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Decarbonisation Strategies In Energy Systems Modelling: Biochar As A Carbon Capture Technology

Authors: Meritxell Domènech Monfort, Anna Sandhaas, Christoph Pönisch, Elmar Zozmann,
Niklas Hartmann

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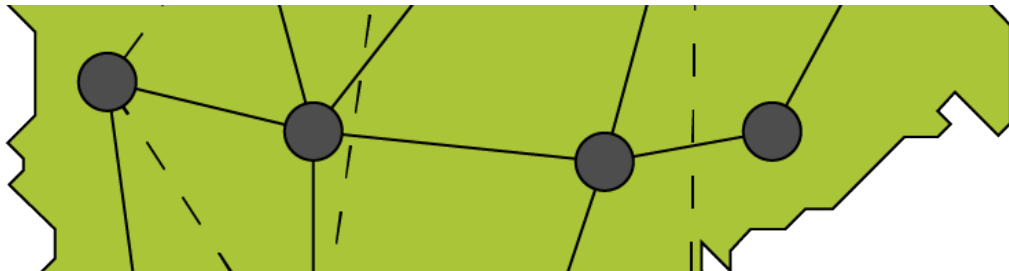
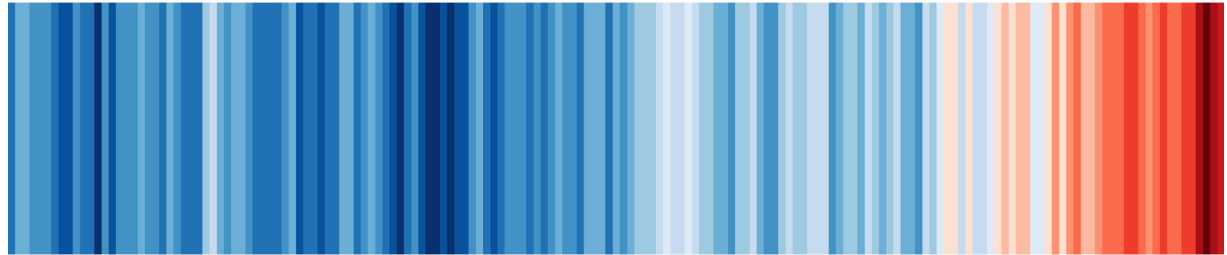
Motivation

Decarbonisation of the energy system

Germany's objective:
Zero emissions for 2045

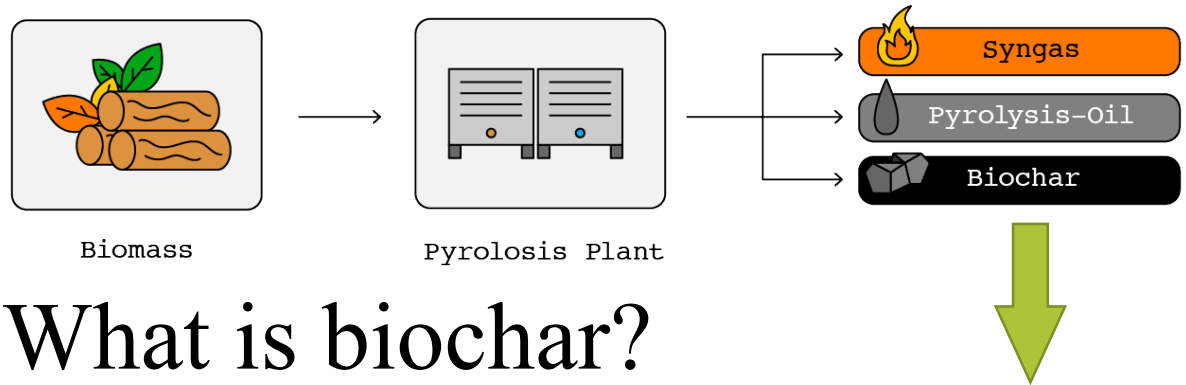
Landgewinn project

Goal: Analyse the effect of introducing pyrolysis in the energy system.



What is pyrolysis?

PYROLYSIS is the thermal decomposition in a limited oxygen environment of biomass into biochar, gases and liquids.

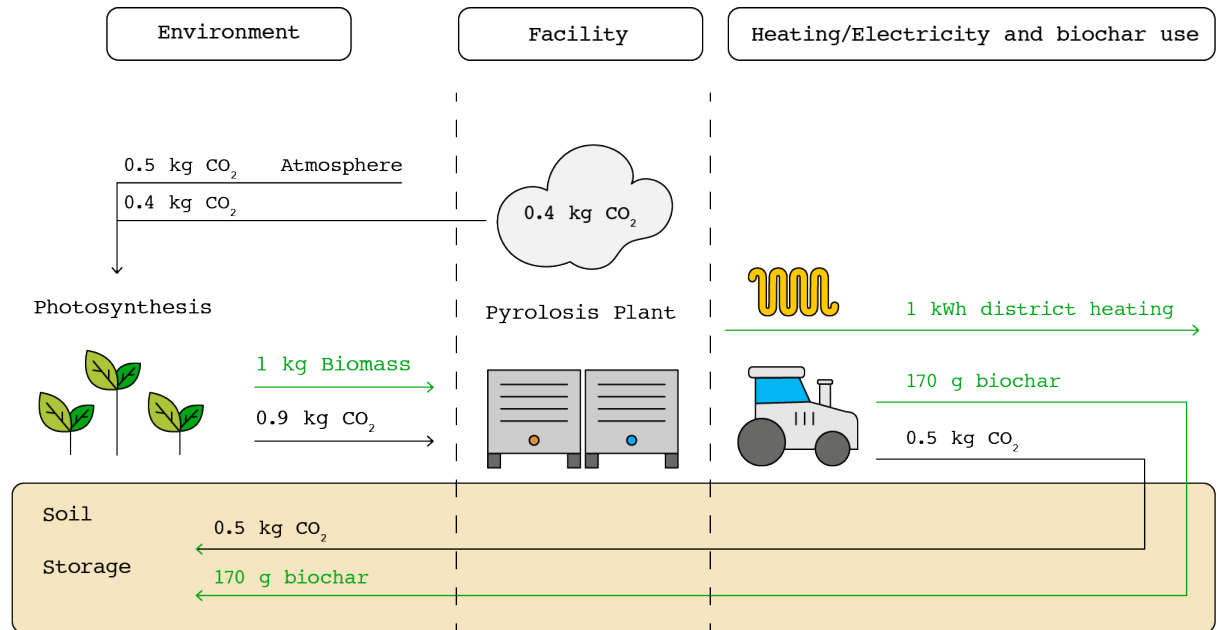


What is biochar?

BIOCHAR is a solid material with a **high carbon content** obtained from the pyrolysis of biomass.

Advantages to use it as a soil amendment:

- Reduce greenhouse gas emissions: C-Sink
- Improve soil quality

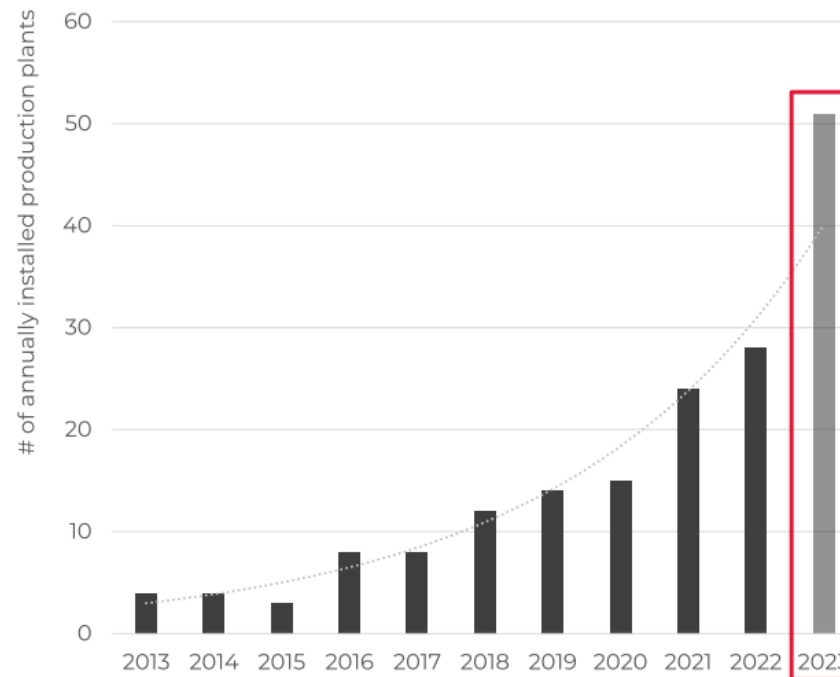


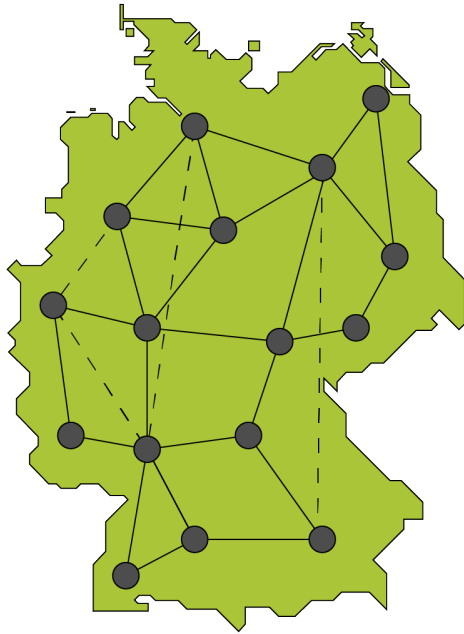
Current situation of biochar production

Source:
European Biochar Industry
Consortium: EU-Biochar
market report 2022/2023.

- Increasing trend
- 130 installations in Europe (end 2022)
- 51 projects are planned for 2023

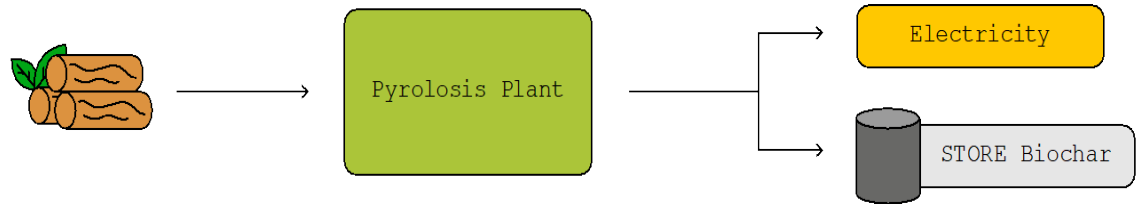
Installation of biochar production plants in Europe





Model

PyPSA-Eur-biochar



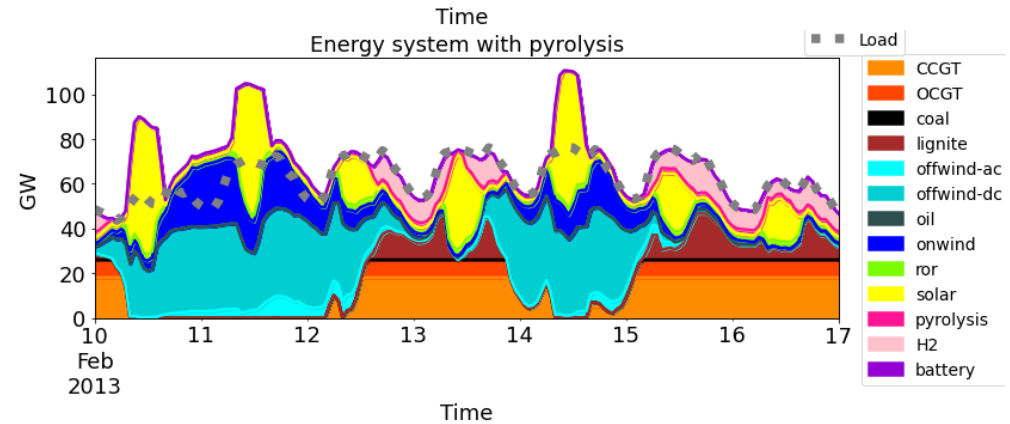
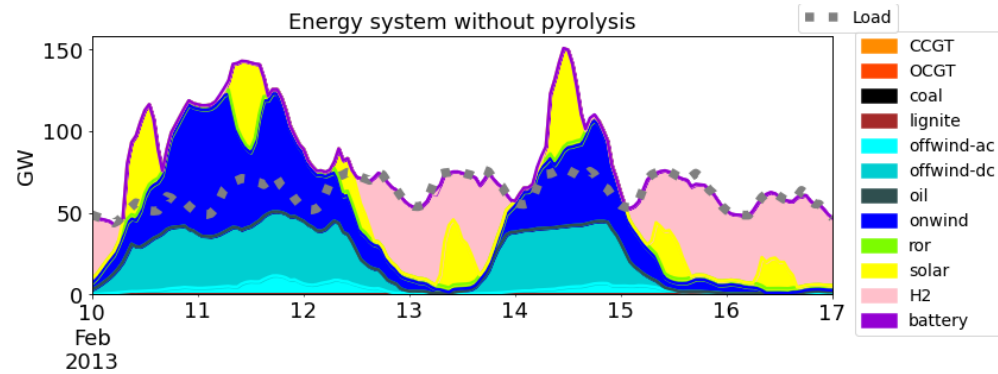
Scenarios settings

- European energy system
- Electricity sector
- Cost optimal solution
- Limit of **0 emissions** of CO₂ equivalent
- **Flexibility** technologies: hydrogen (electrolysis and fuel cell) and battery
- **Conventional** generators: oil, Open Cycle Gas Turbine (OCGT), Combined Cycle Gas Turbine (CCGT), coal, lignite, geothermal.
- **Renewable energy** generators: offshore wind-AC, offshore wind-DC, onshore-wind, run of river (ror) and solar

Results

Unit Commitment

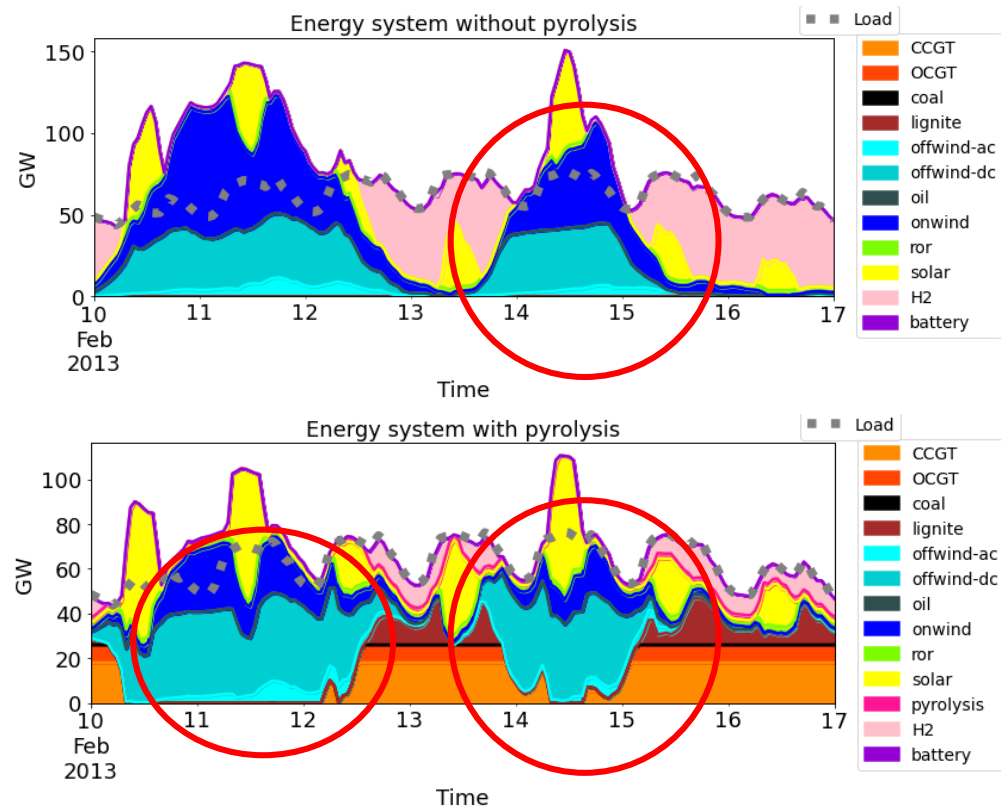
- Conventional power plants
- Capacity installed of renewables



Results

Conventional power plants

- Conventional power plants run when there is **not enough generation from renewables**.
- **Pyrolysis** compensates those emissions
- Energy system **costs** are **22% lower**



Results

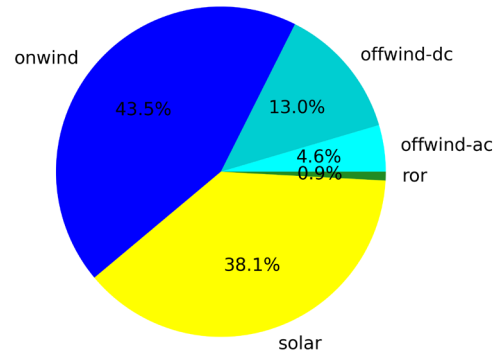
RES capacity

Capacity installed of renewables

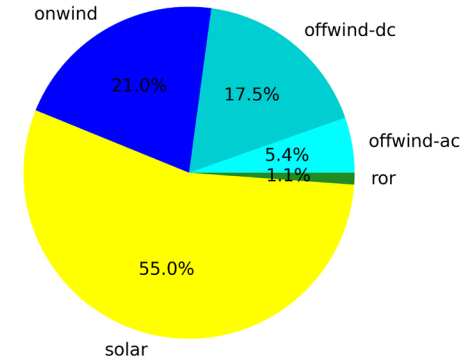
+ solar

- wind

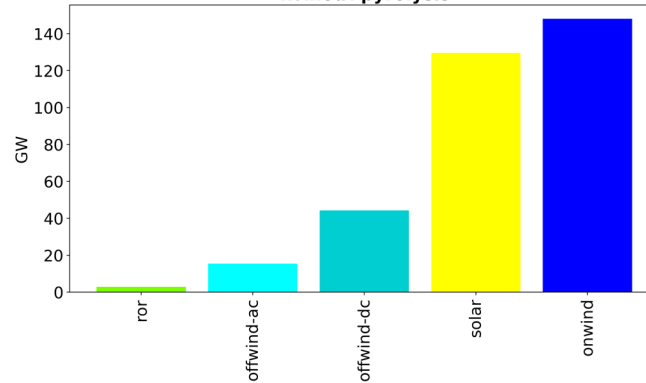
Without pyrolysis



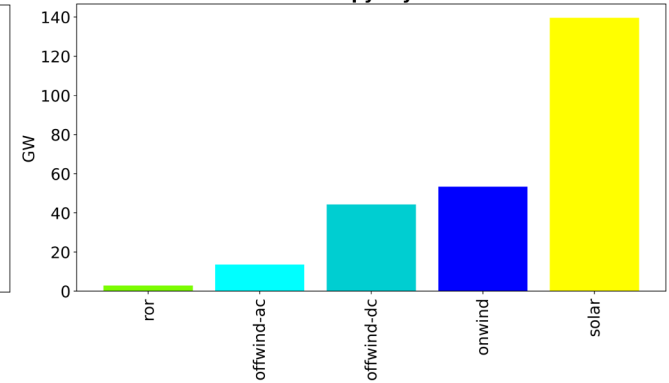
With pyrolysis



without pyrolysis



with pyrolysis



Conclusions

Pyrolysis in the energy system

- Makes the energy system cheaper
- Unit commitment changes
- Solar is more predominant in the system rather than wind

Thank you

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Data

Run	CC	MC	Bm
134	563	36	20.9

Year 2045

- Capacity installed: 2,245 MW
- Electrical production: 13.4 Twh
- Biochar production: 10.5 Mt
- CO2 sequestration: 28.3 Mt

