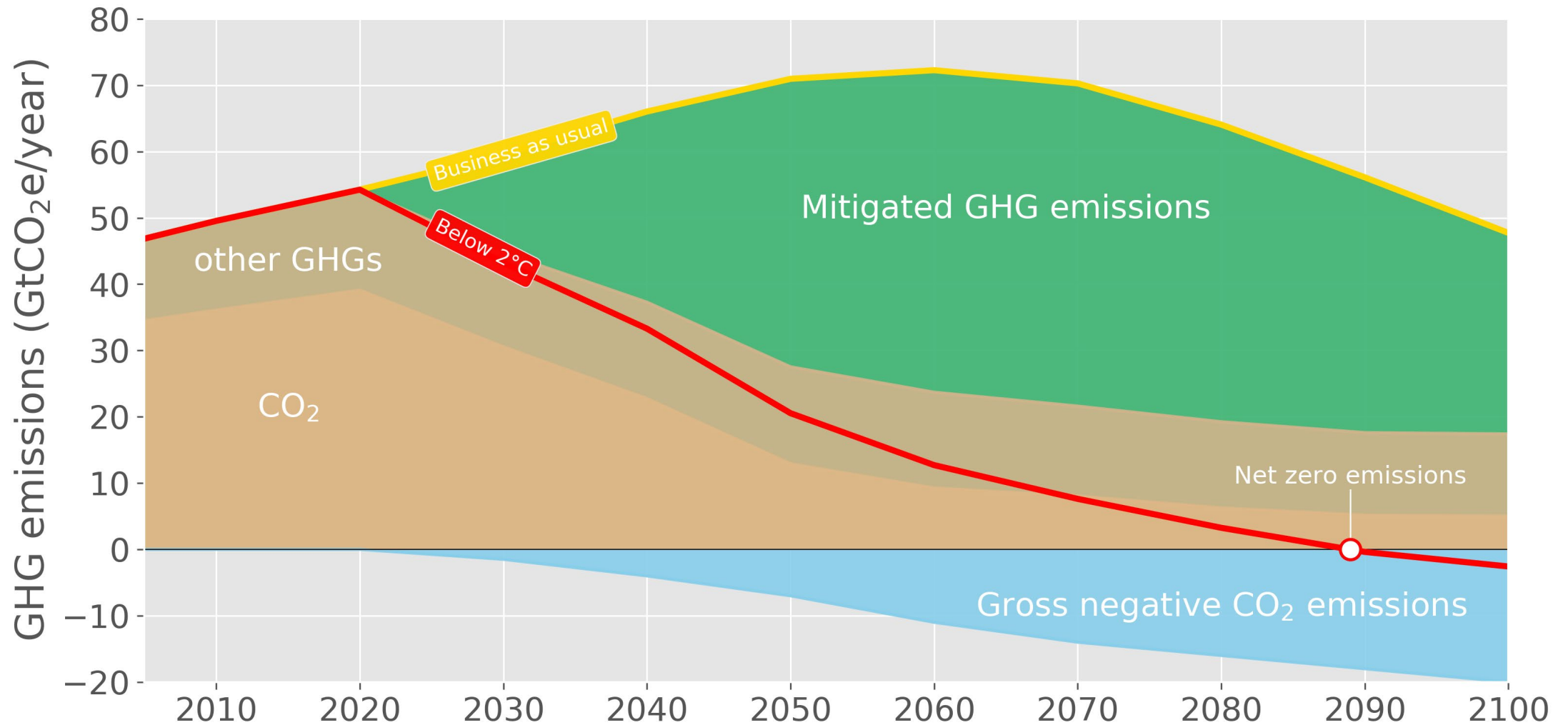# ARPA-E's Direct Air and Ocean Capture Efforts
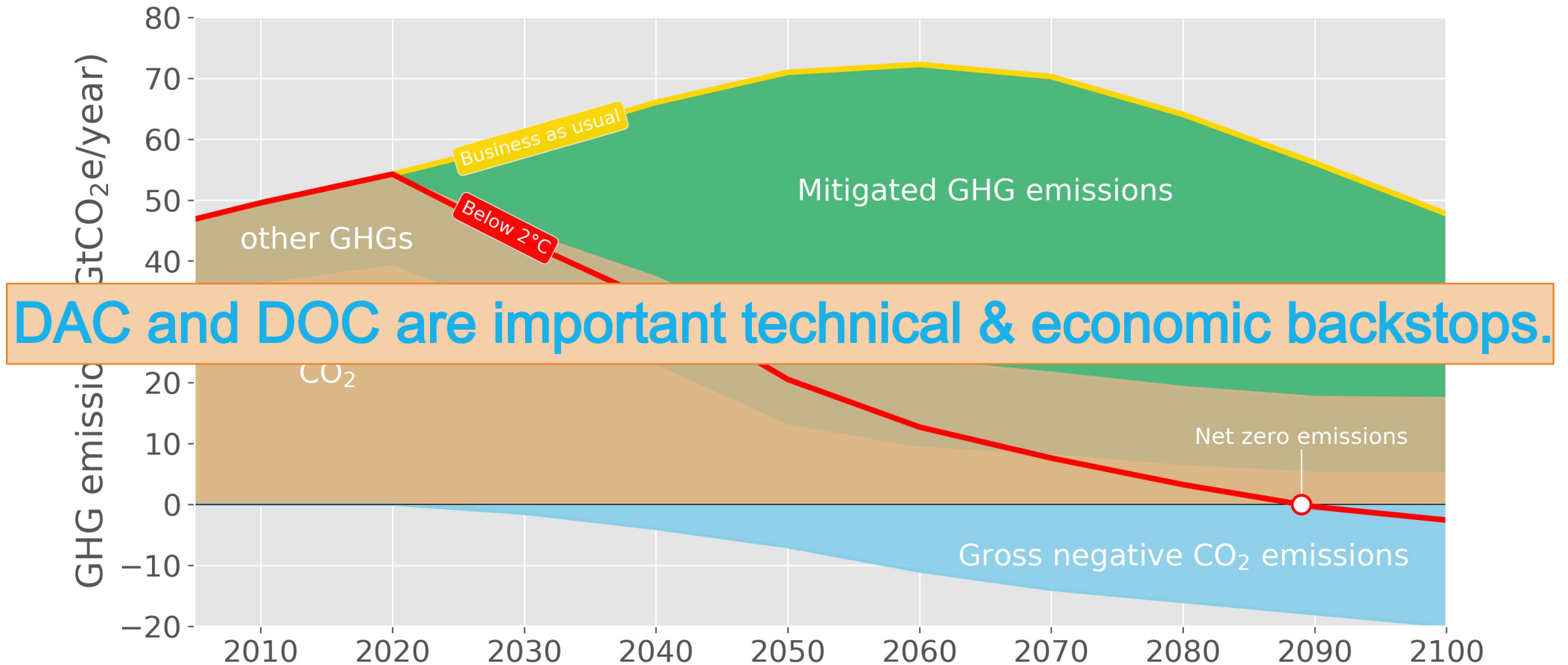
Zara L'Heureux PhD

ARPA-E Fellow

NETL Carbon Capture Project Review Meeting | Government Panel on Direct Air Capture (DAC)

October 7, 2020

ARPA-E has an interest in Negative Emission Technologies (NETs)

Plot is homemade, but adapted from: National Academies of Sciences, Engineering, and Medicine. "Negative emissions technologies and reliable sequestration: a research agenda." (2018); uses LIMITS Scenario database: https://tntcat.iiasa.ac.at/LIMITSDB/dsd?Action=htmlpage&page=welcome

CHANGING WHAT'S POSSIBLE

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ARPA-E DAC & DOC projects

OPEN 2018: ASU
Create hollow fiber membranes that transport H_2O and CO_2

SEEDVerdox
Electroswing:sorbent captures and releases CO_2 based on redox state

FLECCS: GT, MIT, Pitt
Integration between NGCC and DAC systems (lime, sorbent DAC)

2020 DAC & DOC FOAs
Project selections to be announced

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ARPA-E's recent DAC & DOC FOAs: Motivation

▶ Motivation:

– Capture of dispersed greenhouse gases (GHGs) is an important part of a diversified portfolio of technologies to mitigate U.S. GHG emissions.

– A large portion of the 5.2 gigatons (Gt) of CO_2 emitted each year in the US is released in relatively small quantities from distributed sources (e.g., from small po sources or some transportation sources).

– For such emissions, point source capture may be infeasible. In those cases, captu dispersed CO_2 serves as a crosscutting and complementary approach to achieving economy-wide net-zero emissions.

ARPA-E's efforts designed to complement funding opportunities
from Office of Science and Office of Fossil Energy.

ARPA-E's recent DAC & DOC FOAs: Performance targets

Ambient air or ocean water → [ ] → CO_2
→ CO_2-lean air/water
(Variable)
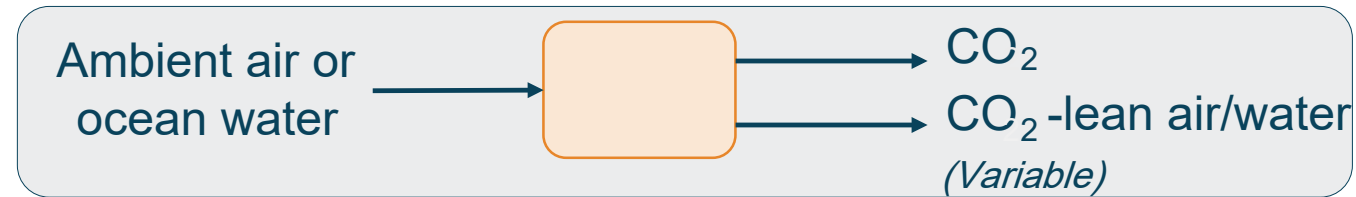
▶ Technoeconomic performance metrics:
  – Levelized cost of capture
  – Second law efficiency
  – Embodied emissions

For more information, visit: arpa-e-foa.energy.gov

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ARPA-E's recent DAC-specific Technical Areas of Interest

▶ Three Technical Areas of Interest (with example metrics)

1. Capture materials
- Active surface area
- Sorbent lifetime
- Rate of CO_2 sorption
- Regeneration energy
- CO_2 selectivity
- State of desorbed CO2
- Etc.

2. Novel air contactor designs(particular interest in passive air collector designs)
- Normalized capital cost
- Geographic footprint
- Spacing design
- Thermal and electrical energy consumption
- Pressure drop
- Volume flow
- Mass transfer boundary conditions
- Etc.

3. Novel process designs
- Major component sizes
- Thermal and electrical energy consumption
- Water or other chemical consumption
- Thermodynamic states at major component boundaries
- Outlet CO_2 state
- Outlet CO_2 impurities
- Etc.

For more information, visit: arpa-e-foa.energy.gov

ARPA-E's recent DOC-specific Technical Areas of Interest

▶ Two Technical Areas of Interest (with example metrics)

1. Salt splitting technologies

- Major component sizes
- Thermal and electrical energy consumption
- Water or chemical consumption
- Required component efficiency or effectiveness values
- Thermodynamic states at major component boundaries
- Outlet CO_2 state & impurities
- Etc.

2. Novel concepts not involving salt splitting

- Cost per membrane surface area
- Membrane lifetime
- Permeability to desired species
- Rejection of undesired species
- Chemical stability in the presence of seawater
- Etc.

For more information, visit: arpa-e-foa.energy.gov

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Keep an eye out for more information coming soon!

Thank you!

https://arpa-e.energy.gov