Supplemental Information: Limited Impact of Solar Energy Expansion on Agricultural Production and Crop Prices in the United States

January 4, 2026

Contents

1 Historic Solar Nameplate Capacity

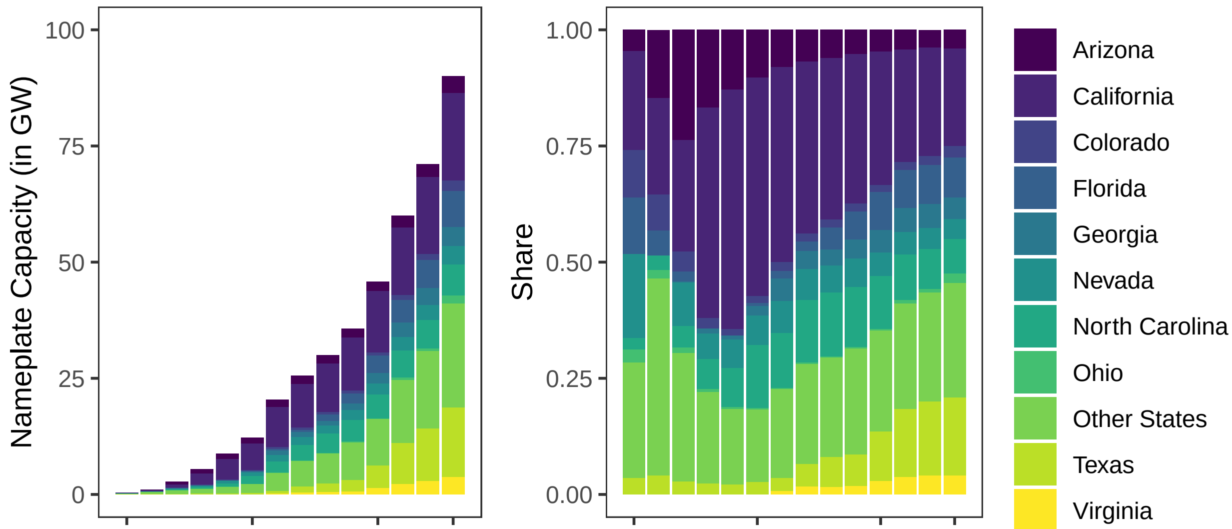

Figure S1. U.S. nameplate capacity in gigawatt (GW) subdivided by the ten largest states in terms of 2023 capacity (left) and share of total nameplate capacity over time (right). Calculations are based on the 2023 Form EIA-860 data.

2 Land Cost Share

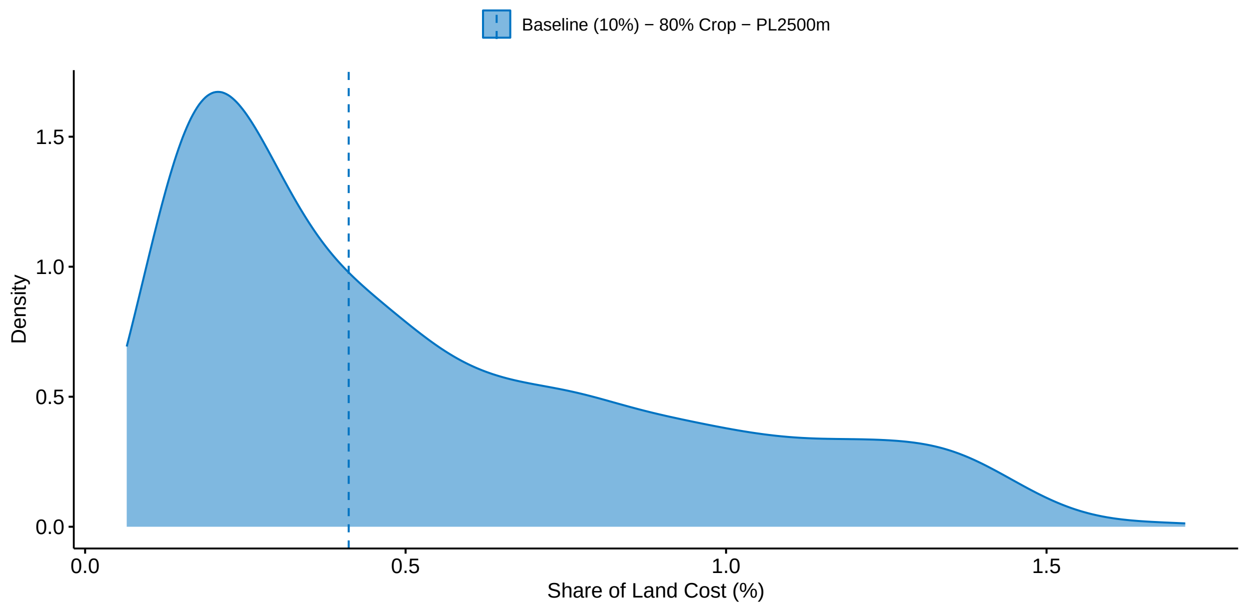

Figure S2. Land cost as a share of total annual cost associated with PV installations.

In previous runs of the model, we also included scenarios requiring 4 ha per installed MW as well as a low capital cost scenario. The land cost share in those scenarios were 6% maximum. Thus, even in cases where a high land requirement is assumed, the land cost purely based on cash rental rates remains small.

3 Annual Energy Outlook Cases

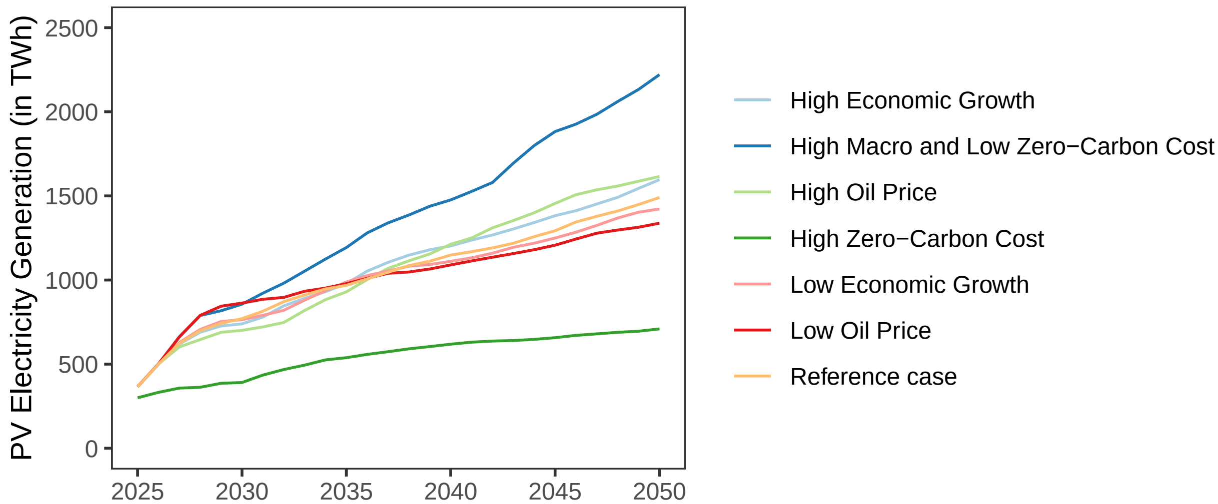

Figure S3. 2023 Annual Energy Outlook projections of electricity generation from solar. The baseline is referred to as the "Reference Case" whereas all other scenarios are side cases.

4 Solar Installation and Land-Use Research

To our knowledge, our study is the first to quantify the effects of utility-scale solar installations on crop prices. While previous research has qualitatively and quantitatively assessed various relationships between agriculture and solar farms, none have modeled nationwide price and production effects under explicit land-use trade-offs. For example, Moore et al. (2022) address the concerns of solar farms on agricultural land by interviewing stakeholders across various U.S. states. Their findings reveal that many view farming as an identity rather than solely an occupation resulting in profit. They also highlight the tension around farmland as a public versus a private good and how it relates to individual landowners decision on how to use the land. The argument of farmland as a public good with potential spillover effects to nearby land is quantified by Abashidze and Taylor (2023) who find that land values in North Carolina are not directly affected by nearby solar farms. However, they show a positive effect on land values of nearby power lines after a solar farm has been built close by. They hypothesize that the transmission lines serve as a signal to landowners of suitability of land for future solar farms.

Land-use impacts in countries other than the U.S. have been analyzed by Ven et al. (2021). They find that solar might occupy up to 5% of land area in the European Union, India, Japan, and South Korea if it accounts for 80% of the electricity mix. The associated carbon emissions due to land-use change range from 0–50 grams of carbon dioxide equivalent per kilowatt hour (g CO_2-e kWh^{-1}). Those values can be compared to the 2023 emissions from U.S. electricity generation which are 1,047.8, 435.5, 1,115.8, and 367.4 g CO_2-e kWh^{-1} for coal, natural gas, petroleum, and all other energy sources, respectively.[1] In addition, those land-use change emissions from solar installations are much lower compared to bioenergy production (e.g., switchgrass, miscanthus). An interesting approach is chosen by Gazheli and Corato (2013) and Lazo et al. (2024) who use real option theory to model the transition from agriculture to solar installations in Italy and Spain, respectively. Usually, real options are used to show the higher return threshold compared to standard net present value analysis when deciding to engage in an investment with stochastic returns. In the present case though, landowners have the choice to switch from an activity (i.e., agriculture) with stochastic returns to solar which—assuming long-term leases—yields a certain payoff. Depending on the risk preferences of landowners, this ability to engage in a non-stochastic use of land could lead to significant transformation of the agricultural landscape.

[1] See How much carbon dioxide is produced per kWh of U.S. electricity generation? provided by the EIA.

5 Additional Notes

See for example Three Mile Island nuclear plant will reopen to power Microsoft data centers published on *National Public Radio (NPR)* on 20 September 2024. The Natural Capital Exchange (NCX) guide for Solar Energy Programs indicates a land requirement of 2–4 ha MW^{-1}, which is approximately the range covered in this analysis.

References

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