August, 2019 | Antrim Township Board of Supervisors| Greencastle, PA

Antrim Township
(and Greencastle Borough)
Solar Infrastructure Assessment

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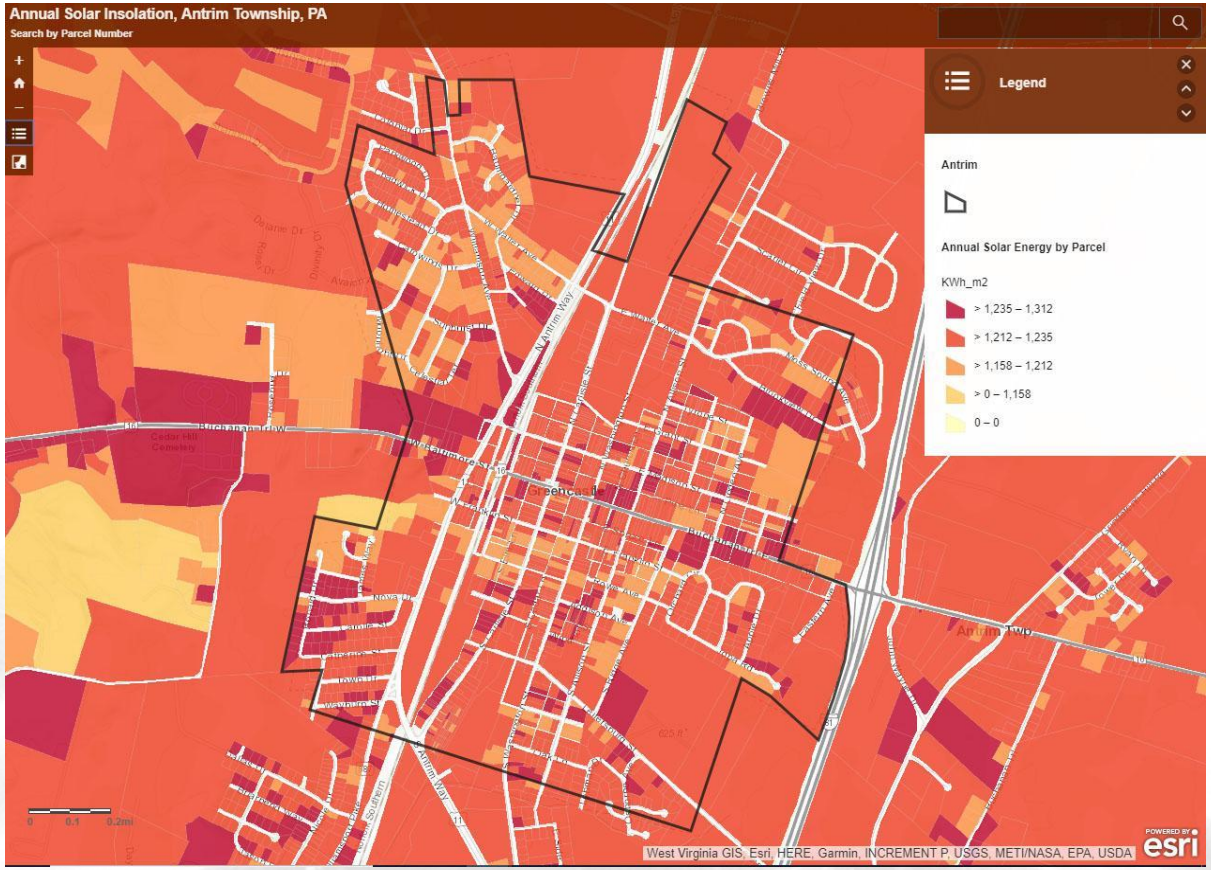
Previous work



- On-line parcel-based solar energy estimator

https://centerforlanduse.org/projects/community-research/

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Study objectives

- What is the current demand for electricity in Antrim Township and Greencastle Borough on an annual, monthly, and daily basis?
- How much land would need to be occupied by solar panels to meet this demand, given the daily and monthly variation in demand and insolation and current panel efficiency?

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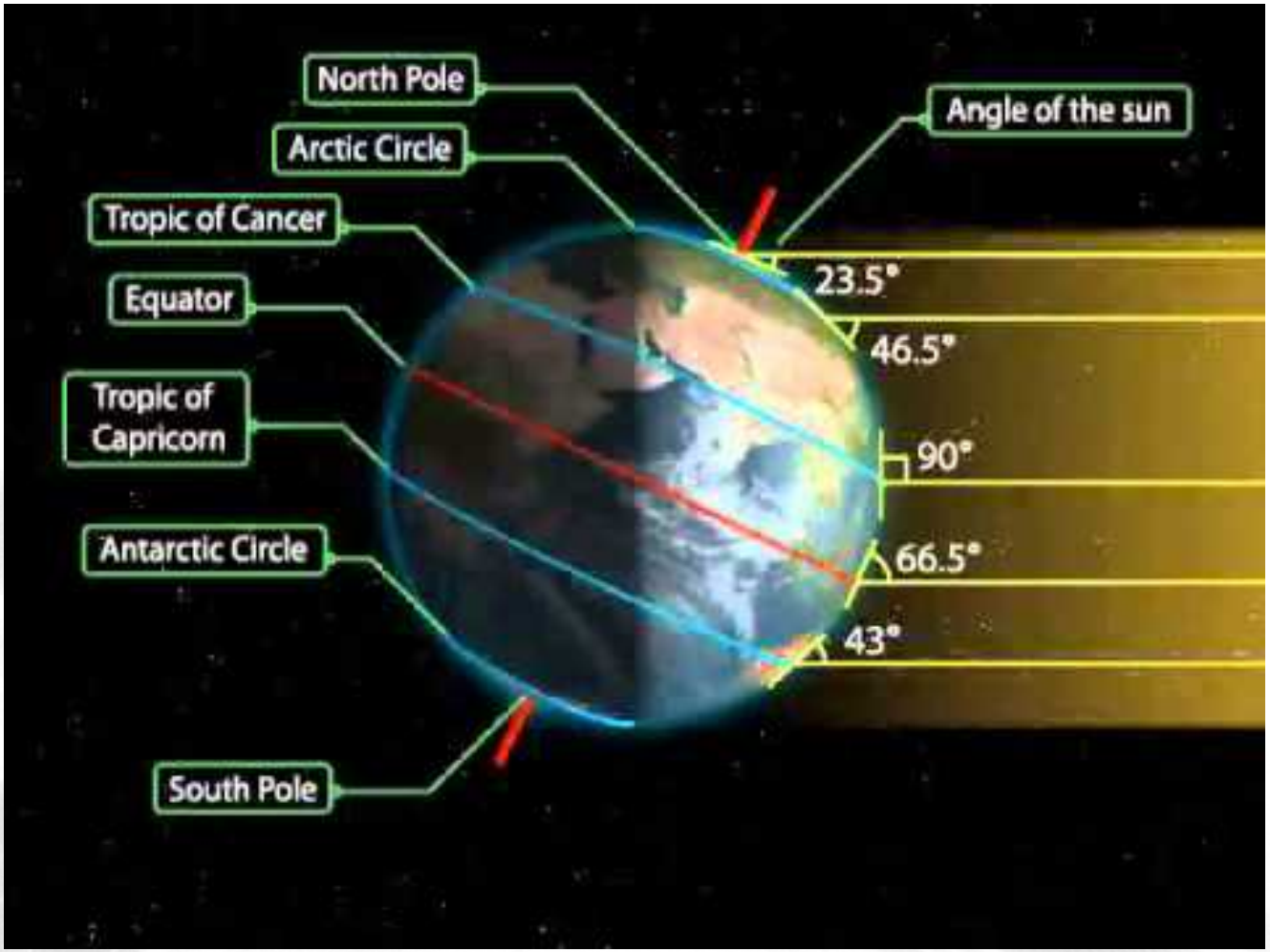
Solar power as a resource



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Solar power as a resource

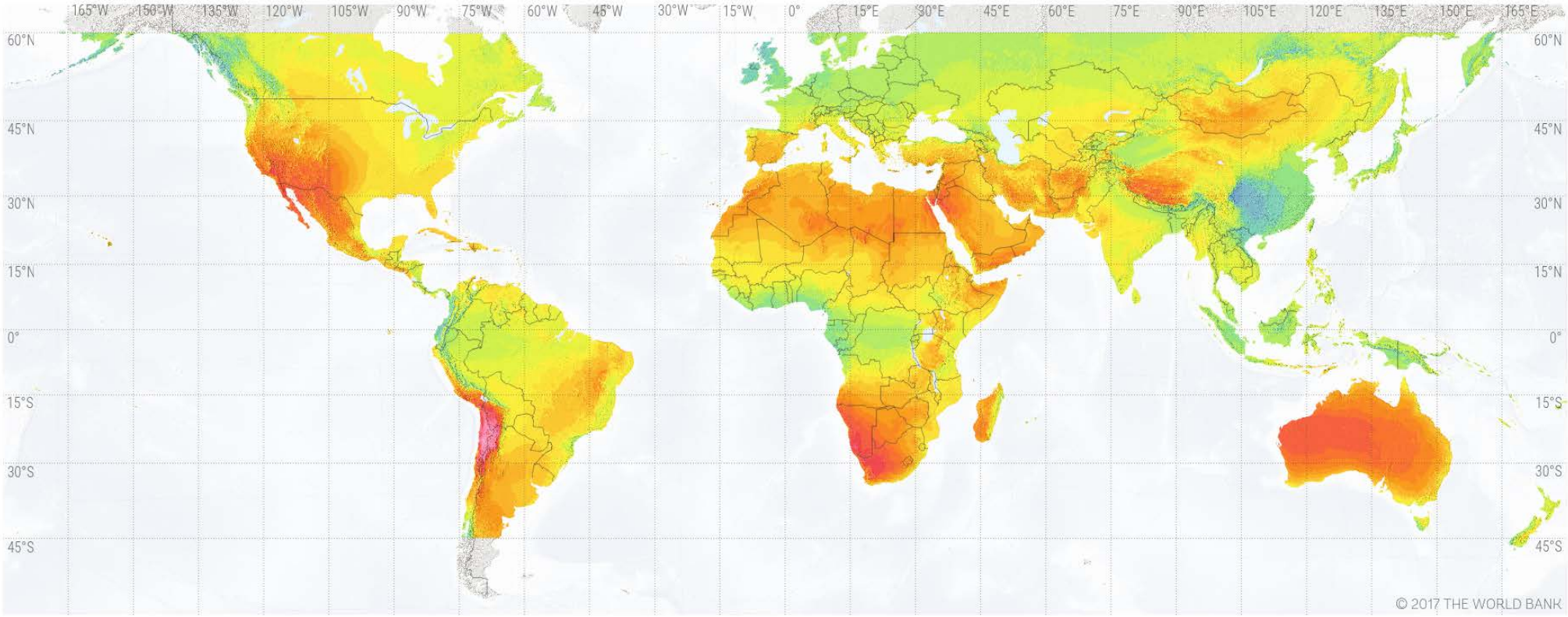
SOLAR RESOURCE MAP

DIRECT NORMAL IRRADIATION

WORLD BANK GROUP
THE WORLD BANK IBRD • IDA | IFC International Finance Corporation

ESMAP Energy Sector Management Assistance Program

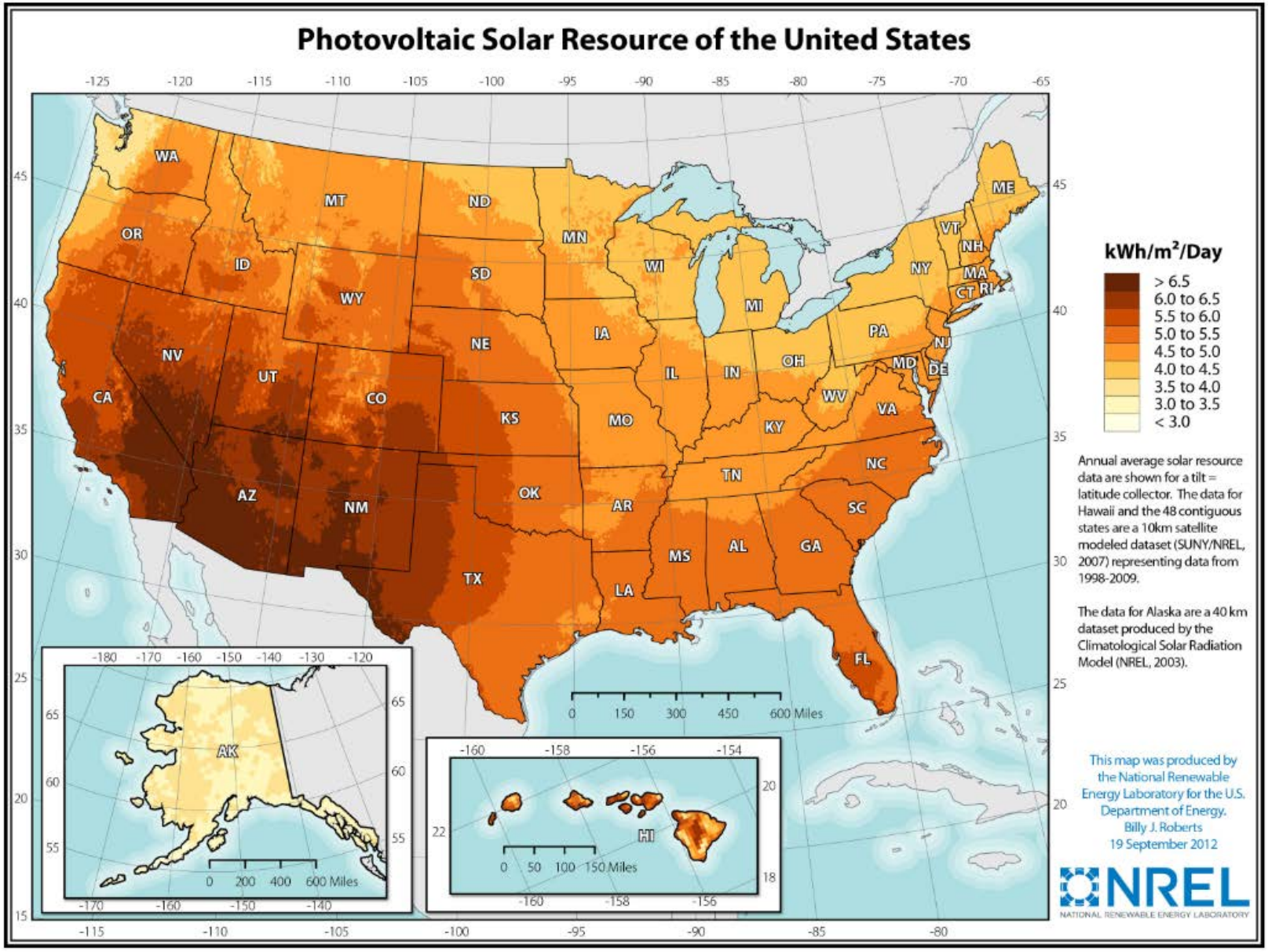
SOLARGIS



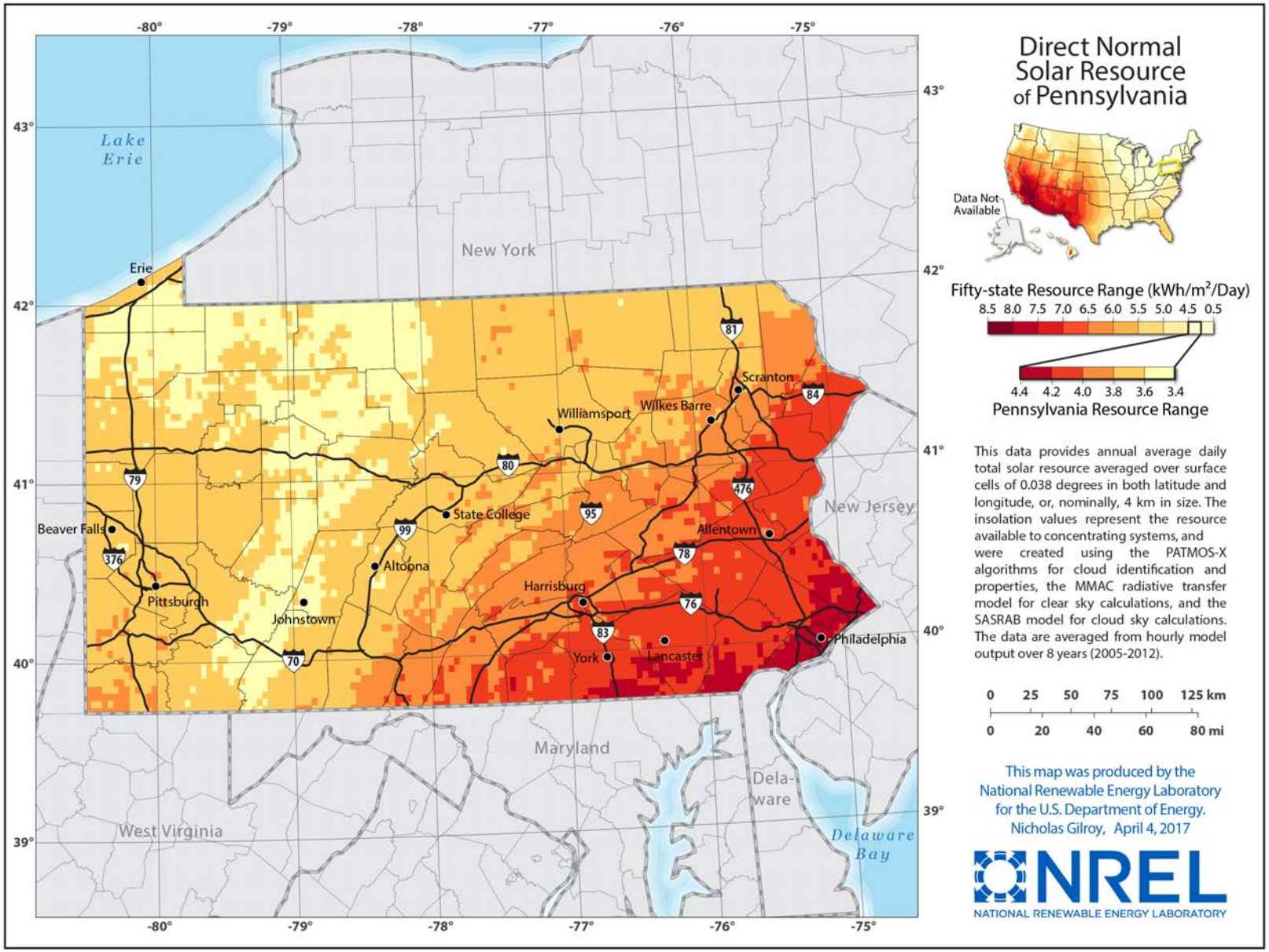
Long-term average of daily/yearly sum

Daily sum:	<	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0 > kWh/m²
Yearly sum:	<	365	730	1095	1461	1826	2191	2556	2922	3287	3652 >

Solar power as a resource



Solar power as a resource



Solar Spotlight – Pennsylvania

SEIA Solar Energy Industries Association®

At A Glance

- **Solar Installed:** 433.1 MW (56.9 MW installed in 2018)[i]
- **National Ranking:** 22nd (26th in 2018)
- **Enough Solar Installed to Power:** 53,000 homes
- **Percentage of State's Electricity from Solar:** 0.24%[ii]
- **Solar Jobs and Ranking:** 4,219 (17th in 2018)[iii]
- **Solar Companies in State:** 563 companies total; 122 Manufacturers, 311 Installers, 130 Others[iv]
- **Total Solar Investment in State:** $1.68 billion ($141.28 million in 2018)
- **Price Declines:** 34% in the last 5 years
- **Growth Projections and Ranking:** 670 MW over the next 5 years (ranks 26th)

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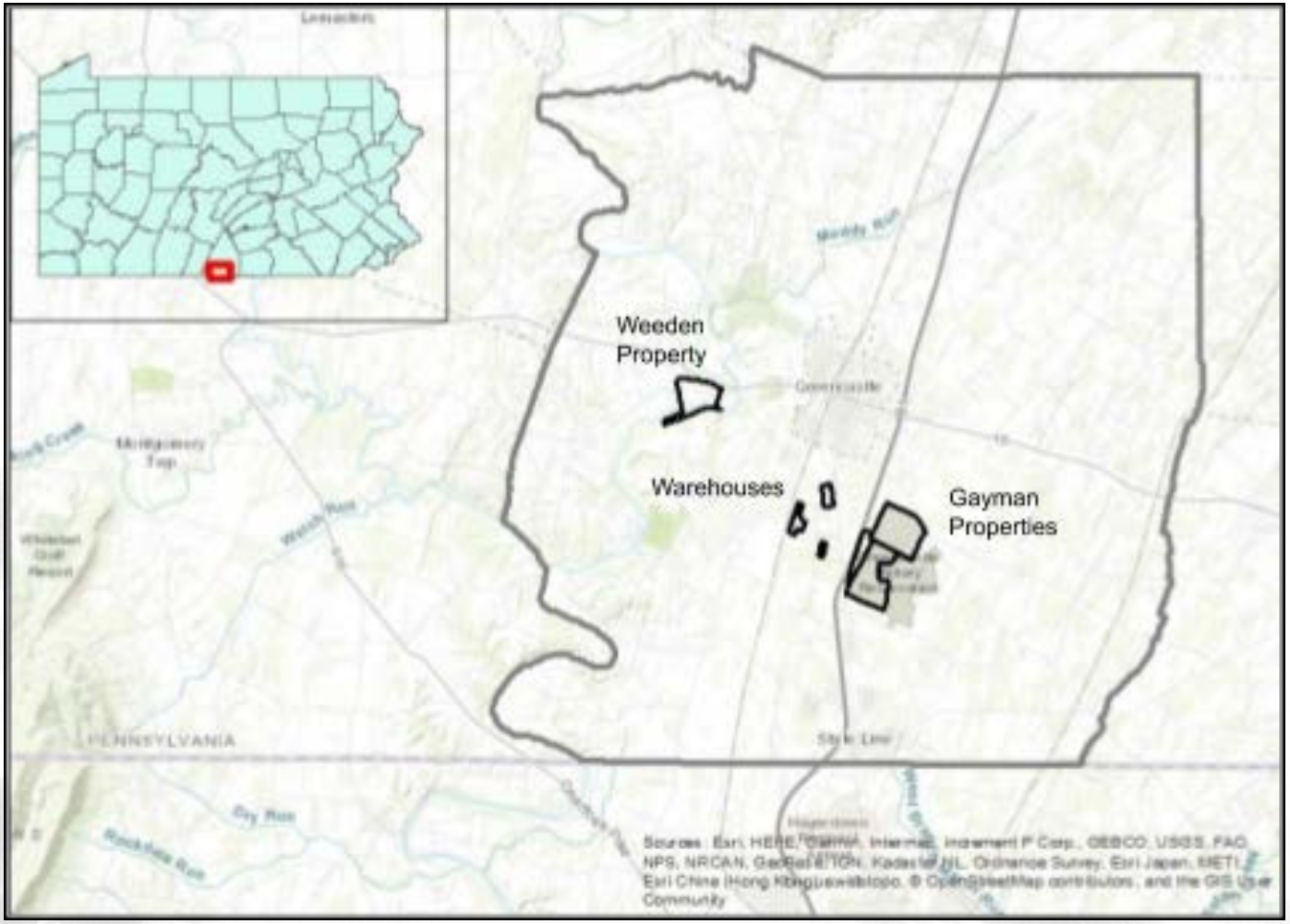
Solar energy terms (handout)

- Photovoltaic panels; solar thermal panels: Photovoltaic panels convert sunlight into electricity while solar thermal panels convert the sun's energy into heat. This study focuses on photovoltaic panels.
- Kilowatt (kW): A unit to measure power; equal to 1,000 watts. Kilowatts are often used to measure electricity demand for large appliances and households. For example, a typical refrigerator consumes 1,000 kilowatts per hour.
- Megawatt (mW): A unit to measure power; equal to 1,000,000 watts and 1,000 kilowatts, used to measure large quantities of power such as electricity for a city or small power plant.
- Kilowatt hours (kWh): Used to measure electricity consumption, commonly seen on electric bills to display the amount of electricity used. A kilowatt hour equals one hour of using electricity at the rate of 1,000 watts.
- Insolation: The occurrence of incident solar radiation onto an object, typically measured in kilowatt-hours or watt-hours.
- Watts/kilowatts per square meter (W/m2 and kW/m2): The power in watts that is received by a surface per square meter. Watt or kilowatt hours per square meter (Wh/m2 and kWh/m2) express the energy per square meter per hour.
- Panel efficiency: The rate (percentage) that sunlight is converted into electricity. For example, current solar panels, on average, convert 15% of the sun's energy into electricity.

Study area: 17225 zip code



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Study objectives

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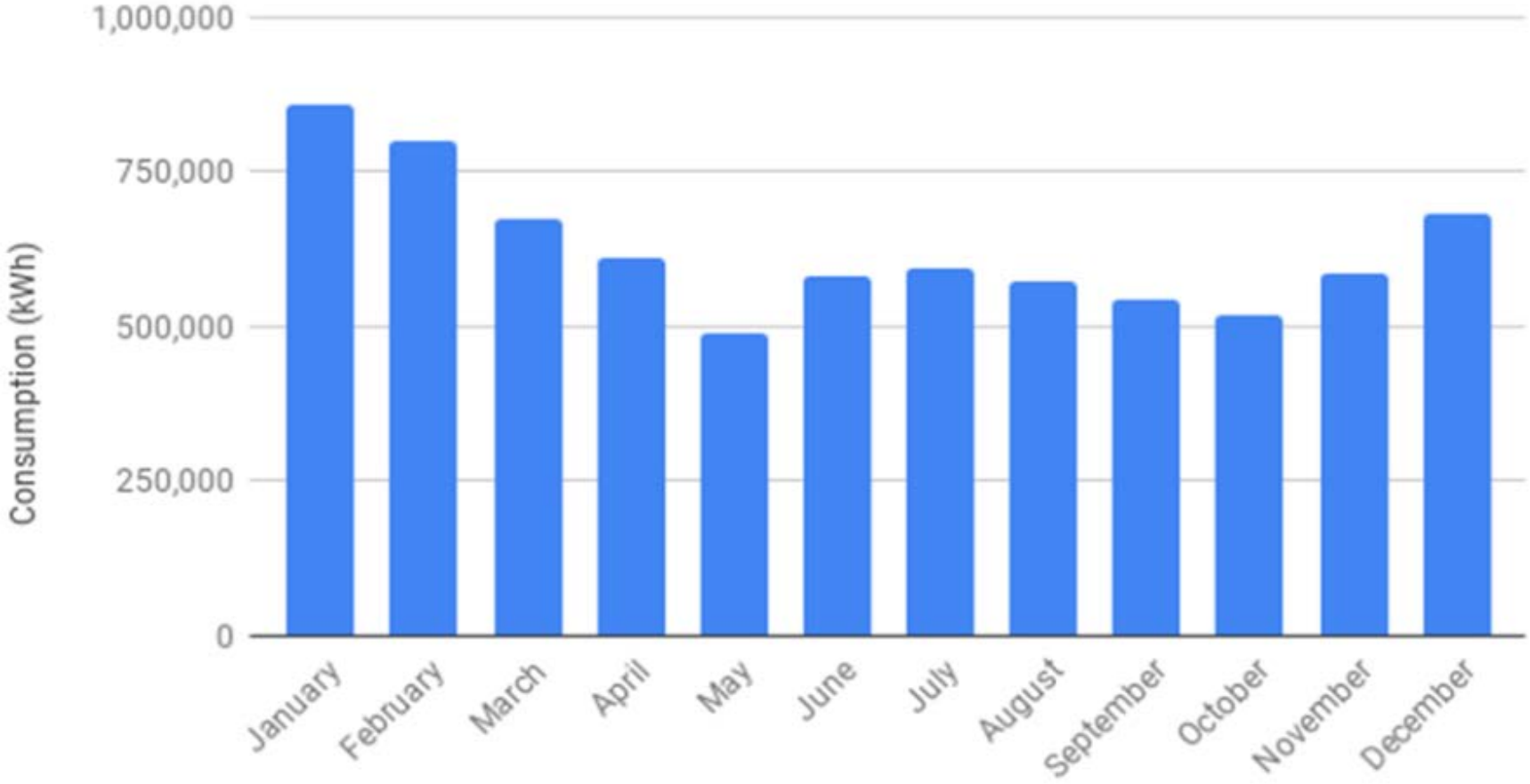
First Energy Corp data for 17225
August 1, 2017 - July 31, 2018



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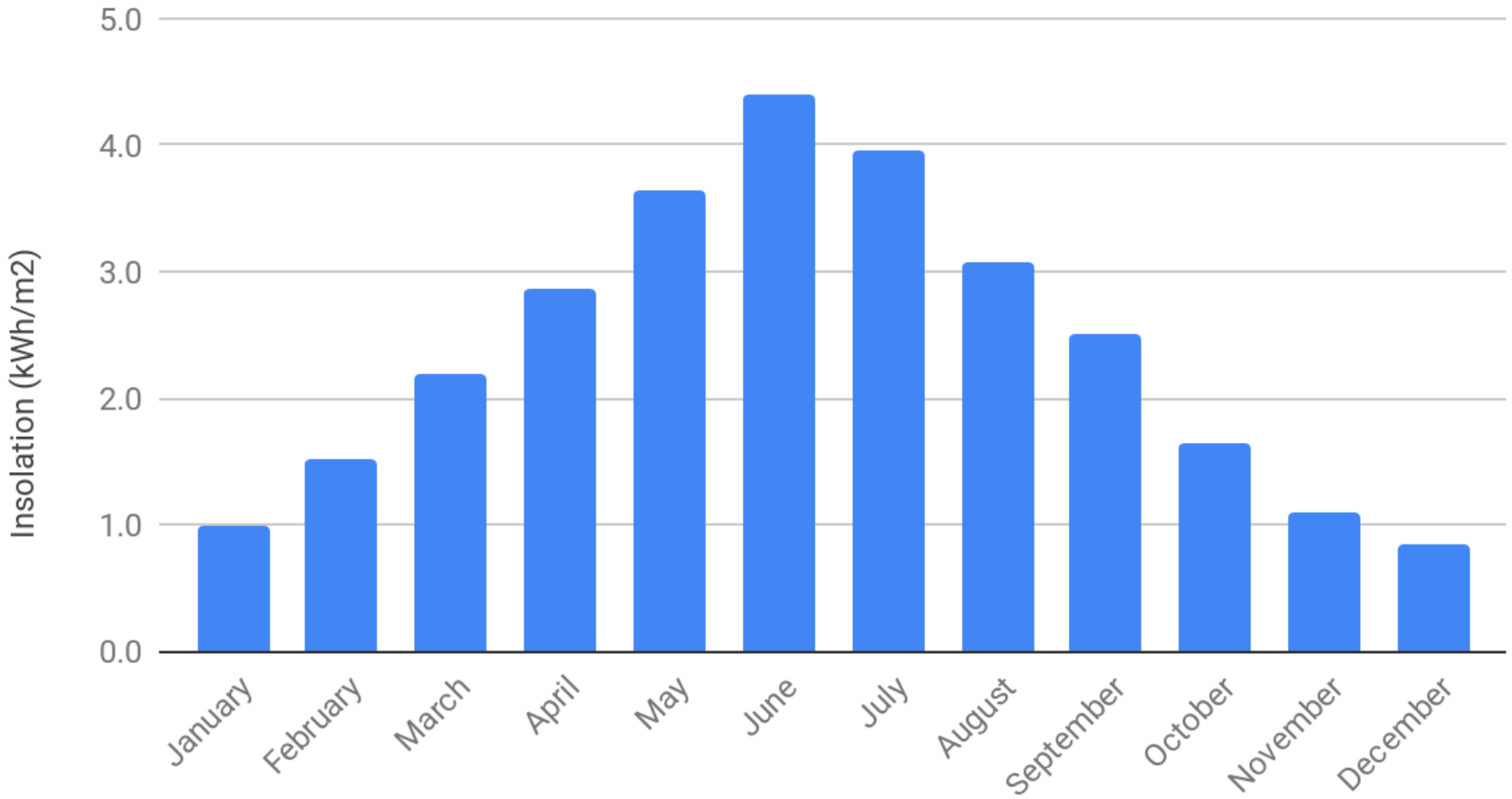
Average daily solar insolation



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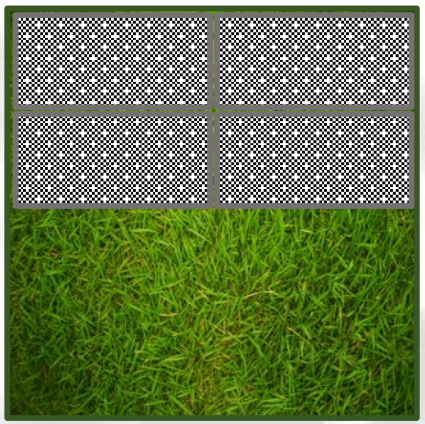
Key assumptions

- Panel efficiency
  - We assume that panels convert 15% of the sun's energy into electricity
- Panel density



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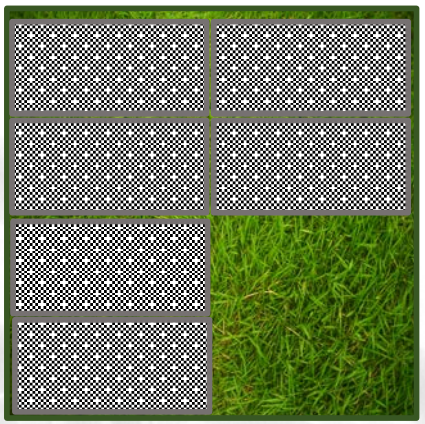

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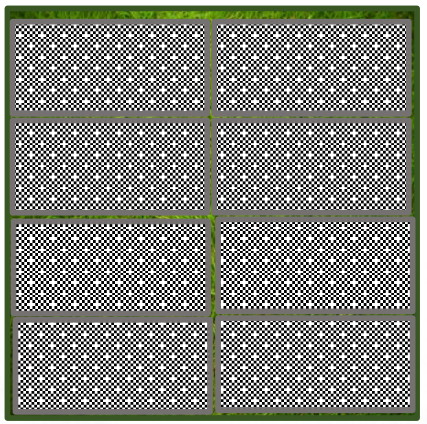

D = 1.0

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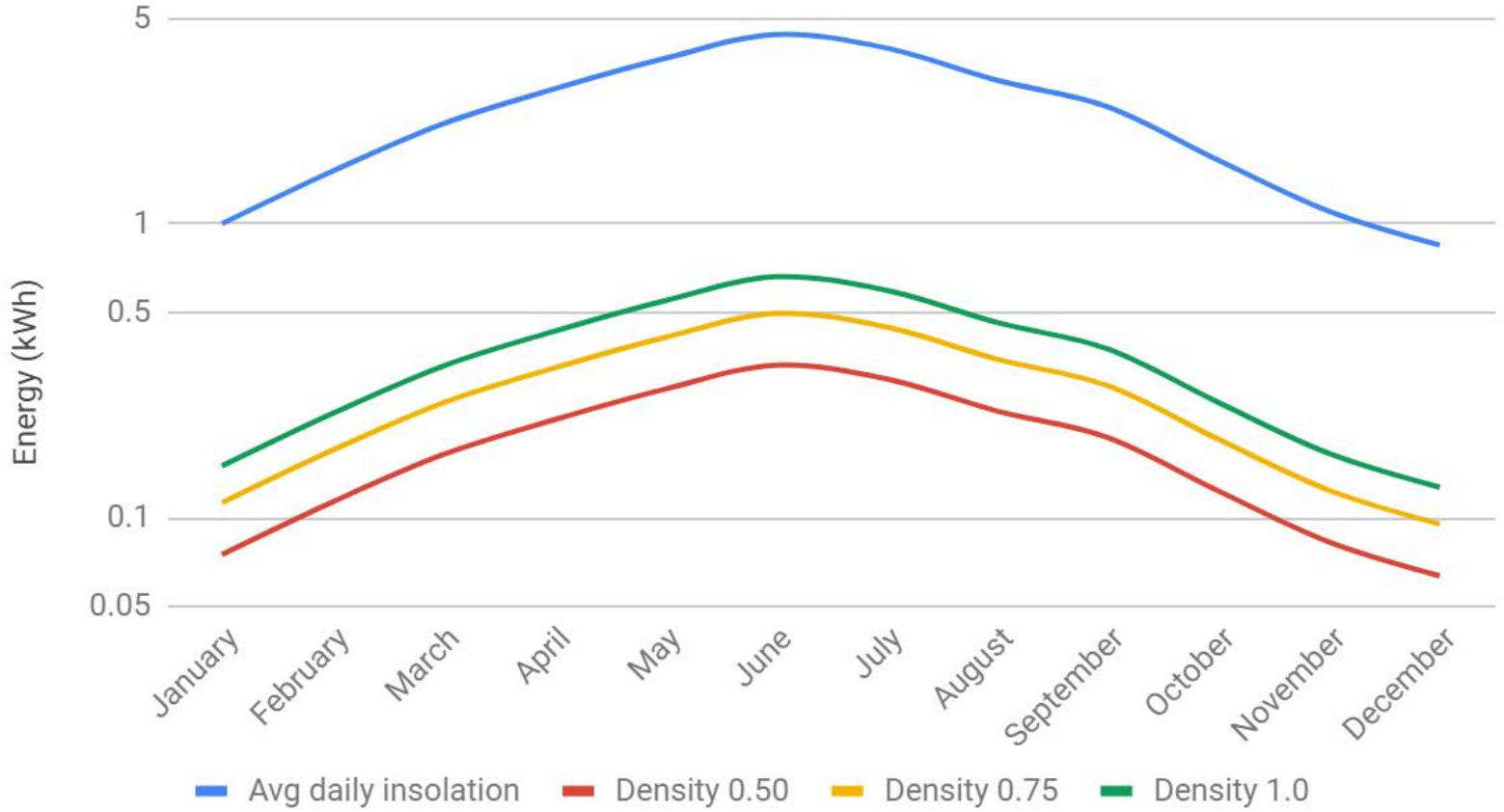
Available solar energy and potential electricity generation



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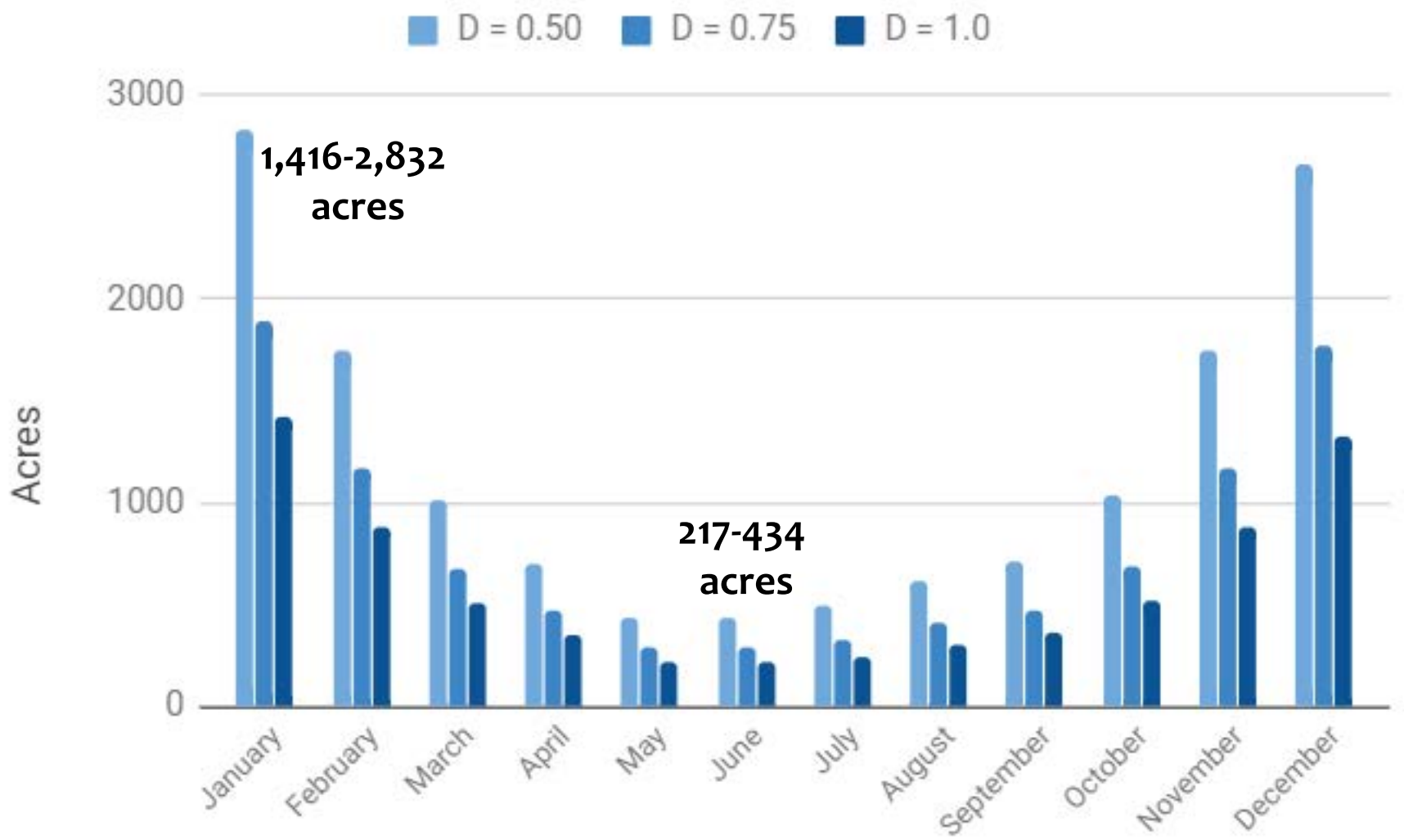
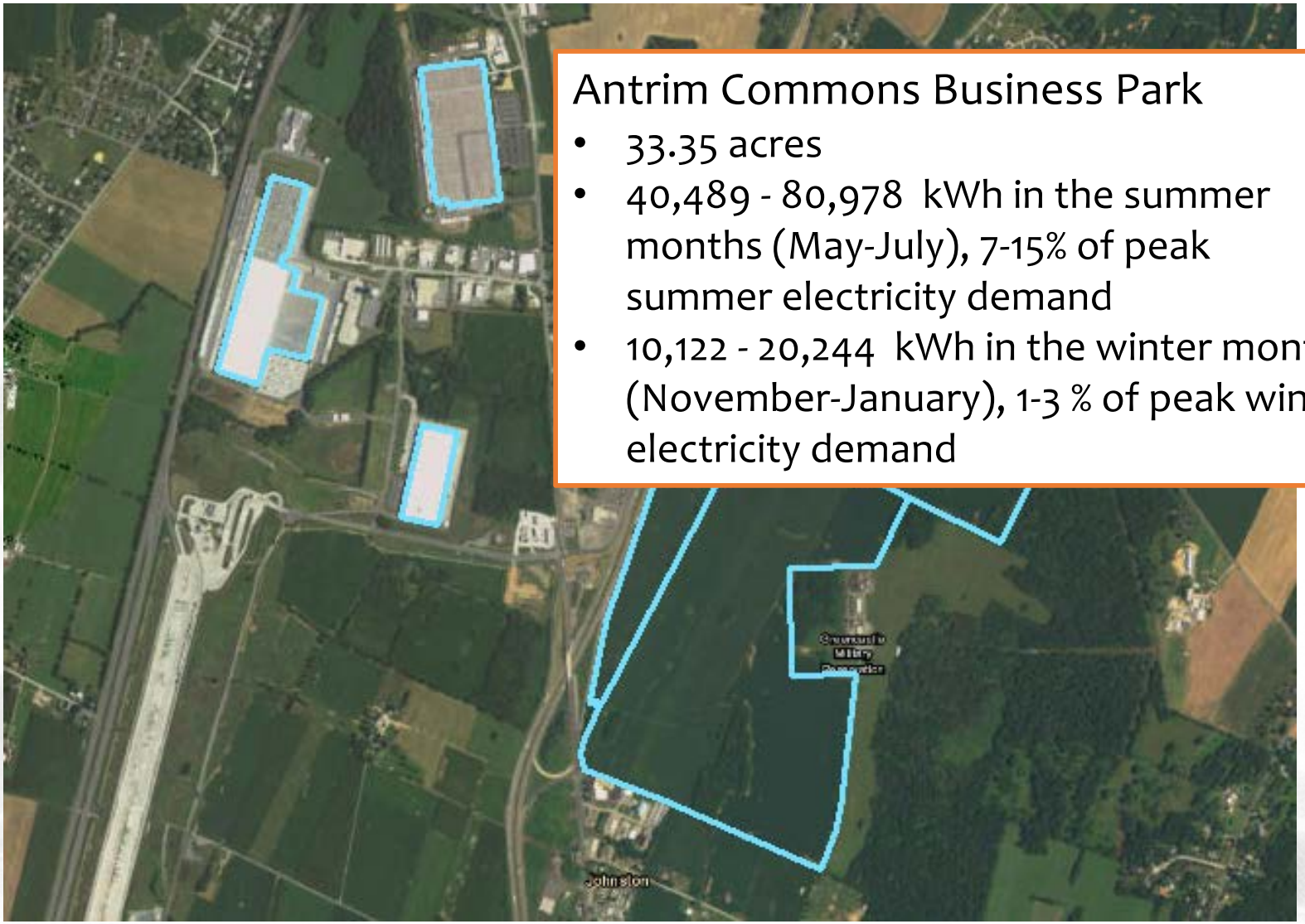
How much land is needed to meet energy demand?



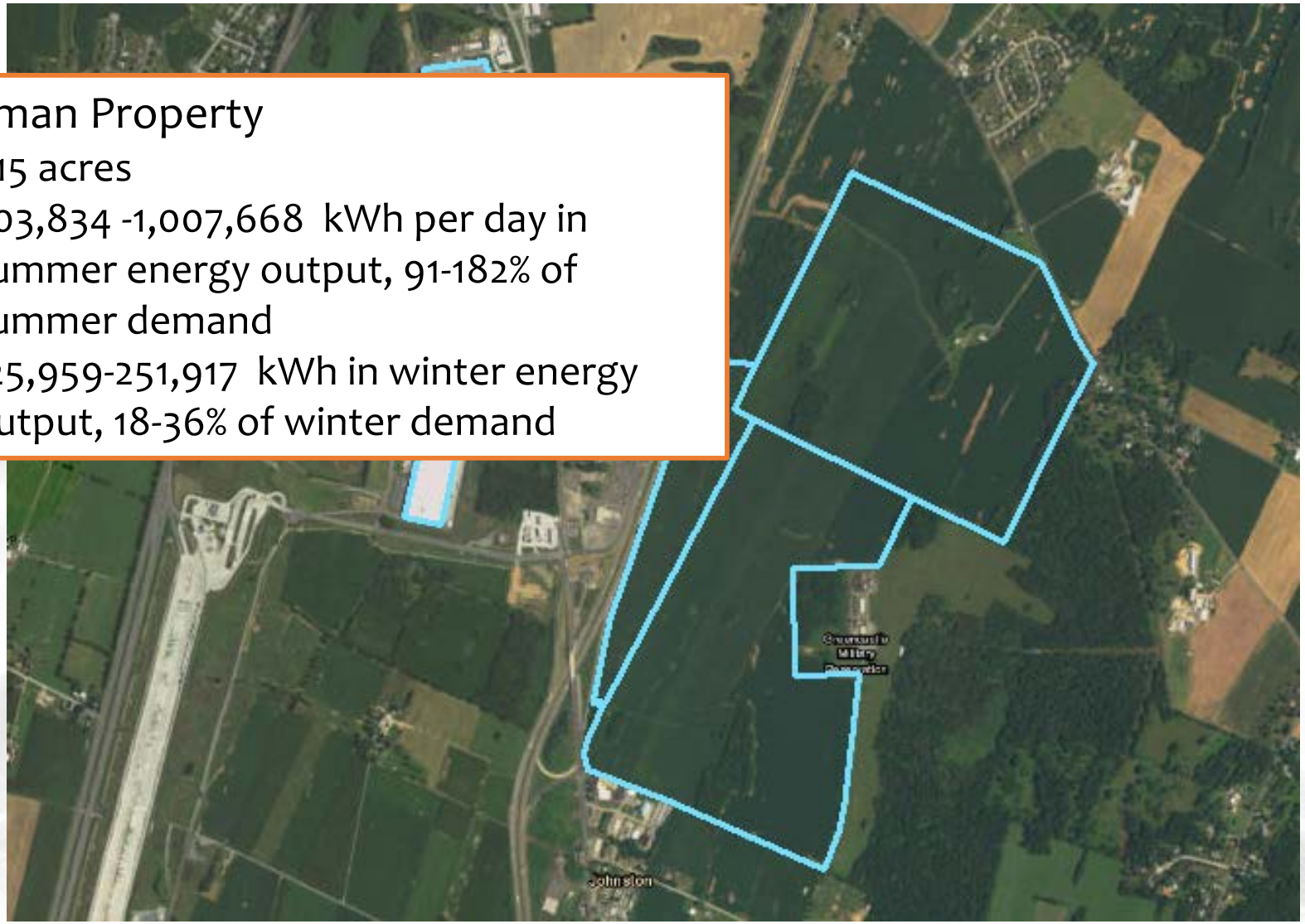
Case studies



Antrim Commons Business Park

- 33.35 acres
- 40,489 - 80,978 kWh in the summer months (May-July), 7-15% of peak summer electricity demand
- 10,122 - 20,244 kWh in the winter months (November-January), 1-3 % of peak winter electricity demand

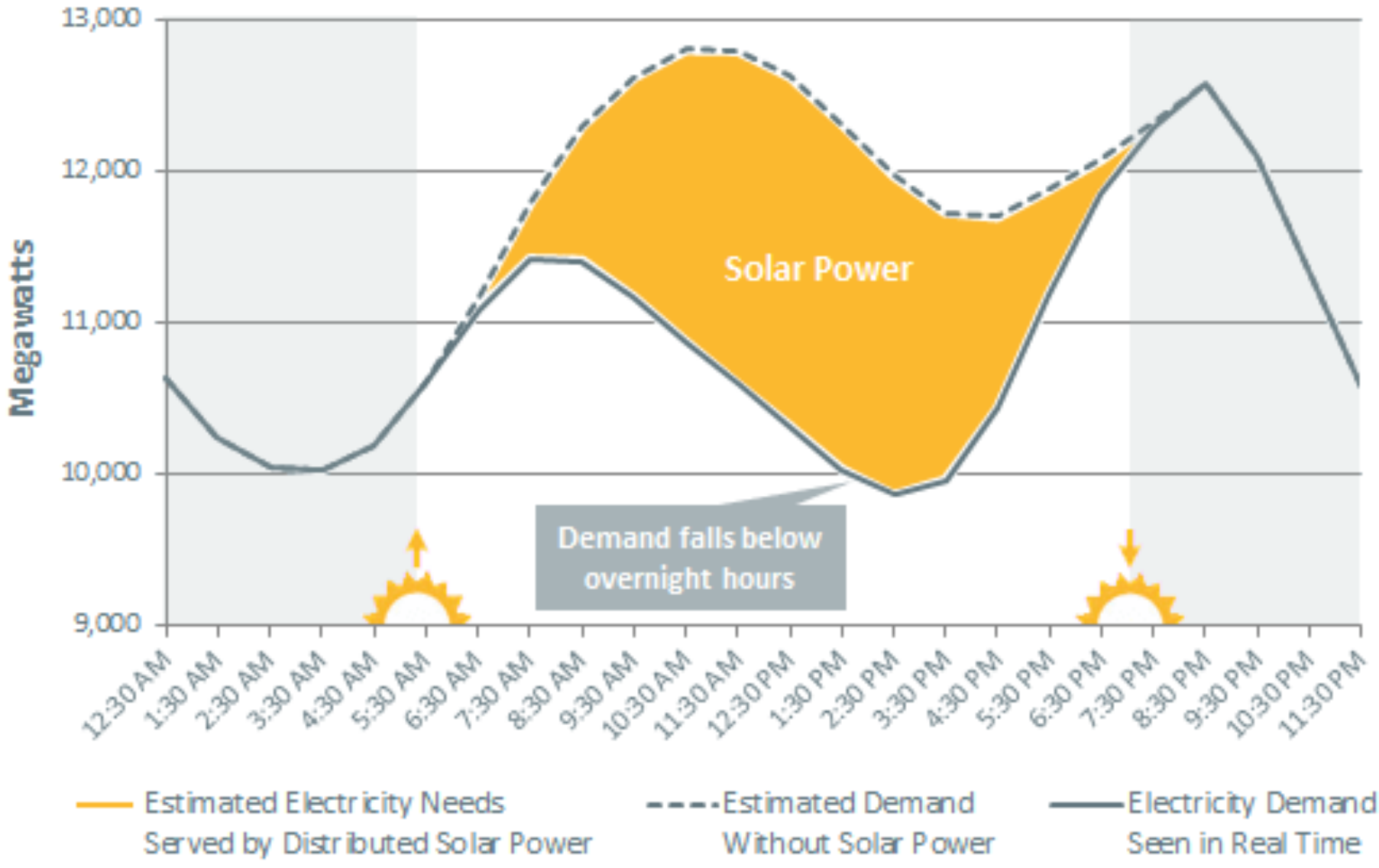
Case studies



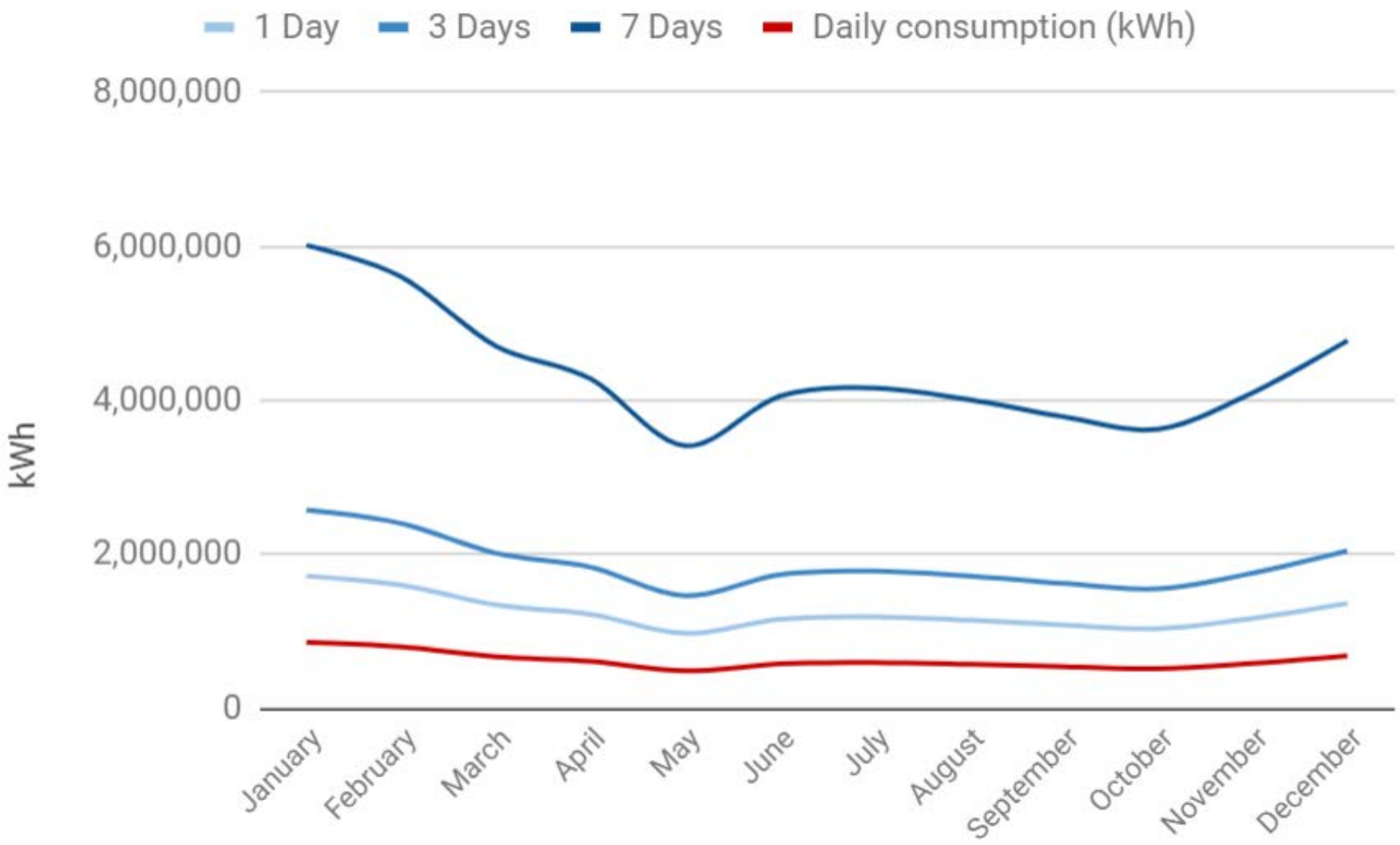
Gayman Property

- 415 acres
- 503,834 -1,007,668 kWh per day in summer energy output, 91-182% of summer demand
- 125,959-251,917 kWh in winter energy output, 18-36% of winter demand

Energy storage considerations



Energy storage requirements



Next steps: Follow-On Questions

- What (conservatively) is (will be) instantaneous power peak?
- What will impact of future (construction, electric vehicles) be?
- PA DEP Solar Futures
- What is storage form Breakdown?
  - Nightly
  - Days/weeks
  - Seasonal

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Next Steps: Local Government

- Solsmart
- USDoE funded consultation
  - Local government awareness/tools/education
    - General Demand/Supply, Energy Market
    - Regulatory Environment (Federal and State)
    - Technology/Innovation
    - Zoning, Ordinance, Permitting

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Thank you!