Space reflectors could ensure bright future for solar power farms

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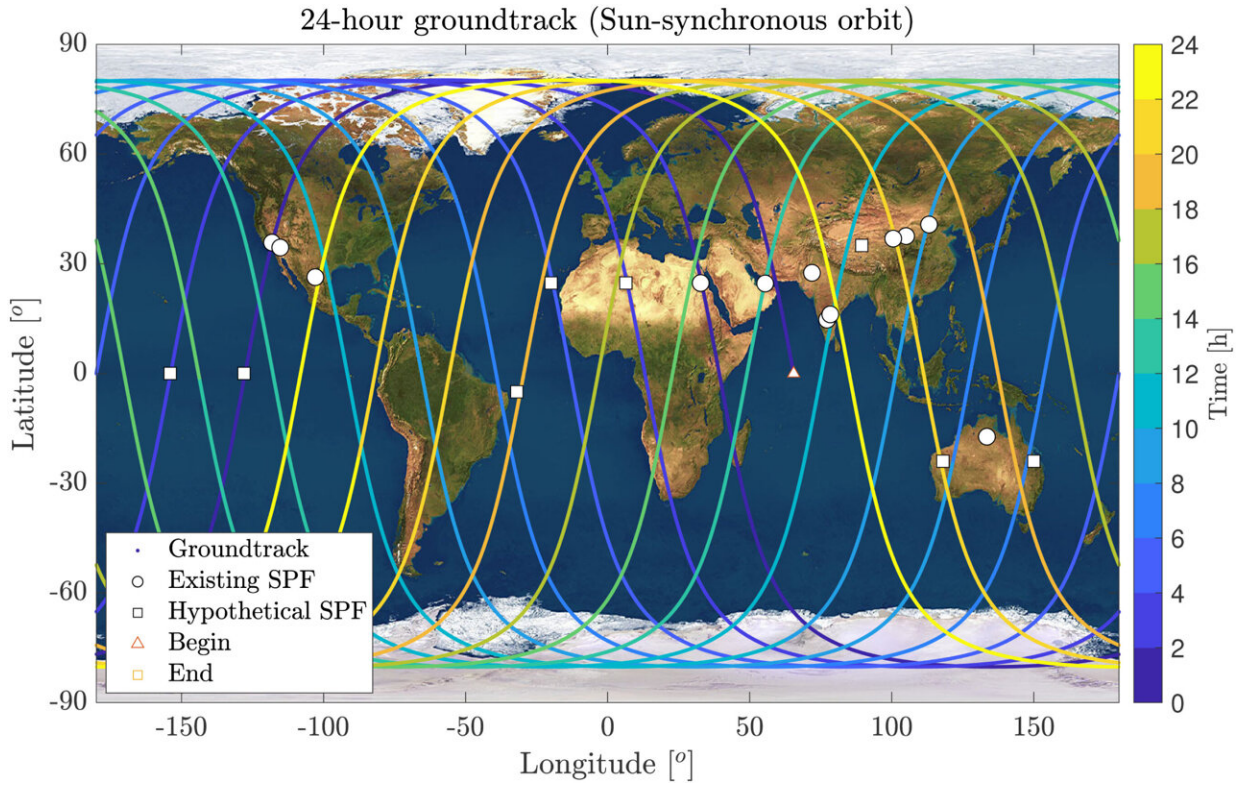

24-h groundtrack of the selected optimal SSO with hypothetical farms. Credit: *Acta Astronautica* (2024). DOI: 10.1016/j.actaastro.2024.01.031

Reflectors placed in orbit around the Earth that reflect sunlight toward future solar power farms at dawn and dusk could help accelerate the transition to net-zero, researchers say.

Space engineers from the University of Glasgow have published new research showing how kilometer-wide orbiting reflectors could boost the output of future large-scale solar farms by reflecting additional sunlight toward them even after the sun has set.

In their paper, "A constellation design for orbiting solar reflectors to enhance terrestrial solar energy," published as a preprint in the journal *Acta Astronautica*, the researchers describe how they used sophisticated computer simulations to help determine the most effective method of using orbiting solar reflectors to generate additional power.

Their models showed that putting 20 gossamer-thin reflectors into orbit 1,000 kilometers from the surface of the Earth could reflect sunlight to solar farms for an extra two hours each day on average. The additional sunlight could boost the output of the world's future solar farms, particularly after sunset when electricity demand is high. The output could be scaled up further by adding more reflectors or increasing their size.

The reflectors would maintain an orbit close to the Earth's terminator line—the boundary where daylight on one side of the planet transitions into night on the other—in an arrangement known as a Walker constellation.

Walker constellations are widely used in technologies like satellite communication systems, where groups of equally-spaced satellites form rings around the planet to ensure consistent communication with the Earth's surface.

The team developed an algorithm to determine how the reflectors could be arranged in the constellation and angled to catch the sun's rays most effectively, maximizing the additional sunlight reflected to solar power farms around the Earth in the early morning and late evening.

The researchers suggest that the 20 reflectors could generate an extra 728 megawatt-hours (MWh) of electricity per day—the equivalent of adding an additional large-scale solar power farm to Earth without the associated cost of construction.

Dr. Onur Çelik, from the University of Glasgow's James Watt School of Engineering, is the corresponding author of the paper. He said, "Solar power has the potential to be one of the key accelerators in our race to reach net-zero, helping us to mitigate the global impacts of climate change by reducing our reliance on fossil fuels.

"The price of solar panels has dropped quickly in recent years, increasing the pace of their adoption and paving the way for the creation of large-scale solar power farms around the world.

"One of the major limitations of solar power, of course, is that it can only be generated during daylight hours. Putting orbiting solar reflectors in place around the Earth would help to maximize the effectiveness of solar farms in the years to come. Strategically placing new solar farms in locations which receive the most additional sunlight from the reflectors could make them even more effective."

The paper is one of the outputs from SOLSPACE, a University of Glasgow-led research project. Professor Colin McInnes is SOLSPACE's principal investigator and is a co-author of the paper. He said, "The idea of orbiting solar reflectors isn't new—in fact, it predates even the space age, as the idea of illuminating cities with light from space was first discussed in the late 1920s.

"However, space reflectors have only been demonstrated once back in the early 90s, when a 20-meter aluminum-foil reflector was released from the Russian Mir space station to reflect sunlight back to Earth.

"The SOLSPACE project is working to devise, develop and demonstrate ideas for orbital reflector technology that could work on a much more ambitious scale to deliver global clean energy services.

"Tackling the challenges of climate change requires big ideas. While this is undoubtedly a big idea, it builds on technologies that are already well-understood and computer models like ours show how they could be scaled up. In addition, the falling cost of launching payloads to space opens up entirely new possibilities for the future."

More information: Onur Çelik et al, A constellation design for orbiting solar reflectors to enhance terrestrial solar energy, *Acta Astronautica* (2024). DOI: 10.1016/j.actaastro.2024.01.031

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