BOKU Energiecluster – Veranstaltung
Energiesysteme in der Landwirtschaft
und negative Emissionen
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Biomasse-basierte Negativemissionstechnologien: Bioenergie mit CO_2-Abscheidung und Speicherung versus Biokohleanwendung in Böden

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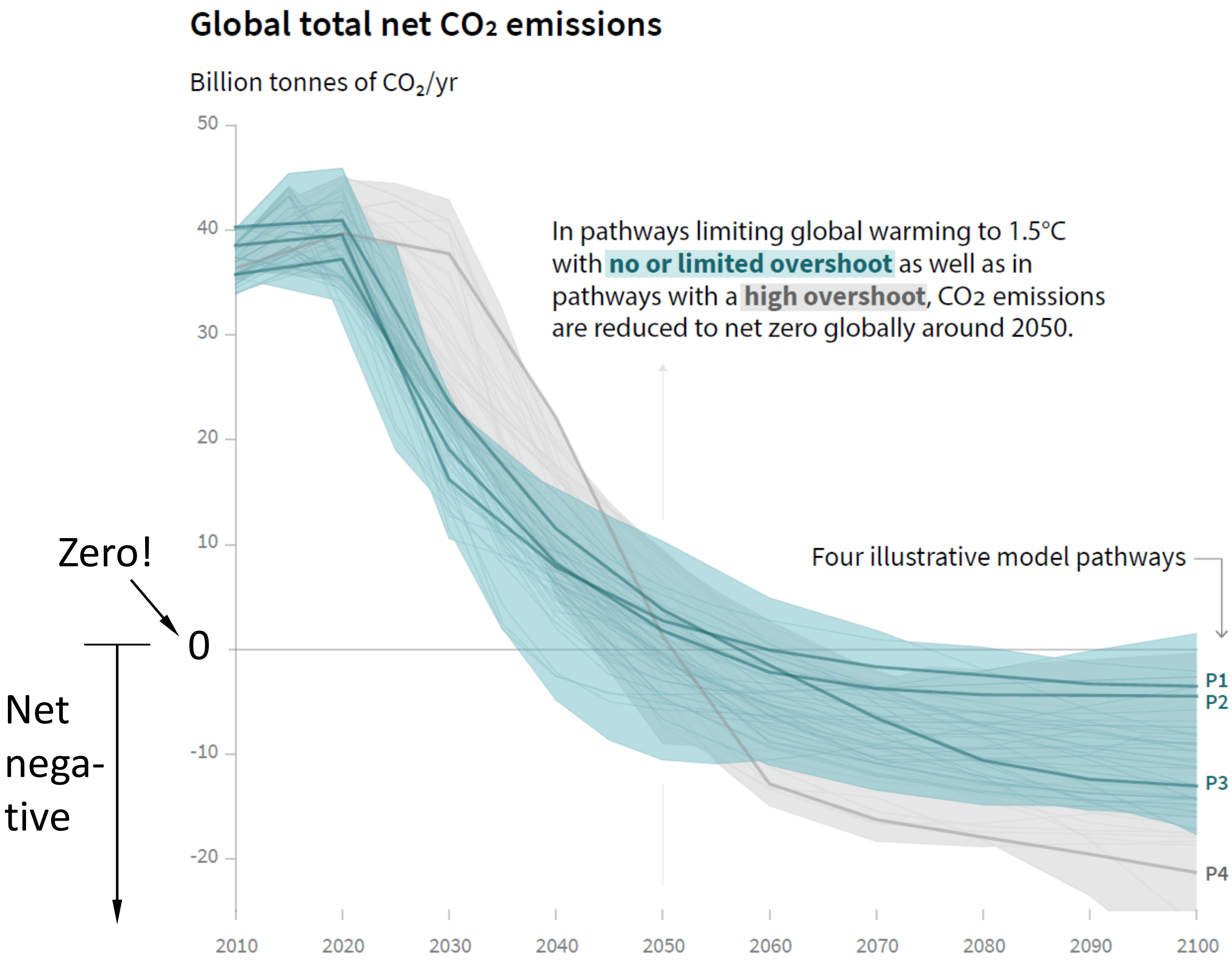
Available CO_2 emission budget for +1.5°C



Source: IPCC Special Report on GLOBAL WARMING OF 1.5 °C, October 2018.

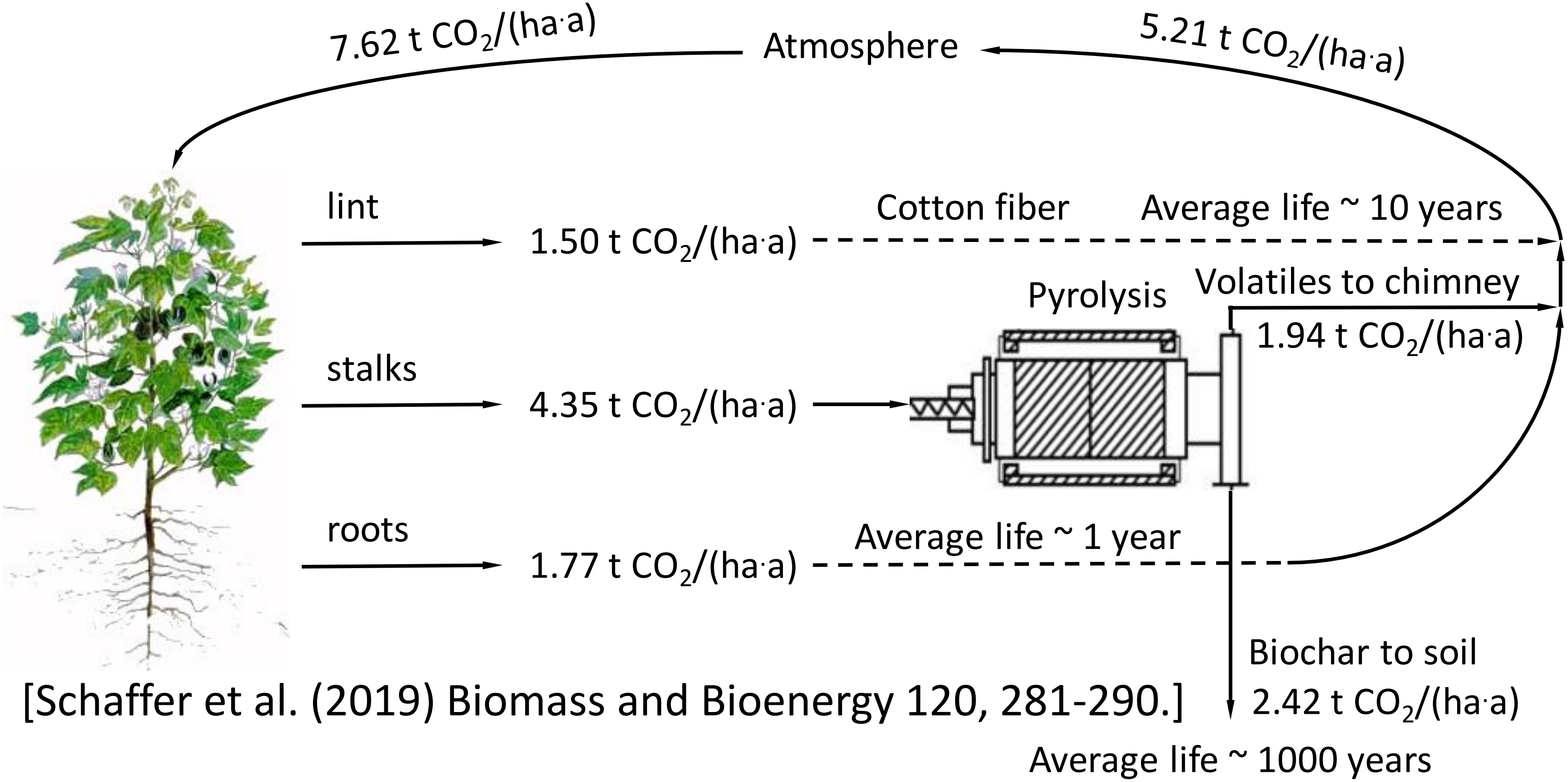
- To reach the +1.5°C target, we need **net negative emissions** from 2050 onwards!
- The longer we wait with deep emission reduction, the greater the problem will get.

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

Negative emission technologies (NETs)

Biochar soil storage



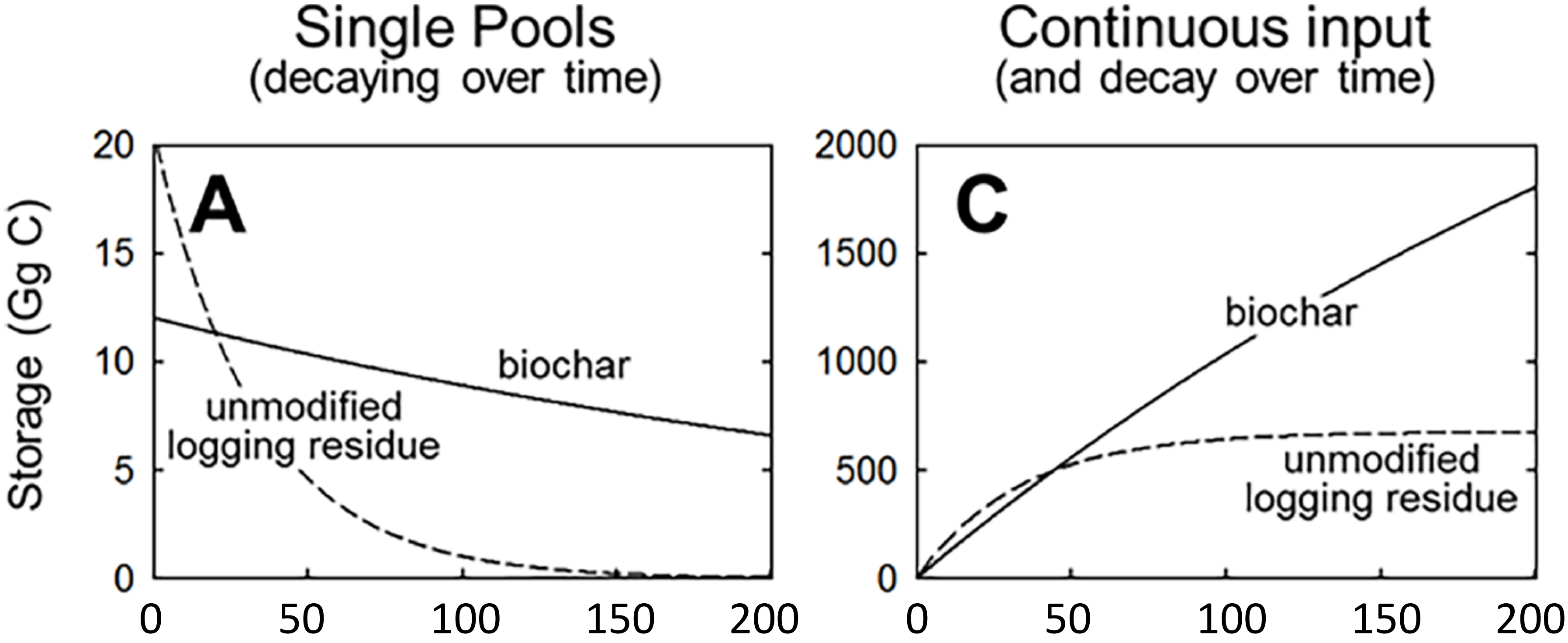
[Schaffer et al. (2019) Biomass and Bioenergy 120, 281-290.]

→ Low-tech approach compared to other NETs

→ About 30% of the assimilated carbon are stored in the soil

Biochar vs. fresh biomass

Recent study on storage of biochar from logging residues (slash) in Oregon/U.S.



Source: Campbell et al. (2018) PLoS ONE 13(9):e0203475.

Bioenergy with Carbon Capture and Storage (BECCS)

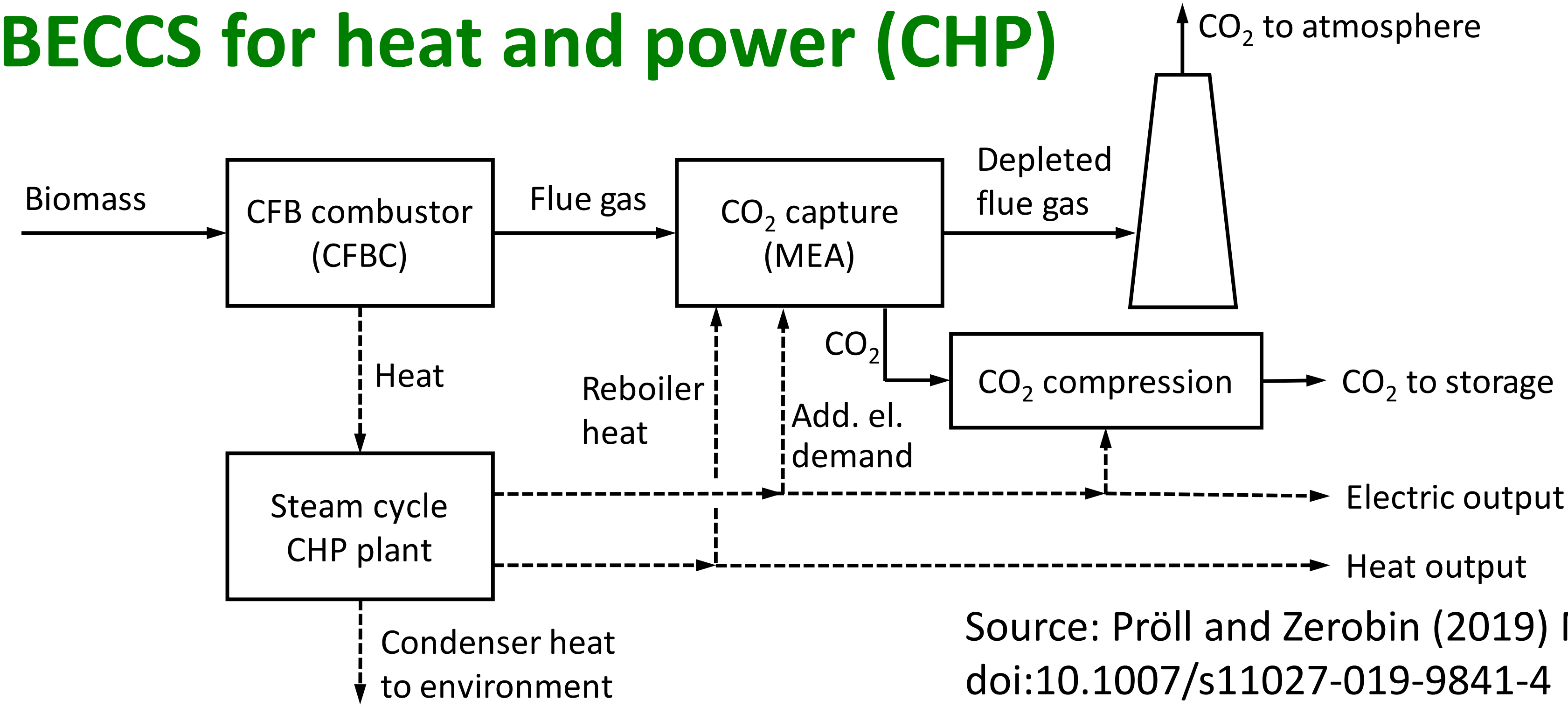
Biogenic waste streams and

Biomass from sustainably managed land ⇨

Combined heat and power (CHP) generation with post-combustion (e.g. monoethanolamine scrubbing – MEA) or inherent (e.g. chemical-looping combustion – CLC) CO_2 capture

⇨ CO_2 permanent storage in geologic formations

BECCS for heat and power (CHP)



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

Parameter	Unit	CHP	MEA	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

Biomass-based NETs – comparison

Biochar

- Simple process, no CO_2 transport and storage infrastructure
- Lower energy output (about 50% of bioenergy w/o CCS)
- No ash melting – nutrients available for recycle
- Suitable for biomass residues with low ash melting point

BECCS

- Higher energy output (about 80% of bioenergy w/o CCS)
- High temperature conversion, ash melting risk
- Suitable for wood as fuel (no ash melting issues)
- CO_2 storage infrastructure required

→ Biochar in sub-tropical and tropical regions where bioenergy is not competitive to solar power and soils are depleted

→ BECCS in cold climate where wood is sustainably available