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Energy and water co-benefits from covering canals with solar panels

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Abstract

Solar power development over canals is an emerging response to the energy–water–food nexus that can result in multiple benefits for water and energy infrastructure. Case studies of over-canal solar photovoltaic arrays have demonstrated enhanced photovoltaic performance due to the cooler microclimate next to the canal. In addition, shade from the photovoltaic panels has been shown to mitigate evaporation and potentially mitigate aquatic weed growth. However, the evaporation savings and financial co-benefits have not been quantified across major canal systems. Here we use regional hydrologic and techno-economic simulations of solar photovoltaic panels covering California's 6,350 km canal network, which is the world's largest conveyance system and covers a wide range of climates, insolation rates and water costs. We find that over-canal solar could reduce annual evaporation by an average of 39 ± 12 thousand m^3 per km of canal. Furthermore, the financial benefits from shading the canals outweigh the added costs of the cable-support structures required to span the canals. The net present value of over-canal solar exceeds conventional overground solar by 20–50%, challenging the convention of leaving canals uncovered and calling into question our understanding of the most economic locations for solar power.