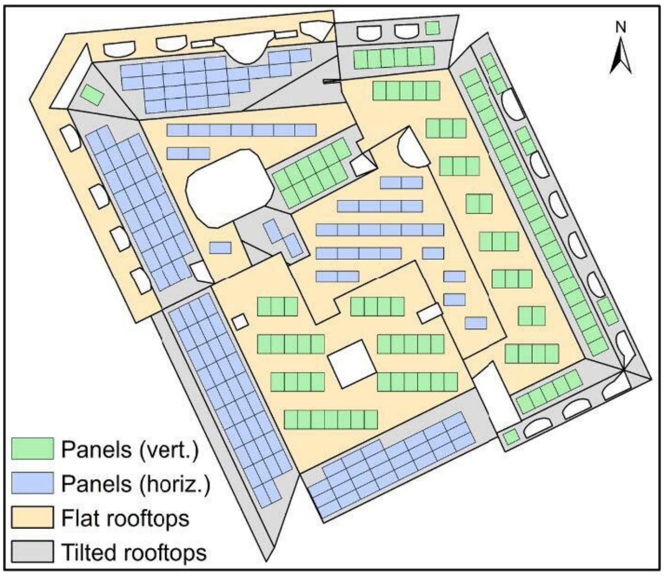
What if half of Switzerland's rooftops produced electricity?

3 February 2020, by Sandy Evangelista



Solar panels adapted to the different geometries of the roofs. Credit: Ecole Polytechnique Federale de Lausanne

Researchers at EPFL are assessing Switzerland's solar power potential. Their results show that photovoltaic panels could be installed on more than half of the country's 9.6 million rooftops. The resulting power would meet more than 40 percent of Swiss electricity demand.

The widespread installation of photovoltaic panels on building rooftops could play an important role in Switzerland's transition to a low-carbon energy system. Until now, however, the overall photovoltaic (PV) potential of Swiss rooftops could not be estimated accurately owing to a lack of data about buildings and their environments, along with wide margins of error arising from existing calculation methods. To fill that gap, researchers at EPFL's Solar Energy and Building Physics Laboratory (LESO-PB) have developed a methodology combining machine learning algorithms with geographical information systems and physical models to estimate PV potential. And, for the first time, they estimated hourly profiles of PV potential. Their results have been published in Applied Energy.

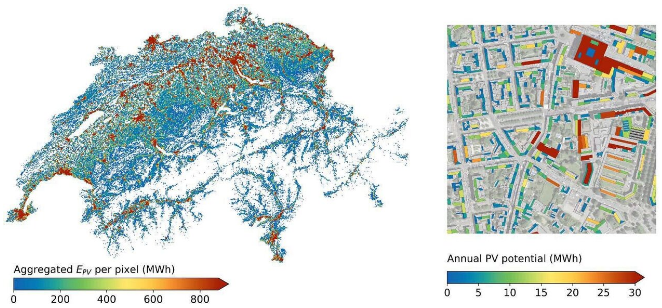
All roofs have their particularity

"We're not just looking at solar radiation, but also at the space available on rooftops. Some rooftops have an unusual shape or contain superstructures such as chimneys that prevent photovoltaic panels from being installed," says Alina Walch, who led the second phase of the study. Their algorithm takes into account parameters such as the size of the roof, its orientation and whether the building is in a city center or a more isolated location. The results show that solar photovoltaic panels could be fitted to 55 percent of Switzerland's total rooftop area. Even if panels were only installed on mainly south-facing rooftops, this could cover more than 40 percent of Switzerland's electricity demand.

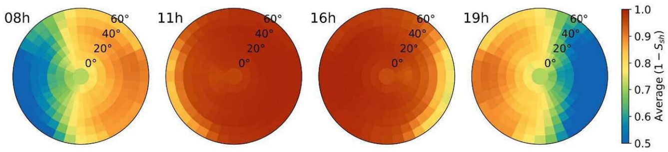
An initial study, using artificial intelligence techniques, had already been carried out in a previous thesis by LESO-PB's Dan Assouline. It was based on data collected in Geneva and then extended to the whole of Switzerland. "That study explored, for the first time, the use of artificial intelligence to quantify the potential for the large-scale installation of photovoltaic panels on building rooftops," says Jean-Louis Scartezzini, the head of LESO-PB. "Using new high-resolution data, we have now improved the estimation method and increased the spatio-temporal resolution of the results. This will enable us to model future energy systems that are 100 percent renewable."

Using the national "SIG-Énergie" geographic information system, the Swiss Federal Office of Energy has created a highly accurate model of Switzerland's buildings. Using machine learning, estimates were made of the total roof area that could be covered by solar panels, depending on their shape and shading. Estimates were made even more accurate by applying real-world practical installation rules, resulting in PV potential of 24 terawatt-hours (TWh), ten times the capacity of existing installations. That figure's margin of error is 9 TWh, due to the variability of solar radiation and the methodology used.

But Walch did not stop there: her study also includes the first ever hour-by-hour estimate of PV potential. This allows power generation to be gauged relative to consumption. "We have a surplus of energy in the summer and a shortage in the winter, and no energy at all at night," she notes. "To address that imbalance, we need to consider other forms of renewable energy to make up for the shortfalls and allow energy to be stored. Hydroelectric power is an attractive way of storing energy, but the content of storage dams varies with the seasons. Wind power, used on a large scale, could fill the gaps."



Credit: Ecole Polytechnique Federale de Lausanne



Hourly fraction of shaded roof area. Credit: Ecole Polytechnique Federale de Lausanne

The results obtained at EPFL could be used to put forward effective policies for installing PV panels on roofs. LESO-PB, the Swiss National Science Foundation, Innosuisse and the Swiss Federal Office of Energy are in talks to develop a platform that will enable cities, cantons and municipalities, but also individuals, to visualize the renewable energy potential of their buildings.

At the moment, Switzerland has tapped into only a tenth of its PV potential, which means that another 90 percent remains to be unlocked.

More information: Alina Walch et al. Big data mining for the estimation of hourly rooftop photovoltaic potential and its uncertainty, *Applied Energy* (2020). DOI: 10.1016/j.apenergy.2019.114404

Provided by Ecole Polytechnique Federale de Lausanne