The SolarEV city concept: A sustainable option for Paris?

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The iconic city of Paris is synonymous with climate change, thanks in part to it being where the landmark 2015 Paris Climate Change agreement was adopted. Now, a research group has investigated the

potential of integrating rooftop photovoltaics (PVs) with electric vehicles (EVs) as an effective and scalable solution for supplying clean, affordable, and reliable electricity in urban environments, with a focus on Paris and its surrounding areas.

Findings from the study were published in the journal *Applied Energy*.

CO_2 emissions from urban areas account for 71%–76% of global CO_2 emissions, making decarbonizing cities a top priority if countries are to realize net zero emissions.

The SolarEV City Concept is a new idea that combines solar panels on rooftops with electric vehicles. By doing this, electric vehicles not only reduce carbon emissions from gasoline and diesel but also store extra electricity from the solar panels, powering the home when the sun is not shining. Yet the effectiveness of such a concept varies widely from city-to-city.

For example, the first study, which was done on Kyoto, discovered that if 70% of the city's rooftops were covered with solar panels and all cars became electric, Kyoto could reduce its CO_2 emissions from electricity and gasoline-powered cars by 60%–74% and save 22%–37% on energy costs by 2030. But for more densely urban areas in Japan, like Kawasaki and Tokyo, these reductions were less.

Other variables that vary from country-to-country include electricity tariffs, climate conditions, and urban structures. Similar studies conducted in South Korea, China, and Indonesia have reported significant emissions reductions and energy cost savings in different urban contexts.

However, until now, no studies have explored PV + EV systems in high-latitude cities with hourly supply-demand balance, where solar insolation

and electricity demand exhibit seasonal variations, particularly influenced by winter heating demand. With this in mind, the researchers examined the benefits of bringing the SolarEV City Concept to Paris. The analysis also included the surrounding region of Ile-de-France and draws comparisons with the reference city of Kyoto.

"As Paris is a highly urbanized area, we found the city could only supply approximately 30% of its electricity needs through rooftop PVs," points out Associate Professor Takuro Kobashi, who co-led the research and is based at Tohoku University's Graduate School of Environmental Studies. "And also, since most PV generation is consumed inside the city, the impact of EVs as storage batteries is limited."

However, in the surrounding Paris region, which comprises many low-rise buildings, the researchers discovered that covering 71% of the rooftops could meet 78% of the annual electricity demand in 2019. When incorporating EVs as storage batteries into the fold, even when accounting for the supply demand of the EVs themselves, it was possible to supply approximately 60% of the electricity. Ultimately, this could lead to a 23% reduction in energy costs by 2030.

"Our study not only highlights the carbon reduction potential of implementing a SolarEV City in Paris and the Ile-de-France, but it shows the need to consider regional variations," adds Kobashi. With achieving carbon neutrality by 2050 top of the agenda for governments across the globe, SolarEV Cities could go a long way to ensuring this happens.

More information: Paul Deroubaix et al, SolarEV City Concept for Paris, *Applied Energy* (2023). DOI: 10.1016/j.apenergy.2023.121762

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