# New tool for energy sector models carbon capture incentives

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Wind turbine in foreground with coal-fired power plant in background. Credit: S. Hermann & F. Richter, Pixabay

The Biden administration has made reducing $CO_2$ emissions a policy priority. Although debate continues over how much to reduce and how quickly, it seems unavoidable that the power sector will face growing pressure to deeply reduce its $CO_2$ emissions. But these efforts cannot be concerned solely with reducing $CO_2$. Both cost and grid reliability—especially after events in Texas in early 2021—must be considered as well.

In a new paper published in the *International Journal of Greenhouse Gas Control*, Carnegie Mellon University's Jeffrey J. Anderson, David Rode, and Paul Fischbeck, together with Haibo Zhai of the University of Wyoming, use a model they published earlier this year in *Applied Energy* to identify new and existing coal- and natural gas-fired electricity generation plants that are candidates for CCS deployment when utilizing the recently-enhanced Section 45Q tax incentives for carbon capture.

"While technologies such as CCS and have been available for years, the industry has faced challenges in employing them due in part to a lack of enabling infrastructure," said Jeffrey Anderson, a doctoral candidate in the Department of Engineering and Public Policy.

Fischbeck, professor of Engineering & Public Policy (EPP) and Social & Decision Sciences, notes that the Biden administration's proposed infrastructure package contains numerous elements that open up a broader, more reliable set of strategies for reducing $CO_2$ emissions. He believes that legislative components such as the SCALE Act are essential to deploying reliable, low-cost technologies to reduce $CO_2$ emissions.

The problem is that it can be difficult to determine what the least-cost configuration of these newly-feasible strategies for a specific generating plant may be, with or without tax incentives, a price on carbon, or a mandate to reduce $CO_2$ emissions to a certain level. David Rode, adjunct research faculty with the Carnegie Mellon Electricity Industry Center, explains how each plant has a unique set of physical and performance characteristics, including age, efficiency, location, capacity factor, and technology.

By including these factors, the team's model is a critical aid for utility managers and policymakers tasked with reducing $CO_2$ emissions. Using it, they're able to explore the impact of various carbon capture technologies like CCS, and compare additional options such as replacing coal fired plants with natural gas or renewable energy. This allows decision-makers to attain the desired $CO_2$ reductions at an optimal cost.

"These strategies are modeled with the help of another model developed at Carnegie Mellon, the Integrated Environmental Control Model (IECM)," commented Zhai, currently the Roy & Caryl Cline Chair of Engineering, Environment and Natural Resources at the University of Wyoming and previously the manager for the IECM project while faculty at Carnegie Mellon. "The combination of these two models provides policymakers with a powerful tool to evaluate $CO_2$-reduction strategies from 10% to near 100% reductions."

Another important distinction of the team's model is the incorporation of uncertainty. Fischbeck explains how it is essential to consider uncertainty when planning for policies that may unfold over ten or twenty years or more. It's important that policymakers have robust strategies for accomplishing their objectives. Uncertainty for energy plant owners may take many forms, such as investments previously made that have not been fully recovered.

"One of the important contributions that this tool makes to actual utilities and ratepayers is that it recognizes the complexities in quickly abandoning fossil fuel for renewable power, as many politicians advocate," stated Rode. "The U.S. has many existing and operating coal-fired and natural gas power plants, and it would be wasteful to suddenly render them 'obsolete' via policy when other paths capable of equivalent $CO_2$ reductions can be lower cost and less socially and economically disruptive."

Indeed, the cost of reliability for an energy system dependent on renewables could be quite high. In their work, Zhai shows how plans to achieve net-zero power sector emissions by 2035 could actually rely on CCS equipped plants for up to 20 percent of the nation's power.

Fischbeck was particularly focused on how modeling of 45Q tax incentives can give policymakers direction: "While it may be difficult to get a price on $CO_2$ through Congress or have the EPA mandate net-zero emissions by 2035 without prolonged court battles, 45Q tax incentives have historically been a bipartisan effort in the House and Senate and are currently the subject of numerous bipartisan proposals. We believe that they represent an under-utilized policy tool for achieving large $CO_2$ reductions in a politically fraught environment while maintaining system reliability."

The team suggests several improvements to the existing program, such as tailoring the tax credits to individual generation technologies, whether coal or natural gas. These changes to the 45Q program should be uncontroversial in Congress and fit nicely with both the administration's interests in building out carbon storage infrastructure and negative emissions technologies. There are currently several proposals in Congress to modify the 45Q program, such as Sen. Lujan's (D-NM) CATCH Act (SB2230), Rep. Schweikert's (R-AZ) HB 2633, and Sen. Wyden's (D-OR) Clean Energy for America Act (SB1298).

"Congress has provided the 45Q incentives for years, but with the Biden administration's push for an infrastructure package that would accelerate development of the enabling infrastructure, we're now at a point where meaningful change is possible," said Fischbeck. "A full toolbox of technologies and strategies—including our model—will be required to balance the competing objectives of zero $CO_2$, low cost, and high reliability, as our existing power plant fleet transitions to a net-zero one."

**More information:** Jeffrey J. Anderson et al, A techno-economic assessment of carbon-sequestration tax incentives in the U.S. power sector, *International Journal of Greenhouse Gas Control* (2021). DOI: 10.1016/j.ijggc.2021.103450

Jeffrey J. Anderson et al, Transitioning to a carbon-constrained world: Reductions in coal-fired power plant emissions through unit-specific, least-cost mitigation frontiers, *Applied Energy* (2021). DOI: 10.1016/j.apenergy.2021.116599

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