RESOURCES for the FUTURE

The Value of Advanced Energy Funding

Projected Effects of Proposed US Funding for Advanced Energy Technologies

Issue Brief 21-03 by **Daniel Shawhan**, **Kathryne Cleary**, **Christoph Funke**, and **Steven Witkin** — April 2021

Key Takeaways

The benefits of additional research, development, and demonstration (RD&D) for advanced energy technologies are likely to greatly exceed the costs. Additional funding like that authorized by the Energy Act of 2020 would generate projected societal benefits averaging $30 billion to $40 billion in present value per technology during 2040–2060.[1]

Twenty-six experts in advanced nuclear, advanced geothermal, energy storage, natural gas with carbon capture and sequestration (NG-CCS), and direct air capture (DAC) projected the effects of the additional RD&D funding on the future costs of the technologies. The experts expect the additional funding to reduce the costs of the technologies by 9–30 percent in 2035, compared with the case of no additional funding.

Average power sector benefits across the technologies are likely to exceed costs by about 7 times if there is no new national clean energy policy and by more than 10 times if there is a national clean energy standard (CES). Benefits outside the power sector may also be significant and would increase these ratios. An economy-wide analysis for DAC found benefits of 27 times the costs of the additional funding, assuming a national economy-wide emissions policy.

Without a CES, the estimated benefits of added RD&D funding are split mainly among lower electricity bills, health benefits, and climate benefits. With a CES, the estimated benefits are mainly in the form of lower electricity bills. Average annual electricity bill savings per household for each technology are about $14 without a CES and $56 with a CES.

1. Context

In December 2020, President Trump signed the Energy Act of 2020 into law, authorizing significant federal funding for the research, development, and demonstration (RD&D) of advanced clean energy technologies. The act earmarked additional funding for each of the technologies addressed in this study.

As of this writing, Congress has not acted to appropriate funds under the Energy Act of 2020. It is uncertain how much funding each of these technologies will receive. They could receive less than authorized in the act, or more, perhaps as part of stimulus, infrastructure, or energy legislation.

This issue brief summarizes the findings of a **new study** that estimates some of the effects of proposed additional spending for these five advanced, clean energy technologies,[2] building on **two 2020 RFF simulation-based studies**. This issue brief illustrates how investing in RD&D can help make these

1 All dollar values in this brief are in 2020 dollars.
2 Parts of the analysis were also done for a sixth technology, multiday energy storage. See the working paper for details.

technologies cost-competitive and, by extension, drive down the cost of energy, whether new national clean energy requirements are adopted or not.

Although this research began before the Energy Act of 2020 was passed, the programs and funding analyzed here closely align with what the act authorized.

2. Summary of Study

This study brings together results from two sources: technology cost projections from 26 technology cost experts, and simulations from **past studies** that calculate societal benefits of cost reductions for the technologies. The analysis estimates the benefit-to-cost ratio of additional funding for each technology in two scenarios: one that includes a national clean electricity standard (CES) that requires 94 percent of power to be generated from clean sources by 2050, and another that assumes status quo domestic climate policy without a national CES. For direct air capture technology (DAC), an additional third scenario—achieving cost-effective economy-wide emissions at approximately 50 percent below 2005 levels by 2050—is used to estimate the economy-wide benefits of the technology.

To assess future technology costs, the experts provided estimates for average lifetime costs of the technology they study in 2035, both with and without 10-year additional funding streams similar to those authorized under the Energy Act of 2020. The experts also estimated the increase in public and private RD&D spending from 2022 to 2031 that would result from such funding.

Societal benefits of additional funding were estimated by mapping the experts' cost predictions onto simulation results in Shawhan, Funke, and Witkin (2020), which models power-sector effects of all five technologies, and in Hafstead (2020), which models economy-wide effects of DAC. This study uses the simulations to estimate annual power sector benefits in 2050 and assumes that they are representative of the annual benefits from 2040 to 2060.

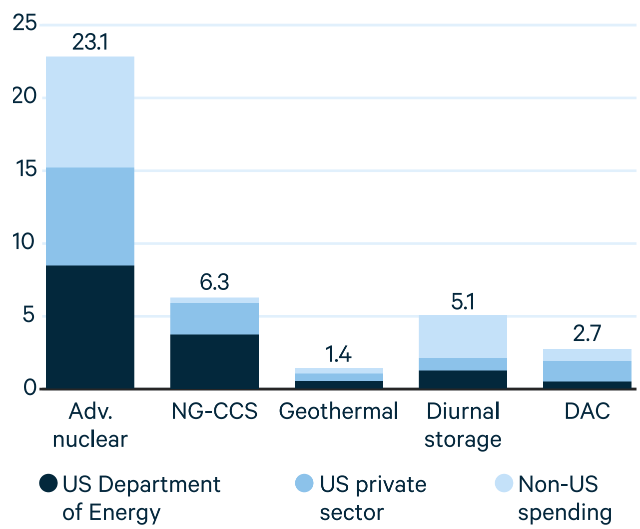
Notably, several categories of benefits are not included here: benefits outside the electricity sector (except for DAC), benefits outside the years 2040–2060, US export profits, benefits from reduced foreign emissions, or benefits from the use of the advanced energy technologies outside the United States. Including these would likely increase the benefits of this funding. Also, the benefits are modeled under the conservative assumption that cost projections for 2035 would still apply in 2050. In reality, costs tend to decline over time, especially with use, and our detailed results in the full report show that as the cost reductions grow larger, the central benefit estimates grow much larger.

3. Findings

3.1. Effects of Funding on Public and Private RD&D Spending

For all technologies studied, the experts estimate that additional RD&D funding by the US government (dark blue in Figure 1) will also increase US private RD&D spending (light blue) and foreign RD&D spending (lightest blue).

Figure 1. Projected Effect of Legislation on RD&D Spending if Fully Funded for 10 Years, FY2022–FY2031 (billions of undiscounted 2020$)



3.2. Effects of Funding on Future Technology Costs

Experts' responses show that 10-year RD&D funding (like that authorized by the Energy Act of 2020) could reduce the costs of each of the five analyzed technologies by 9–29 percent in 2035.

Figure 2. Estimated Average Cost Reductions in 2035 Due to 10-Year RD&D Funding

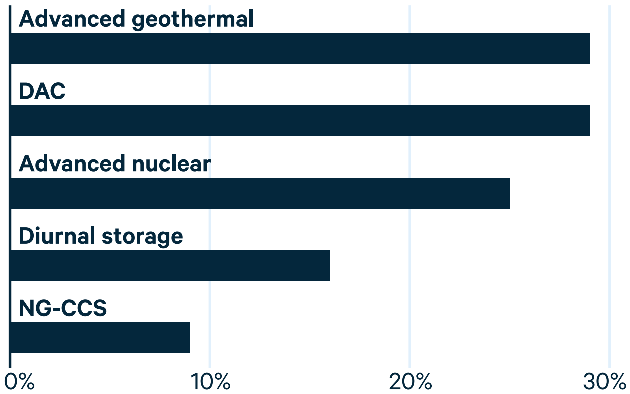


Figure 2 shows the average cost reductions expected for each technology. Figure 3 shows the same cost reductions plus the uncertainty about each one.

Figure 3 also shows cost-competitiveness thresholds calculated in Shawhan, Funke, and Witkin (2020). Cost-competitiveness is defined here as the cost needed for a technology to account for 1 percent of power generation.

Figures 2 and 3 provide a few key takeaways:

Experts expect the additional RD&D funding to reduce levelized costs of these technologies across the board, though by different amounts for different technologies.

The dashed lines, showing cost-competitiveness thresholds with and without a national CES, provide context for these estimates of cost reductions. Across all five technologies, legislation increases the likelihood of future cost-competitiveness with other, more traditional technologies, by 20 percentage points on average.

None of the technologies are certain to be cost-competitive, which is a reason to fund RD&D for multiple technologies.

3.3. Benefits of Additional RD&D Funding

Additional funding for advanced energy technologies is likely to bring down the costs of the technologies, but what effect will these reduced costs have on society? Based on the results above and in **previous simulations**,

Figure 3. Uncertainty Ranges for Levelized Cost, With and Without Added RD&D Funding

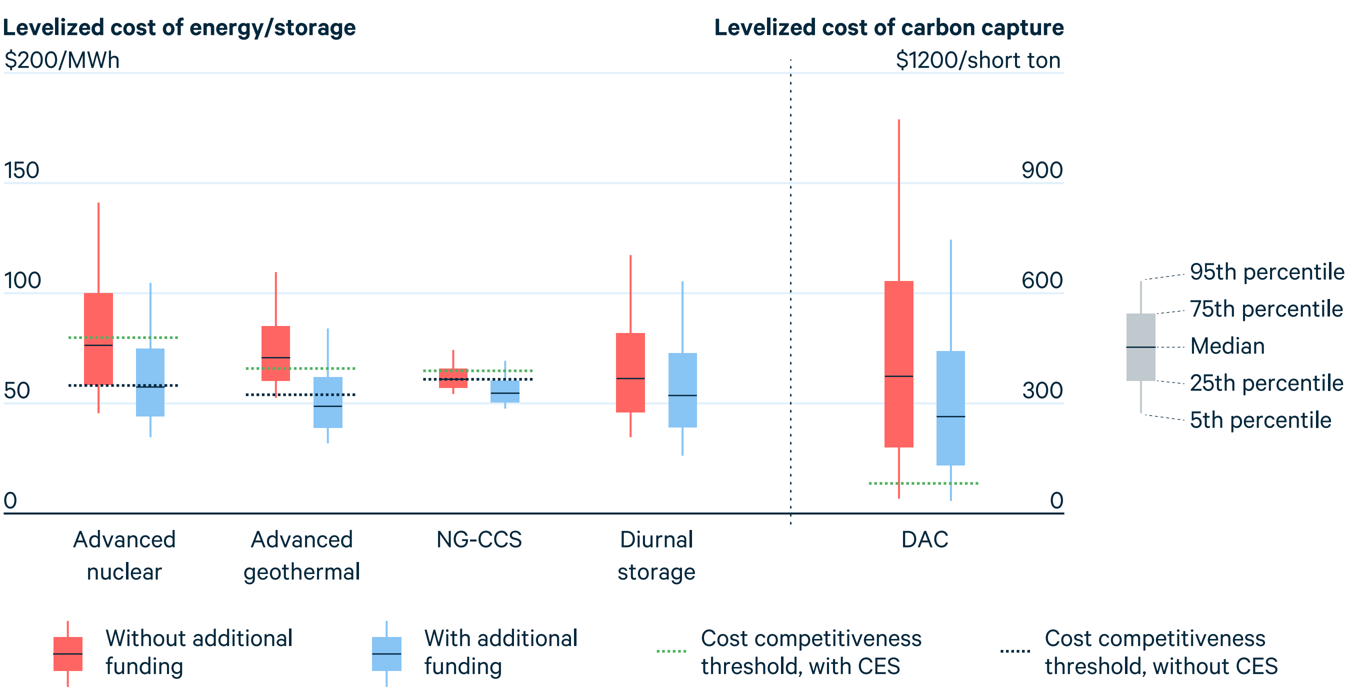
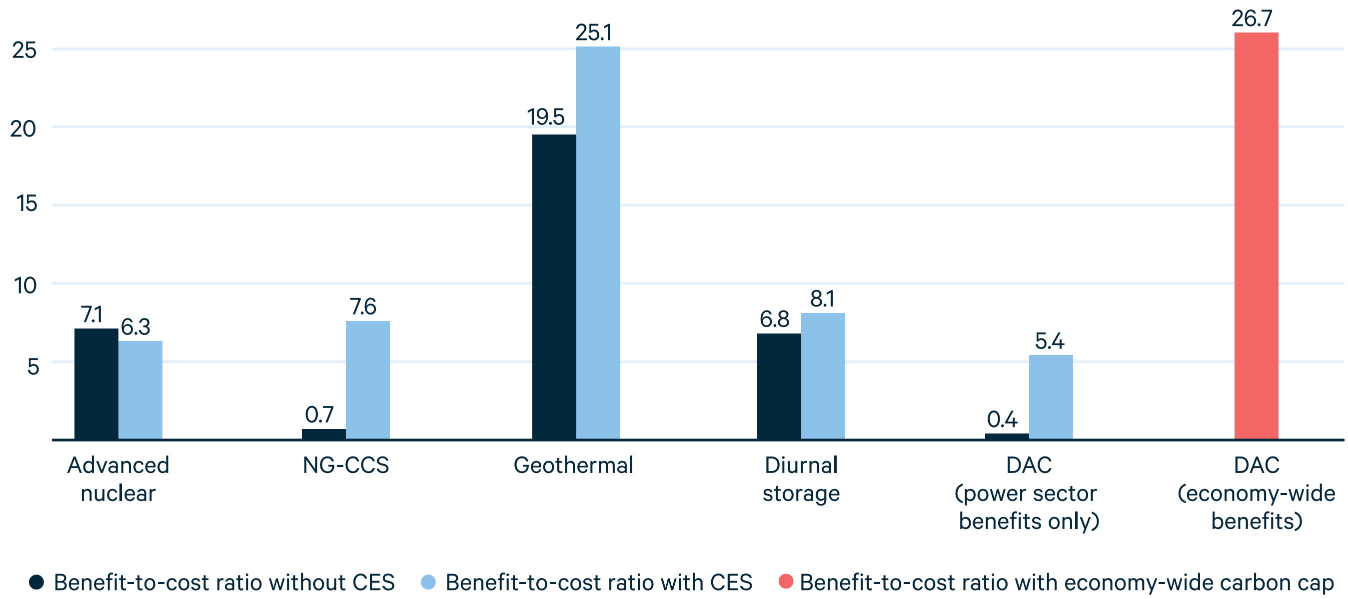


Figure 4. Estimated Benefit-to-Cost Ratios from 10 Years of RD&D Funding



the additional funding would generate estimated average societal benefits of $30 billion per technology without any new national clean energy policy, assuming a 20-year benefit stream. With a CES requiring that 94 percent of electricity generation come from clean energy sources, the average societal benefits over 20 years jump to an average of $39 billion per technology. Both of these are present values discounted at 3 percent annually. All dollar values in this brief are in 2020 dollars.

Both with and without a CES, the benefits of the additional funding are, on average, several times as large as the costs. An estimated benefit-to-cost ratio—the benefits of funding per dollar of costs—is presented for each technology in Figure 4. In the figure, all benefit-cost ratios include only benefits from the technology's power sector use, except those in the right-most column for DAC. Among the five analyzed technologies, average estimated benefits in the power sector are 6.9 times greater than costs in the case without a CES, and 10.5 times the costs in the case with one. All of the benefit estimates in this study are central estimates for the types of benefits included in the study; the true benefits could be considerably higher or lower.

Without a CES, the estimated benefits of added RD&D funding are split mainly among lower electricity bills, health benefits, and climate benefits. With a CES, the estimated benefits are mainly in the form of lower electricity bills. Electricity bill savings amount to an average of approximately $14 per household per year for each technology without a CES and $56 per household per year for each technology with a CES.

4. Conclusions

Experts believe that increased US federal funding will reduce the costs of these five advanced energy technologies, partly through spillover effects on private and international RD&D spending.

Under a national CES, the estimated benefits of additional funding are more than four times the costs for all five technologies for which benefits are calculated. Without any new national clean energy policy, this is true for three of the five technologies.

Ten years of federal RD&D funding at the levels authorized in the Energy Act of 2020 would create an estimated $30 billion to $40 billion in future societal benefits per technology, with a substantial amount directed back to electricity users in the form of reduced electricity costs.

5. References

Hafstead, M. 2020. Benefits of Energy Technology Innovation: Part 2, Economy-wide Direct Air Capture. Working Paper 20-20. Washington, DC: Resources for the Future.

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