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Argonneâ??s Decarbonization Scenario model analyzes Net-Zero Carbon Emissions Pathways

18 April 2024 | News

Developing carbon-mitigation strategies

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The US Department of Energy's Argonne National Laboratory has developed a Decarbonization Scenario Analysis Model to predict the effects of carbon mitigation strategies on energy use and greenhouse gas emissions (GHG) across the U.S. economy. Greenhouse gases, Regulated Emissions, and Energy use in Technologies (GREETÂ®) lifecycle analysis models were used to develop the tool.

A recent study published in Sustainable Energy & Fuels examined decarbonization scenarios for five sectors of the U.S. economy: transportation, industry, agriculture, residential/commercial, and energy power from 2020 to 2050 using the Decarbonization Scenario Analysis Model. These sectors of the economy are the primary sources of CO2 emissions and other greenhouse gases such as methane that are warming the planet.

Climate change cannot be stopped or slowed by any single pathway, even though the world would love to have a quick fix. All carbon dioxide (CO2) mitigation strategies across the U.S. economy rely on clean energy technologies and low- and zero-carbon fuels, while decarbonization pathways vary and are specific to individual industries. Scientists are also developing tools for assessing strategies as they develop them.

Based on the life-cycle analysis of technology pathways, Hawkins' approach combines both top-down and bottom-up modeling in order to provide a high level of detail. The top-down approach offers a high-level perspective, while the bottom-up

approach analyzes each scenario in detail.

Researchers developed carbon mitigation strategies for each sector based on decarbonization scenarios from 2020 to 2050. In comparison with the baseline, researchers proposed a decarbonization pathway that would reduce GHG emissions by 80-90% economy-wide in 2050. Over the specified timeframe, the modeling effort represents a variety of factors, trends, and potential advancements in the U.S. energy landscape.

Key components of the economy-wide pathway are replacement and scale-up of the electric grid with renewable energy sources such as wind, solar, hydropower, geothermal and biomass; partially electrifying the transportation sector; using low- or zero-carbon biofuels; improving building energy efficiency and replacing natural gas with renewable energy sources.

Carbon-mitigation pathways at the economy-wide level are feasible, but reducing GHG emissions 80-90% would be extremely difficult. Progress depends on transforming each area of the economy, including deep CO2 emission cuts across all industries and in hard-to-abate sectors like aerospace and locomotives.

In addition, the model is not intended to bring users to net-zero overnight. As a data-driven tool, the Decarbonization Scenario Analysis Model helps users assess what works and what doesn't in specific decarbonization scenarios to guide their future decisions. Technology choices - the engine that drives decarbonization - can have long-term effects on carbon mitigation.

Researchers focused on transitioning from high-carbon to low-carbon technologies, making current technologies more efficient and replacing conventional fuel with renewable options.

The model does not include carbon-negative technology such as carbon capture and storage but can be expanded to include carbon-reduction technologies that would reduce CO2 emissions even further. Expansion of biofuel pathways could also reduce CO2 emissions.