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What is the role of carbon fuels and infrastructure in decarbonization?

Panel Discussion
AEC 2021

Elizabeth “Beth” Zeitler, Ph.D.
Associate Director, Board on Energy and Environmental Systems

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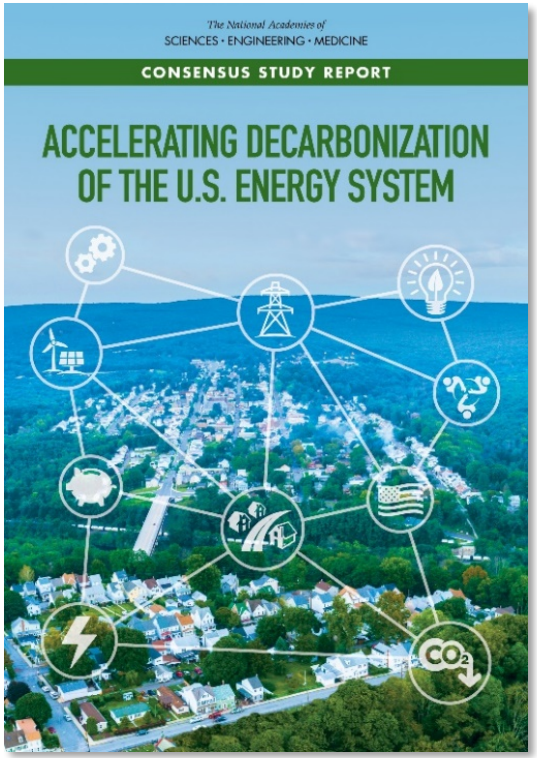
What does “decarbonization” mean? How do carbon fuels fit in a decarbonized world?

- Human-generated CO_2 emissions to the atmosphere are the most important driver of global climate change, and cannot continue.
- Decarbonization is shorthand for **transforming systems** to produce **zero net human-generated CO_2 emissions to the atmosphere.**
- Current one-way flows of carbon from fossil fuel combustion to CO_2 emissions will be broadly replaced with carbon-free systems (renewable electricity, for example).
- **Carbon fuels or products** (for aviation fuels, for example) can participate in this future, but they **must not result in net emissions to the atmosphere**, requiring cyclic systems of production, use, and recycling/disposal.

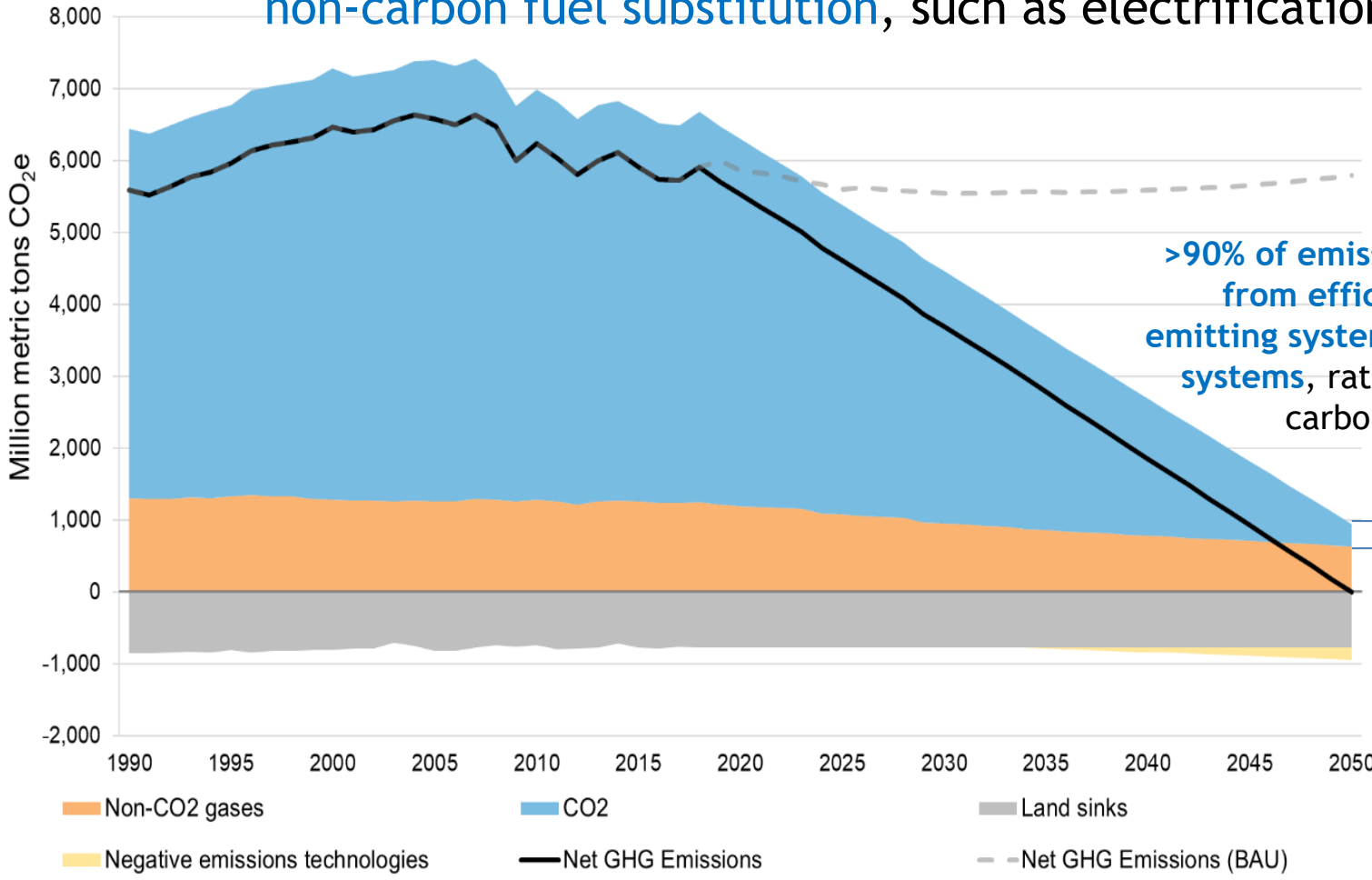


nap.edu/decarbonization

National Academies' identifies decarbonization consensus path, policy recommendations for next 5-20 years. Independent experts agree:

- Immediate action on decarbonization is needed to avoid worst consequences of climate change in the U.S.
- Decarbonization is feasible, with investment capital similar to historic investments in on the U.S. energy system, and health benefits outweighing costs.
- Social dimensions, including a fair, equitable, and participatory transformation are required.

The Academies report envisions most decarbonization will occur through non-carbon fuel substitution, such as electrification and efficiency



>90% of emissions reductions are from efficiency and replacing emitting systems with carbon-free systems, rather than maintaining carbon fuels with negative emissions

Technology Goals: 2021 – 2030

Electrify energy services in transportation, buildings, and industry

Examples include moving half of vehicle sales (all classes combined) to EV's by 2030, and deploying heat pumps in one quarter of residences.

Improve energy efficiency and productivity

Examples include accelerating the rate of increase of industrial energy productivity (dollars of economic output per energy consumed) from the historic 1% per year to 3% per year.

Produce carbon-free electricity

Roughly double the share of electricity generated by carbon-free sources from 37% to 75%.

Expand the innovation toolkit

Triple federal support for net-zero RD&D.

Plan, permit, and build critical infrastructure

Examples include new transmission lines, an EV charging network, and a CO_2 pipeline network.

Socio-Economic Goals

Strengthen the U.S. economy

Use the energy transition to accelerate US innovation, reestablish US manufacturing, increase the nation's global economic competitiveness, and increase the availability of high-quality jobs.

Support communities, businesses, and workers

Proactively support those directly and adversely affected by the transition

Promote equity and inclusion

Ensure equitable distribution of benefits, risks and costs of the transition to net-zero.

Integrate historically marginalized groups into decision-making by ensuring adherence to best practice public participation laws.

Ensure entities receiving public funds report on leadership diversity to ensure non-discrimination.

Maximize cost-effectiveness

What did the Academies have to say about carbon fuels in a decarbonized future?

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Plan, Permit, and Build Critical Infrastructure:

Key Actions by 2030 and Beyond

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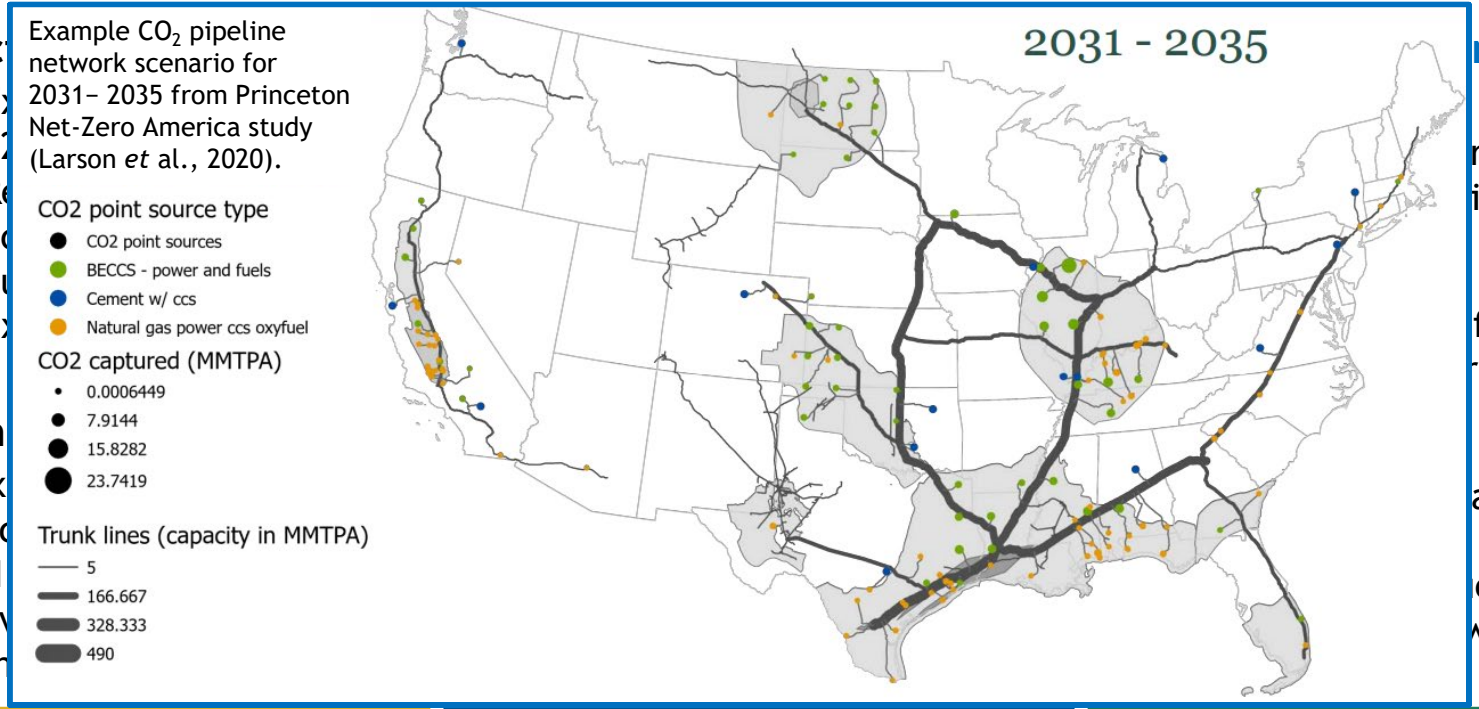
Example CO_2 pipeline network scenario for 2031– 2035 from Princeton Net-Zero America study (Larson *et* al., 2020).



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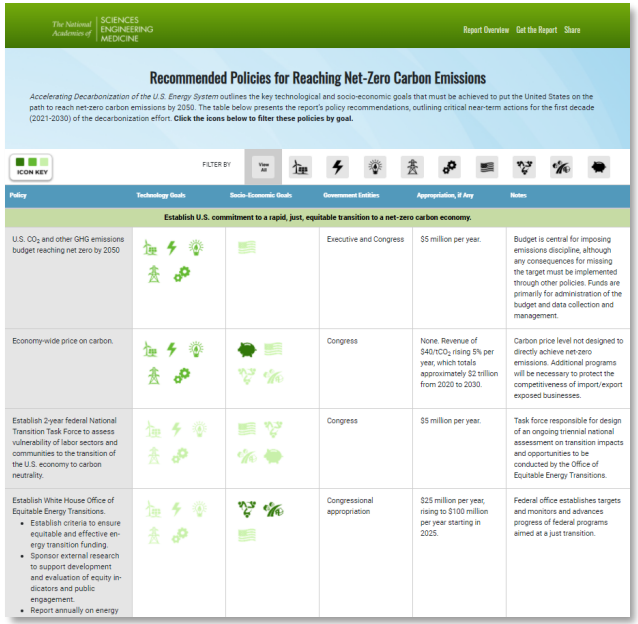
Policy Recommendations for Infrastructure



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Report Overview Get the Report Share

Recommended Policies for Reaching Net-Zero Carbon Emissions

Accelerating Decarbonization of the U.S. Energy System outlines the key technological and socio-economic goals that must be achieved to put the United States on the path to reach net-zero carbon emissions by 2050. The table below presents the report's policy recommendations, outlining critical near-term actions for the first decade (2021-2030) of the decarbonization effort. **Click the icons below to filter these policies by goal.**

ICON KEY FILTER BY View All

Policy	Technology Goals	Socio-Economic Goals	Government Entities	Appropriation, if Any	Notes
Establish U.S. commitment to a rapid, just, equitable transition to a net-zero carbon economy.					
U.S. CO_2 and other GHG emissions budget reaching net zero by 2050			Executive and Congress	$5 million per year.	Budget is central for imposing emissions discipline, although any consequences for missing the target must be implemented through other policies. Funds are primarily for administration of the budget and data collection and management.
Economy-wide price on carbon.			Congress	None. Revenue of $40/tCO$_2$ rising 5% per year, which totals approximately $2 trillion from 2020 to 2030.	Carbon price level not designed to directly achieve net-zero emissions. Additional programs will be necessary to protect the competitiveness of import/export exposed businesses.
Establish 2-year federal National Transition Task Force to assess vulnerability of labor sectors and communities to the transition of the U.S. economy to carbon neutrality.			Congress	$5 million per year.	Task force responsible for design of an ongoing triennial national assessment on transition impacts and opportunities to be conducted by the Office of Equitable Energy Transitions.
Establish White House Office of Equitable Energy Transitions. • Establish criteria to ensure equitable and effective energy transition funding. • Sponsor external research to support development and evaluation of equity indicators and public engagement. • Report annually on energy			Congressional appropriation	$25 million per year, rising to $100 million per year starting in 2025.	Federal office establishes targets and monitors and advances progress of federal programs aimed at a just transition.

View full table of 30 policies at
nap.edu/decarbonization-policies

- Establish federal Green Bank to finance low-carbon technology, business creation, and infrastructure
- Amend Federal Power Act and Energy Policy Act to facilitate new transmission infrastructure
- Plan, fund, permit, and build electrical transmission, including HVDC
- Expand EV charging network for interstate highways
- Expand broadband for rural and low-income customers to support advanced metering
- Plan and assess requirements for national CO_2 transport network
- Establish educational and training programs to train the net-zero workforce

Policy Recommendations for Carbon Transport

Policy Recommendations	Appropriation	Notes
• Plan and assess the requirements for national CO2 transport network, • characterize geologic storage reservoirs, and • establish permitting rules. • Require fair public participation measures to ensure meaningful community input.	$50 million to Department of Transportation (DOT) with other agencies involved for 5-year planning plus $50 million for block grants for community and stakeholder engagement. $10 billion to $15 billion total during the 2020s to DOE, United States Geological Survey (USGS), and Department of Interior (DOI) to characterize reservoirs. Extend 45Q and increase to $70/tCO2—$2 billion per year.	Modeling studies and other analysis indicate that significant amounts of negative emissions will be needed to meet net-zero emissions. The CO2 pipeline network is needed even with 100% non-fossil electric power to enable carbon capture at cement and other industrial facilities with direct process emissions of greenhouse gases and to enable capture of CO2 from biomass or via direct air capture for use in production of carbon-neutral liquid and gaseous fuels.

View full table of 30 policies at nap.edu/decarbonization-policies

Carbon fuels will play a decreasing role in decarbonized energy systems, but may remain for certain applications where storability, high energy density, and other properties are required.

- Remaining uses of carbon fuels must be non-emitting or offset with negative emissions.
- Non-emitting systems require
  - RD&D developments
  - Repurposing, improving, and building infrastructure

Let’s hear from today’s experts

- Kevin W. Harrison, Program Manager, NREL
- Eric Dupont, Executive Vice President and Chief Commercial Officer, PowerSecure
- Christopher A. Cavanagh, Principal Program Manager, Customer Distributed Energy Resources - Future of Heat, National Grid
- Joanne Mello, Director of Sustainability and Energy Policy, Southern Gas