PATHWAYS TOWARD GRID DECARBONIZATION: IMPACTS AND OPPORTUNITIES FOR ENERGY CUSTOMERS FROM SEVERAL U.S. DECARBONIZATION APPROACHES

SUMMARY FOR POLICYMAKERS

OVERVIEW

The power sector can play a leading role in cost-effective, economy-wide emission reductions because it can reduce emissions at lower costs than any other major sector, and it can enable other sectors like transportation and buildings to substantially decarbonize through electrification. Commercial and industrial (C&I) energy customers account for approximately half of all electricity-related greenhouse gas (GHG) emissions and have an important role to play in reducing those emissions.

The recently passed Inflation Reduction Act (IRA) includes strong incentives for clean electricity, but complementary pathways can reduce costs and increase decarbonization and net benefits. The Pathways Toward Grid Decarbonization: Impacts and Opportunities for Energy Customers from Several U.S. Decarbonization Approaches report by authors from **Resources for the Future (RFF)** projects the costs and benefits of five such pathways using detailed simulation modeling. The report was funded by the **Clean Energy Buyers Institute** and RFF.

COST-REDUCING PATHWAYS

This Summary for Policymakers of the full report summarizes modeling results and conclusions. Three pathways in particular indicate opportunities to reduce costs and hence inflation, in addition to reducing emissions.

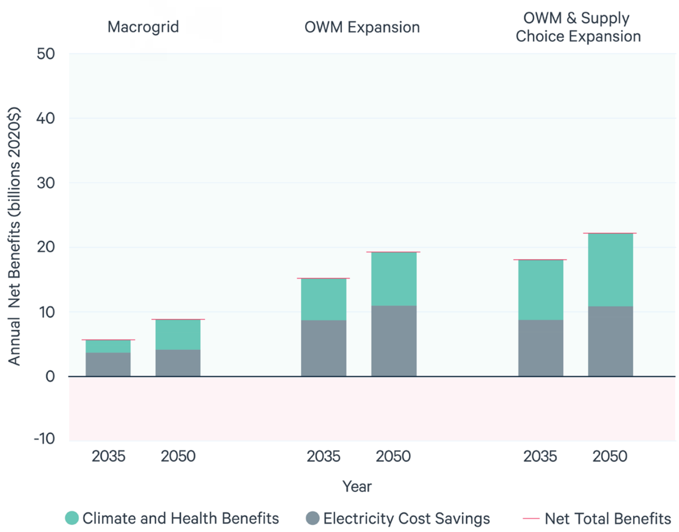
A national high-capacity transmission **Macrogrid**. This is just one example of numerous potential transmission expansions. The estimated benefits of the modeled Macrogrid are 3-4 times the estimated costs. It reduces national average electric rates by approximately 1% while reducing annual U.S. power-sector GHG emissions 2.6% by 2050.

Expansion of competition among electricity generators via expansion of **Organized Wholesale Electricity Markets** (OWMs) to the parts of the U.S. that do not currently have them, which are the Southeast and much of the West. The estimated cost savings would be $11 billion per year in 2035 and $14 billion in 2050, in addition to reducing annual U.S. power sector GHG emissions 8% by 2035. Expansion of OWMs would reduce electricity production costs, increase grid operational efficiencies, and increase access to voluntary clean power purchasing, partly through power purchase agreements (PPAs) by C&I customers.

Expansion of **Electricity Supply Choice** to C&I customers in the parts of the country that do not have it. Expanding C&I supply choice increases C&I voluntary clean power access, particularly through competitive suppliers and physical PPAs. The modeled supply choice expansion reduces power-sector GHG emissions a further 2% beyond the reduction achieved by expanding OWMs.

The results shown in Figure S1 are without the IRA, and did not assume the existence of any clean energy tax credits. In another scenario, not shown, the Macrogrid was modeled in the presence of strong incentives for clean generation, akin to what is in the IRA. This made the value of the Macrogrid even higher, since it enables use of lower-cost clean energy resources. OWM expansion, as well, could be more valuable in the presence of the IRA, as OWMs facilitate the cost-competitive integration of clean energy technologies.

FIGURE S1 Projected Health, Climate, and Electricity Cost Savings Benefits of the Cost-Reducing Pathways



OWM refers to organized wholesale markets.

“Climate and Health Benefits” consist of reduced human losses from climate change and reduced human mortality and illness from sulfur and nitrogen oxide emissions.

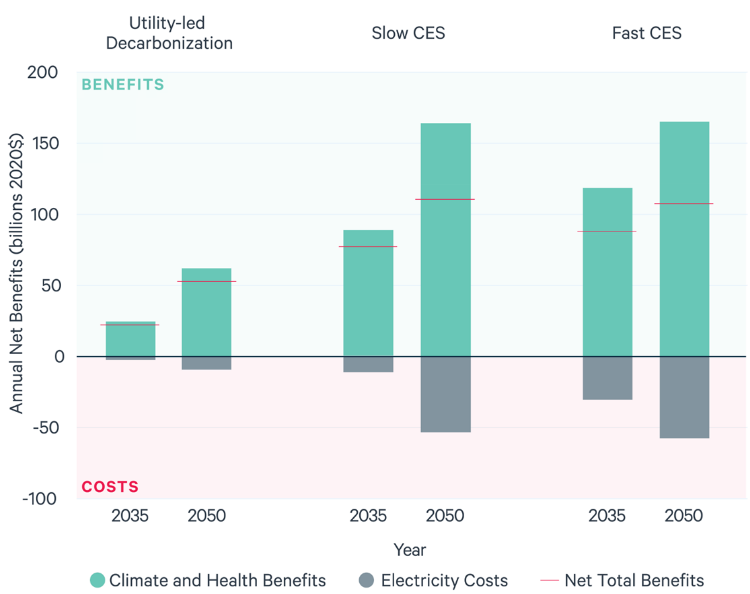
CLEAN POWER FOR ALL

The two other pathways modeled were potential policies for going beyond the IRA in select parts of the country or nationally.

Utility-led Decarbonization. Vertically integrated investor-owned utilities (IOUs) supply 42% of U.S. electricity. In this scenario, it was assumed that all vertically integrated IOUs fully decarbonize by the end of 2050, in keeping with the trend of decarbonization goal setting by some such utilities. This would reduce 2050 U.S. power-sector GHG emissions by 38%. The ratio of estimated environmental benefits to non-environmental costs is 7 to 1, as shown in Figure S2. In the absence of any federal tax credits for clean energy, it would raise average electricity rates 2.6%, but the IRA is likely to greatly reduce the electricity rate impacts of utility decarbonization and of CESs.

A national **"Slow" Clean Electricity Standard** (CES) with a non-emitting generation target that reaches 100% by 2050 and a **"Fast" CES** with a target that reaches 100% by 2035. These do not quite reach their 100% targets because they have cost ceilings, but they come close. Both CESs produce estimated annual net benefits of approximately $80 billion by 2035 and $110 billion by 2050. The Slow CES increases projected 2035 clean generation from 42% in the reference scenario (and less than 40% at present) to 78%, while increasing the projected national average retail electricity rate by just 3% in the absence of any tax credits, and less in the presence of the IRA.

FIGURE S2 Benefits and Costs of Utility-led Decarbonization and Clean Electricity Standards



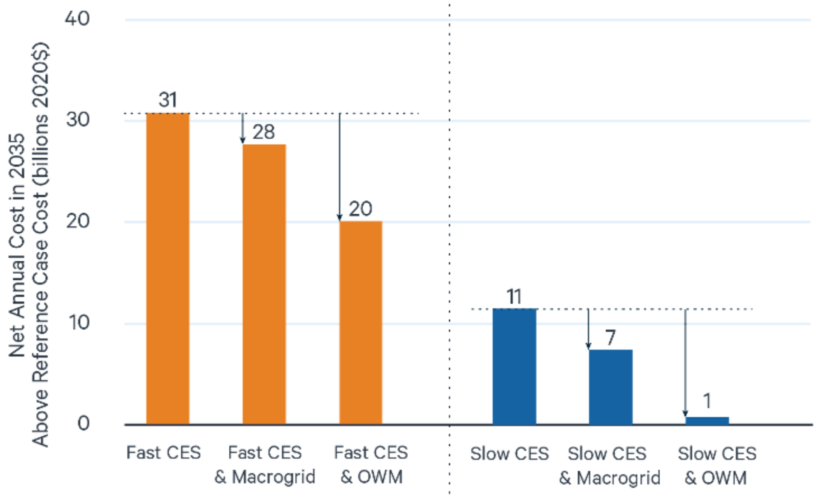
This figure has a different vertical scale, compared to Figure S1.

Utility-led decarbonization or a CES would provide cleanly generated power for all customers. For energy customers wanting to voluntarily purchase a different mix of clean power, these pathways could increase or decrease access to options depending on decisions made by utilities and regulators regarding such access.

The **CESs and Utility-led Decarbonization increase projected employment** through 2035. A Slow CES produces an average of 210,000 more energy sector jobs at any given moment through 2035, a Fast CES an average of 290,000 more, and Utility-led Decarbonization an average of about 50,000 more, compared to reference scenario. After 2035, the projected employment effects are mixed.

Combining cost-saving policies with ambitious emission reduction policies can offset the costs of the emission reductions, as illustrated in Figure S3. OWM expansion and the Macrogrid together could more than fully offset the cost of the Slow CES through at least 2035. Put differently, OWM expansion, the Macrogrid, and the Slow CES together could more than double the market share of non-emitting generation, to approximately 80% of U.S. generation, while lowering the costs of the electricity supply, even before counting the effects of the IRA.

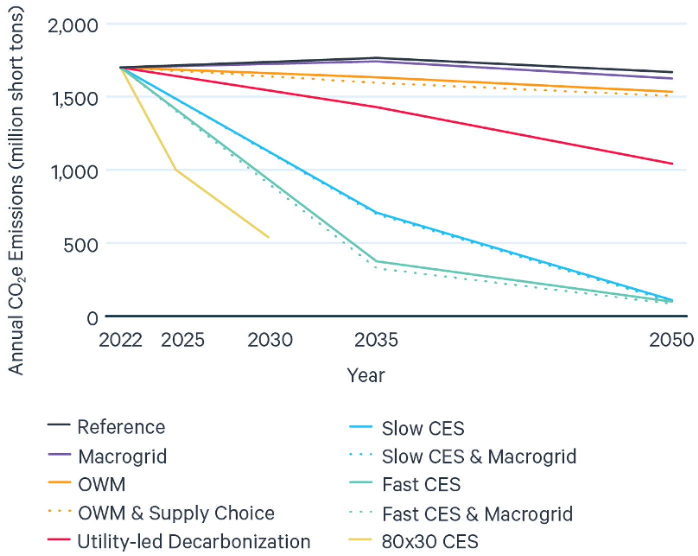
FIGURE S3 Effects of CESs and policy combinations on cost of U.S. electricity supply in 2035



COMPARISON OF EMISSIONS TRAJECTORIES

Figure S4 shows the projected GHG emission trajectory for every pathway, as well as some combinations of the pathways. The CES and Utility-led Decarbonization pathways produce the largest emission reductions and have estimated net benefits much larger than their estimated costs, as shown in Figure S2. The other pathways reduce emissions less, but save money, as shown in Figure S1.

FIGURE S4 Projected U.S. Power-Sector Annual Greenhouse Gas Emissions for Each Pathway and Some Pathway Combinations



NOTES

- All emission and cost effects reported in this document are relative to a Reference scenario, which has none of the pathways in it.
- The damage per short ton of carbon dioxide (CO_2) is conservatively assumed to be $61 if emitted in 2035 and $77 if emitted in 2050. The very recent updates to these estimates (https:/www.nature.com/articles/s41586-022-05224-9) are more than three times as large. Using those recently updated values would result in much higher estimated benefits of all of the pathways.
- Some other studies have estimated even lower electricity rate impacts of similar policies. This is at least partly explained by the fact that the modeling in the report conservatively assumes no tax credits for clean generation. Inclusion of such credits would reduce the rate impacts of achieving clean generation targets.
- The report assumes that total U.S. electricity demand in 2035 and 2050 is 19% and 47% higher than 2019 demand, respectively.
- The costs reported in this document include the cost of all new generators and transmission, levelized over the first 30 years of operation, including cost of financing. (Exception: The cost of the macrogrid is levelized over 50 years given its very long expected lifetime.)
- The EPA recommended value per life saved was used, which is $12 million in 2050 and slightly less in 2035.
- The CES credit price ceilings were assumed based on proposed legislation: For Slow CES, $46 in 2035 and $85 in 2050. For Fast CES, $54 in 2035 and $85 (same as for Slow CES) in 2050.
- All dollar values in this document are in 2020 dollars.