April 6, 2023

Versant Power Operations & Interconnection Technical Update

Agenda

- Grid
- Current Interconnection Landscape
  - Versant Power's Interconnection Process
- High Penetration of Renewables
  - Northern Maine
  - Small Projects (Level 1)

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What is the “Grid”?

- Just-in-time system for generating and delivering electricity
- It is balanced, always – that is, the desired demand must be met by supply, nearly instantaneously
- Imbalances, and by laws of physics they may only be relatively fleeting in nature, are primarily met by inertia
- Seasonal changes create substantial challenges
- It is often called the single most complicated machine built in the history of the world

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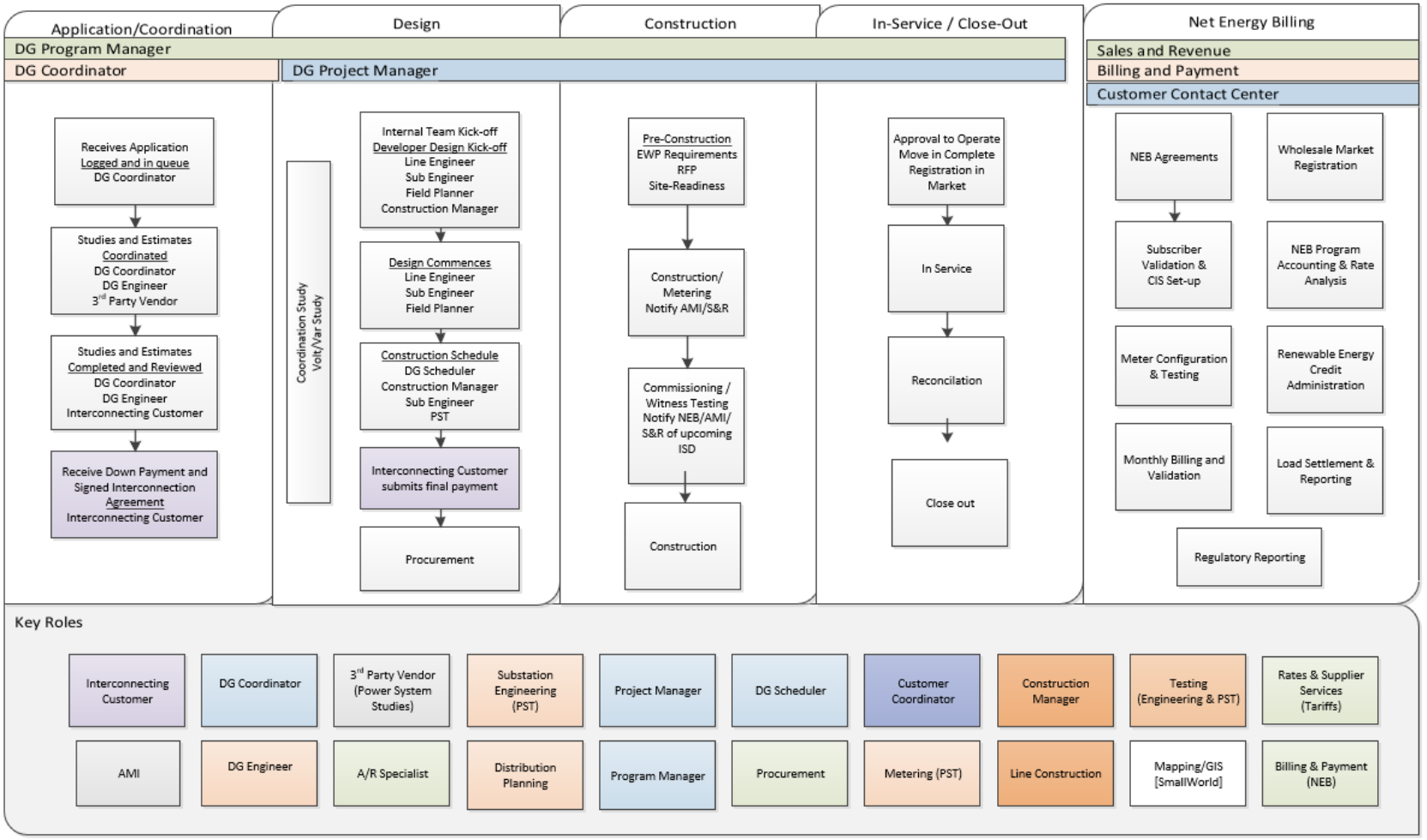
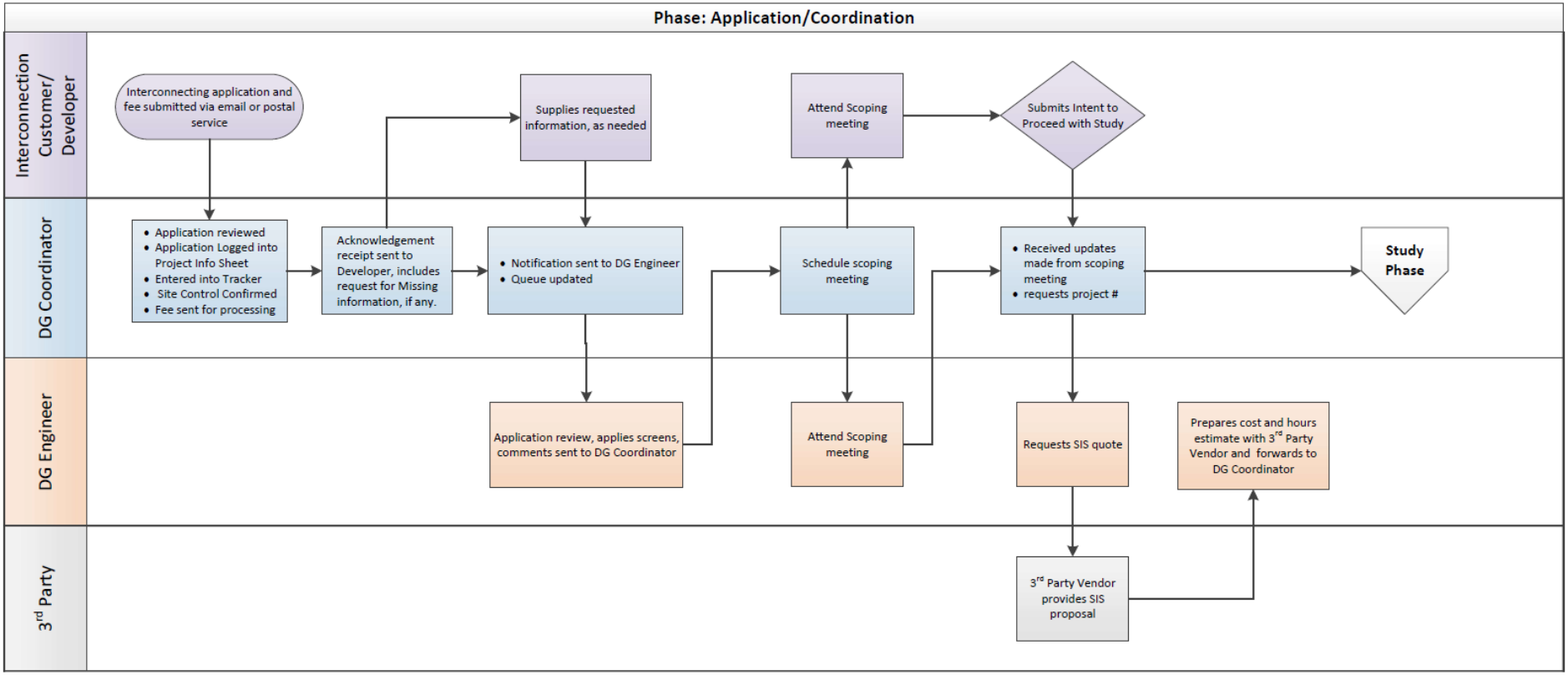
DG Interconnection Process



DG Interconnection Process



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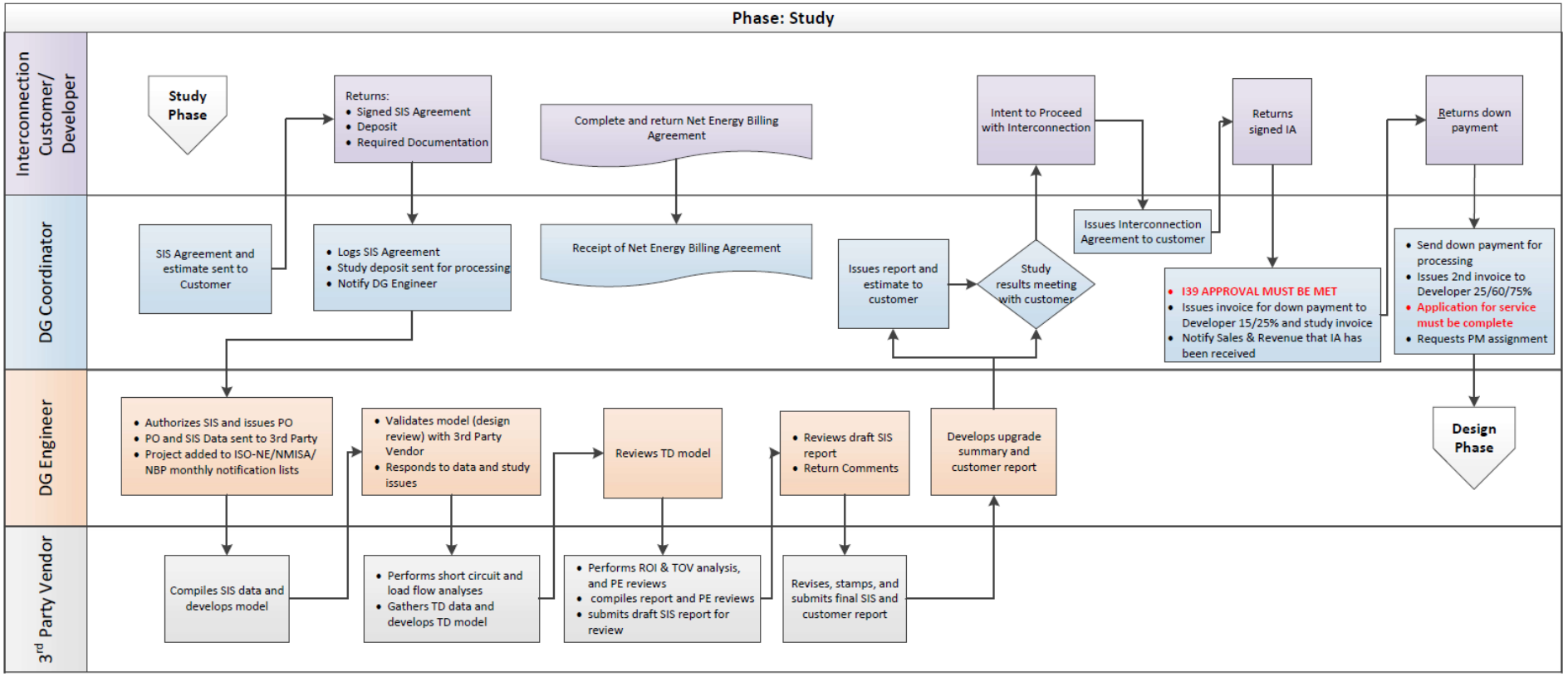

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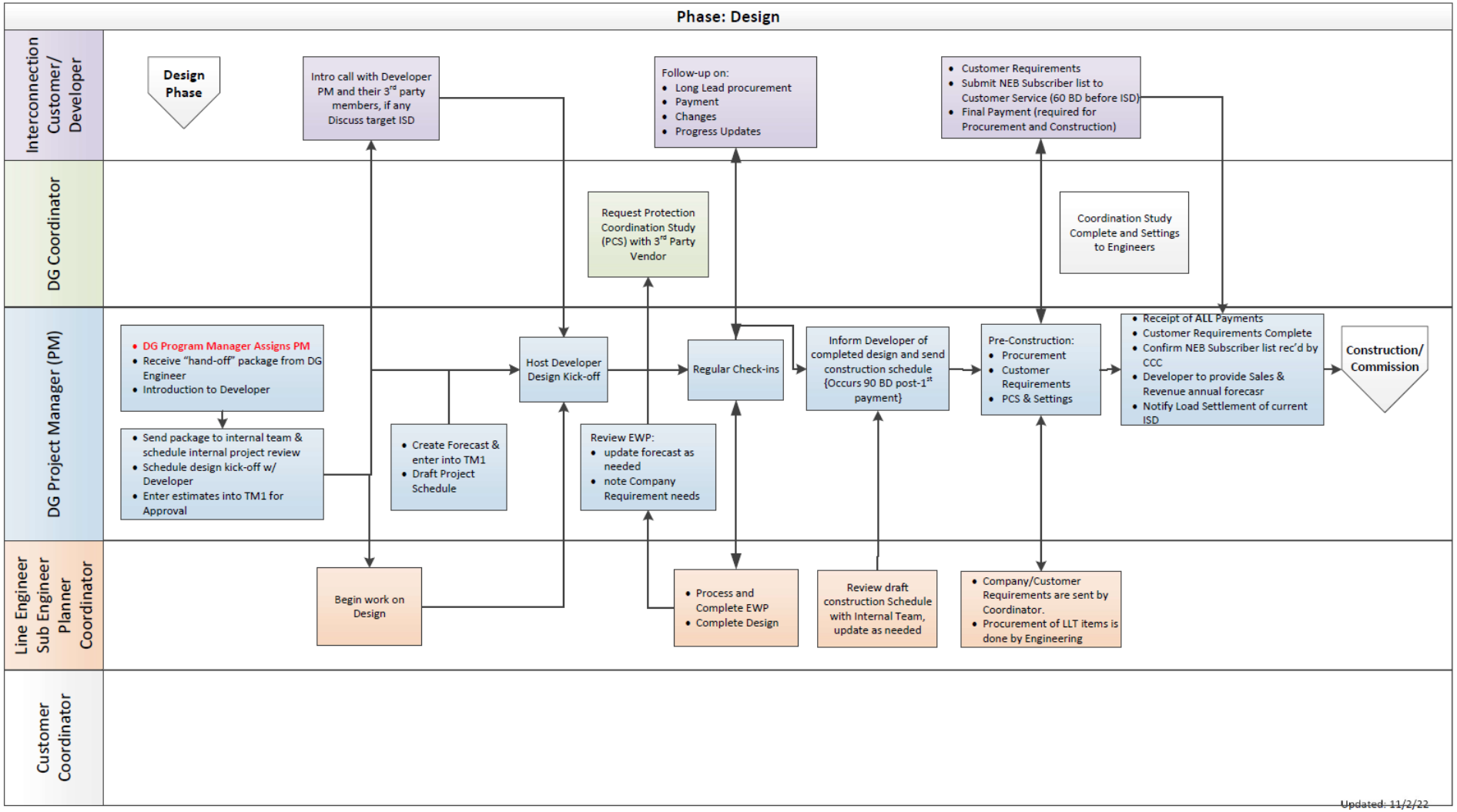
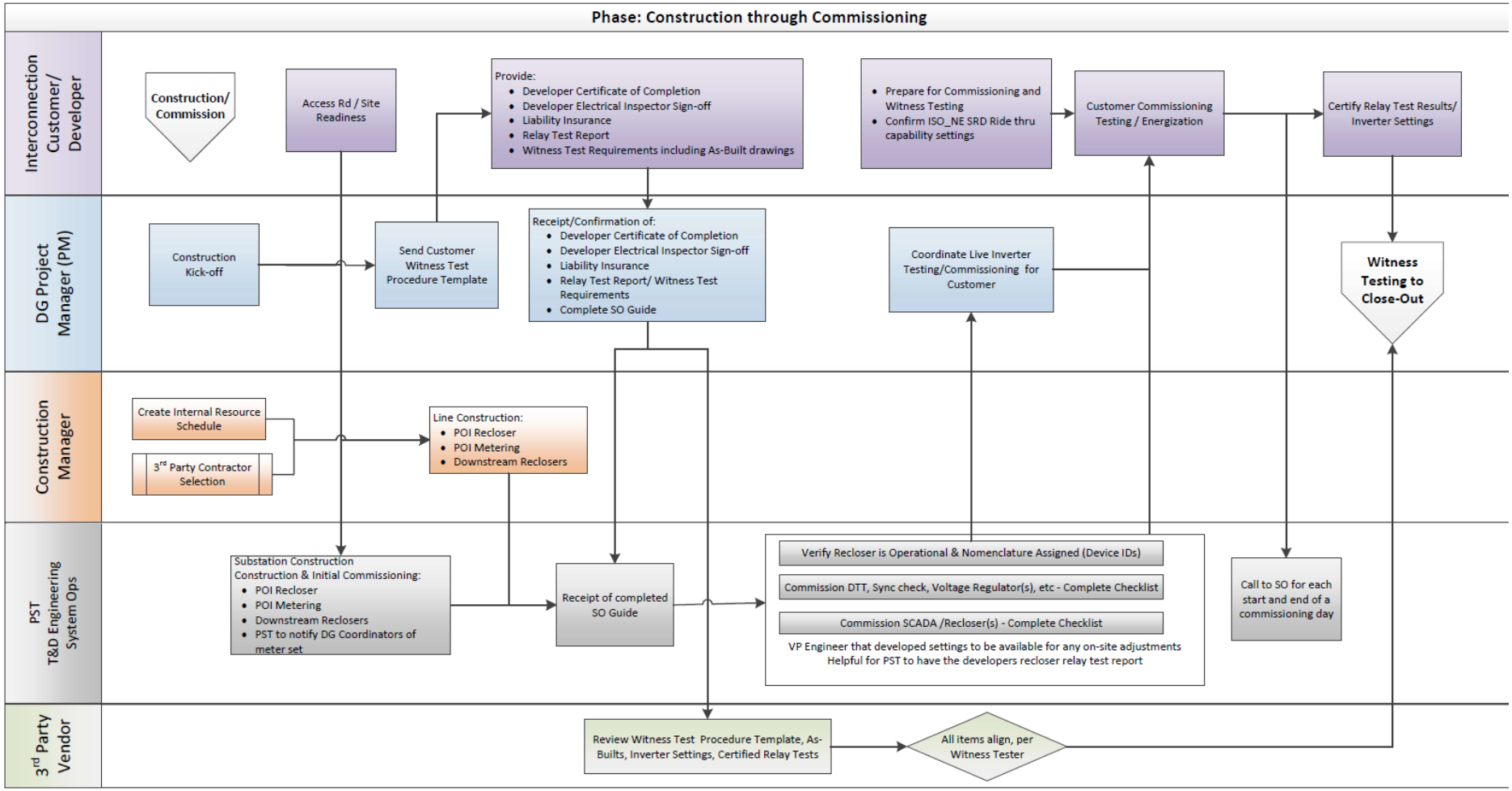
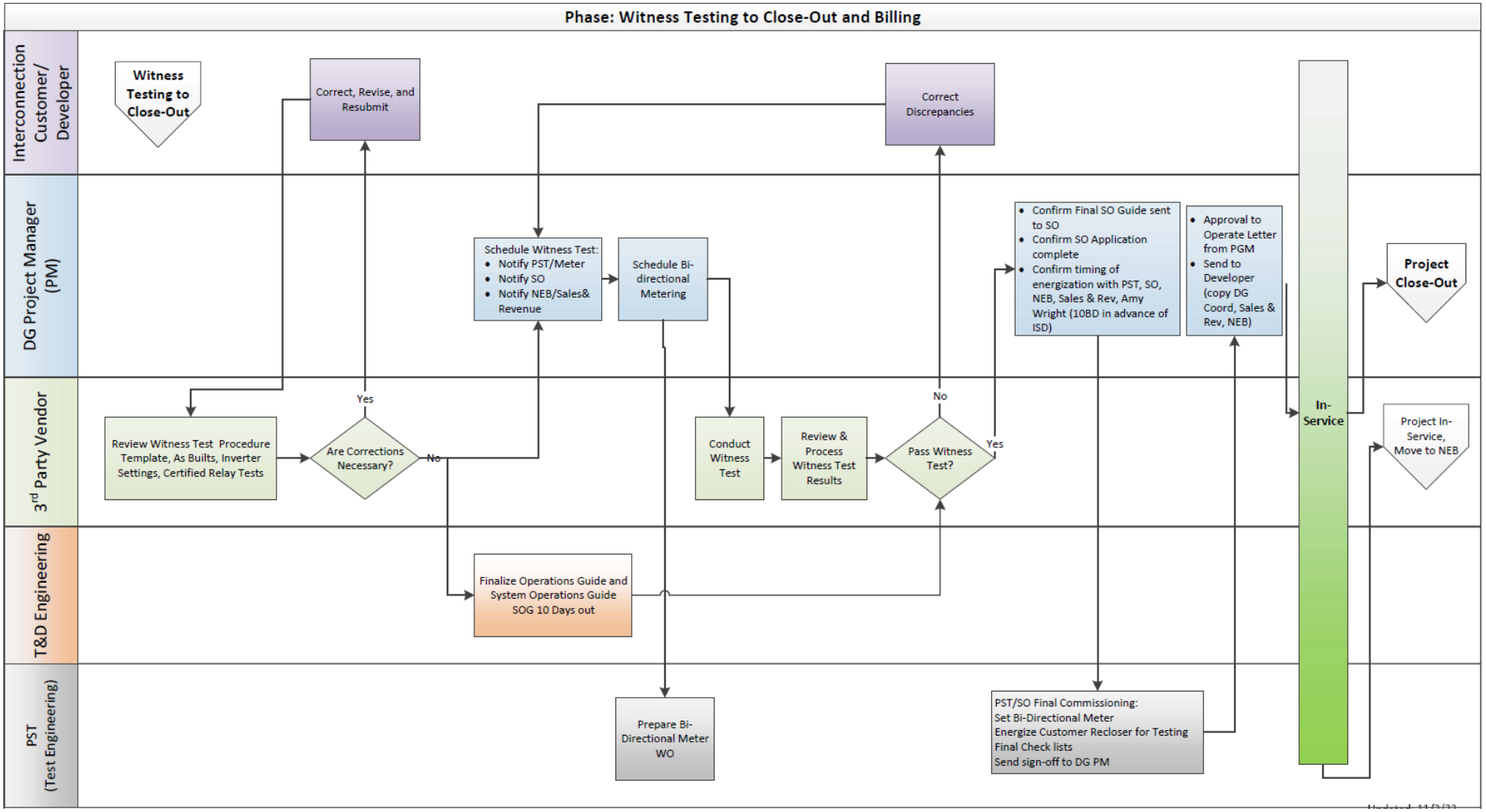


DG Interconnection Process



DG Interconnection Process



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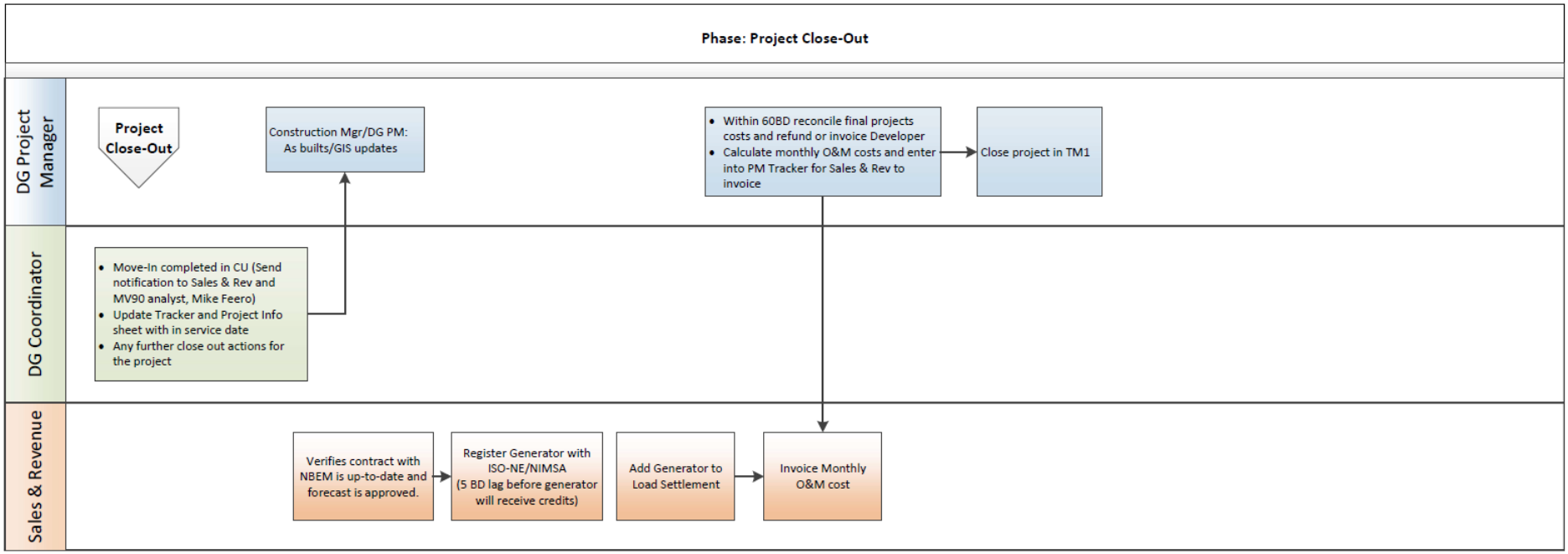

Versant's Interconnection Process

- Since 2020, Versant has processed more than 1,220 applications to interconnect renewable energy generators and worked with developers to interconnect more than 71 megawatts of solar energy to the grid.
- Versant is working with the owners of more than 444 active projects to integrate an additional 514-plus megawatts of renewable energy in northern and eastern Maine.

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Versant's Interconnection Process

- Safety and reliability are our top two priorities. When we consider an application to interconnect to the grid, we must ensure safety and reliability for that customer as well as their neighbors.
- The interconnecting customer is required to pay for upgrades needed to maintain safety and reliability of the grid.
- Versant does not "deny" or "refuse to interconnect" projects. We provide information to customers regarding the necessary upgrades to interconnect. The customer must then decide whether to proceed. In limited cases, upgrade costs may be large due to capacity issues at certain locations on the system.
- It is likely that more projects will confront such obstacles given the dramatic increase in interconnection requests we've seen since 2019.

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Versant's Interconnection Process

- Developers usually size solar arrays by a factor of 7x to make enough energy to offset customer's entire bill. The 7x factor is based on average use (due to the 14-15% solar "capacity factor").
- In total, Versant has requests for solar interconnections that would generate more electricity than the peak demand for electricity on our system.
- To maintain a safe and reliable grid, voltage must remain balanced. The grid cannot accommodate limitless amounts of added generation.

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High Penetration of Renewables

- Two places/areas where interconnection-related challenges are appearing first:
  - Requires technical and policy solutions
- Northern Maine Queue
- Small Projects

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High Penetration of Renewables

- Northern Maine interconnection queue + operating projects = about 180% of peak load.
- Including existing intermittent generation, the total is about 220%, or 2.2 times the peak load.
- What this means:
  - On a clear, windy day, not including hydro, we would be making 220 MW, vs. Versant's peak of about 100 MW
  - In reality, the load will be significantly less (50-70 MW) so there will be times when Versant will "have to find a home for" 150-170 MW of generation
  - Without significant storage, much of that excess generation will need to be curtailed.

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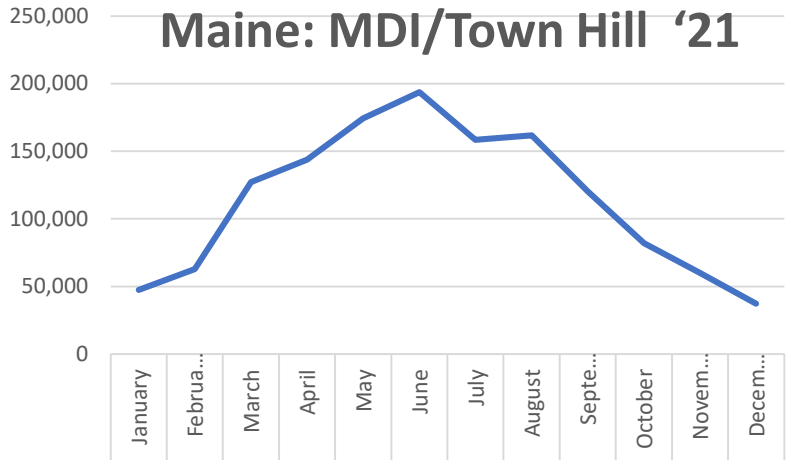
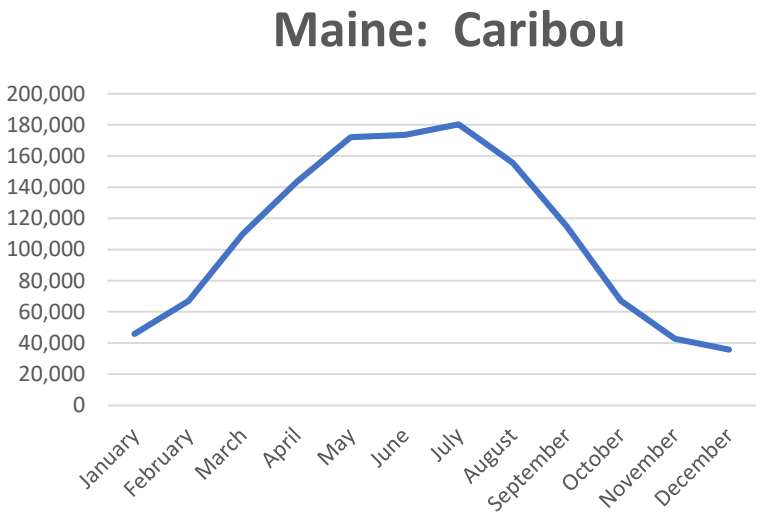
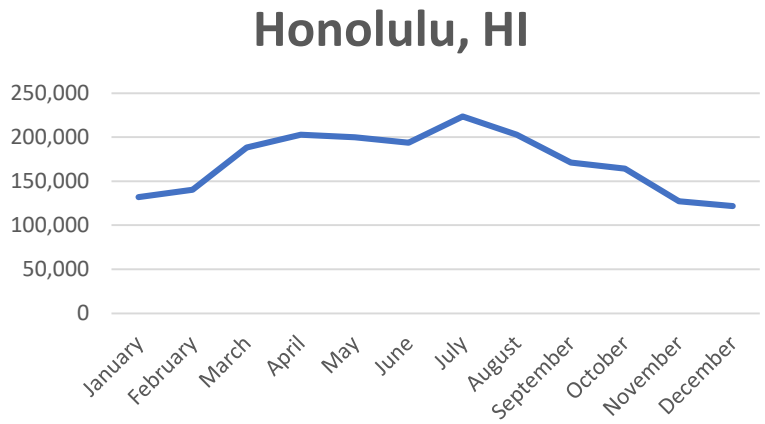
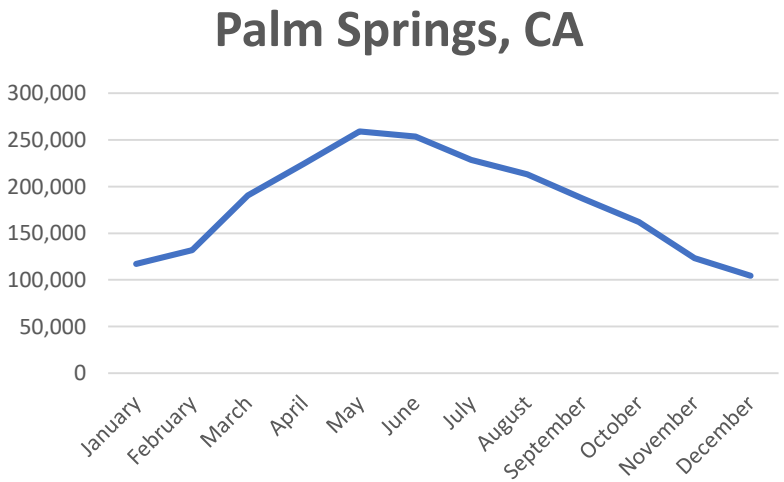
Solar Output Curves: Irradiance









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Source: NREL Database

Challenges for Maine

- Significantly lower solar generation in December means we won't have solar when needed most
- December is the peak month in Aroostook County and will become the peak month in the Bangor Hydro District (electric vehicles and heat pumps)
- Maine is challenged because solar output is so seasonal – Hawaii and California annual curves are much flatter (see graphs)

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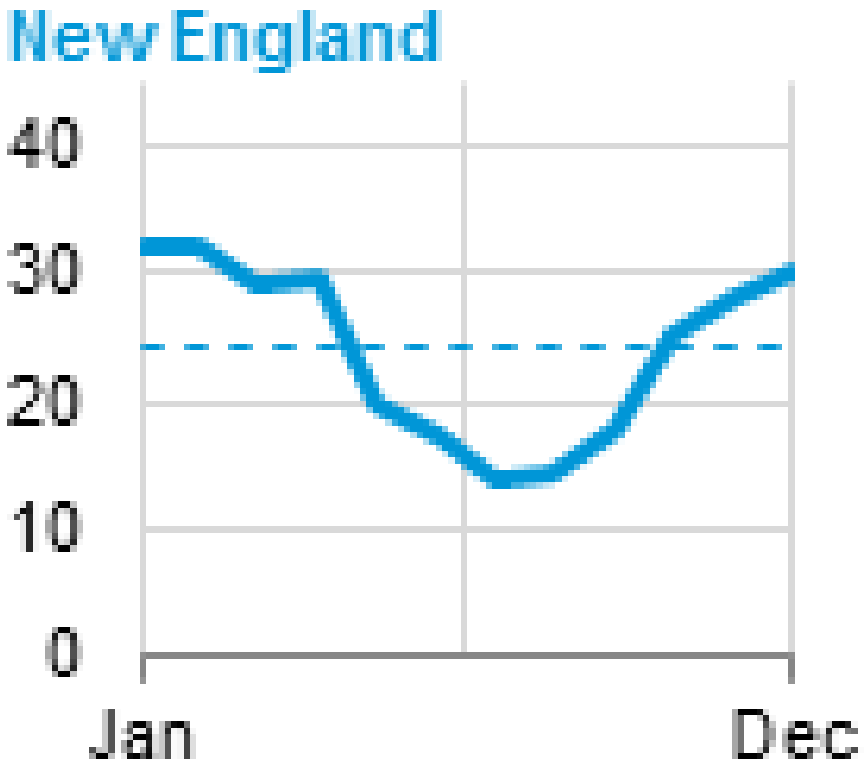
Solution

- **Mix of resources:**
  - **Onshore Wind, Offshore Wind, Solar and Hydro – with storage**



Source: EIA

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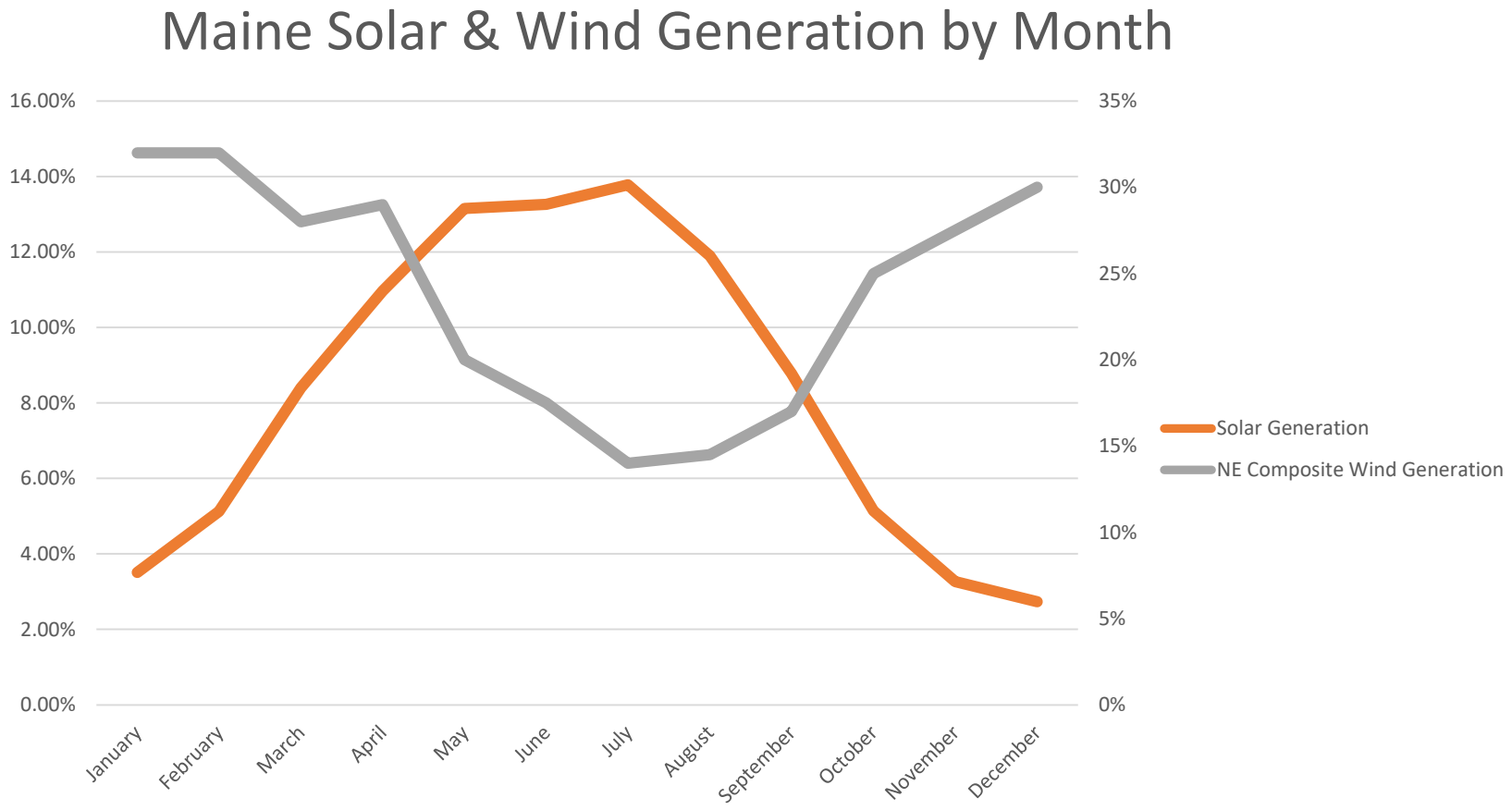
Solution

Solar and Wind match up well! But must plan.



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Small Projects

- Small projects, in the aggregate, designed at 7x load, drive system voltages too high.
- Occurs particularly on low-voltage, long rural circuits
- As stated earlier, Versnt provides alternatives, but the cost is well above the “Minor System Modification” cost of $30k.
- Versant has been asked in rate cases to hold off on replacing all copper conductor, but copper conductor is becoming one of the primary reasons for constraints in some areas.

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Small Projects: Policy Discussion

- As recently came up in Chapter 324 comments, we said the decision when to upgrade these lines, and whether to socialize the cost, is a policy decision
- Many of these circuits will have to be upgraded anyway to support electric vehicles and heat pumps : Experts have stated peak load may grow by 5x
- Versant asked how the upgrades should be socialized and prioritized – they can't be done all at once.

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Thank you

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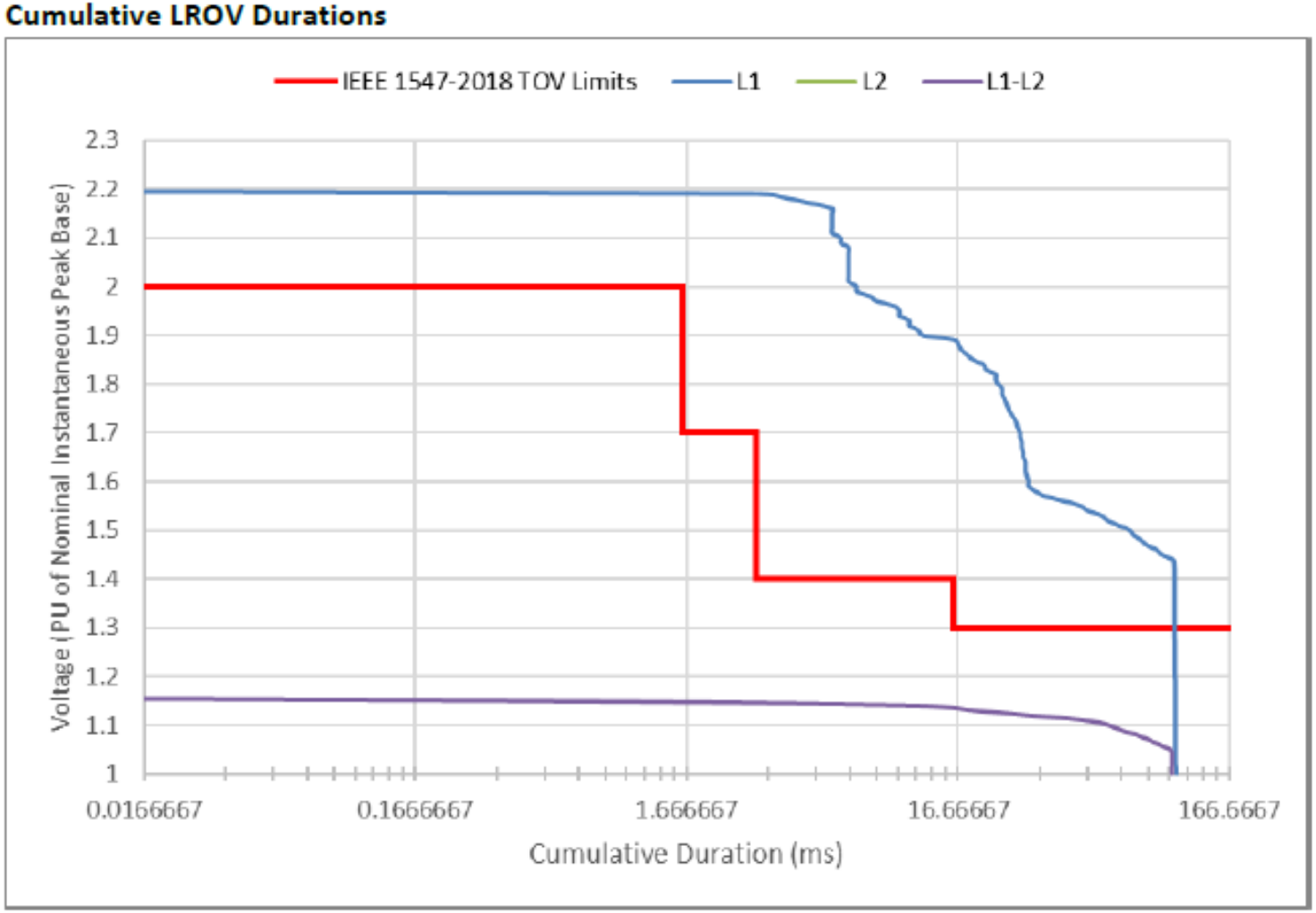
Appendix

Single Phase PV-DER (Actual Test Results)



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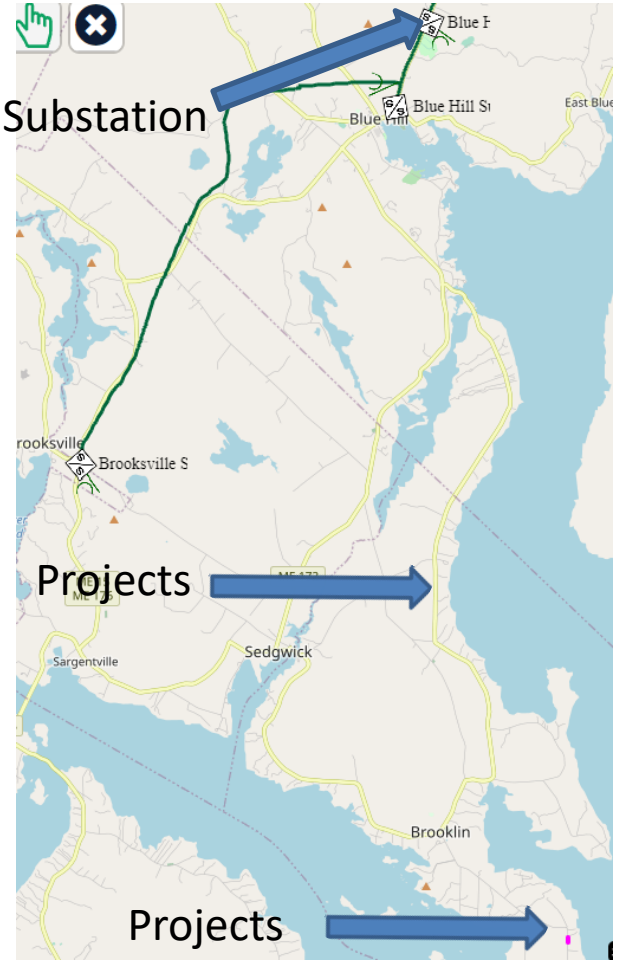
Brooklin - Various Projects

- Some projects are about 17 miles from the substation
- And close to the very end of the circuit
- This entire circuit is adequate to serve the load as it has existed for decades – but when projects are designed to be 7x their load, the generation is high, and drives high voltage during low load situations during the day
- High voltage has nothing to do with large project



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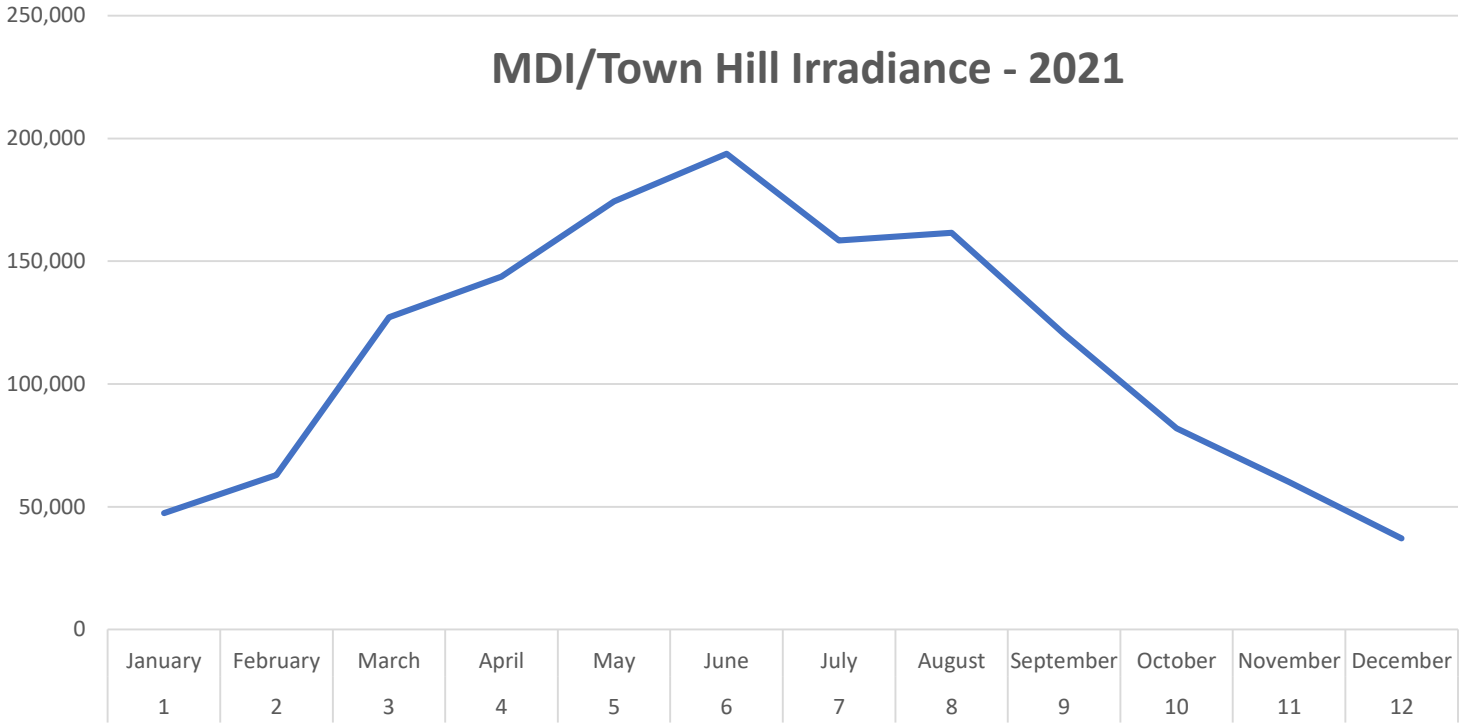
Maine Solar Output Curve (Bar Harbor)



Source: NREL Database

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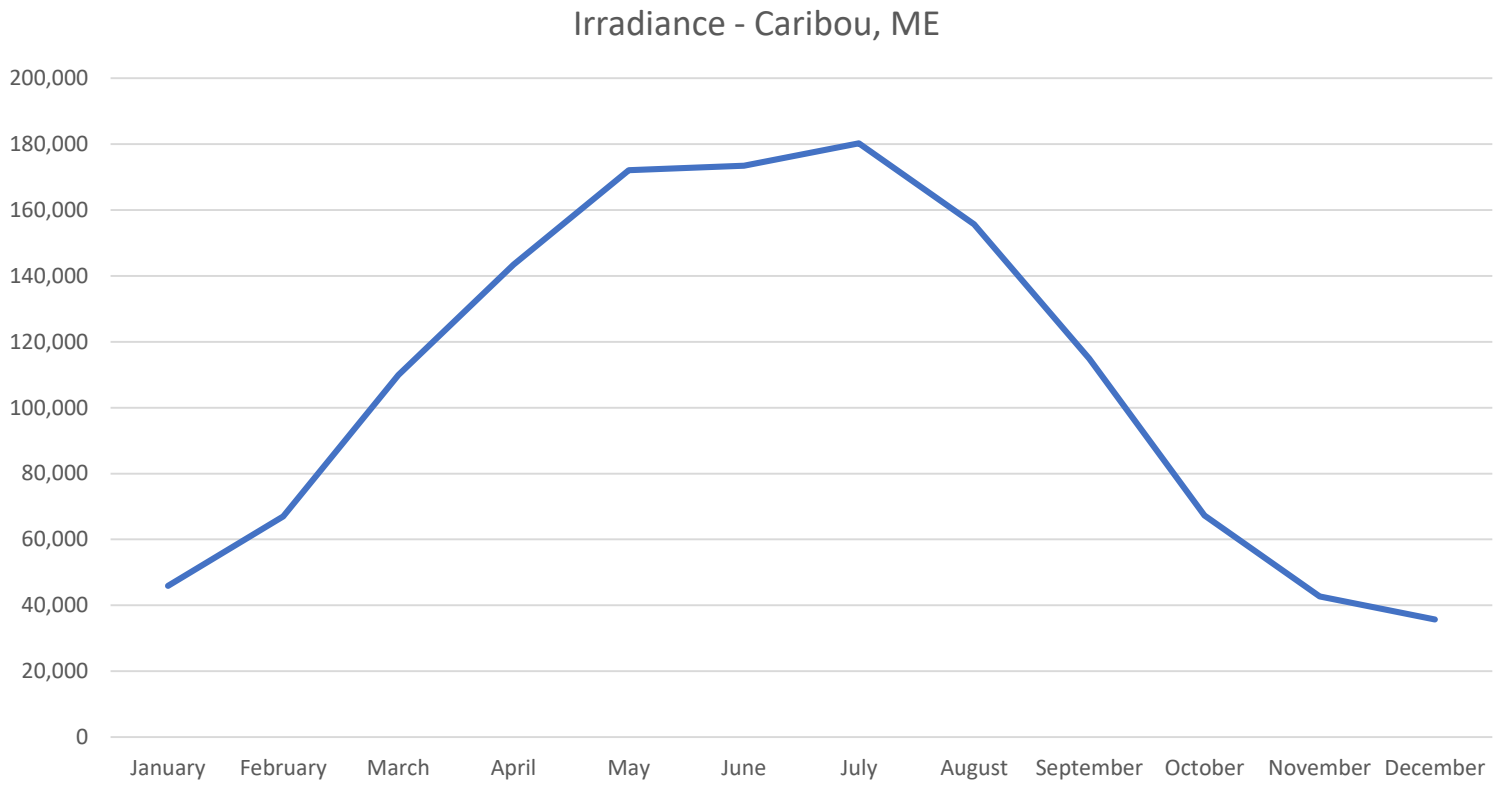
Maine Solar Output Curve (Caribou)



Source: NREL Database

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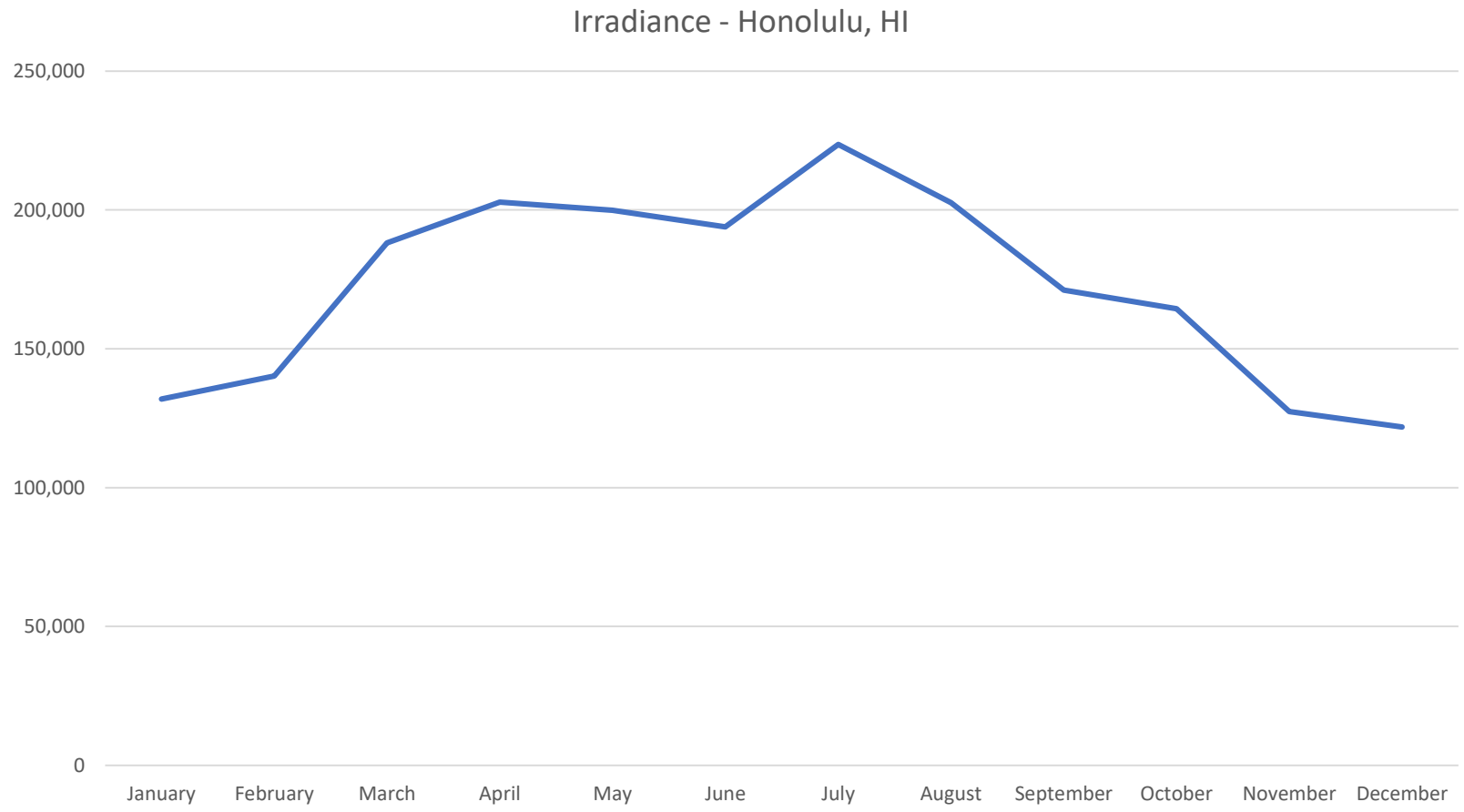
Hawaii Solar Output Curve



Source: NREL Database

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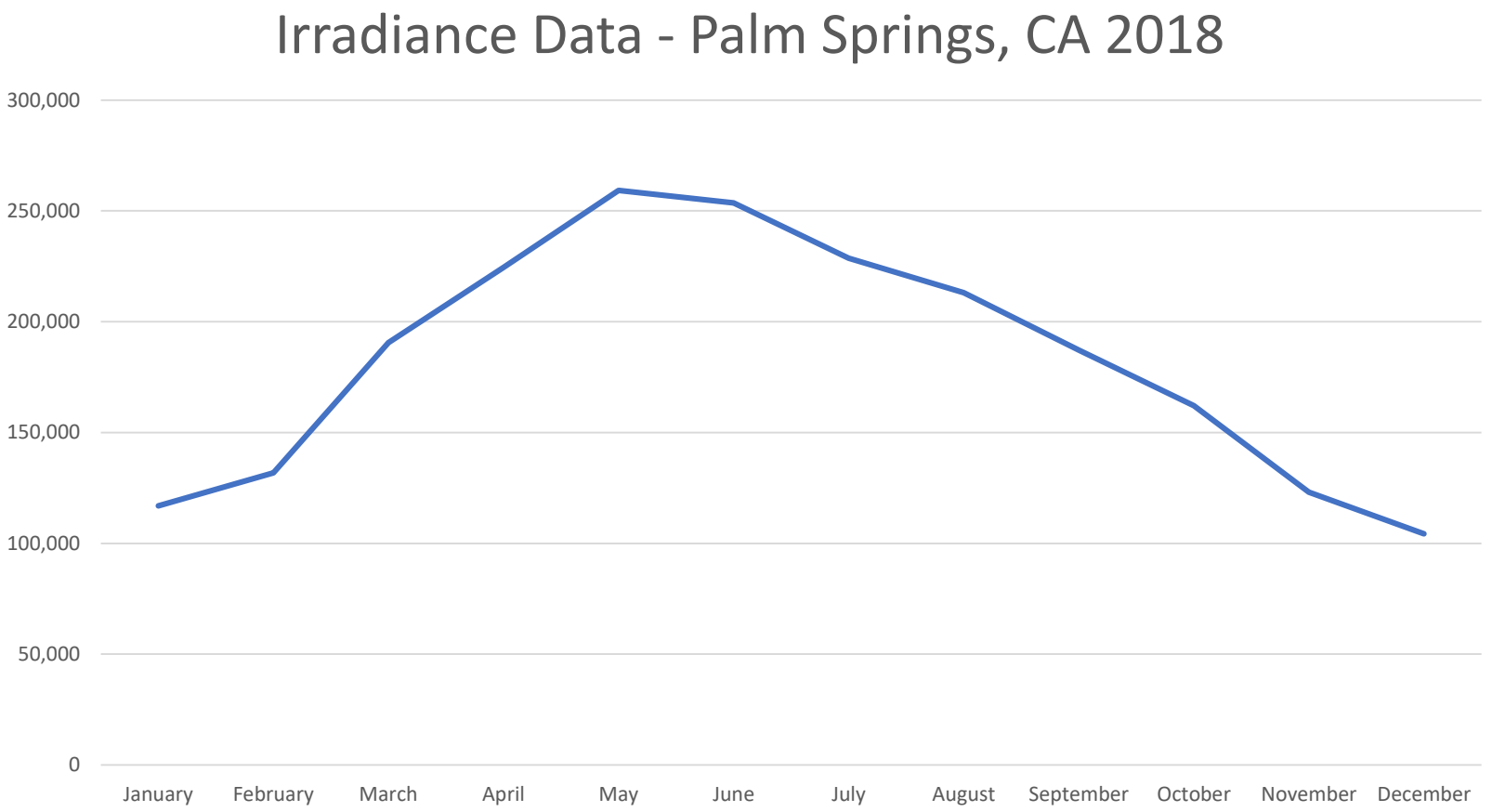
California Solar Output Curve



Source: NREL Database

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