

OPTIMIZING UTILITY-SCALE SOLAR SITING FOR LOCAL ECONOMIC BENEFITS AND REGIONAL DECARBONIZATION

Papa Yaw Owusu-Obeng, Steven R. Miller, Sarah B. Mills, & Michael T. Craig



Solar farm. Photo by Kev of Pixabay.

Traditional electric grid planning typically focuses on reducing system-wide electricity costs. But utility-scale solar, which is often built on agricultural lands in the Great Lakes region, affects local economies as well as system-wide electricity costs. We integrate local economic impacts into an energy system planning model to assess how solar development on agricultural lands affects system-wide electricity costs and local economies. We consider county-level variation in property tax benefits from solar and the opportunity costs of converting farmland to determine where solar development creates the highest local economic benefit. We then investigate whether prioritizing solar in high-economic-return counties impacts system-wide electricity costs.

Key findings:

- 1. Counties with strong economies offer the highest gains:** Solar projects built in counties with large, diverse economies tend to deliver the highest economic benefit per MW of solar installed because more of the solar construction activity and operations and maintenance hiring can be sourced within the county. In Ohio, for example, a solar project in a county with a large economy can generate around \$34,500 per MW per year in local economic benefit, which is roughly 30% higher than the same project in an Ohio county with a small economy.
- 2. Net benefits are highest where there is low agricultural productivity:** Even when accounting for lost agricultural productivity, solar development has a net positive impact in all counties in the region. The gains are highest, though, where the agricultural productivity is lowest. Converting high-productivity land to solar increases the loss of agricultural output by up to 16% in some counties.
- 3. Prioritizing local economic benefit has a minimal impact on system-wide electricity costs:** Prioritizing community economic benefits in solar siting significantly increases local economic gains with minimal impact on system costs. When the energy system planning model was told to deploy solar to maximize local economic benefit, total local economic benefit to local communities grew by approximately 11% (roughly \$1 billion) compared to the cost-only approach, while overall electricity costs rose by just 0.5%.
- 4. Solar projects shift to high-benefit areas:** Prioritizing local benefits leads to a spatial shift in new solar investments. States like Ohio and Minnesota, where there are counties with larger economies and less productive farmland, see increased development; conversely, states with smaller county economies or greater farmland productivity, like Michigan and Wisconsin, see reductions in PV.

Summary of Methods

Access the paper describing the complete methodology [here](#).

1. Estimated county-level economic impacts across our six Great Lakes states by tracing net economic transactions throughout each phase of a solar project's lifecycle (installation, operations and maintenance, and decommissioning). Transactions included direct effects (e.g., expenditures, lease payments, taxes, and lost agricultural revenue), indirect effects (supply chain responses to direct expenditures), and induced effects (increased household spending driven by wages and land lease income). An explanation of this model is [here](#).
2. Developed marginal benefit (see Fig. 1) and supply curves (i.e., how much land could theoretically be developed into solar, and at what cost), ranking counties by economic value added and system cost per MW of solar installed. These curves enable a direct comparison of sites based on both cost and economic benefit.
3. Integrated benefit and supply curves into a multi-objective planning model that co-optimizes solar generation and transmission investments by balancing system cost and local economic benefits. Evaluated scenarios with varying priorities on cost vs. benefit, under an 80% CO₂ emissions reduction target by 2040. (see Fig. 2.)

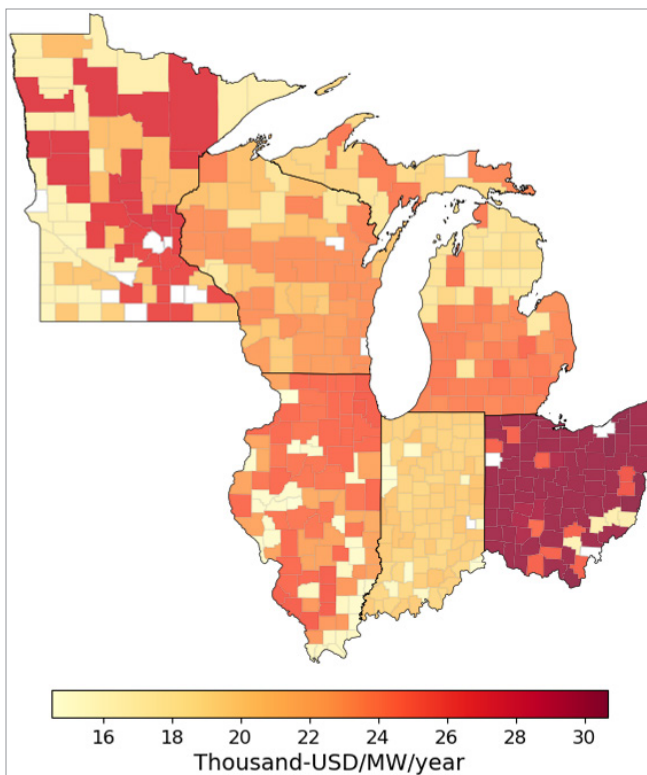


Fig. 1. County-level classification of net economic impact per MW of installed solar capacity, accounting for the loss of agricultural output.

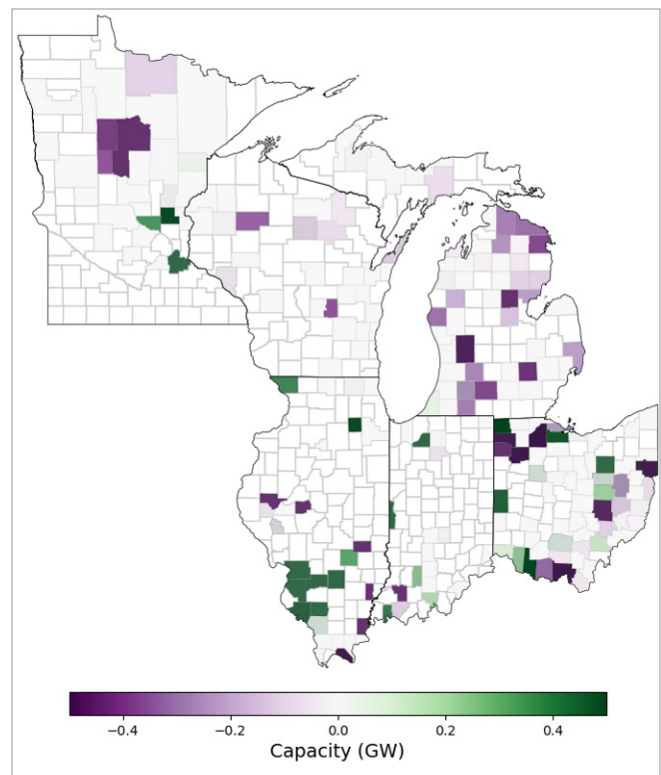


Fig. 2. Geographic shifts when co-optimizing for local economic benefit (80% priority) as well as cost (20%). This shows which counties would see more solar capacity (in green) and less solar capacity (in purple) compared to a business-as-usual model that gives 100% priority to minimizing electricity cost.

Acknowledgment: This material is based upon work supported by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) under the Solar Energy Technologies Office Award Number EE00009361. The views expressed herein do not necessarily represent the views of the U.S. Department of Energy, or the United States Government.

The U.S. Department of Energy Solar Energy Technologies Office accelerates the advancement and deployment of solar technology in support of an equitable transition to a decarbonized economy. Learn more at energy.gov/eere/solar.