The Economics of BECCS Deployment in a 1.5^{o}C or 2^{o}C World

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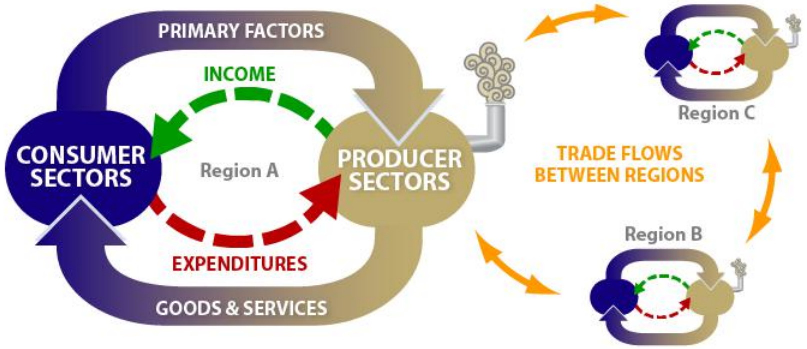
Intro

- Negative emission technologies (NETs) are valuable in 2C and 1.5C scenarios
  - In IPCC 1.5C report, BECCS and afforestation are main NETs (up to 23 $GtCO_2$/yr)
- Land-based approaches raise concerns about economic impacts (especially food prices) and environmental impacts (sustainable biomass, land use change, etc.)
- **Goal:** Quantify potential scale of BECCS and its impact on the economy
  - Considering technology and economics
  - Excluding sustainability and political aspects

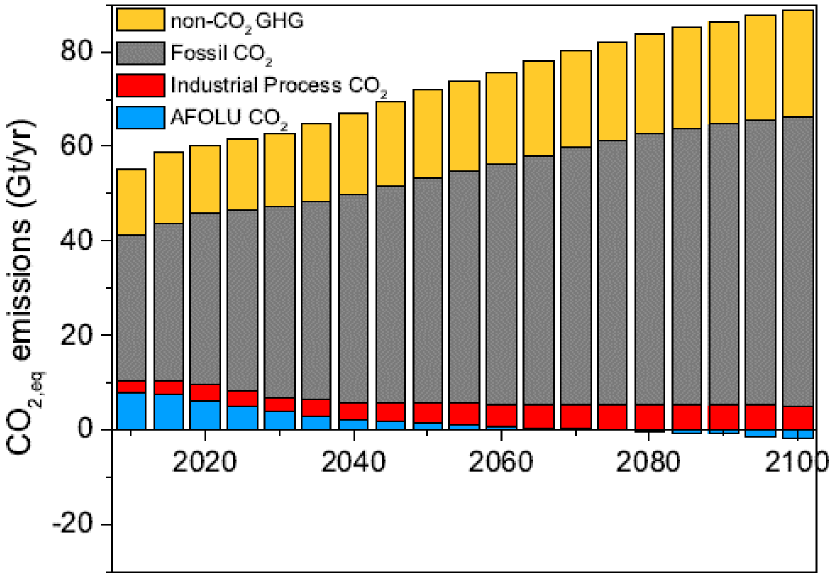
Approach

- Integrate a BECCS technology into MIT EPPA model and explore implications under 2C and 1.5C scenarios
- Model accounts for all major components of BECCS process:
  - Land availability
  - Crop production and transport
  - Biomass conversion to electricity with CO_2 capture
  - Transport and underground storage of CO_2
  - Endogenous land use change
  - Direct and indirect land use change emissions

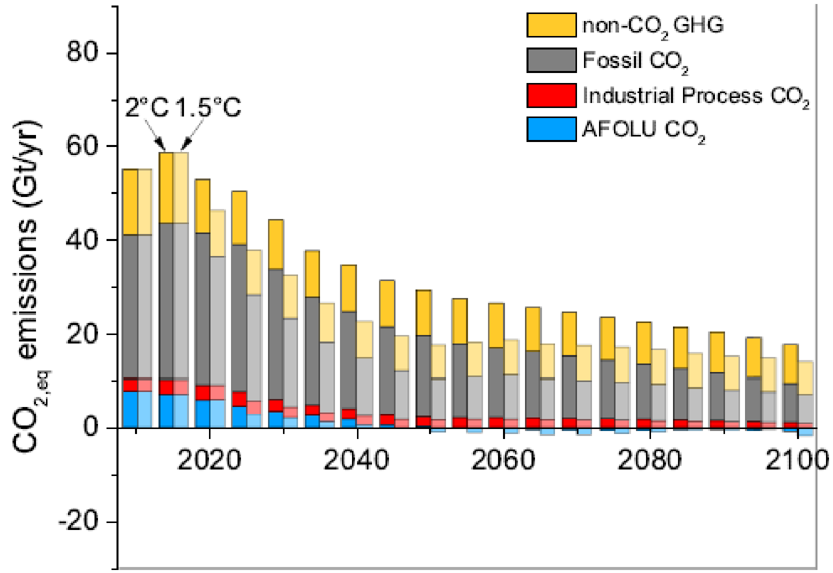


Total Net CO_2eq Emissions

(a) **BAU**

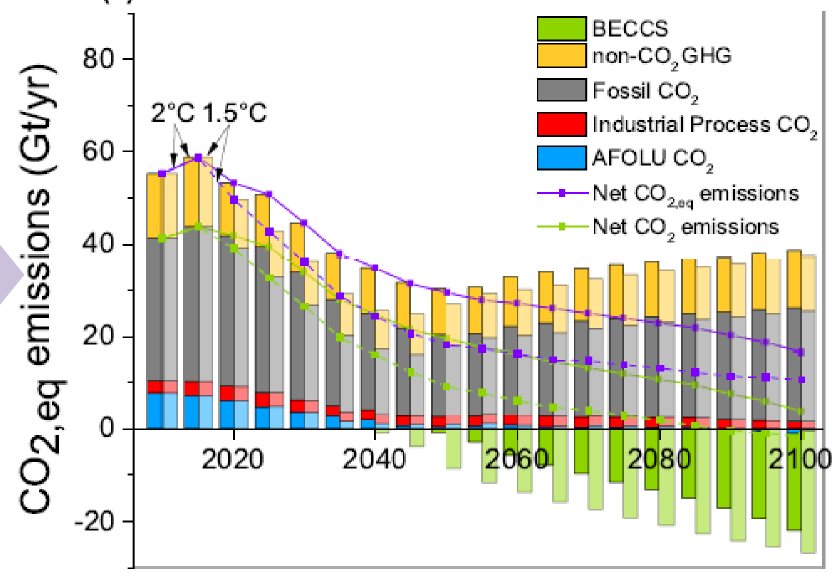


(b) **2C and 1.5C NO BECCS**



↓86-90% fossil CO_2
↓79-82% industrial process CO_2
↓64-70% non-CO_2 GHGs

(c) **2C and 1.5C BECCS**

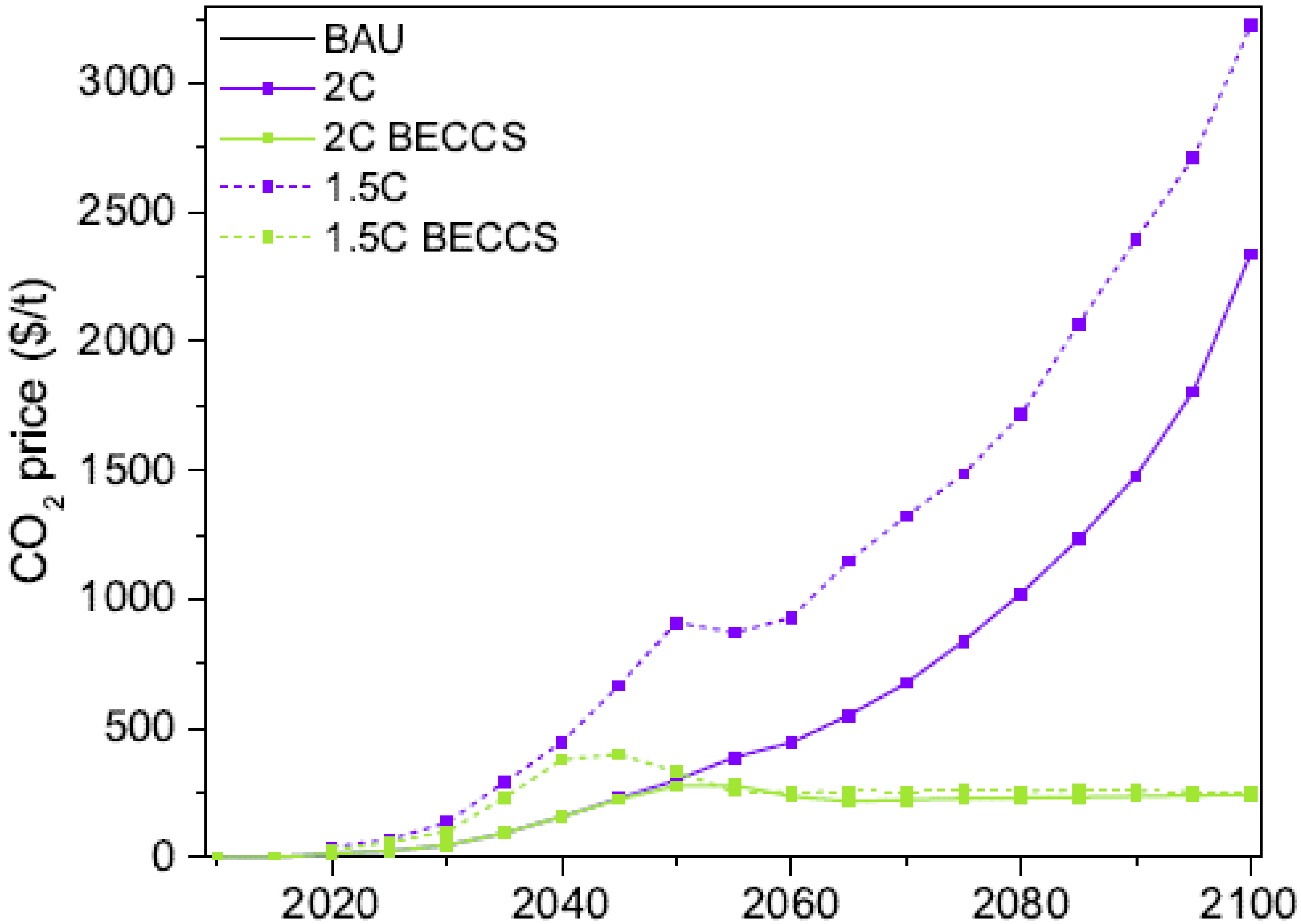


- 21-26 $GtCO_2$/yr negative emissions by 2100
- Allows 3x more fossil CO_2 compared to NO BECCS

2020-2100: 620-1060 $GtCO_2$

http://globalchange.mit.edu/

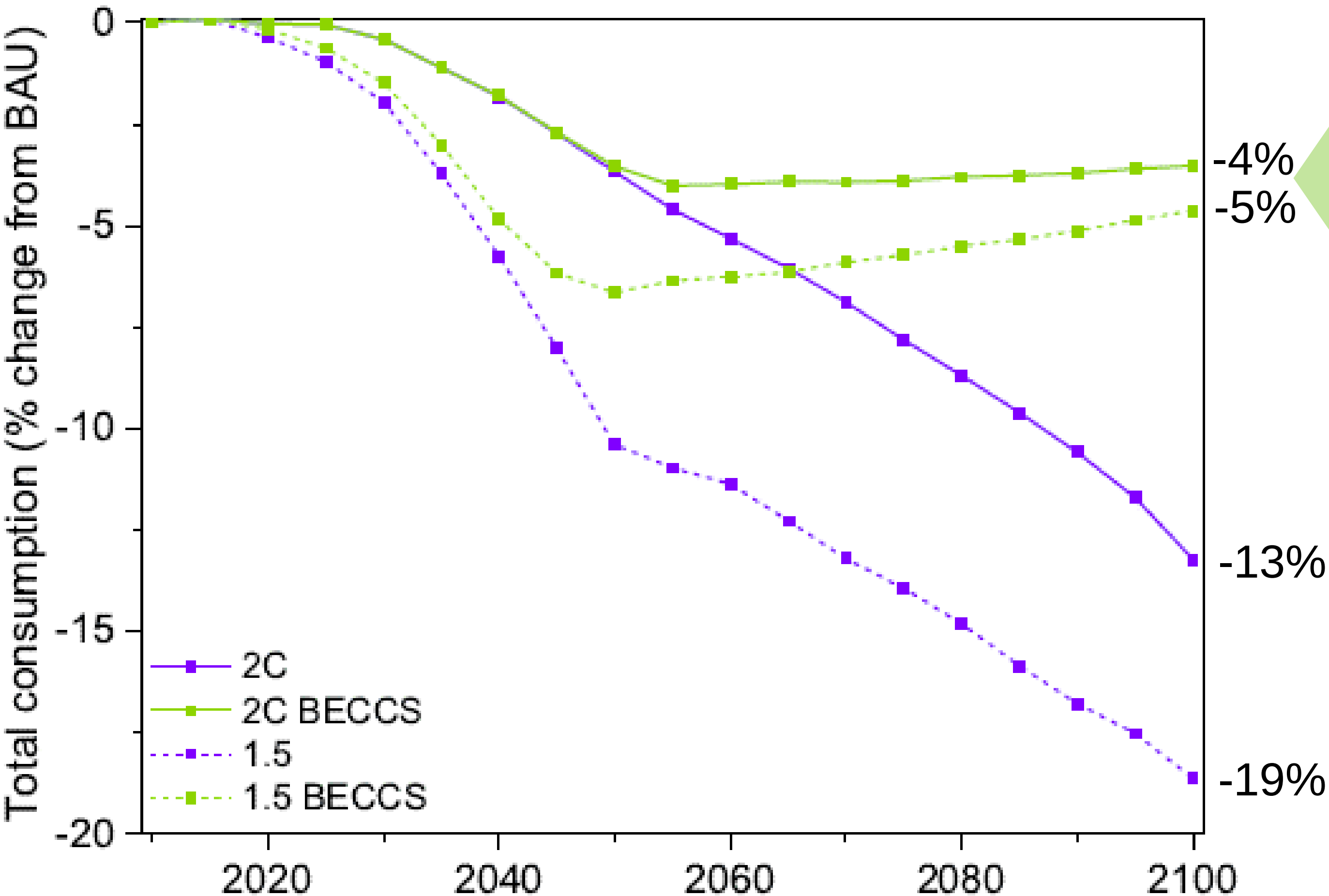
Global Carbon Price



BECCS effectively caps carbon price at about **$240/tCO$_2$eq,** an **order of magnitude less** than price without BECCS

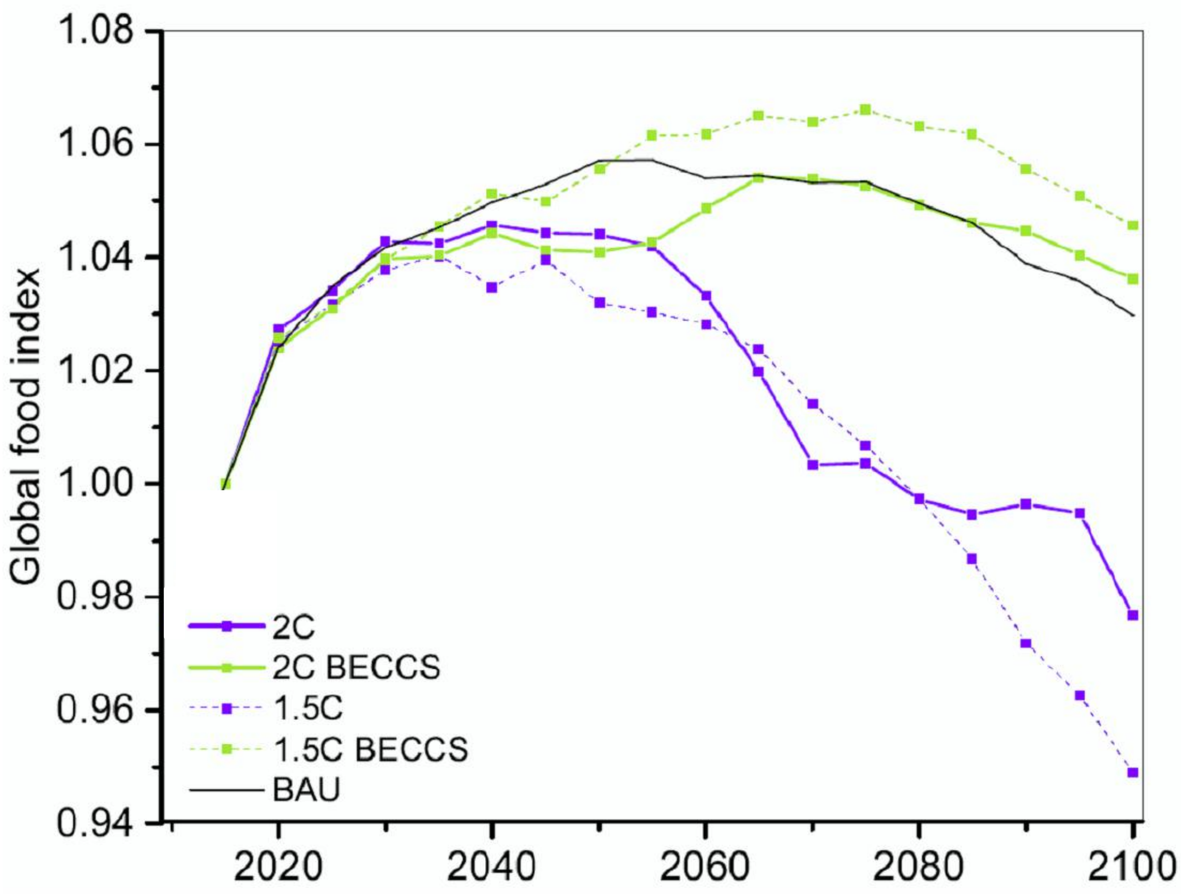
Global Policy Cost

Percentage change in economy-wide consumption relative to consumption in the BAU scenario



BECCS significantly reduces the cost of meeting long-term targets

Global Food Price Index



With BECCS: price rises, ends up 0.6-1.5% higher than BAU in 2100

Competition for land: 490-650 Mha for bioenergy by 2100

Without BECCS: price falls, ends up 5-8% lower than BAU in 2100

BECCS with limited impact on global food prices

Findings and Discussion

- BECCS can be significant mitigation technology
  - Lowers carbon price and policy cost, causes significant land use change, but only increases food prices by ~1.5%
- Main uncertainties that could limit BECCS deployment
  - **Availability of sustainable biomass**, availability of CO2 geologic storage sites, policy incentives, development of a credible accounting and valuation system for negative emissions, social acceptance
- Ecosystem impacts also a concern
  - Ecosystem impacts and social acceptability of reductions of natural land were not considered and could limit deployment
  - Impacts can be mitigated by rules and regulations; forests can be maintained for multiple purposes: bioenergy production, ecosystem preservation and recreation
- All technical components for large-scale BECCS currently exist
  - Large biomass power plants operate today (e.g. Drax power station in England capable of producing 2.6 GW of bioelecticity)
  - CCS has been demonstrated on Mt scale at two coal fired power plants: Boundary Dam in Canada and Petra-Nova in Texas
  - Pilot CCS unit at Drax captures one tonne CO2 per day

Thank you

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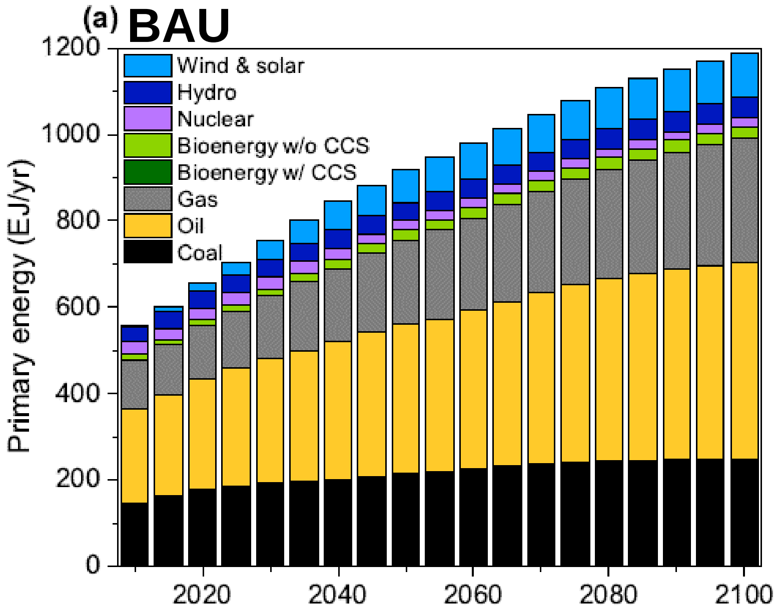
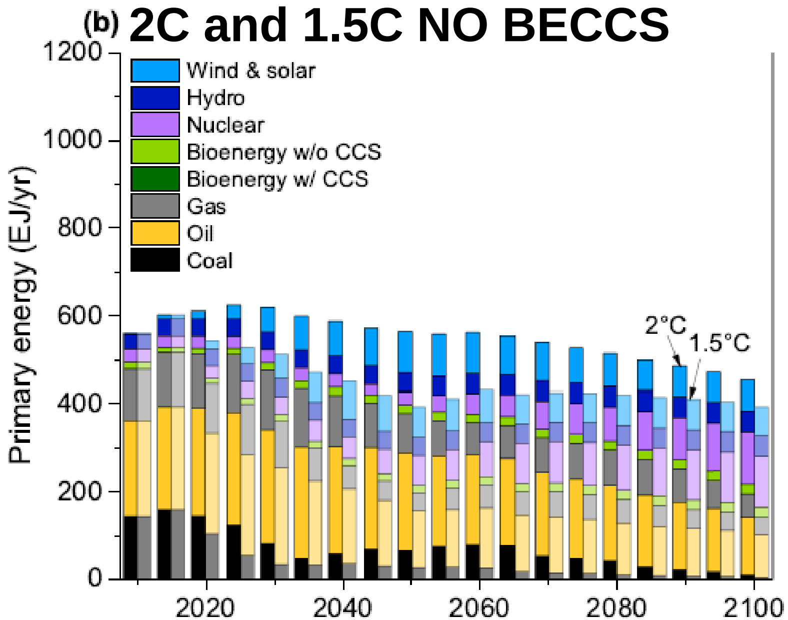
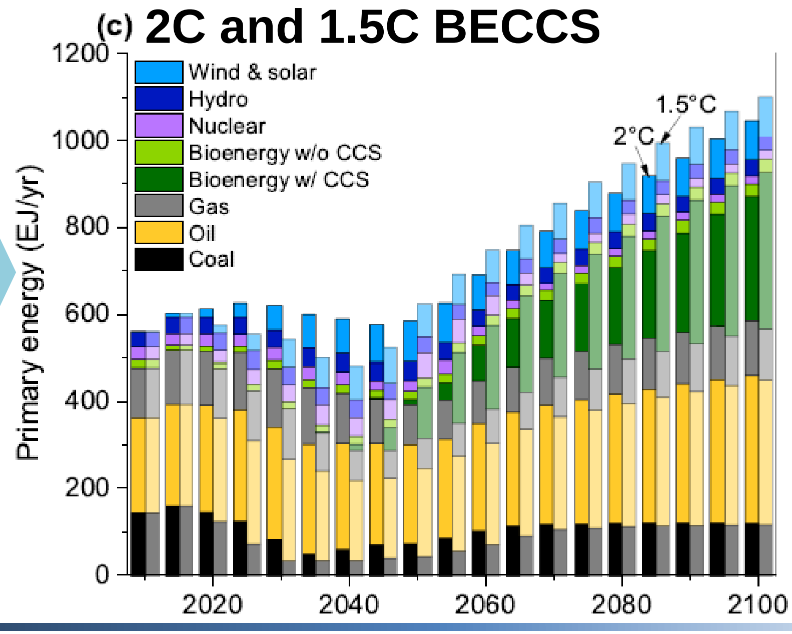
MIT Energy Initiative

Total Primary Energy





33-38% of BAU



Just below BAU

- Bioenergy: 30-140 EJ in 2050; 320-390 EJ in 2100
- 3x fossil fuels vs. NO BECCS
- Most coal and gas with CCS
- Emissions from oil use offset by BECCS