



Report says geothermal is leaving wind, solar in the dust

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Geothermal is the cheapest source of alternative electricity and shows the fastest improvement per dollar invested, according to a study from NYU.

Just \$3.3 billion in R&D spending could propel geothermal energy to be the cheapest energy technology, even beating fossil fuels on a cost-per-kilowatt-hour basis, according to a new study.

The report from Melissa Schilling, a professor at New York University at Stern, indicates that geothermal has surpassed wind as the most efficient alternative energy technology. In addition, geothermal technology is improving at the fastest rate, the report says.

Those accomplishments are even more noteworthy considering that geothermal has been underfunded by the government and private sectors, indicating that geothermal has the biggest impact among alternative energies for each dollar of R&D spending, she said.

"Current capacity doesn't give you that much insight into what technology will win the race," Schilling said. "Instead, investors should be looking at the shape of the performance trajectory."

The study included data from the U.S. Department of Energy's National Renewable Energy Laboratory on the cost per kilowatt-hour at active power generation projects in 2005:

- Geothermal, \$0.031 to \$0.08
- Wind, \$0.043 to \$0.055
- Biomass, \$0.066 to \$0.08
- Solar, \$0.11 to \$0.31
- Hydroelectric, \$0.006
- Coal \$0.021
- Nuclear, \$0.022

Schilling's study examines various energy technologies and tracks their S-curves, which plot the performance of technology against the money invested to reveal the biggest technological payoffs. Schilling determined that geothermal is on track for significant future improvements in technology that will reduce the cost further.

Wind energy is just a few cents more than geothermal, but "the performance trajectory of wind is already slowing, while geothermal is exponentially increasing," Schilling said.

Meanwhile, solar lags significantly behind both technologies in cost and projected improvement, according to the study. Hydroelectric is cheap but geographically constrained, while wave and tidal technologies are too immature to provide concrete data on cost, she said. Biomass is too land- and water-intensive to be competitive, she said.

"The findings are very surprising because most people are not paying attention to geothermal," she said. "We went into this really rooting for wind and solar, probably because they're the ones you hear about the most, and they've received a lot of investment, particularly solar."

The study also looked at fossil fuels, noting little-to-no improvement in efficiencies despite continued government investment. Schilling said the findings indicate that traditional fossil fuels have likely reached their performance limits.

Schilling called for governments to invest more evenly across energy technologies, calling both geothermal and wind underfunded relative to solar and fossil fuels.

"It doesn't make that much sense to be putting that much money in fossil fuels," she said. "If that money were directed to geothermal, it could move a lot faster. Solar is so far away from being cost effective, and tremendously far away from being efficient. Right now the bigger and quicker payoff is geothermal."

Last year, [Google](#) (Nasdaq:[GOOG](#)) announced plans to invest \$10 million in enhanced geothermal systems and to pressure the federal government to provide more funding for the sector (see [Google pushes for enhanced geothermal](#)).

Two other recent studies also touted the benefits of geothermal (see [MIT report says geothermal power not to be ignored](#) and [New USGS study pumps geothermal](#)).

Schilling's study took into account the two types of geothermal technologies: hydrothermal and hot dry rock. Hydrothermal, also called hot water, is much cheaper right now because it's an easier technology, but its growth is limited because it's geographically constrained, she said. Hot dry rock is more complicated and more expensive but can be developed anywhere in the U.S., she said. The U.S. has enough hot dry rock resources to serve as the primary energy source for 30,000 years, the report said.

The study was based on the amount of public-sector spending on each technology, as well as the NREL's aggregate data on the cost per kilowatt-hour at active power generation projects, providing more accurate results than looking at individual companies' claims, Schilling said.

While most of the projects are located in the United States, the findings can be applied to other countries because the U.S. has broad spectrum of geographical terrains that can be found elsewhere, she said.

"It's not representative of the world, but the U.S. is not a specialized part of the world," she said. "At the end of the day, a certain cents-per-kilowatt-hour in Kansas would be the same as in Europe."

Schilling said that the projected growth trajectories could change if governments adjust their renewable energy spending. Additionally, an advantage for solar and wind is that they can be enacted on a small scale, while geothermal requires significant upfront investment and transmission lines. However, the study cites a report from NREL suggesting that the cost to build transmission lines is often overstated.

"I would not count wind out. I think it's a good idea to have a slightly diversified energy portfolio," she said. "But wind and geothermal are in a completely different class than solar thermal and solar photovoltaics. It will be a long time before they could be competitive."

Schilling said she's already working on a study to explain why certain energy technologies receive more attention and investment.

One factor, she said, could be whether existing companies would benefit from the emergence of a new industry with closely related technologies. She referenced semiconductor makers such as Applied Materials turning to solar, and turbine engine makers such as General Electric or Siemens embracing wind. However, the companies most equipped to develop geothermal are oil and gas developers, who would benefit the least from geothermal's success, she said.

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