International Energy Agency

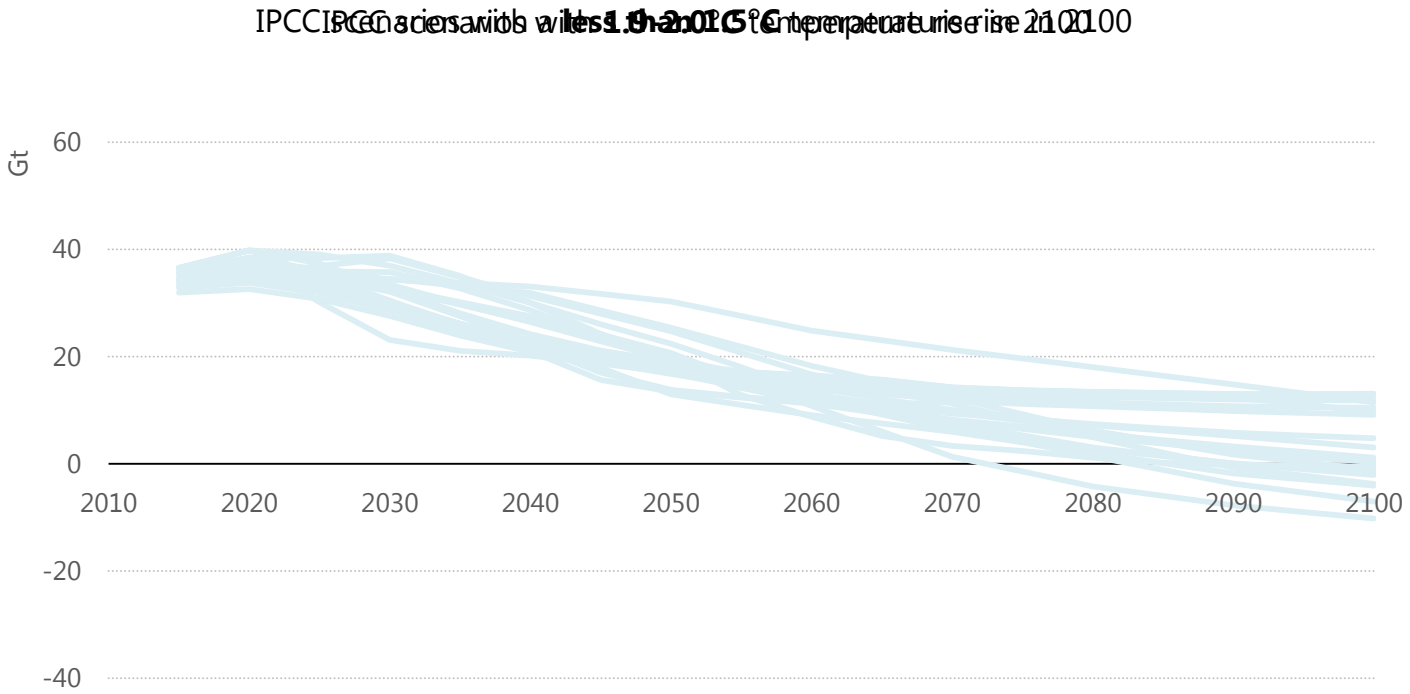
CCUS and carbon removal

Samantha McCulloch

Head of CCUS Unit, International Energy Agency

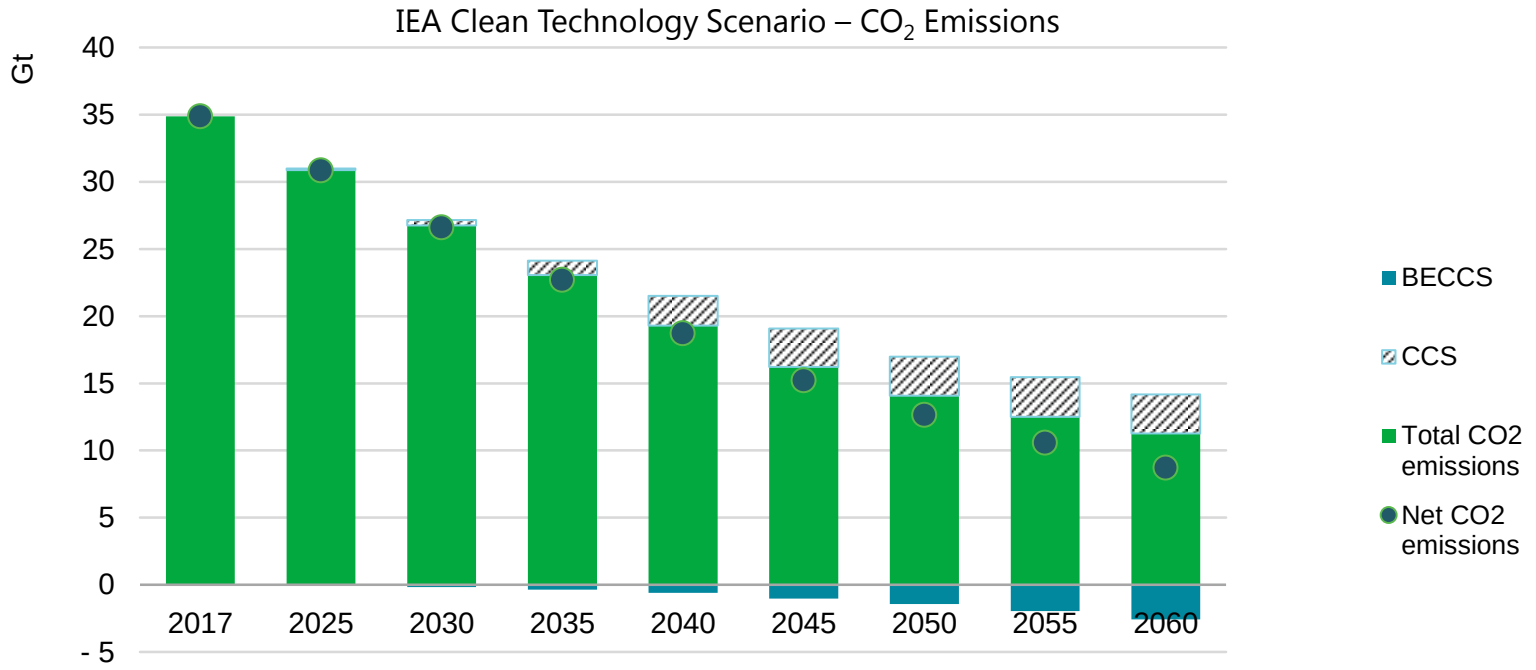
Innovation for Cool Earth Forum, Tokyo 10 October 2019

Ambitious climate goals will almost certainly require carbon removal



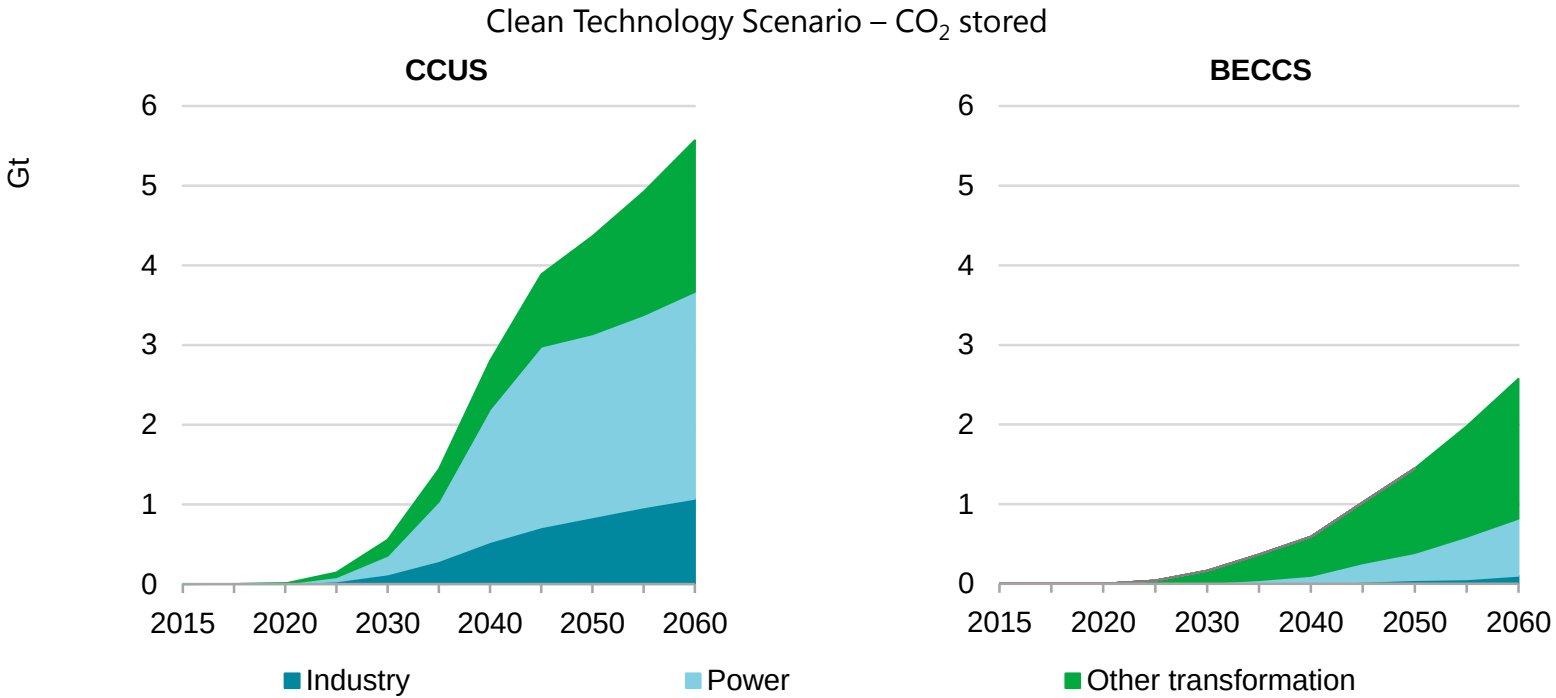
Many IPCC scenarios targeting future temperature increases between 1.5°C and 2.0°C rely on significant carbon removal in the second half of the 21st Century

Carbon removal can offset emissions from harder-to-abate sectors



In the IEA's Clean Technology Scenario, bioenergy with carbon capture and storage (BECCS) plays an important role in meeting Paris Agreement climate goals

Bioenergy with CCUS requires rapid scale-up



In the Clean Technology Scenario (CTS), by 2060 CCUS technologies capture up to 5.6 Gt per year. Almost half of this is associated with BECCS.

Large-scale BECCS may face challenges

Power

- Renewable power
  - Solar PV
  - Onshore wind
  - Offshore wind
  - Hydropower
  - Bioenergy
  - Geothermal
  - Concentrating solar power
  - Ocean
- Nuclear power
- Natural gas-fired power
- Coal-fired power
- CCUS in power

Industry

- Chemicals
- Iron and steel
- Cement
- Pulp and paper
- Aluminium
- CCUS in industry & transformation

Transport

- Electric vehicles
- Fuel economy
- Trucks & buses
- Transport biofuels
- Aviation
- International shipping
- Rail

Buildings

- Building envelopes
- Heating
- Heat pumps
- Cooling
- Lighting
- Appliances & equipment
- Data centres and networks

Other supply

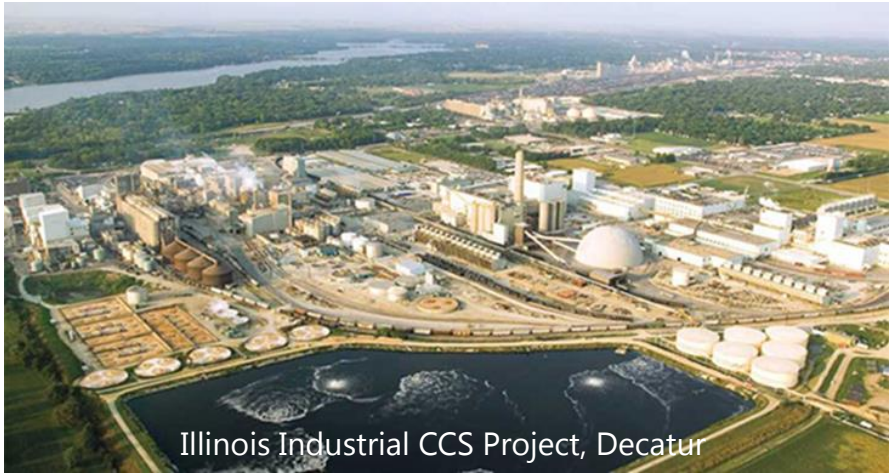
- Methane emissions from oil and gas
- Flaring emissions

Energy integration

- Energy storage
- Smart grids
- Hydrogen
- Demand response

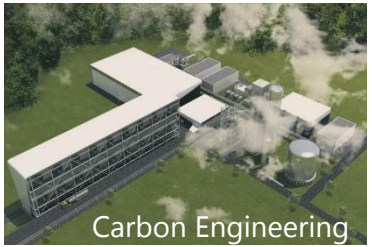
Large-scale BECCS is already a reality

- 11 facilities are capturing CO_2 from bioenergy production today:
  - Size ranges from 330 tonnes to 1 million tonnes of CO_2 captured/year.
- The Illinois Industrial CCS Project is the only project with dedicated CO_2 storage:
  - The bioethanol facility has been storing 1 million tonnes of CO_2/year since 2017.
- Other BECCS projects use the CO_2 for enhanced oil recovery (EOR) or other uses.

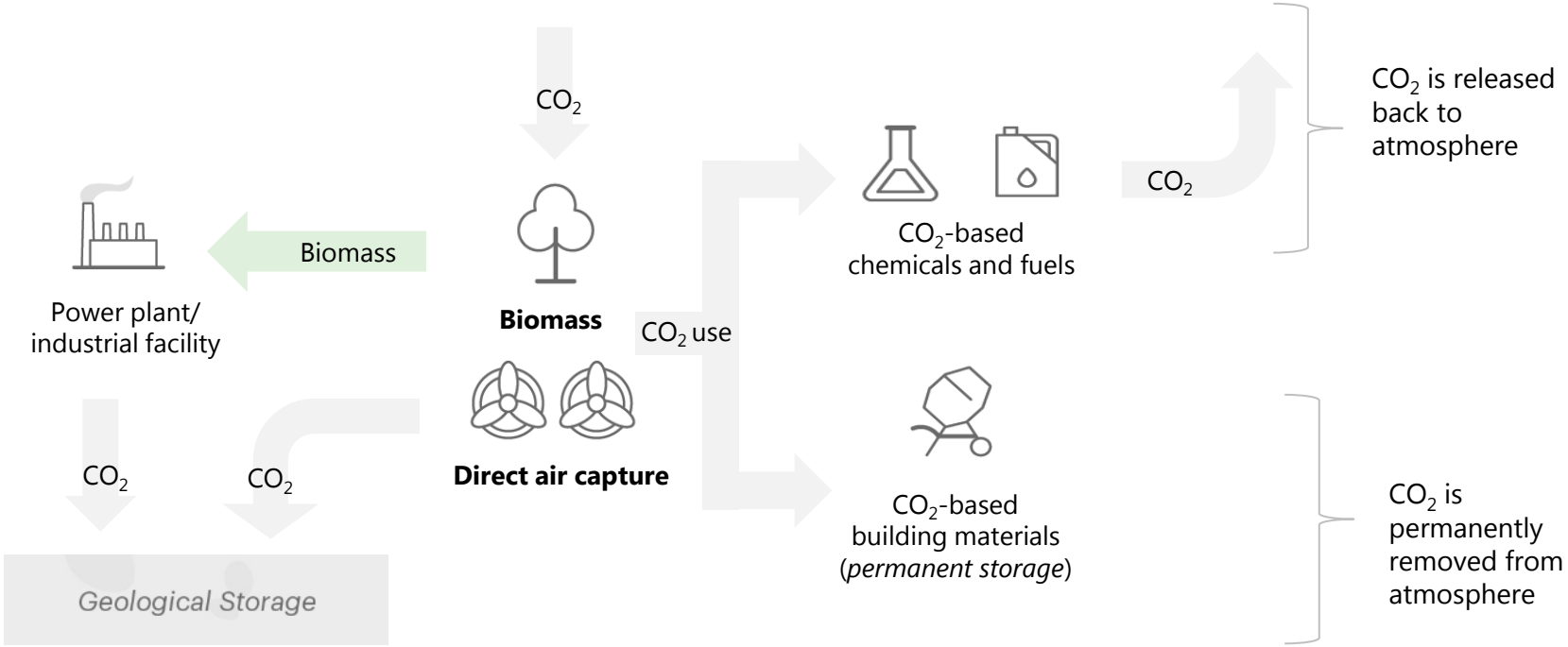

Illinois Industrial CCS Project, Decatur

Direct Air Capture (DAC) is making progress

- More than 10 DAC plants are operating in Europe, US and Canada:
  - Most plants are small/pilot scale
  - CO_2 is used in greenhouses, power-to-X, and beverage carbonation
  - One facility involves permanent CO_2 storage (mineralization)
- Carbon Engineering and Occidental Petroleum will build the first large-scale DAC facility in the US:
  - Capture capacity of 1 million tonnes of CO_2 per year, to be used in enhanced oil recovery (EOR)



CO_2 storage is key for carbon removal from BECCS and DAC



CO_2 use can support climate goals but has relatively limited potential for negative emissions*

*excludes EOR

Key messages

- Carbon removal is expected to play an important role in achieving net zero climate ambitions.
- BECCS can be a competitive near-term carbon abatement option, but may face challenges for deployment related to availability of sustainable biomass and CO_2 storage.
- Other technology options, including Direct Air Capture, are making important progress.
- Further RD&D is needed to drive cost reductions and to quantify the potential of emerging technologies.
- Accelerated investment in CO_2 transport and storage infrastructure is needed for large-scale carbon removal via BECCS and DAC.