

# Renewable energy sources can take up to 1000 times more space than fossil fuels

28 August 2018



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To generate renewable energy takes more space than one might think. New research by environmental scientist Paul Behrens and master's student John van Zalk shows how much space is needed for nine specific types of energy. Biomass, hydro and wind, while vital, take up the most space. Natural gas and nuclear take least. Publication in *Energy Policy*.

Different fuel types need different amounts of space, and renewable energies generally need more space than [fossil fuels](#). One way to compare them is to use the concept of power density – the average electrical power produced in one horizontal square metre of infrastructure. For the first time, researchers at the University of Leiden, Netherlands, gathered 177 estimates of U.S. power densities across the scientific literature and compared the power density for nine specific energy types. The results can be applied to other countries as well.

## More space, but less polluted

They found that power densities can vary by as

much as 1000 times, with biomass the lowest (at 0.8 W/m<sup>2</sup>) and [natural gas](#) the highest (at 1000 W/m<sup>2</sup>). Solar and wind power needs around 40-50 times more space than coal and 90-100 times more space than gas. "However, the production of fossil fuels is a very dirty business," says Paul Behrens, environmental scientist at Leiden University. "So, while renewable energies take up more space, that space will be less polluted, and can be developed for multiple uses such as farming around the base of wind turbines."

## Rooftop solar

The analysis also found that solar power densities are continuously increasing over time, with research suggesting that new three-dimensional designs could reach over three to five times today's figures by the middle of the century.

With an increasing population, and the need for food and housing, land will be at a premium moving into the middle of the century. "The very low power densities of biomass make it a difficult sell, especially since the land on which it is produced can sometimes be used for growing food instead," Behrens says. "To avoid competition, rooftop solar will be the best bet—providing clean power that doesn't compete with other land uses. Offshore wind will help, and future technologies such as algae farms may be another option to avoid land competition."

To investigate where the impact would be felt most intensely, the authors applied their [power densities](#) to the National Renewable Energy Laboratory's Renewable Electricity Futures Scenarios. Despite a near tripling in land used by the power sector in southern states, the northeast would experience the greatest visible change with over 10 percent of land devoted to energy generation in nine states.

**More information:** John van Zalk et al. The spatial extent of renewable and non-renewable

power generation: A review and meta-analysis of power densities and their application in the U.S., *Energy Policy* (2018). DOI: [10.1016/j.enpol.2018.08.023](https://doi.org/10.1016/j.enpol.2018.08.023)

Provided by Leiden University

APA citation: Renewable energy sources can take up to 1000 times more space than fossil fuels (2018, August 28) retrieved 23 January 2021 from <https://phys.org/news/2018-08-renewable-energy-sources-space-fossil.html>

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