ELECTRIC POWER RESEARCH INSTITUTE

P201 Back Pocket Insights

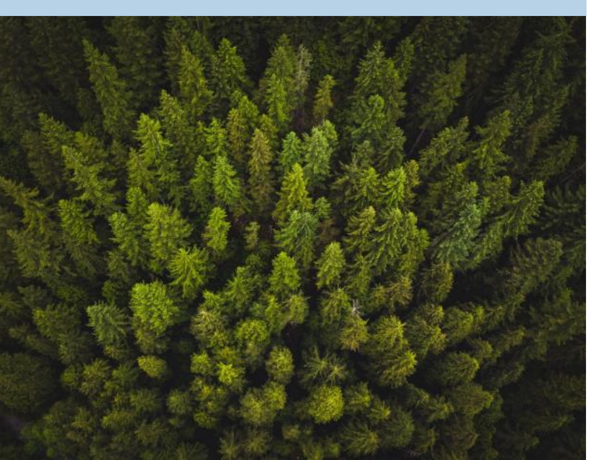
KEY INSIGHTS

- **Carbon removal technologies paired with low-carbon generation lower the costs of deep decarbonization** and can materially impact power sector planning decisions.

- **Carbon removal is increasingly valuable as electric sector emissions approach net-zero levels.**

- **The impact of direct air capture on electricity demand is relatively small** compared with other factors such as expected transport electrification and net losses from energy storage.

This brief is based on the paper "Impact of Carbon Dioxide Removal Technologies on Deep Decarbonization of the Electric Power Sector" published in *Nature Communications* (2021)



Impacts of Carbon Removal on Power Sector Decarbonization

by John Bistline and Geoff Blanford

A new paper explores impacts of carbon dioxide removal (CDR) technologies on electric sector investments, costs, and emissions using an energy model with technological, temporal, and spatial detail.

CDR technologies such as biomass with carbon capture and storage (BECCS) and direct air capture (DAC) create net negative emissions flows that offset expensive last tons of abatement, allowing zero CO_2 emissions targets to become "net zero." CDR helps to achieve greater emissions reductions with equivalent spending or to reach the same emissions at lower costs.

We find that **a broad deployment range of deployment for BECCS and DAC is possible**, especially for CO_2 reductions of 90% and higher, though the mix of CDR is sensitive to cost assumptions and biomass availability (Figure 1). This finding should encourage modelers and resource planners to incorporate BECCS, DAC, and other CDR options into their modeling.

Bioenergy with carbon capture is selected for net-zero electric sector emissions targets in part because BECCS produces firm negative-CO_2 electricity as a coproduct, whereas DAC consumes electricity and heat. However, DAC deployment increases as biomass supply costs rise in scenarios with higher CDR demand.

CDR availability impacts power sector planning and provides flexibility in meeting decarbonization goals, reducing the dependence on more costly abatement options and avoiding the overdependence on any single technology. CDR has significant **effects on the size and composition of energy storage deployment (lowering long-duration storage capacity) and decreases firm low-carbon capacity**.

Despite uncertainty about reducing the last 10% to 20% of CO_2, a robust finding is that **renewables comprise a central role in electric sector decarbonization** scenarios, even if value deflation means that least-cost decarbonization pathways includes other technologies.

The cost savings from CDR increase with more stringent policies. Without CDR, electric sector abatement costs sharply increase for CO_2 reductions beyond 80%, even with significant cost reductions in renewables and battery storage. Having both DAC and BECCS is only slightly lower cost than DAC alone. A key dimension of cost savings from CDR availability is that **DAC and BECCS (despite their potential flexibility) tend toward high-utilization operations** and replace lower-utilization assets.

The impact of direct air capture on electricity demand is small relative to other factors such as expected transportation electrification and net losses from energy storage, even under high deployment scenarios.

DAC electricity demand is only 0.4% of projected demand under a 100% cap with DAC only. In fact, net energy storage losses in the 100% CO_2 cap case without CDR (548 TWh) are an order of magnitude higher than DAC electricity use in the 100% DAC Only case with (24.8 TWh), since gas turbines are replaced with hydrogen and electrolysis with low roundtrip efficiencies.

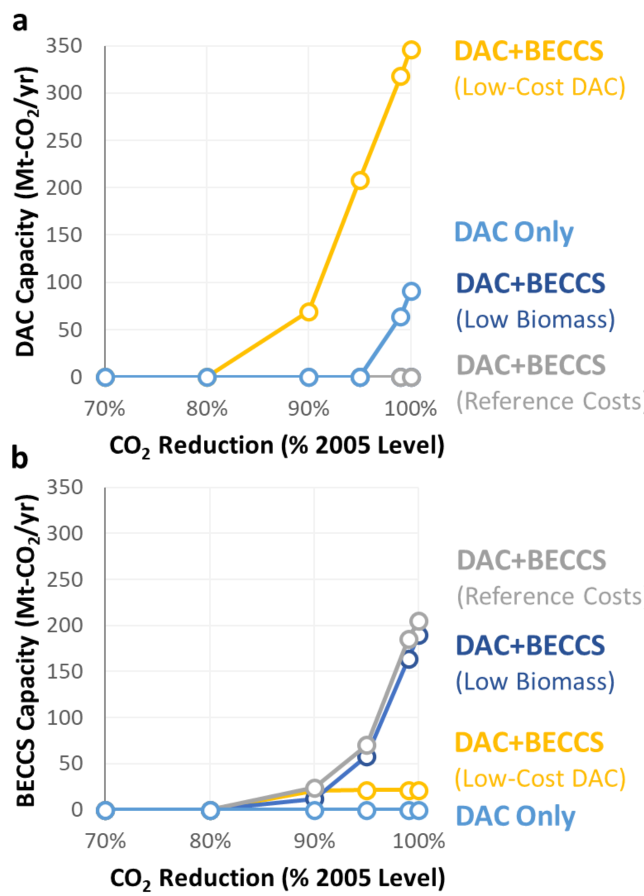


Figure 1. CO_2 removal capacity for DAC (a) and BECCS (b) by electric sector CO_2 reduction level (% 2005 level) and CDR availability scenario.

For more information about EPRI's Regional Economy, Greenhouse Gas, and Energy (REGEN) model and other recent papers, visit https://esca.epri.com/models.html

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