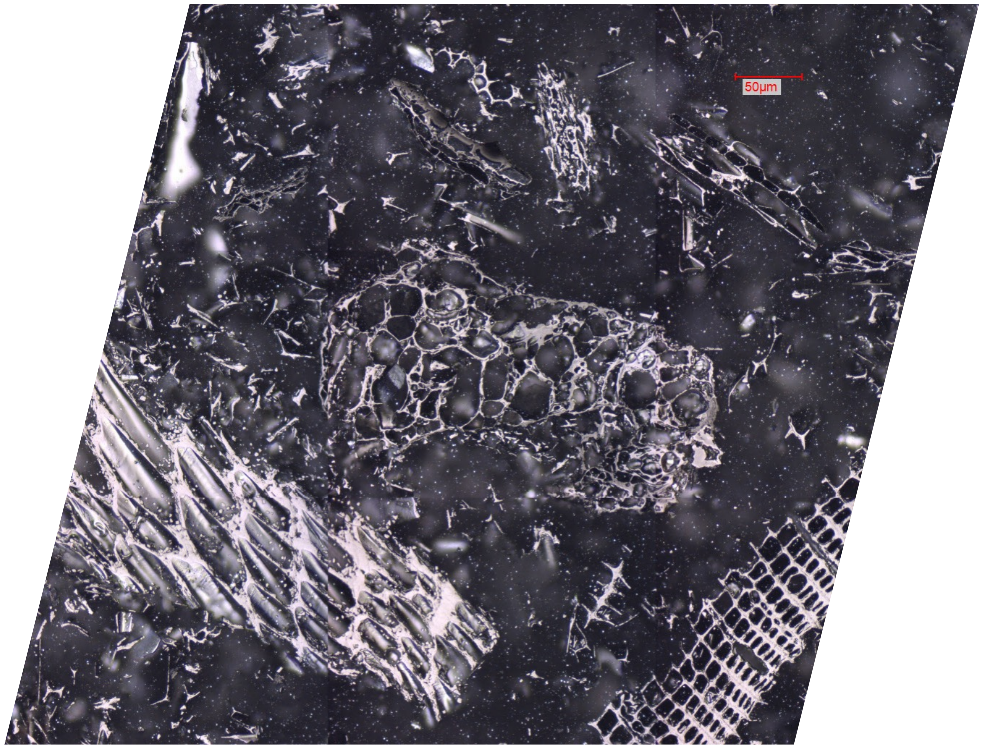
Climate Positive Solutions.

SYNCRAFT BIOCHAR.

Inertinite

SYNCRAFT® Climate Positive Solutions.

- **Inertinite** is carbon found in the lithosphere of earth's crust.
- It has been derived from biomass over ages and describes carbon at its most stable form.
- Organic geochemists determine its maturity (inertness) of organic carbon by measuring its reflectance (more reflective = more structured/aromatic = more inert). At a reflectance of 2%, these carbons are considered chemically inert (geologically stable).
- With an average reflectance of almost **4%, SYNCRAFT generated biochar** is among the most stable forms of carbon currently existing.



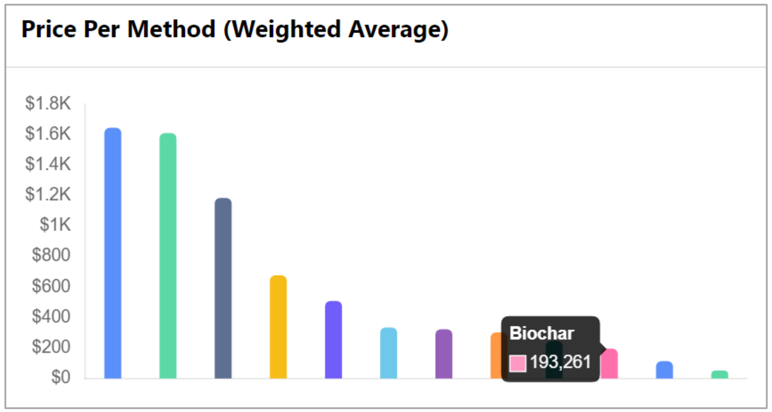
SYNCRAFT BIOCHAR.

Price tag BioChar / BCR

Scenario 1 – Replacing carbon in a sink application
135 €/t + (3* x 190 €/t CDR) = 705 €/t BioChar
Raw material value + CDR Credit

Scenario 2 – Replacing carbon in a none sink application
135 €/t + (3* x 85 €/t ETS) = 390 €/t BioChar
Raw material value + ETS saving compared to fossile carbon

** Typical certified EBC sink value for SynCraft BioChar*



https://www.cdr.fyi/, 27.11.2023

BECC(S)
TECHNOLOGY.

BECCS Technology.

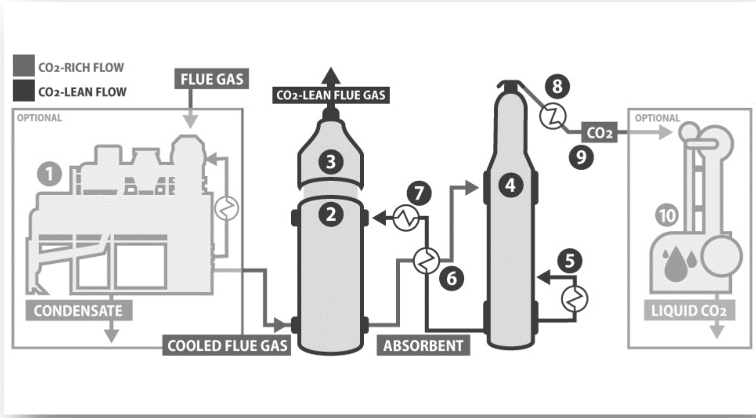
Reference: Dornbirn Stöcken / AUSTRIA

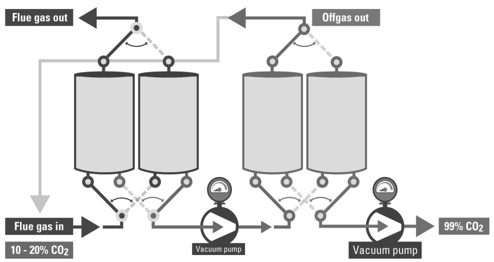
SYNCRAFT®
Climate Positive Solutions.

- Project target is to produce green soda / E290 for regional CCU
- The high-purity carbon dioxide (CO_2) obtained can be used for food and beverages and thus replace the use of CO_2 from fossil sources.
- Reduction of annual greenhouse gas emissions: 93.9%
- Savings in CO_2 equivalent to 3,117 tons per year
- Potential source for regional CCS application like re-carbonisation of concrete

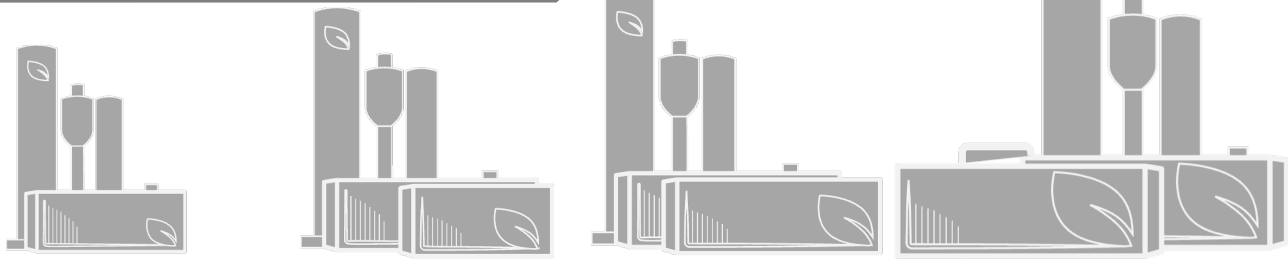
BECCS TECHNOLOGY.

Comparision of technologies





Liquid Amine Scrubber



Pressure Swing Adsorption

	Pico	Mini	Compact	Medium	Grand
Flue gas range (Nm^3/h)	500 – 2,500	2,500 – 5,000	5,000 – 12,000	12,000 – 20,000	20,000 – 30,000
Container size	40 ft	45 ft	40 ft + 20 ft	45 ft + 45 ft	45 ft + 45 ft
CO_2 captured (@ 15% v/v)	125 to 625 kg/h	625 to 1250 kg/h	1250 to 3125 kg/h	3125 to 5000 kg/h	5000 to 7500 kg/h
CO_2 captured (@ 7% v/v)	50 to 300 kg/h	300 to 600 kg/h	600 to 1500 kg/h	1500 to 2500 kg/h	2500 to 3500 kg/h

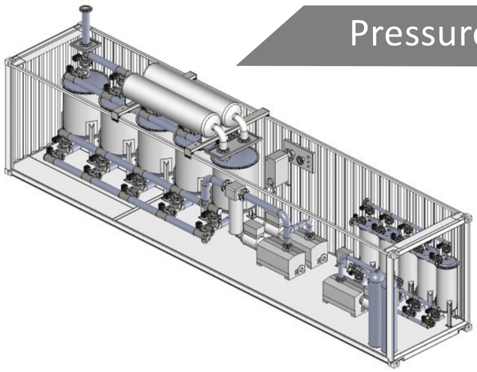
BRIGHT

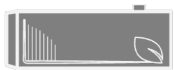
BECCS Technology.

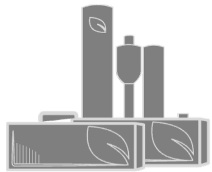
Comparision of technologies

Pressure Swing Adorption

Liquid Amine Scrubber







PSA	Parameters	Amine Scrubber
Up to 80%	**Carbon Capture Efficiency**	Up to 85%
Up to 0,15	**Electrical Consumption ($kWh/kgCO_2$)**	Up to 0,04
-	**Thermal Consumption ($kWh/kgCO_2$)**	Up to 1,1
Industrial grade (>99,5%)	**CO_2 Quality**	Foodgrade (>99,9%)

BECCS Technology.

Pricing Carbon Capture & CO_2 Liquefecation

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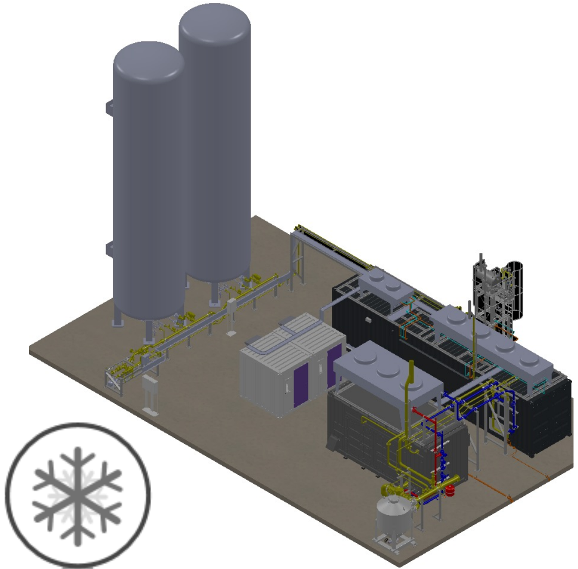
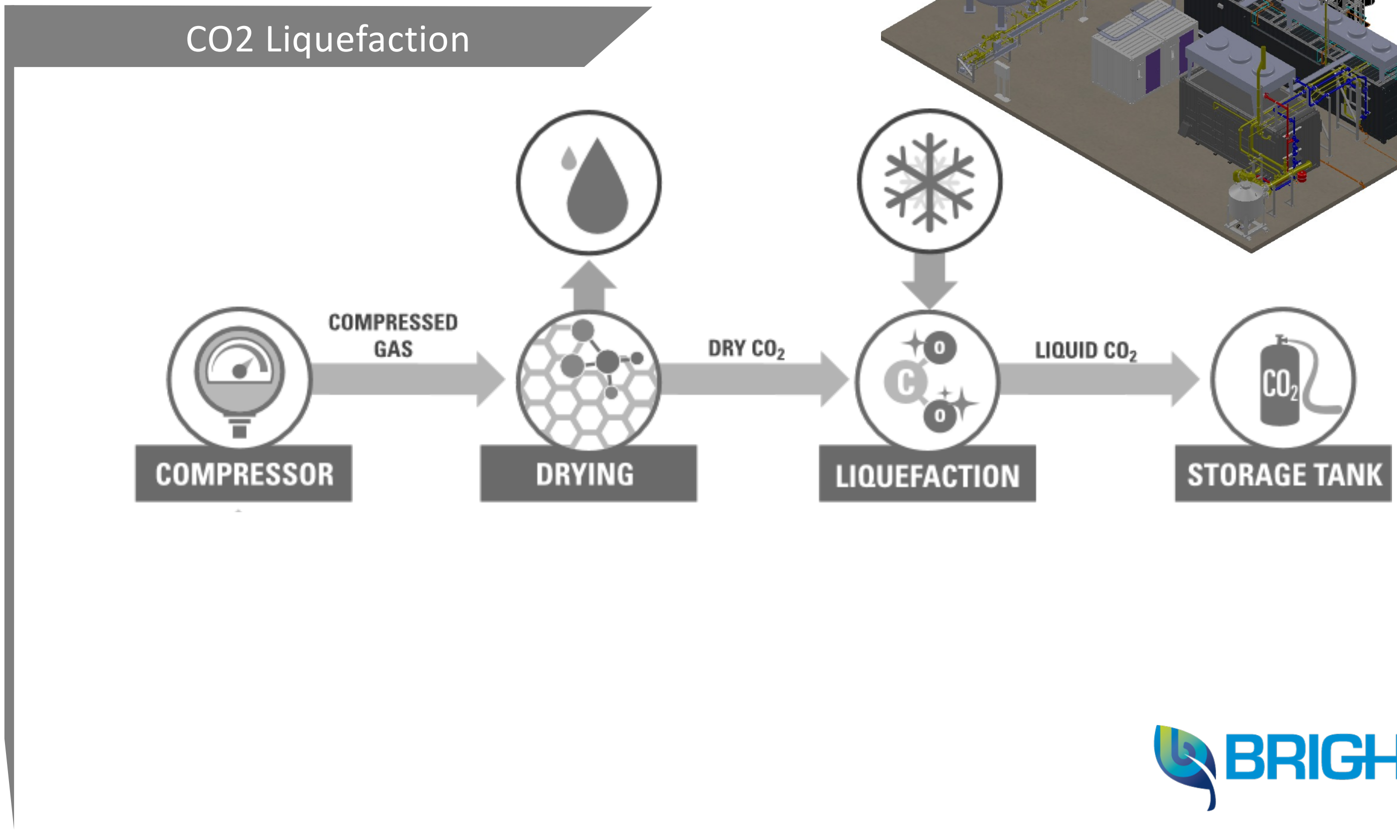
Climate Positive Solutions.

BRIGHT

BECCS Technology.

Pricing Carbon Capture & CO_2 Liquefecation





BECCS TECHNOLOGY.

Price tag CO_2 / E290

Side Facts

- Wood consists of ~ 50 % C
- 1t of wood = 1.8 t of CO_2
- C : CO_2 = 1 : 3.67

Profitability

- Costs: ca. 3.8 Mio. €
- Funding: KPC - Transformation der Wirtschaft / 80%
- Operation costs: 80 – 100 € / ton CO_2
- Target selling price: 150 – 200 €/ton CO_2
- Full costs (without funding): 250- 300 € / ton CO_2

BECCS Technology

Applications for the CO2 and more

CO_2 Applications:

- Food and beverages
- Greenhouses
- Cooling systems
- E-fuels (green H2 + biogenic CO2)
- Sequestration (geological storage)

Advantages of CO_2 capture in a biomass CHP plant:

- Heat heat at temperature (95°C)
- Regional CO_2 production
- CO_2-negative approach
- Retrofitting possible if CCS ready
- To be considered: energy consumption

No Regrets.
Modern Bioenergy in a decarbonised Energy System.

CO2 FOOTPRINTS OF ENERGY GENERATION.

In Europe

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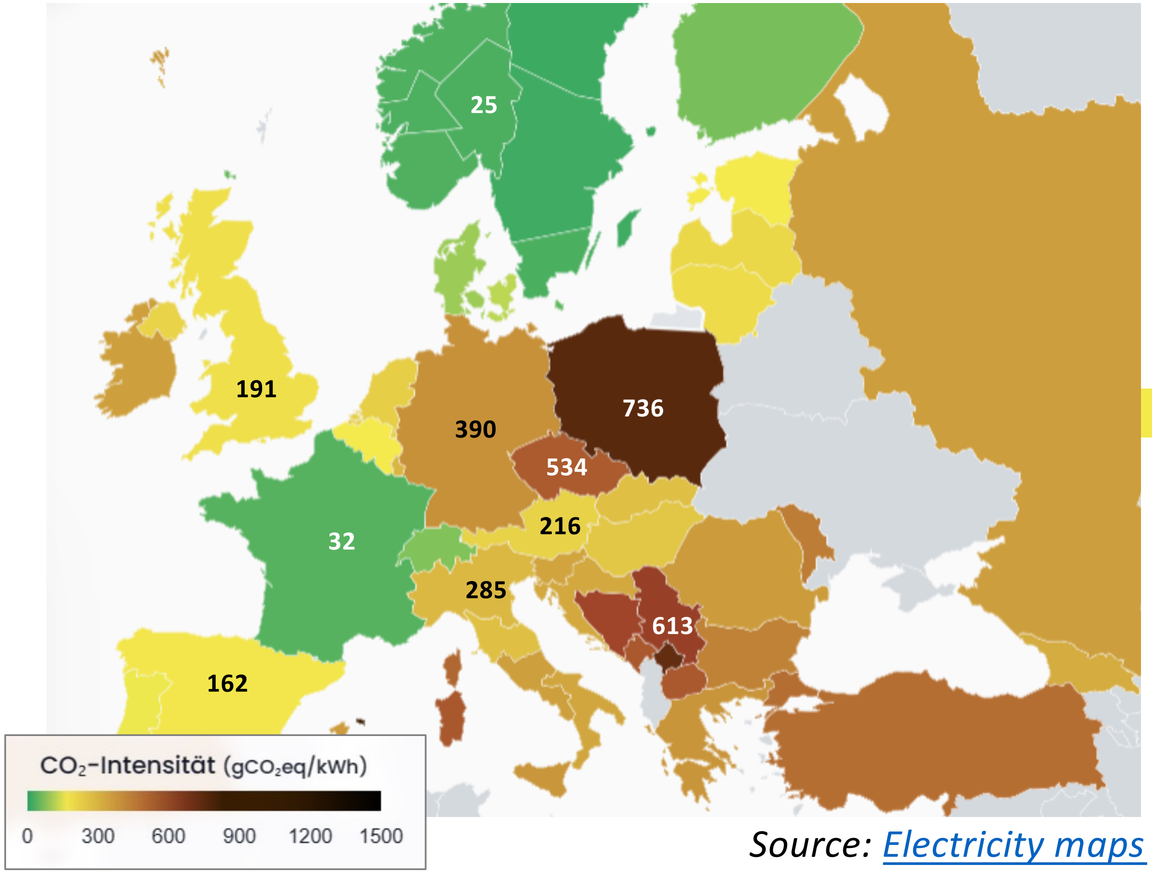
Climate Positive Solutions.



Source: Electricity maps

Ø EU*

600 g/kWh_{el}	300 g/kWh_{th}	becoming irrelevant
400 g/kWh_{el}	230 g/kWh_{th}	still relevant
210 g/kWh_{el}	130 g/kWh_{th}	highly relevant
25 g/kWh_{el}	25 g/kWh_{th}	partially relevant

Source:
BECC(S), BCR/BCR+ and other CDR options
Economics, carbon efficiency, limiting factors
Meyer T.; Lerchenmüller H.; eta al 2024

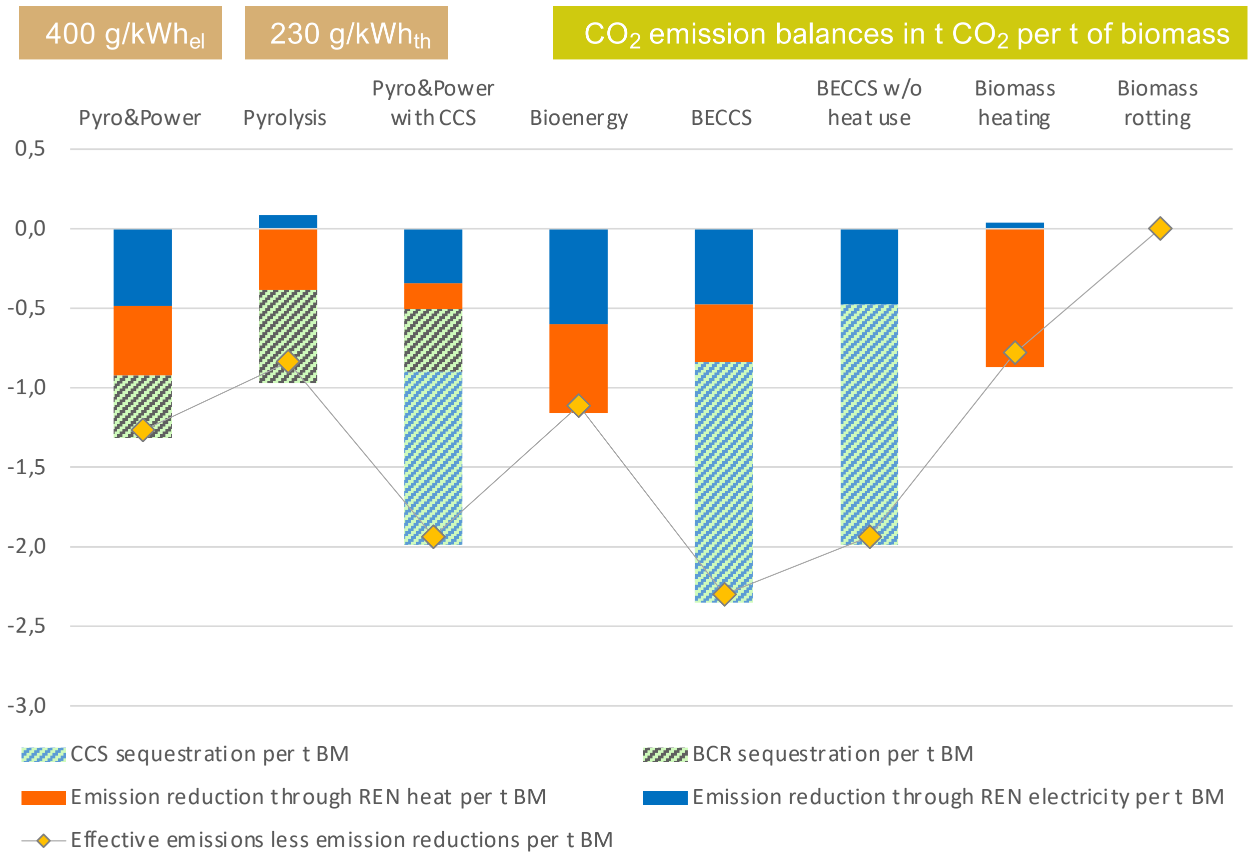
3E. Energie auf den Punkt

Supported by:
Carbonfuture

* the average footprint in Europe in 2020 was 226 g/kWh_{el}

The CO_2 Perspective.

with a look at biomass resource efficiency



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3E. Energie auf den Punkt

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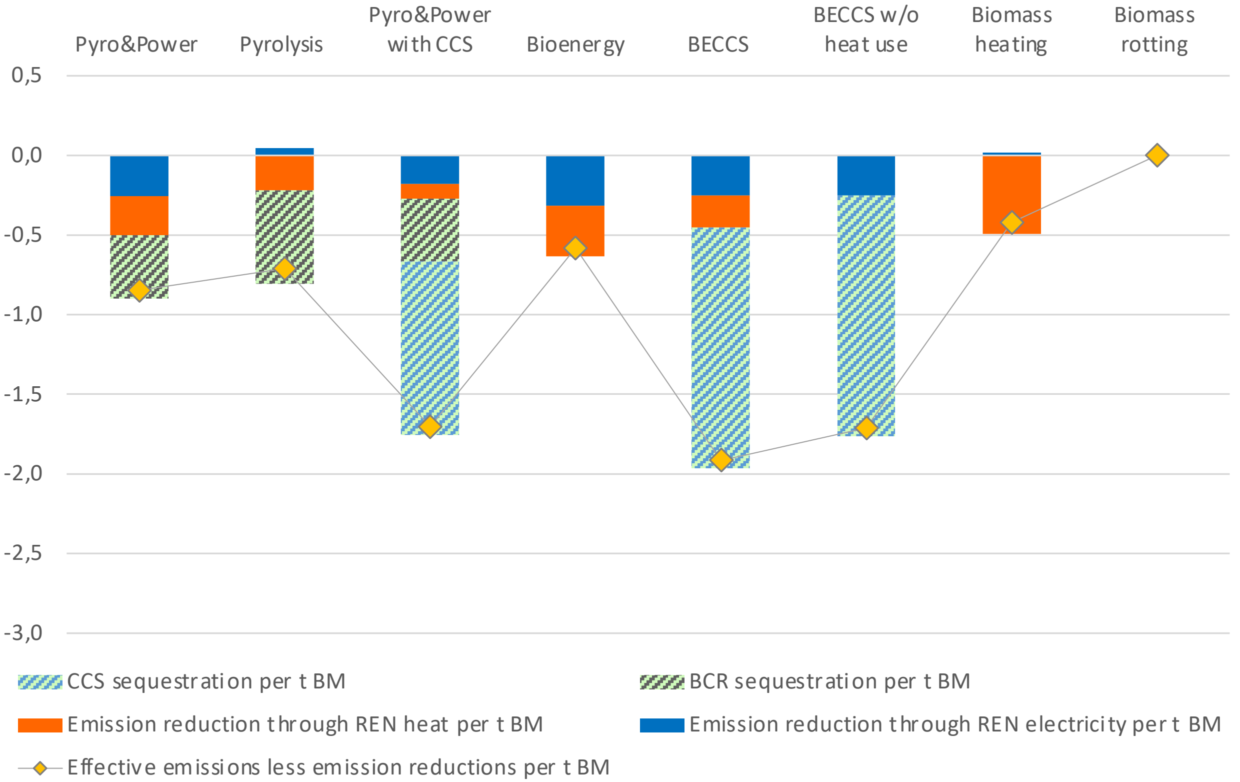
THE CO_2 PERSPECTIVE

with a look at biomass resource efficiency

210 g/kWh$_{el}$ 130 g/kWh$_{th}$ CO_2 emission balances in t CO_2 per t of biomass



Source:
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Economics, carbon efficiency, limiting factors
Meyer T.; Lerchenmüller H.; eta al 2024

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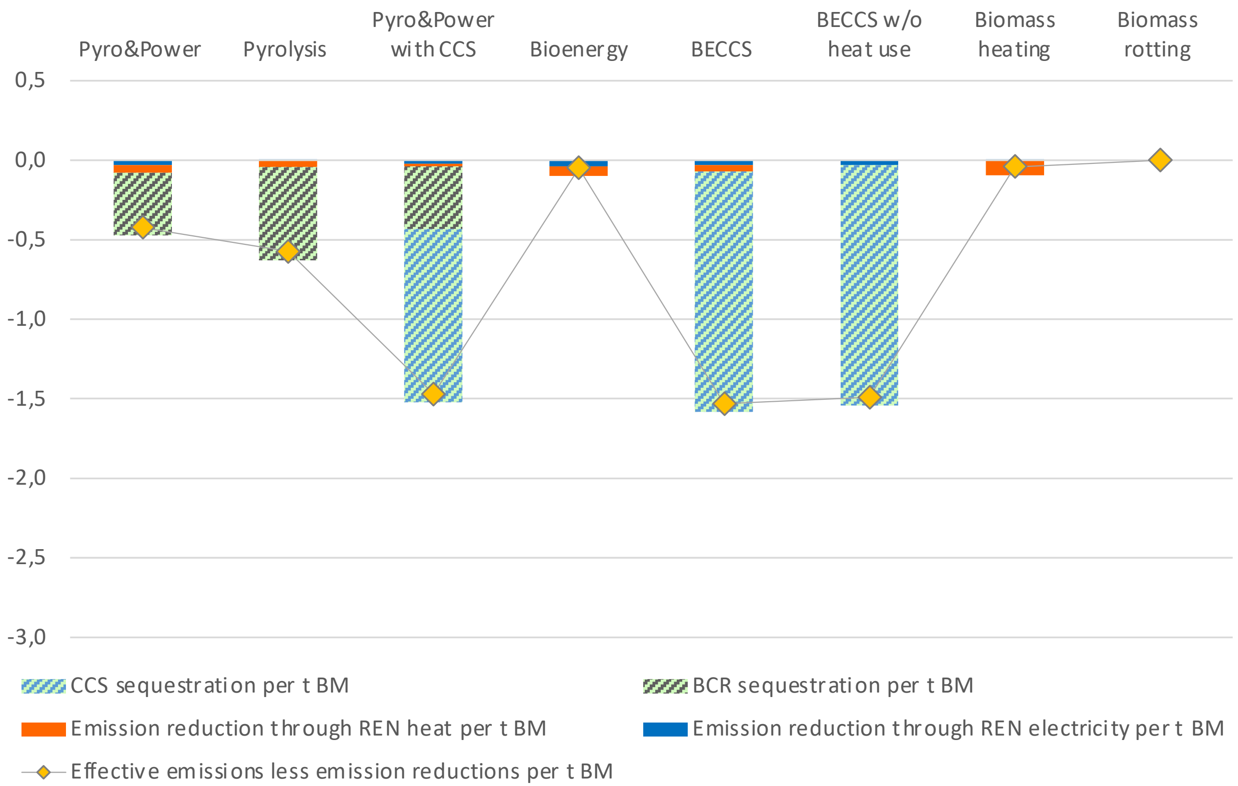
THE CO_2 PERSPECTIVE

with a look at biomass resource efficiency

25 g/kWh$_{el}$

25 g/kWh$_{th}$

CO_2 emission balances in t CO_2 per t of biomass



Source:
BECC(S), BCR/BCR+ and other CDR options
Economics, carbon efficiency, limiting factors
Meyer T.; Lerchenmüller H.; eta al 2024

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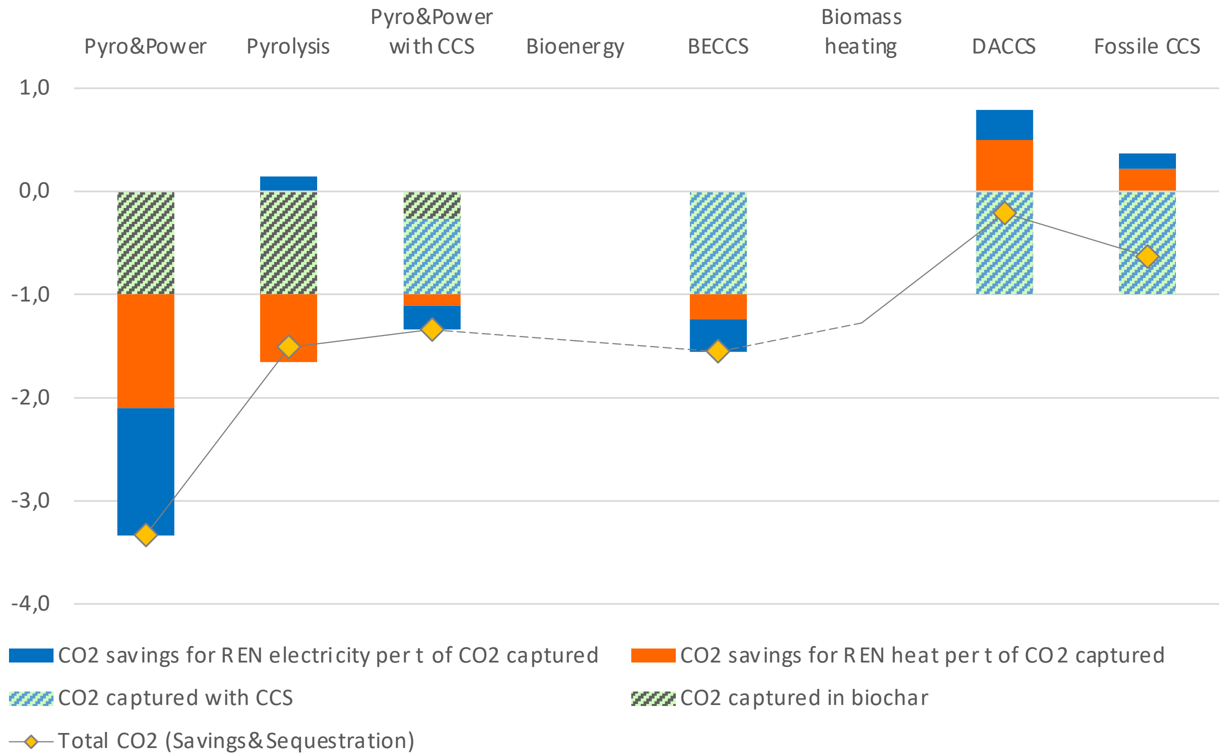
Carbonfuture

THE CO_2 PERSPECTIVE

with a look at net CO2 effect per captured t of CO2

400 g/kWh$_{el}$ | 230 g/kWh$_{th}$ | CO_2 emission balances in t CO_2 per t CO_2 captured



Source:
BECC(S), BCR/BCR+ and other CDR options
Economics, carbon efficiency, limiting factors
Meyer T.; Lerchenmüller H.; eta al 2024

Supported by:
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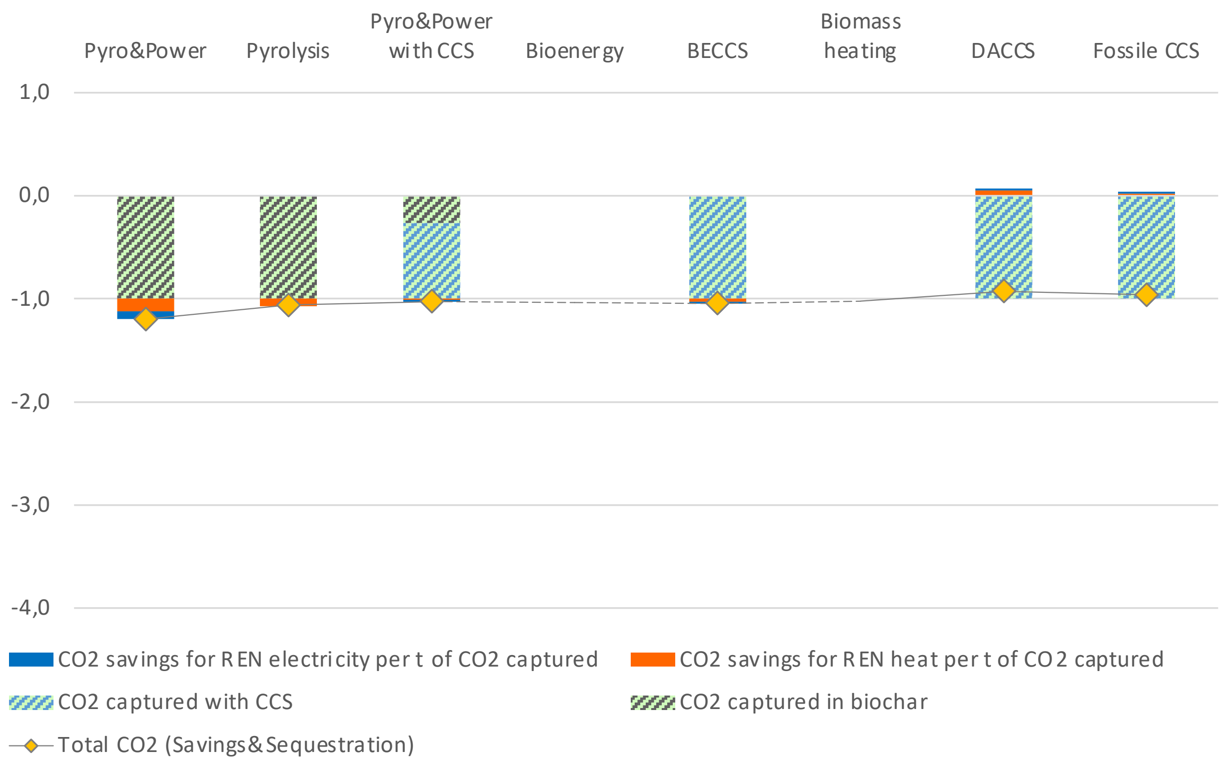
THE CO_2 PERSPECTIVE

with a look at net CO2 effect per captured t of CO2

25 g/kWh$_{el}$ | 25 g/kWh$_{th}$ | CO_2 emission balances in t CO_2 per t CO_2 captured



Source:
BECC(S), BCR/BCR+ and other CDR options
Economics, carbon efficiency, limiting factors
Meyer T.; Lerchenmüller H.; eta al 2024

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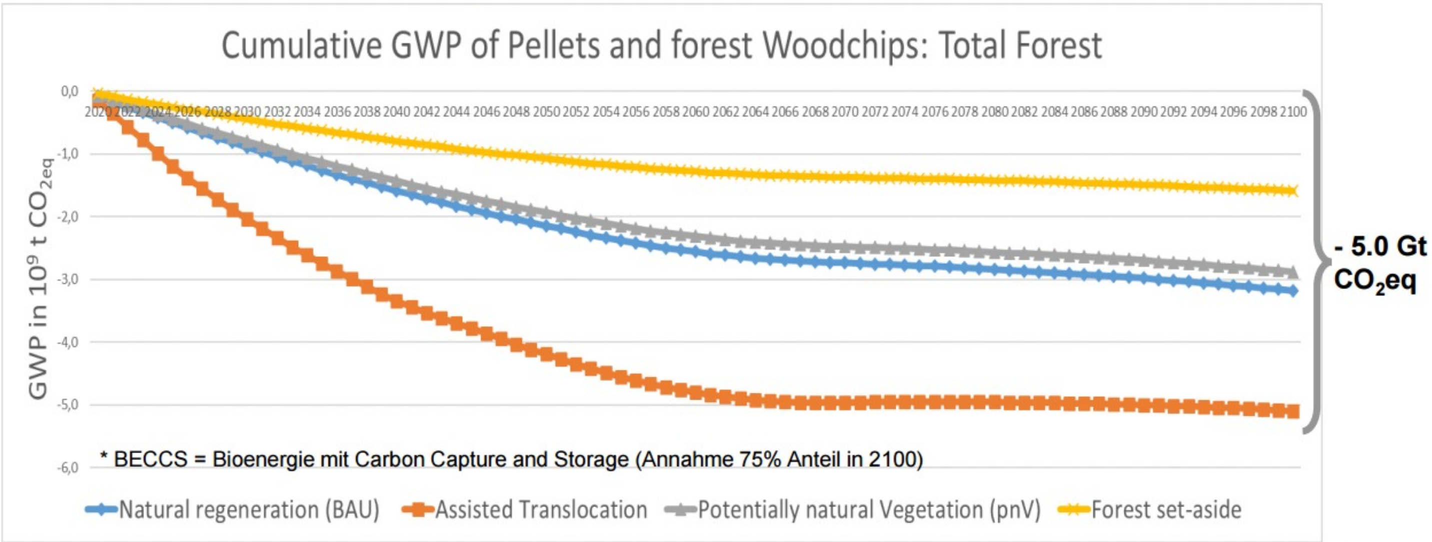
THE CO_2 PERSPECTIVE

The full potential of BCR, BECCS and Bioenergy together with an **assisted translocation** of forests.

SYNCRAFT® Climate Positive Solutions.

The elimination of fossil fuels reduces the substitution effect of bioenergy. With **BECCS** and **BCR** and an assisted translocation of the forest, the potential could be cumulatively increased to approx. 5 Gt Co_2eq by approx. 2060 and secured in the long term.



HOCHSCHULE WEIHENSTEPHAN-TRIESDORF UNIVERSITY OF APPLIED SCIENCES

Technische Universität München

PROJEKT KLIMAHOLZ 14
ÖSTERREICHISCHER BIOMASSETAG
08.11.2023

Source: Röder et. al, 2023, TUM

THE CO_2 PERSPECTIVE.

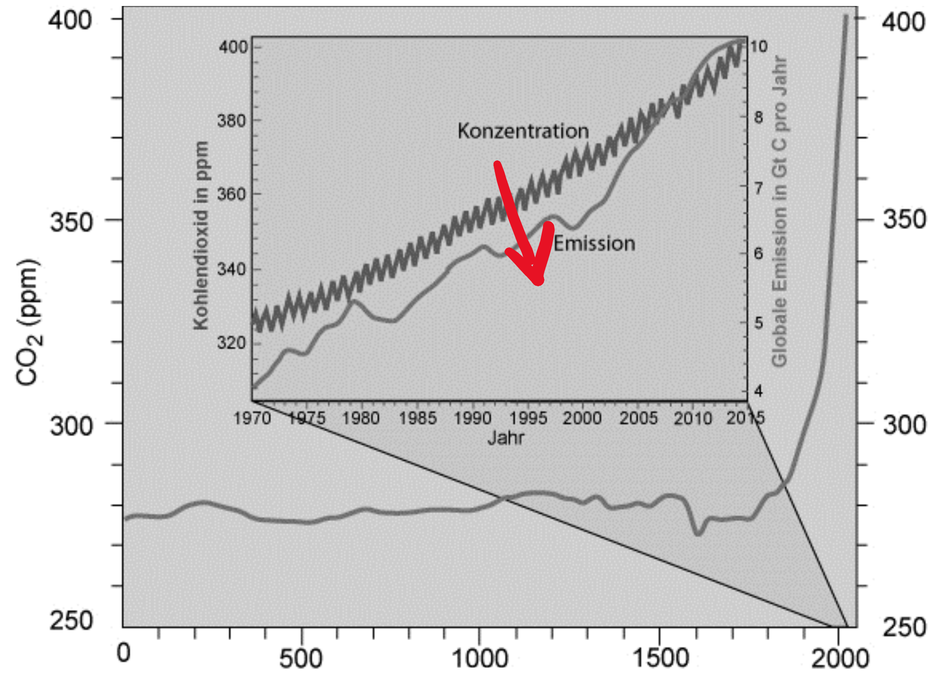
Let's ask the atmosphere if there is enough biomass to combat climate change with BECCS / BCR?

SYNCRAFT®
Climate Positive Solutions.

- Every summer in the northern hemisphere, atmospheric CO_2 is reduced despite the 50 Gt/a anthropogenic CO_2 emission.
- If we could stop the re-release of CO_2 from biomass in winter, the increase would already be halted today.
- Our plants stabilize* and concentrate >30% biogenic CO_2 in the form of biochar, in addition to providing renewable energy.
- If we, together do that consequently and at the right scale, we can **combat climate change.**

*forever until burned

Atmospheric concentration of carbon dioxide 0 - 2015



Source: CO_2 2007.jpg – Klimawandel (bildungsserver.de)


Let's
BCR + BECC(S)
work together
to write an
Incredible
new
Bioenergy Story
SYNCRAFT®
Climate Positive Solutions.