RETHINK PRIORITIES

Clean energy price trajectories and their impact on frontier innovations

Global Health and Development
Research in Brief

We expect that reading the full report might be helpful for:

Organizations or individuals seeking to understand what the economic growth literature — and insights from three relevant experts — suggests about:

- Energy innovation and the future costs of clean energy
- The relative value of research and development in clean energy relative to other areas of innovation

Context

In May 2022, Open Philanthropy commissioned Rethink Priorities to conduct research to inform its perspectives on the prices of clean energy over the next 25-100 years, as well as whether resource or scientific constraints may inhibit clean energy innovation and scaling. For its modeling of the relative value of investments in research and development (R&D) across areas, Open Philanthropy also asked Rethink Priorities to identify potential reasons that clean energy R&D investments may be more or less valuable than pursuit of other kinds of innovation. It was particularly interested in how academic literature, forecasts, and experts approach these questions, and the (speculative) conclusions that may be drawn from these sources.

Research process

Over the course of five weeks, we conducted:

- A desk review of a subset of the available literature on (i) clean energy cost projections, and (ii) the drivers of economic growth and the role of energy inputs;
- Four expert interviews, including interviews with a prominent energy economist and modeler, an energy innovation and climate policy expert, and an energy economic historian.

Based on this research, our final ~35-page report is approximately split between an overview of cost projections of clean energy sources — both variable, such as wind and solar, and dispatchable, such as advanced nuclear and geothermal — and a discussion of the relative value of energy over "other" R&D.

Final report and key takeaways

The report finds that future prices of clean energy from various sources will continue to decline, with experts mentioning solar with battery storage, geothermal power, and nuclear fusion as potential candidates for lowest levelized cost of energy (LCOE) by the end of the century. Based on the literature, our best guess lower-bound estimate of LCOE ranges from ~$75/MWh for battery storage (low confidence), ~$60/MWh for advanced nuclear (medium confidence), and ~$25/MWh for both geothermal (medium-high confidence) and fusion (low-medium confidence). Experts forecast that the levelized cost of wind energy will experience

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Project funder: Open Philanthropy
Project duration: May – June 2022 • 220 Hours

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a ~35%-50% decline (translating to about $20-$25/MWh) by mid-century, although such experts often underestimate forecasted declines.

Academic sources highlight the importance of resource constraints to achieving a global clean energy transition. However, according to intergovernmental organizations as well as experts we have interviewed, materials constraints will not prevent the energy transition. Instead, geopolitics; environmental, social, and governance ("ESG") concerns; market transparency issues; and long lead times will slow the transition until they are appropriately addressed.

Historical data and theoretical models largely suggest that energy transitions, and falling energy prices, are disproportionately linked to economic and total factor productivity (TFP) growth. Using two largely intuitive approaches — applying a historical perspective to the next century as well as our best intuitions based on our read of the theoretical literature — we have moderate confidence that energy R&D would be slightly more valuable than other forms of R&D, with realization of a significantly transformed (i.e., more "futuristic") economic trajectory increasing the value of cheap and abundant clean energy. However, experts agree that a high-growth, high-energy economy is likely to be net-negative for the environment, even if all of the energy used is characterized by low or zero emissions.

Open Philanthropy

We thank Open Philanthropy for commissioning and funding this research project.
The views expressed in the report are not necessarily endorsed by Open Philanthropy.