

4. Carbon Capture FORUM

Potenziale von Nature-based Solutions zur langfristigen Kohlenstoffspeicherung

Organisiert von Climate Change Center Austria (CCCA) und BioBASE GmbH

15. März 2023, 9:00-11:00 Uhr, online



**150 YEARS
FEATURING
FUTURE**
1872 - 2022

UNIVERSITY OF NATURAL RESOURCES AND
LIFE SCIENCES, VIENNA

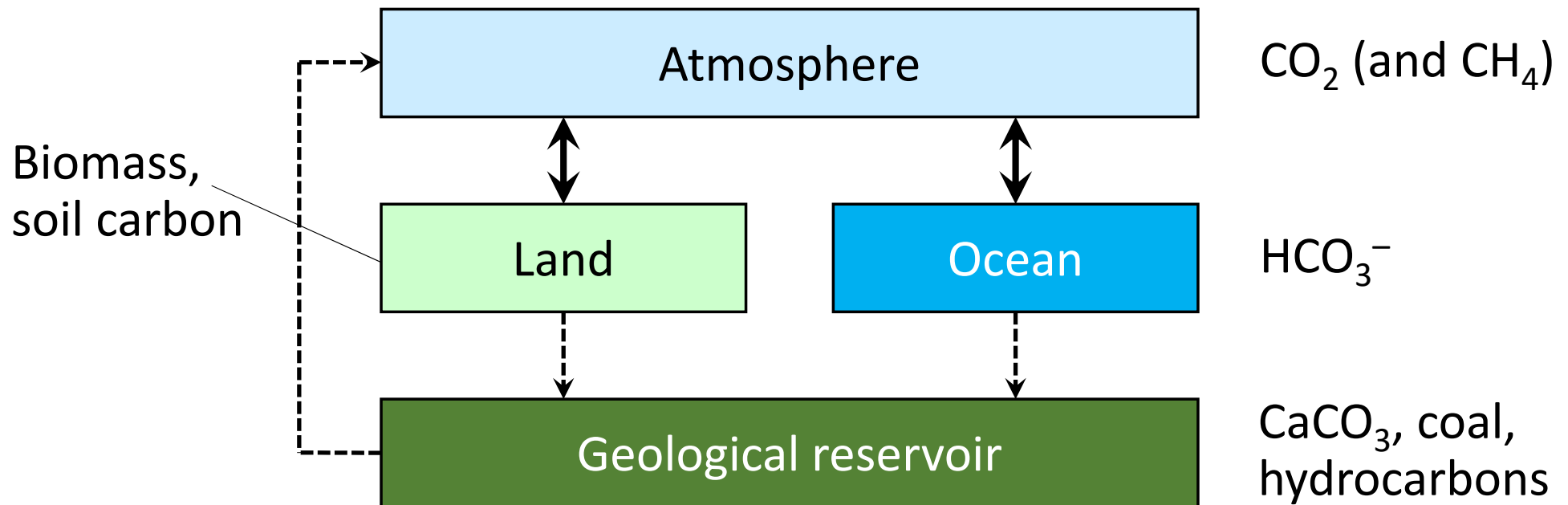
Bioenergy with carbon Capture and Storage (BECCS) – A Negative Emission Technology

Tobias Pröll

University of Natural Resources and Life Sciences, Vienna

tobias.proell@boku.ac.at

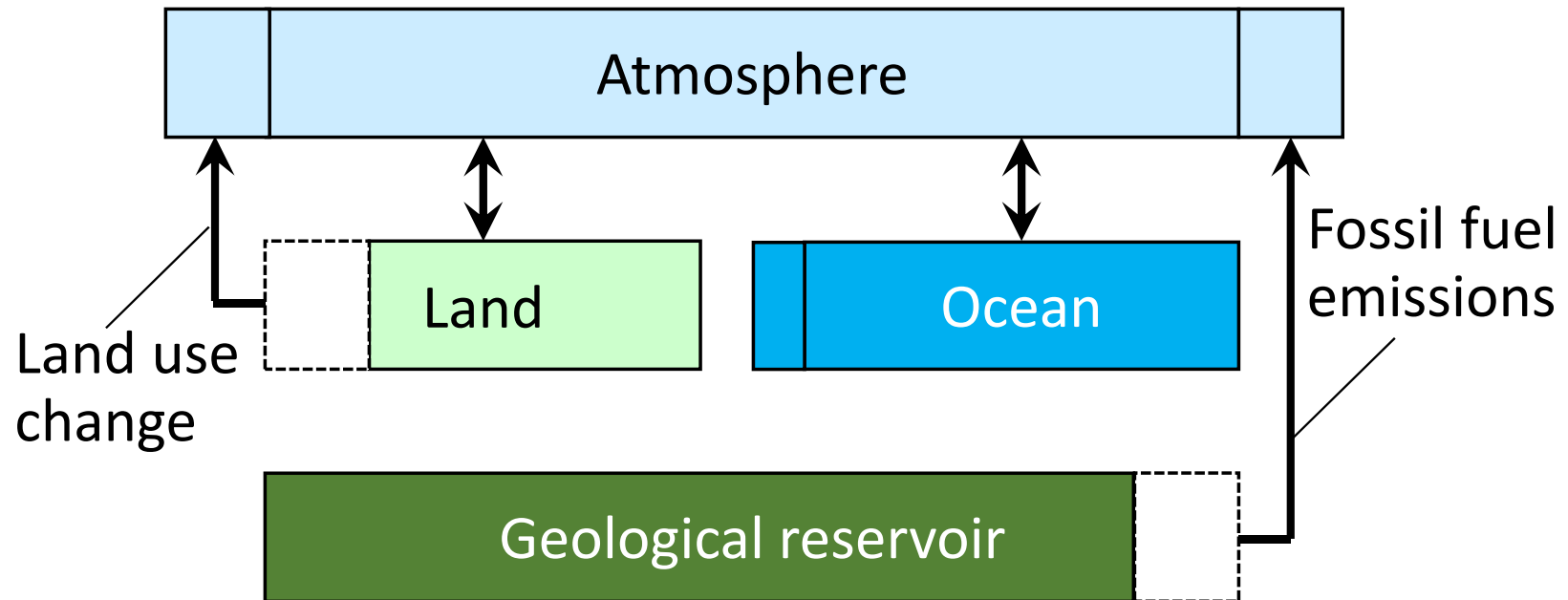
Unperturbed carbon cycle – without human activity



→ Bold arrows indicate active equilibria (short-term cycle)

→ Broken-lined arrows indicate slow geological processes

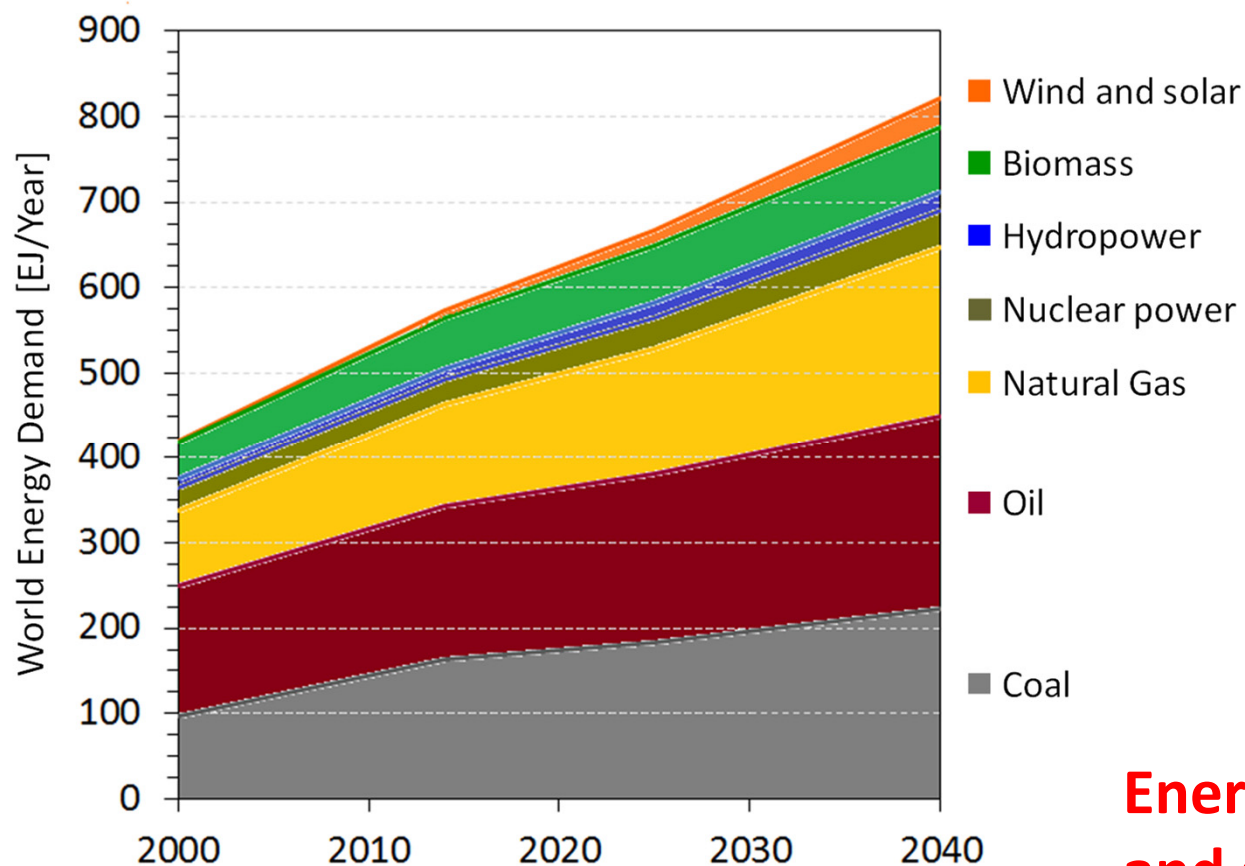
Currently: Land use change and fossil fuels



→ Increasing CO₂ concentration in the atmosphere

→ Increasing CO₂ concentration in the ocean via equilibrium

The Reality: World Primary Energy Supply 2000-2040



- **World: 80% Fossil**
(value unchanged for last 30 years!)
- **Austria: Still 65% Fossil**
- Increasing energy demand outperforms newly built renewables

Energy supply crucial for economic and social development!

[IEA World Energy Outlook 2016 – iea.org]

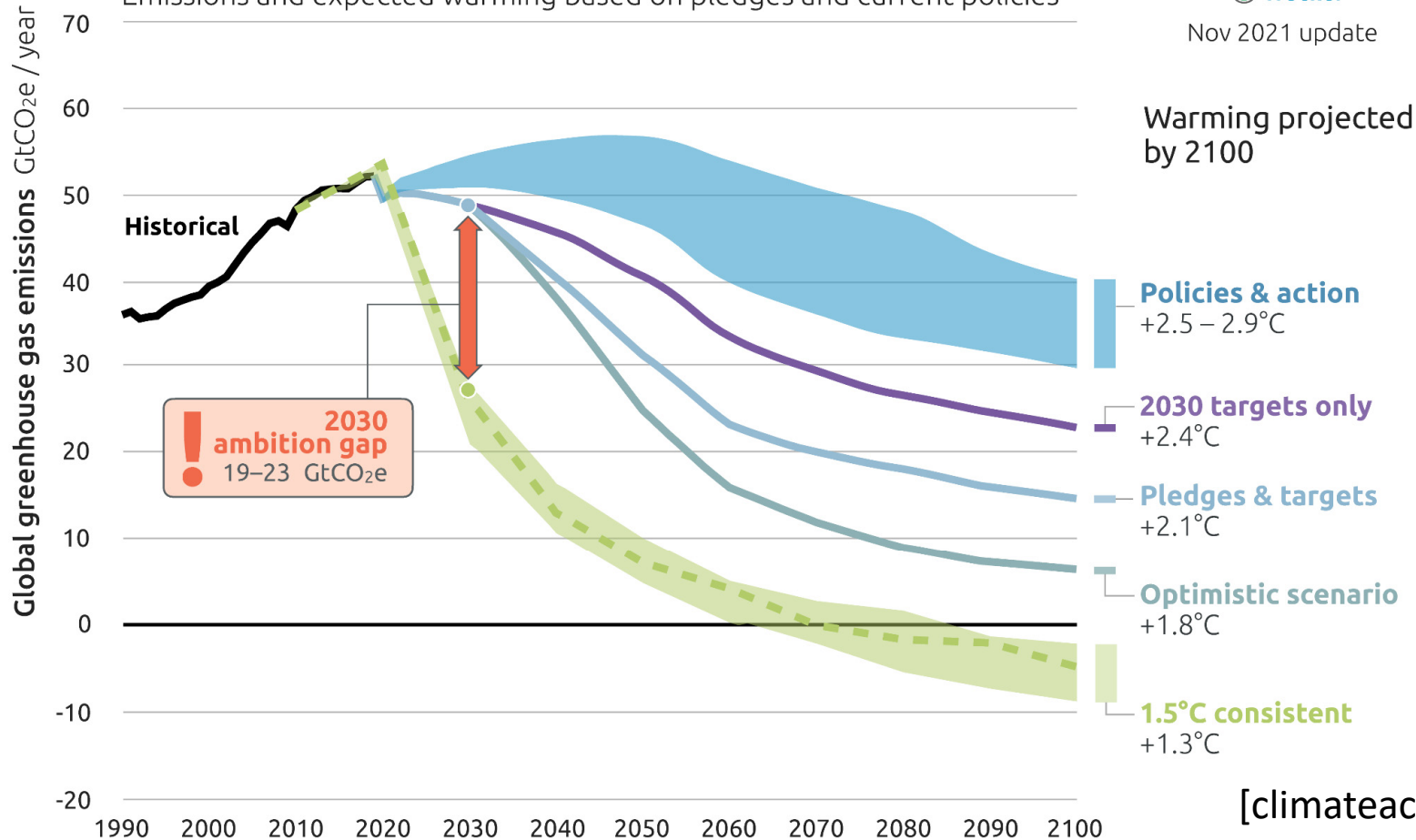
Where we should go: CO₂ emission budget for +1.5°C

2100 WARMING PROJECTIONS

Emissions and expected warming based on pledges and current policies



Nov 2021 update



[climateactiontracker.org]

Copyright ©2021 by Climate Analytics and NewClimate Institute. Free for non-commercial use.



Conclusions from the recent IPCC Reports

- Option of **negative emissions** is **required additionally** and must **not** serve as an **excuse to slow down action** on emission reduction.

- **There is no magic formula**, i.e. the statement above applies to all negative emission technologies known today.

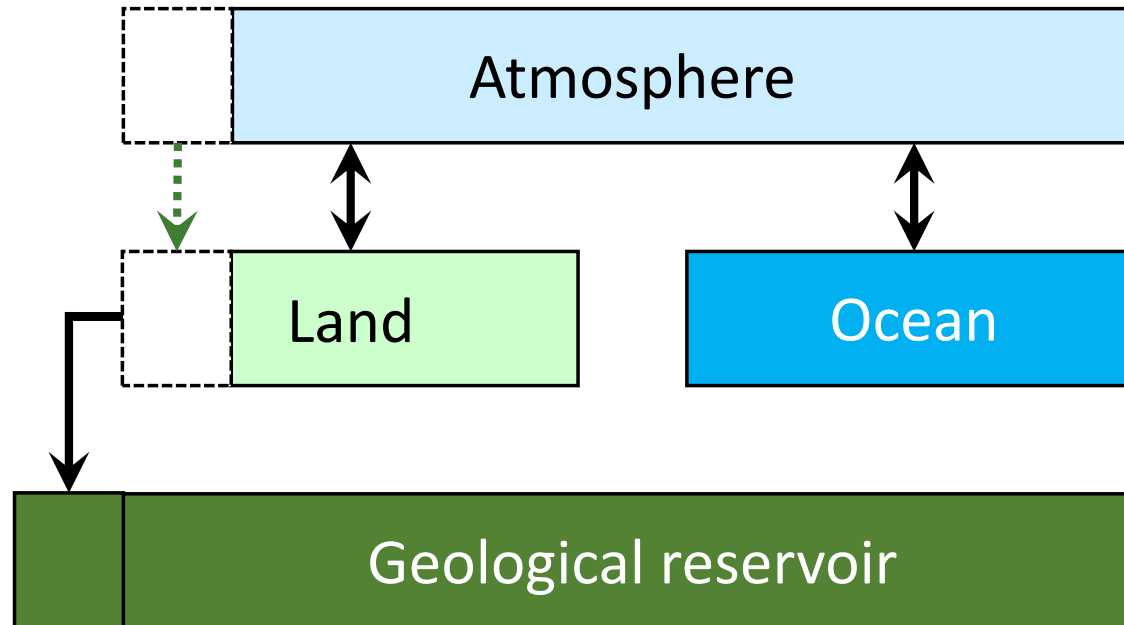
Carbon dioxide removal (CDR) options

- Agriculture, forestry and other land use change (AFOLU)
 - Afforestation and reforestation, Land restoration
 - Soil carbon sequestration
- Biochar addition to soil
- Bioenergy with carbon capture and storage (BECCS)
- Direct air capture and storage (DACs)
- Enhanced weathering
- Ocean alkalinisation

Nature-based solutions

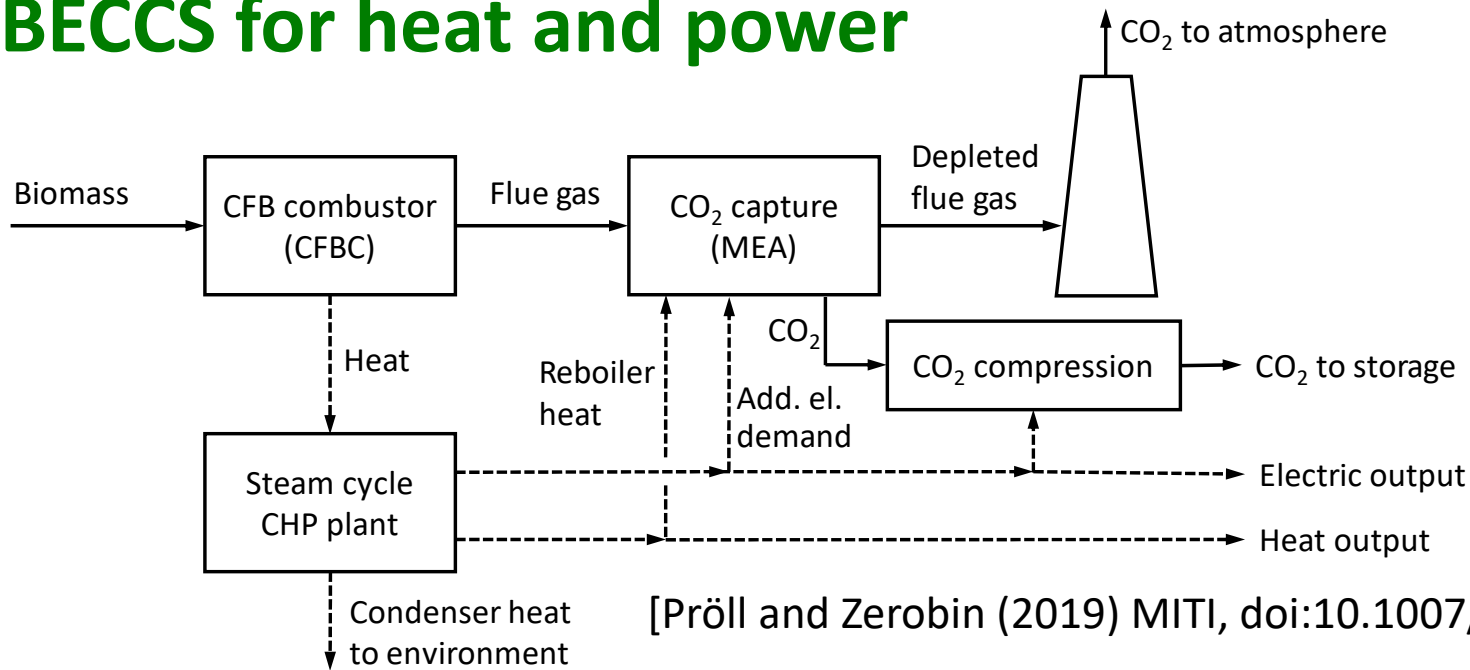
Negative emission technologies (NETs)

Bioenergy with Carbon Capture and Storage (BECCS)



- Pre-concentration of carbon in biomass by photosynthesis
- Biomass converted to energy, CO₂ captured and stored
- Lower energy output compared to bioenergy without CCS

BECCS for heat and power



[Pröll and Zerobin (2019) MITI, doi:10.1007/s11027-019-9841-4]

PCC ... Post Combustion CO₂ Capture (available technology)

CLC ... Chemical Looping Combustion (emerging technology) – lower energy penalty

Parameter	Unit	No capt.	PCC	CLC
Max. electric efficiency with CO ₂ compr. (90% capture)	%	37.1	27.0	31.4
Maximum heat efficiency	%	53.0	25.1	47.7
El. efficiency in max. heat case with CO ₂ compr.	%	26.5	22.0	21.9
Maximum fuel power utilization rate with CO ₂ compr.	%	79.5	47.1	69.6

Large BECCS project underway in Northern Europe

- Stockholm Exergi launched 800.000 t/y BECCS project for **CO₂-negative district heating** supply: Pilot plant operational, Full Scale Planned for 2026
- EU Innovation Fund Project
- Stockholm Exergi currently in negotiation with four(!) different consortia for ship transport and underground storage of CO₂



<https://beccs.se/about-beccs-stockholm-2/>

Take-home messages

Any **climate change mitigation** action should:

1. Be **effective** in **reducing** CO₂(eq.) **emissions on a life cycle basis**
2. Be **cost-efficient** (in terms of EUR/tCO_{2e} avoided/removed)
3. Get the support of the majority in democratic societies

Some **technologies** allow for net **removal of CO₂** from the short-term carbon cycle, **BECCS** based on **sustainably produced biomass** fulfils the criteria above potentially well.

Effective policies are needed **to enable** investment in **the most** energy and cost **efficient zero- and negative-emission technologies.**