



Extending Fleet Forecasting Capability into the Probabilistic Realm

Tom Hoff

Founder and Chief Research Officer

tomhoff@cleanpower.com

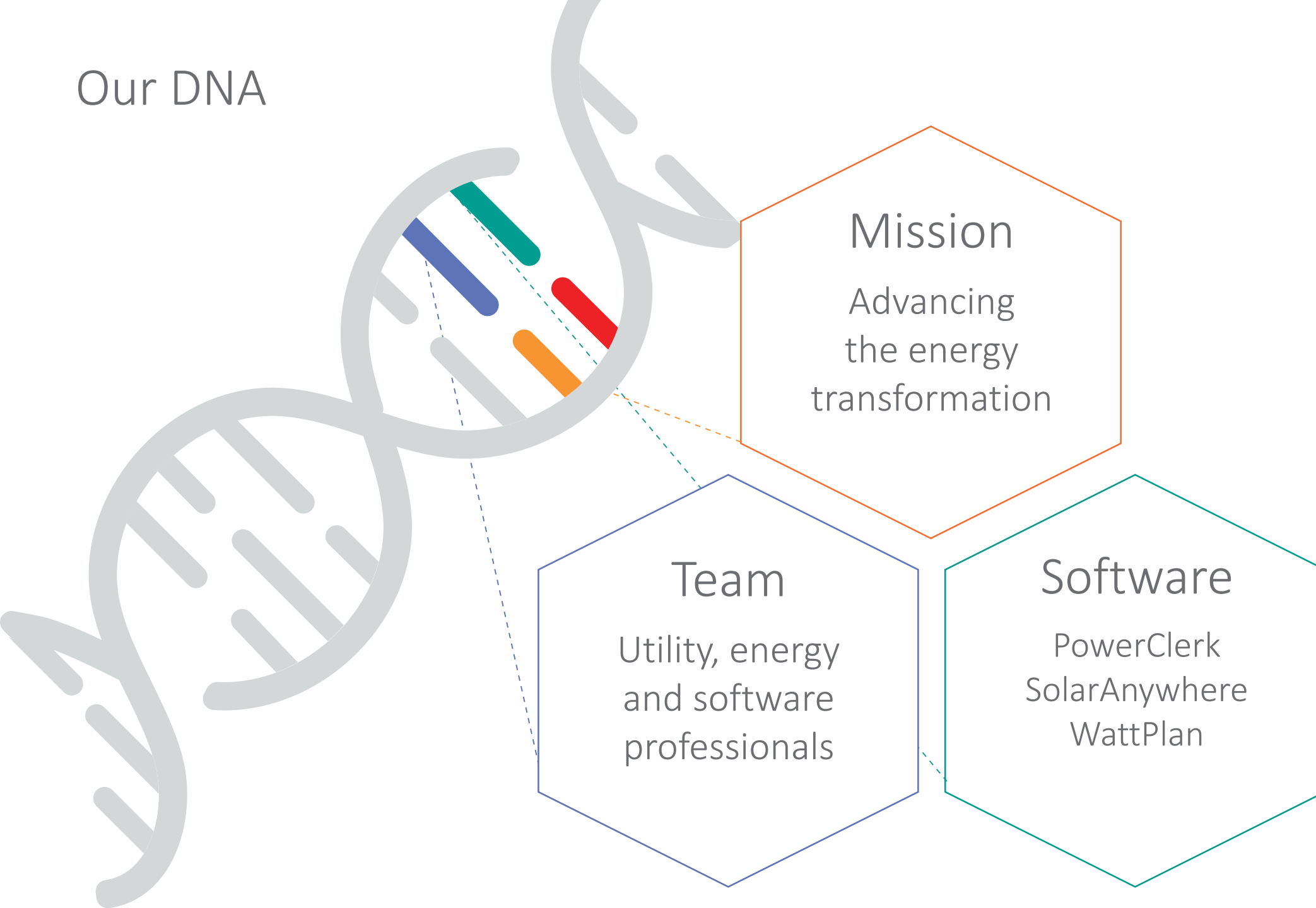
ESIG, Applying Meteorology in Power Systems

June 19, 2018

Copyright © 2018 Clean Power Research, L.L.C.



Our DNA



What Issue is CPR Addressing?

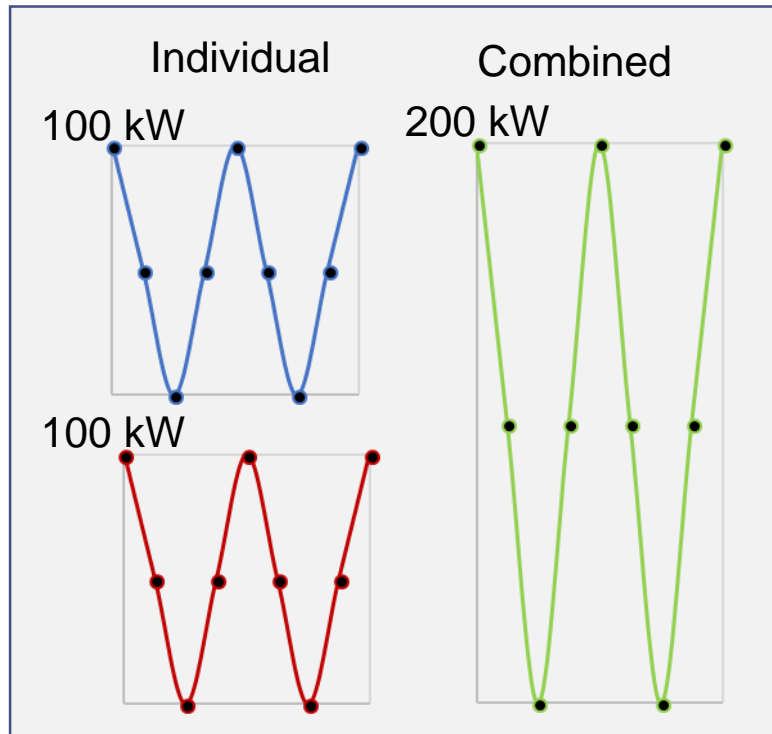
- PV fleet simulation introduces an issue that individual plant simulations do not encounter
- Due to fixed solar resource resolution, nearby plants must share the same irradiance input data when simulating forecasted output
- This may lead to an overestimate of inter-plant correlation and an artificially high variability of the aggregated fleet

How can one address this issue when irradiance data limitations exist?

What is Correlation?

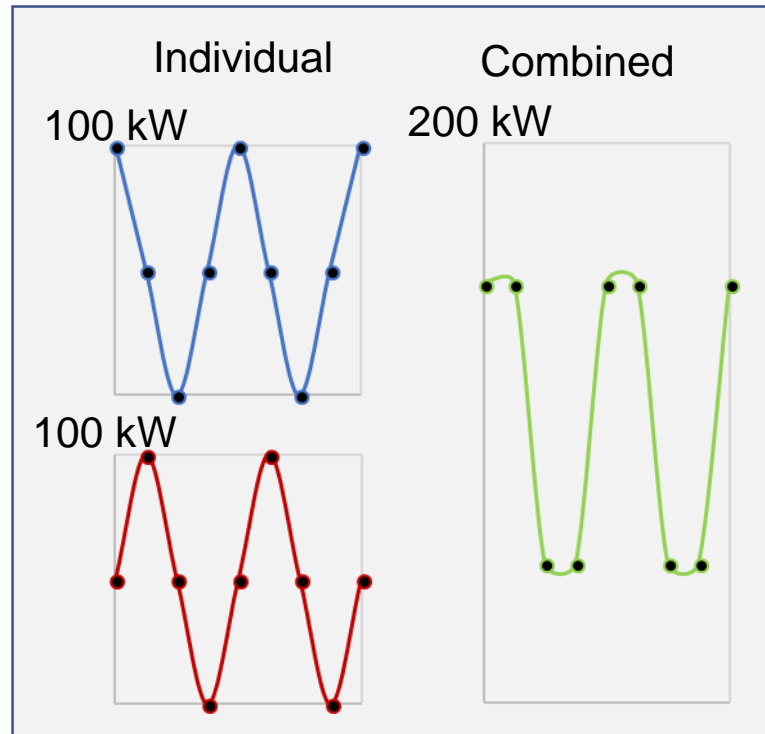
Scenario 1

100% Correlation Coefficient



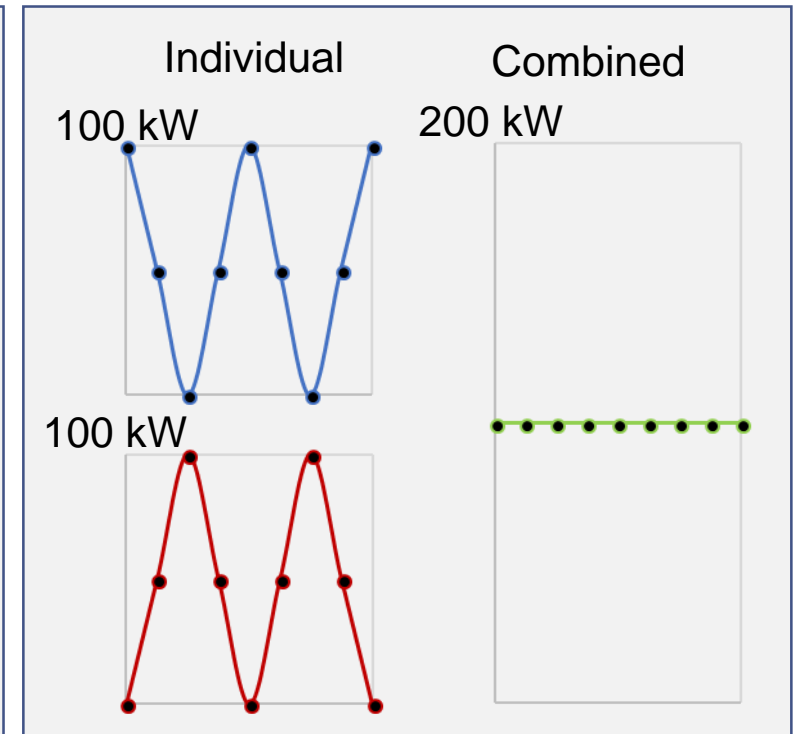
Scenario 2

0% Correlation Coefficient

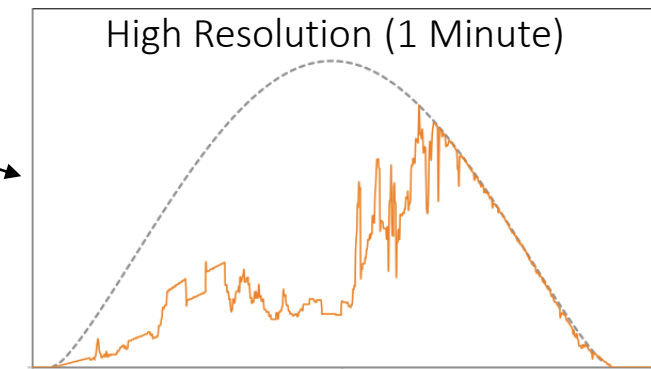
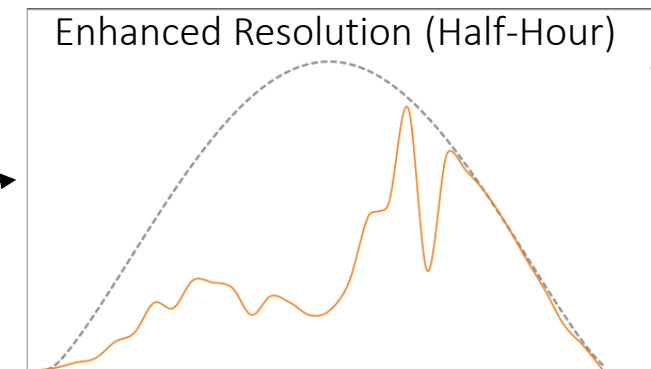
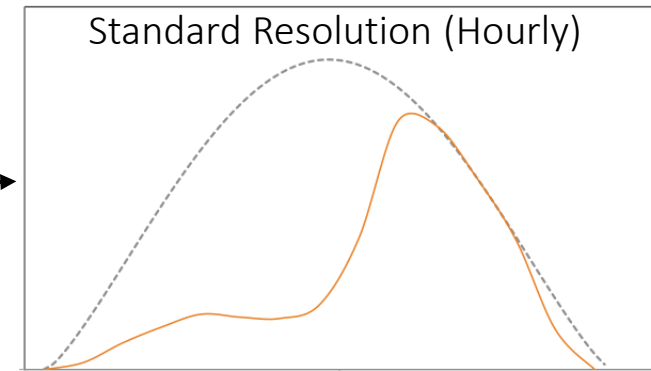
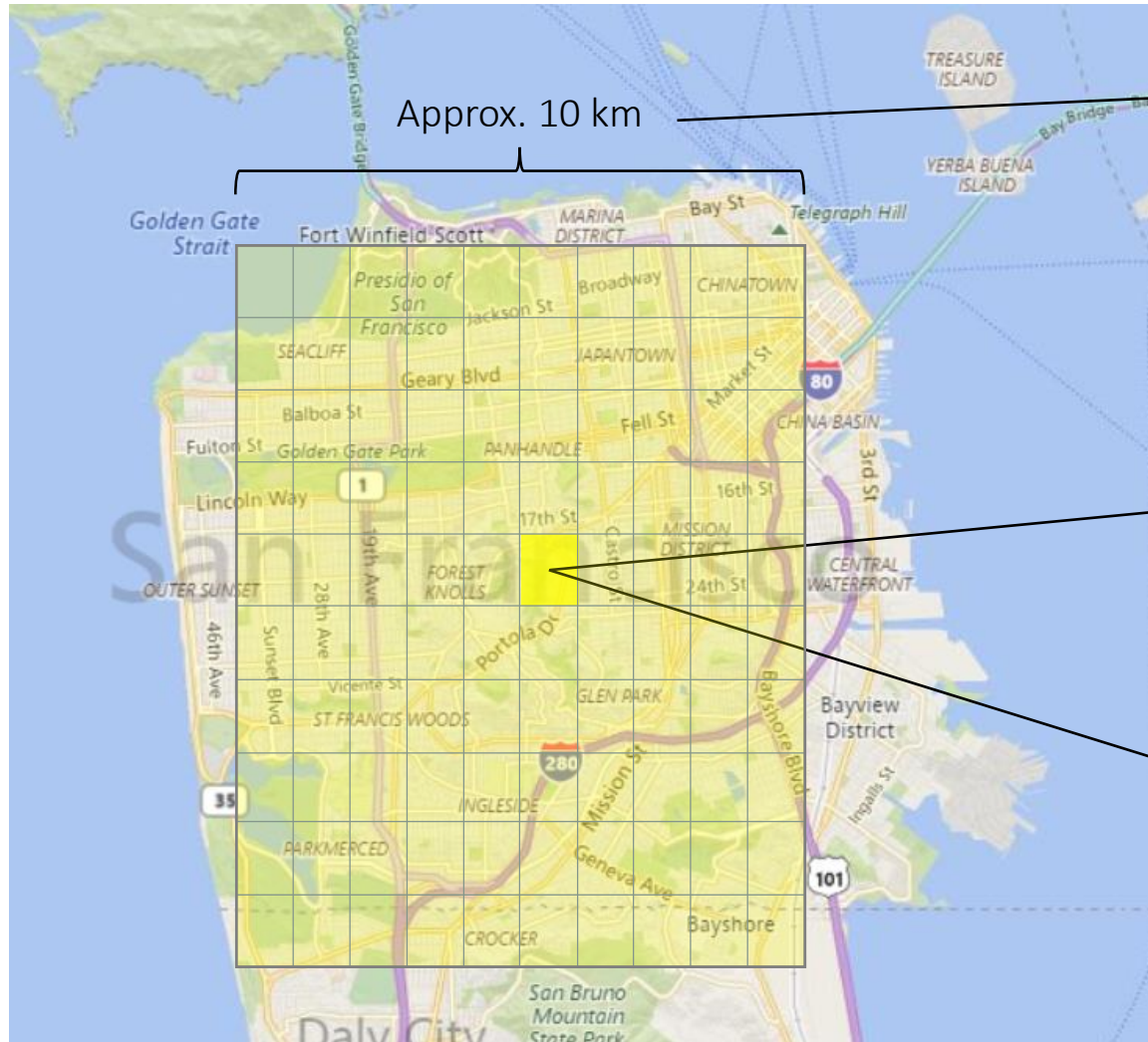


Scenario 3

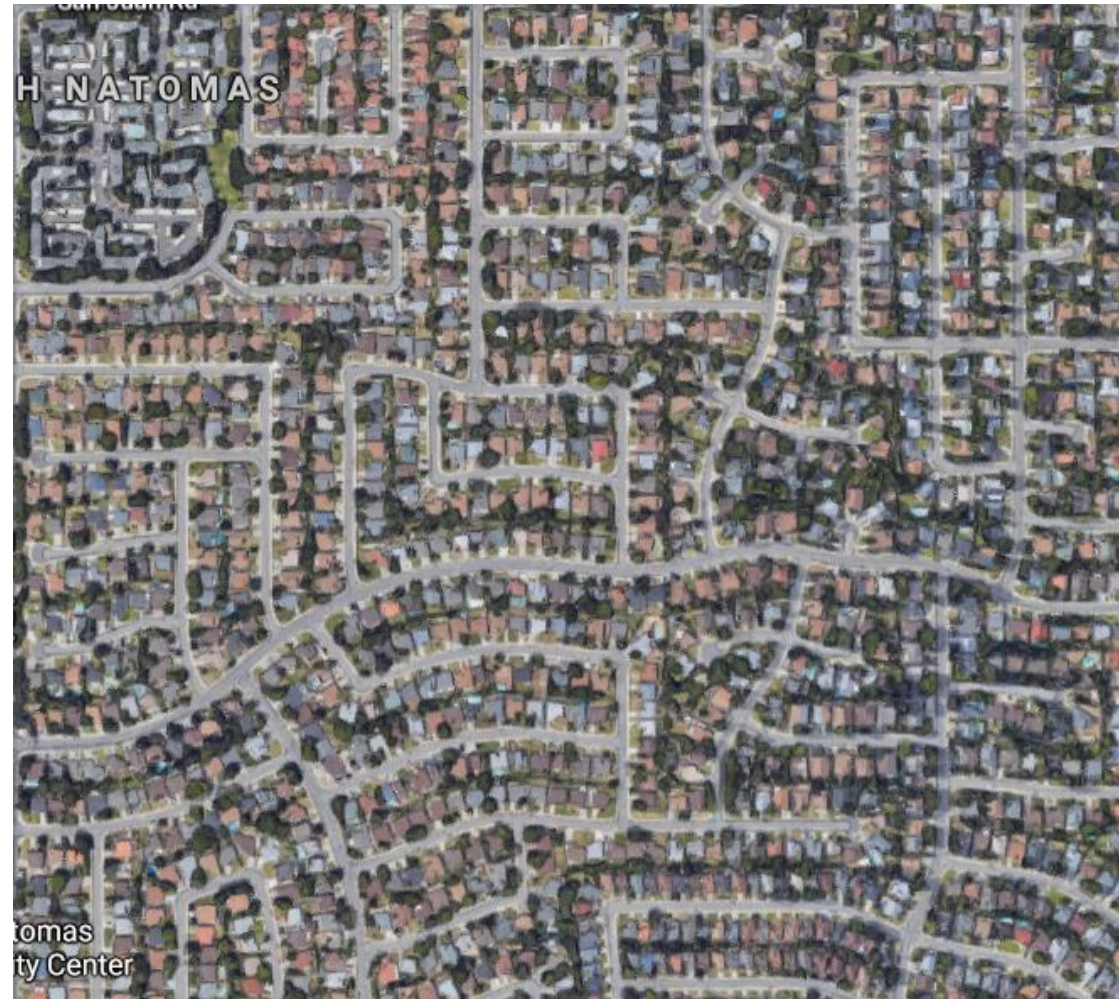
-100% Correlation Coefficient



SolarAnywhere Data Resolutions



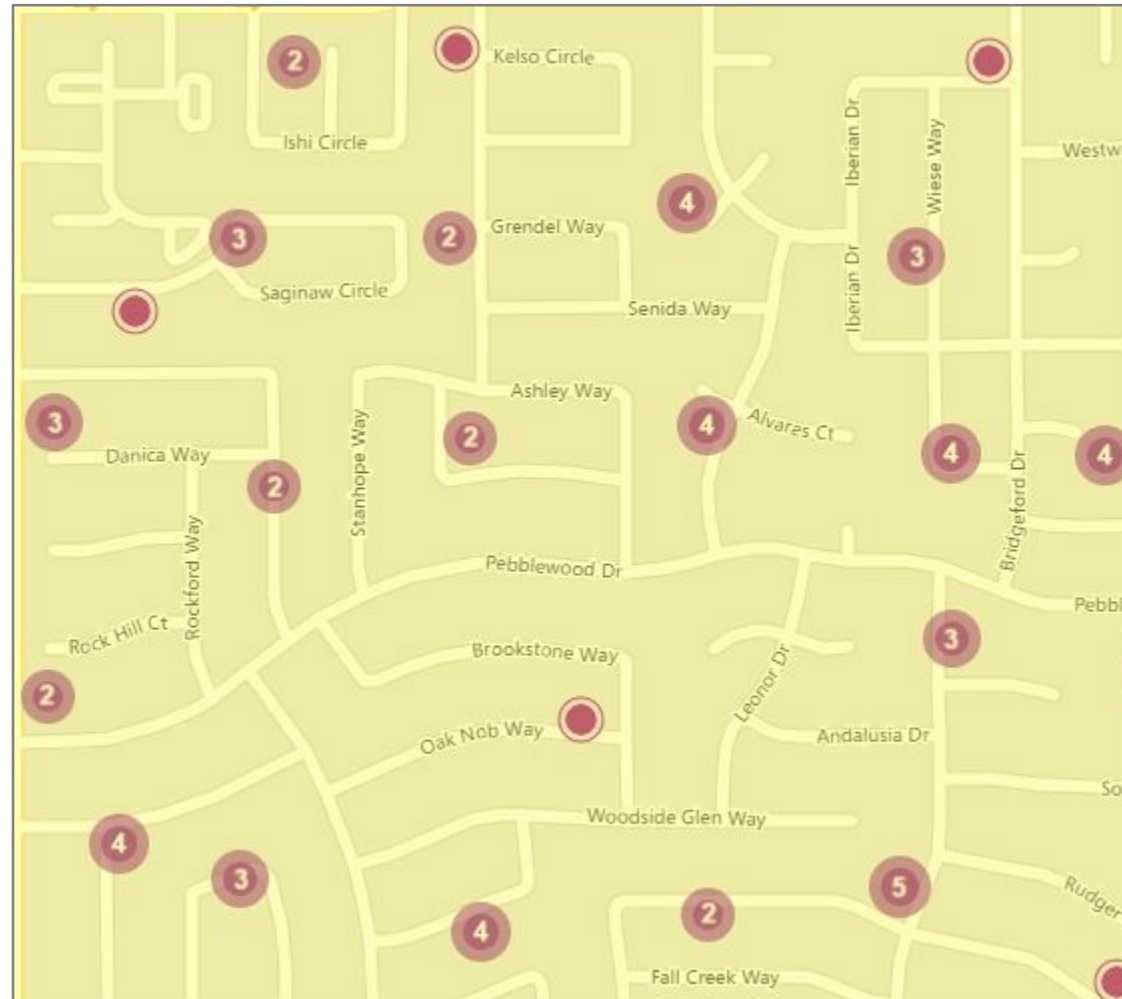
Consider Situation at Distribution Feeder Level



Source:

<https://www.google.com/maps/place/Sacramento,+CA/@38.6214829,-121.496456,15z>

There are Many PV Systems and One Irradiance Observation

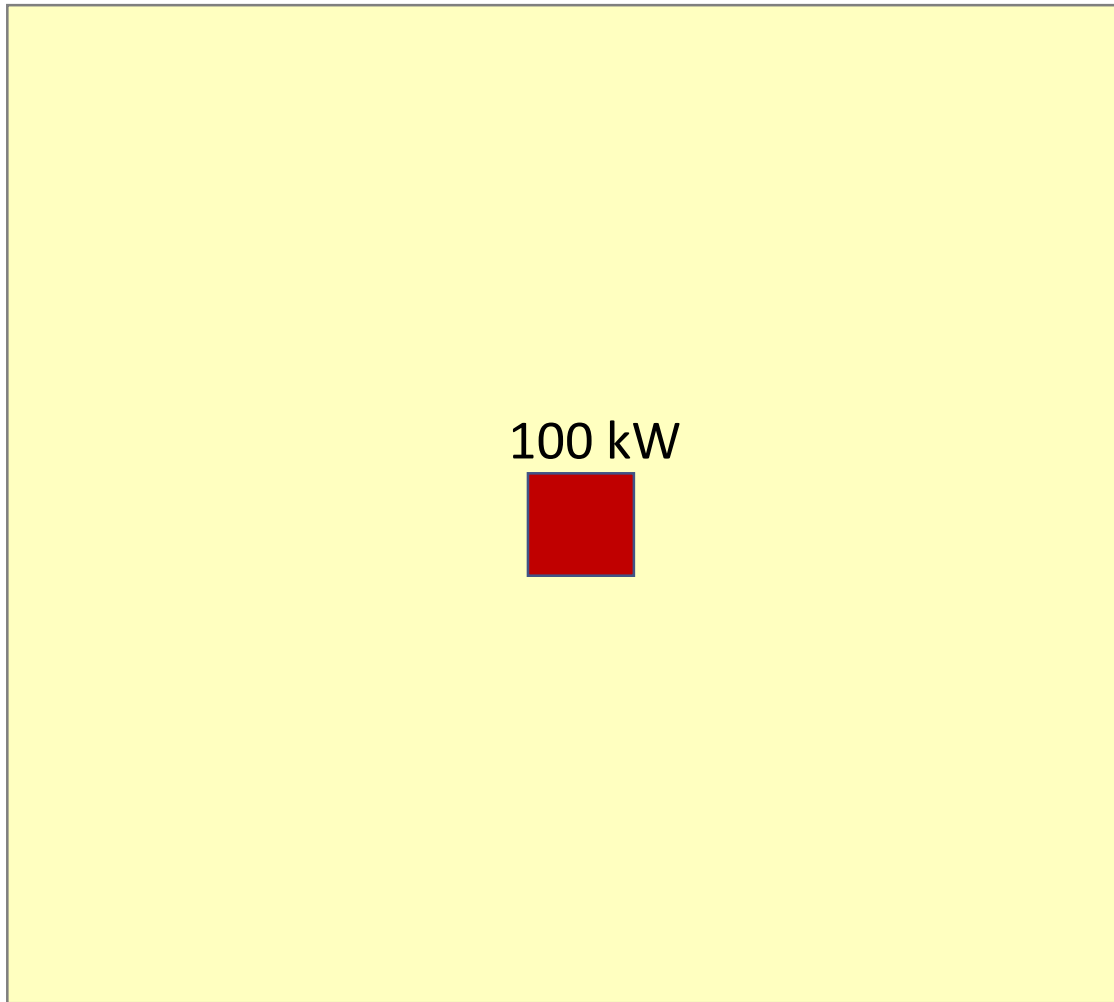


Circles represent number of PV systems on surrounding homes

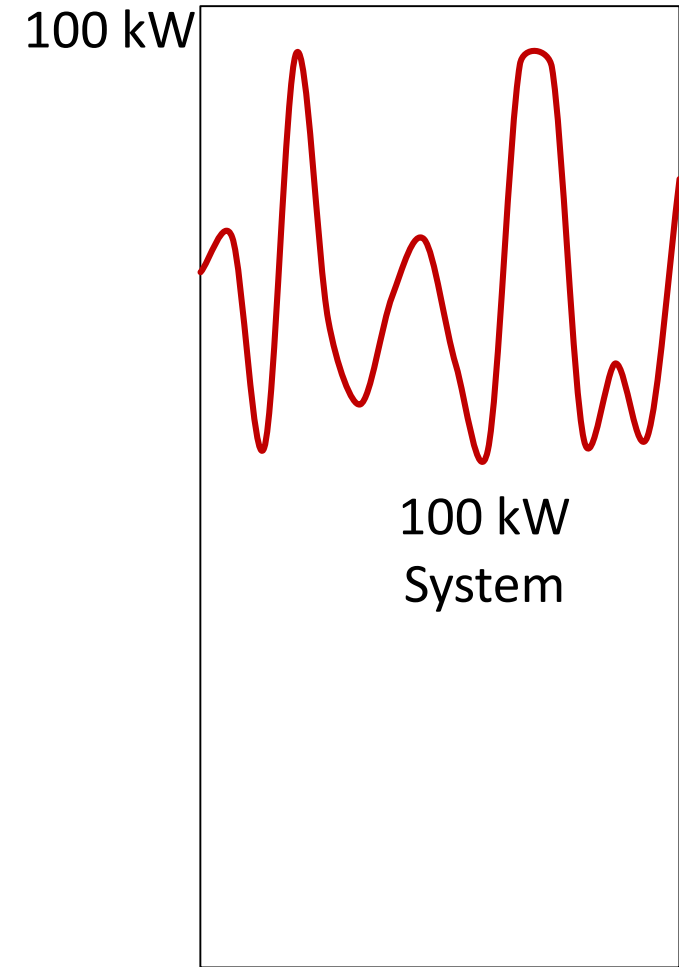
One - 1 km irradiance grid tile for 50+ PV systems

Source:
<https://smud.wattplan.com>

Output Variability is Higher for 1 - 100 kW System ...

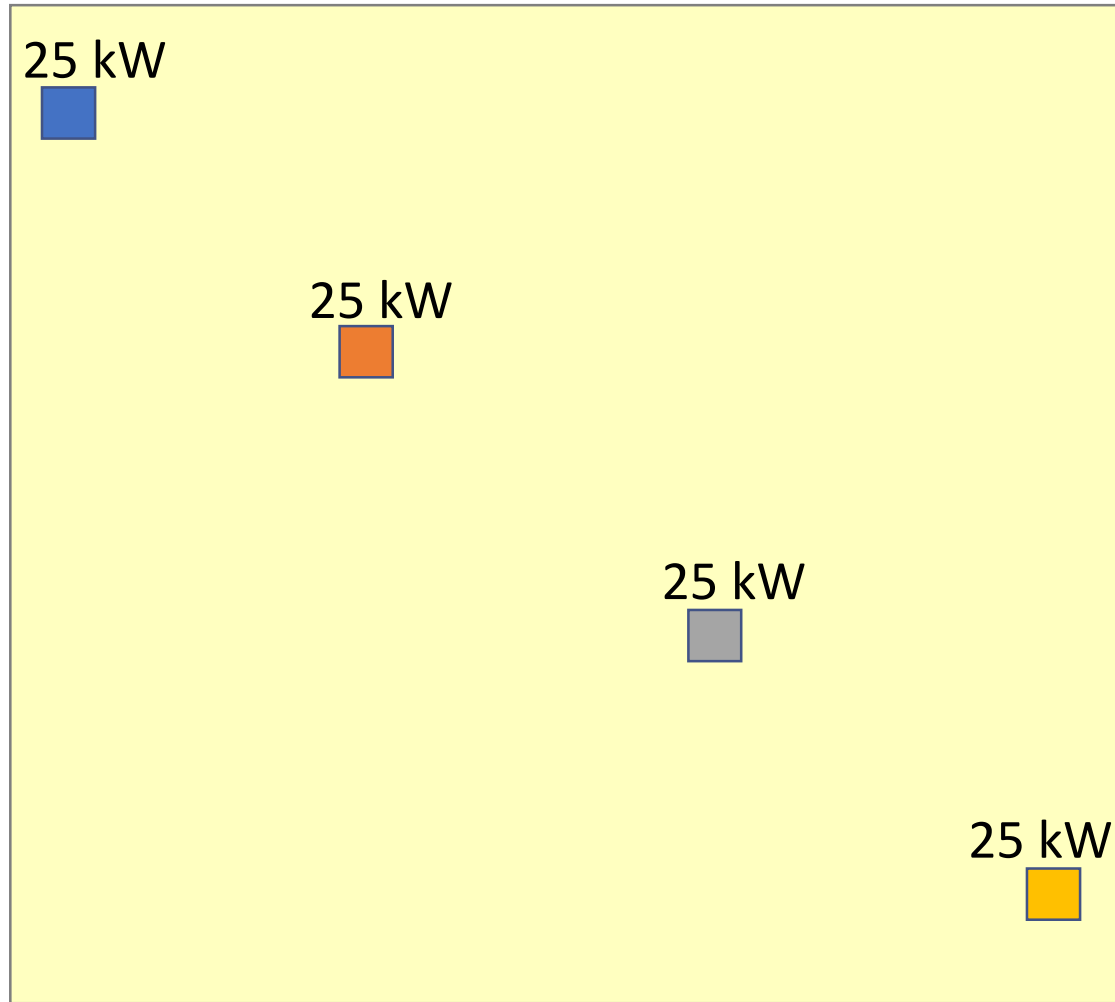


1 km Grid Tile

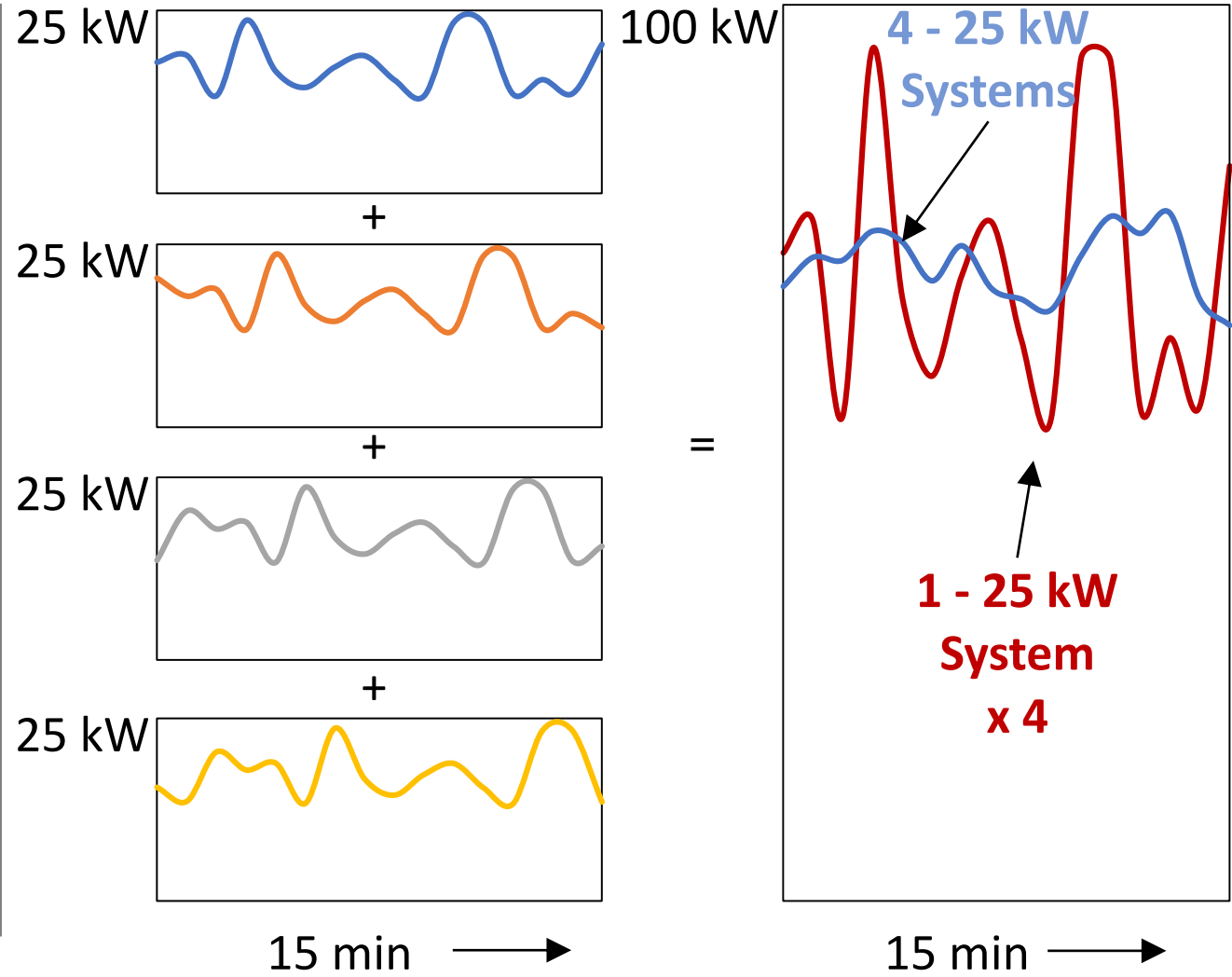


15 min →

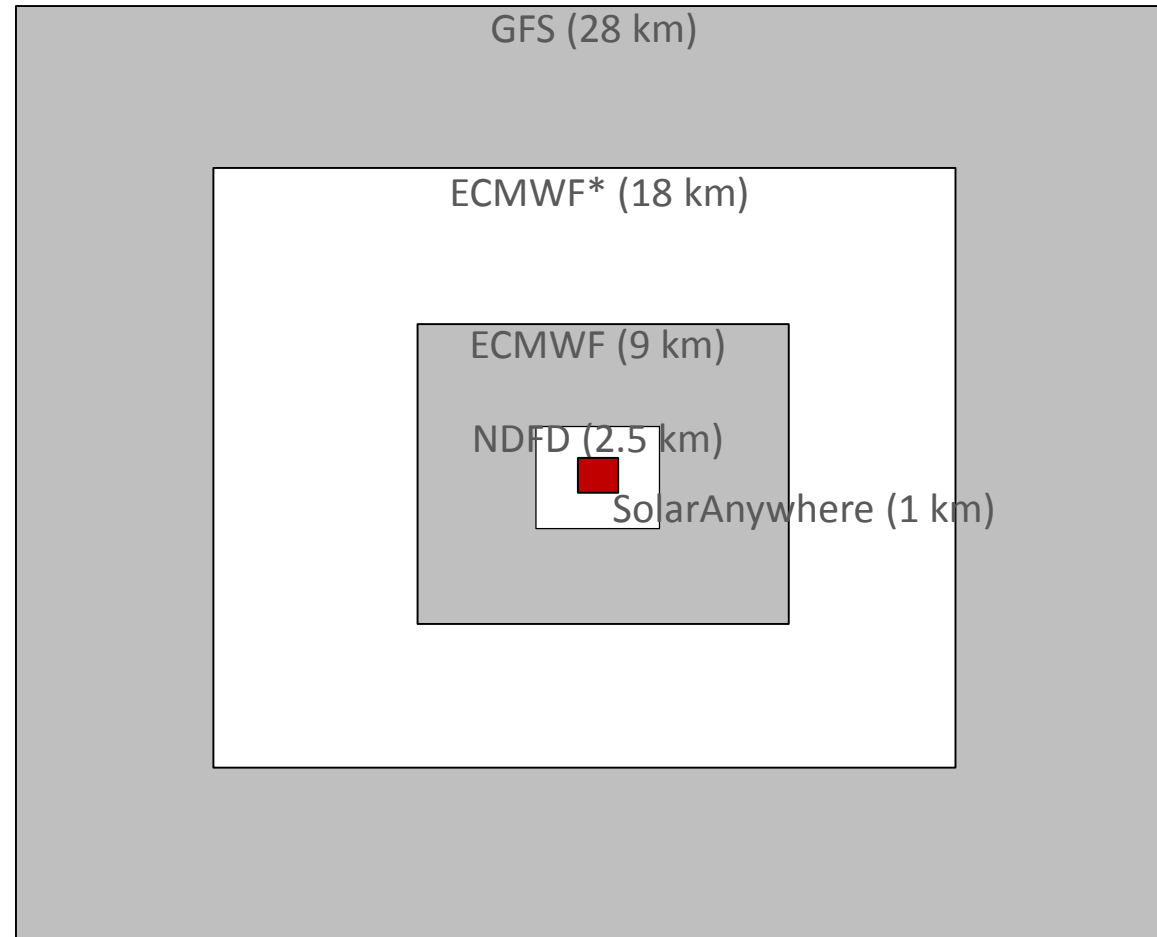
... than for 4 - 25 kW Systems



1 km Grid Tile



Irradiance Resolution is Not Only a Distribution Level Issue



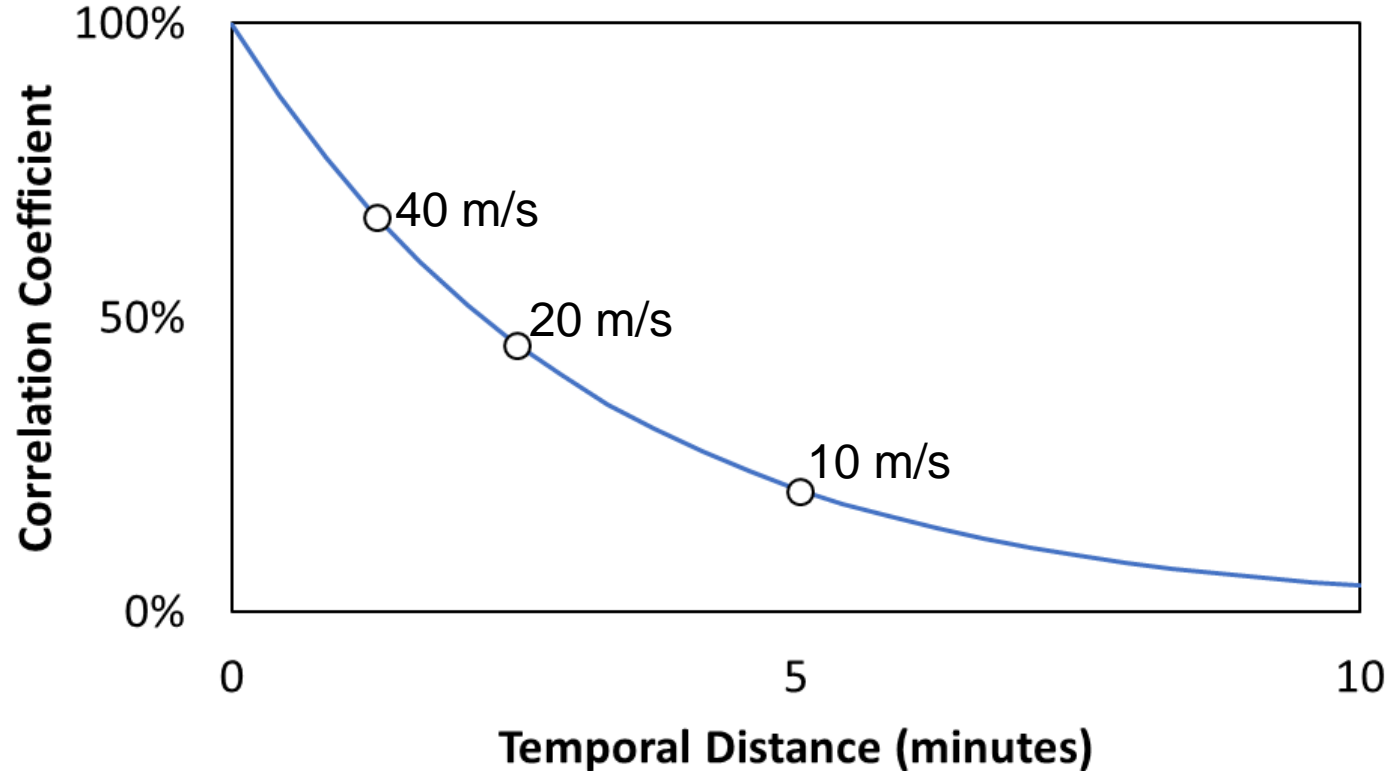
These are key data sources that commercial providers use

How to Address this Problem

- ✓ Divide forecast of PV systems into two parts:
 - Forecasted production under ideal "clear sky" conditions
 - Modulating effect of local sky/cloud conditions
- ✓ Calculate clear-sky fleet output based on:
 - Individual system ratings
 - Individual system sun position
- ✓ Calculate PV fleet correlation coefficient based on:
 - Distance between systems
 - Cloud speed
- ✓ Combine clear-sky fleet output and fleet correlation with effect of clouds
- ✓ Probabilistically simulate PV production

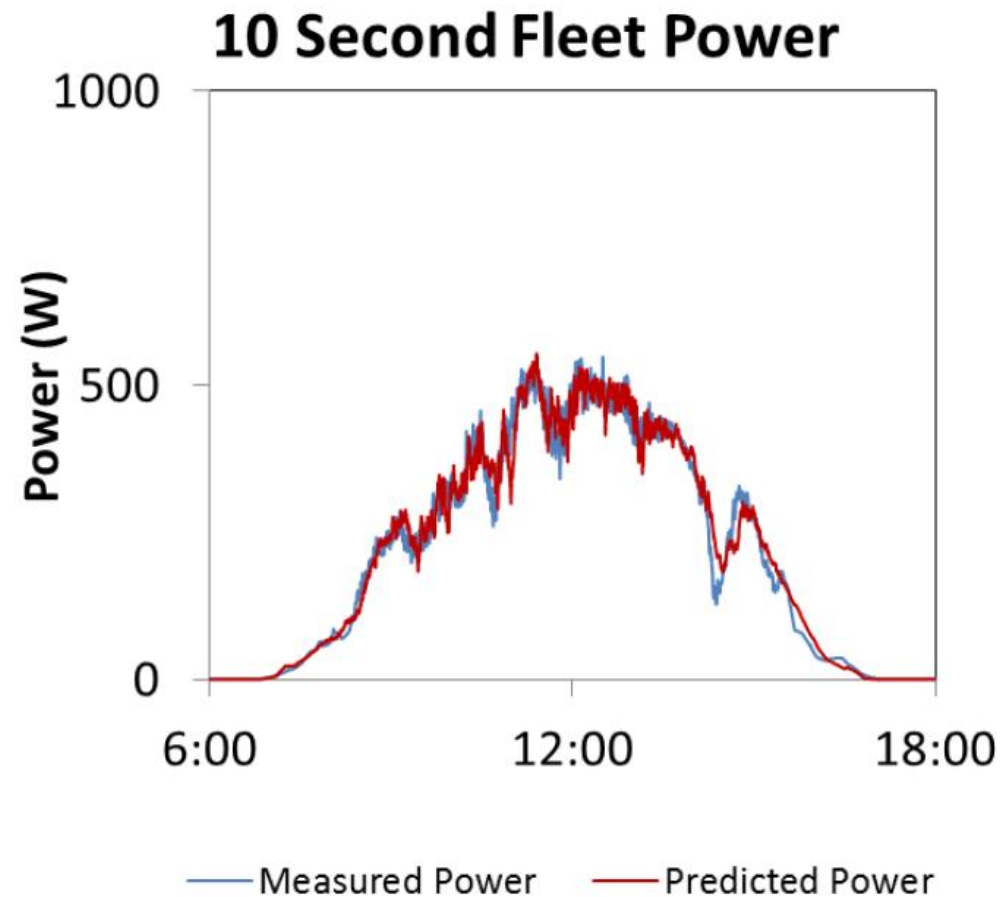
Output Correlation Between PV Systems is Predictable

PV systems are 3 km apart



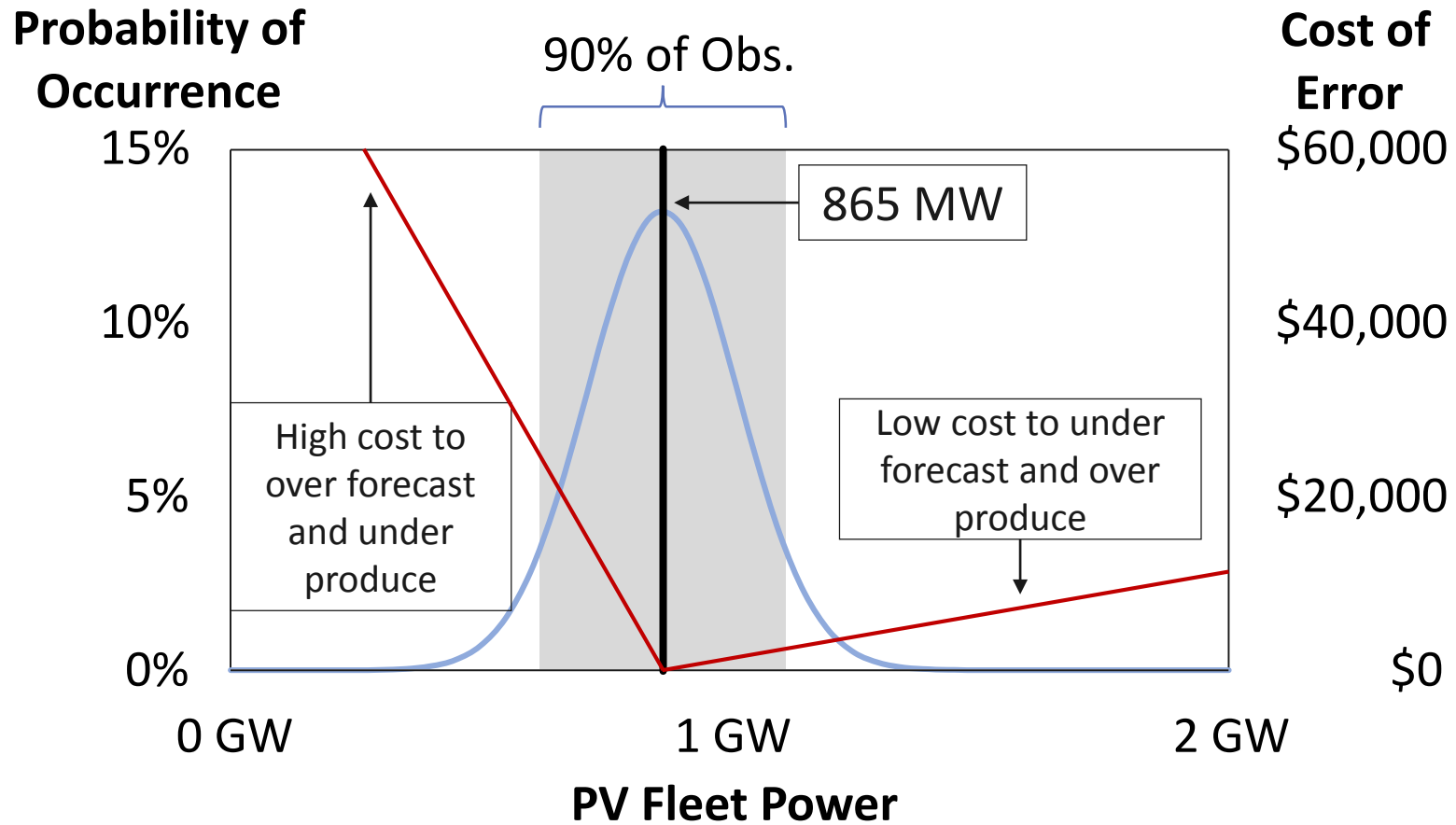
Temporal Distance @ 10 m/s
= (3,000 m) / (10 m/s) = 300 s

Probabilistically Simulate PV Fleet Power



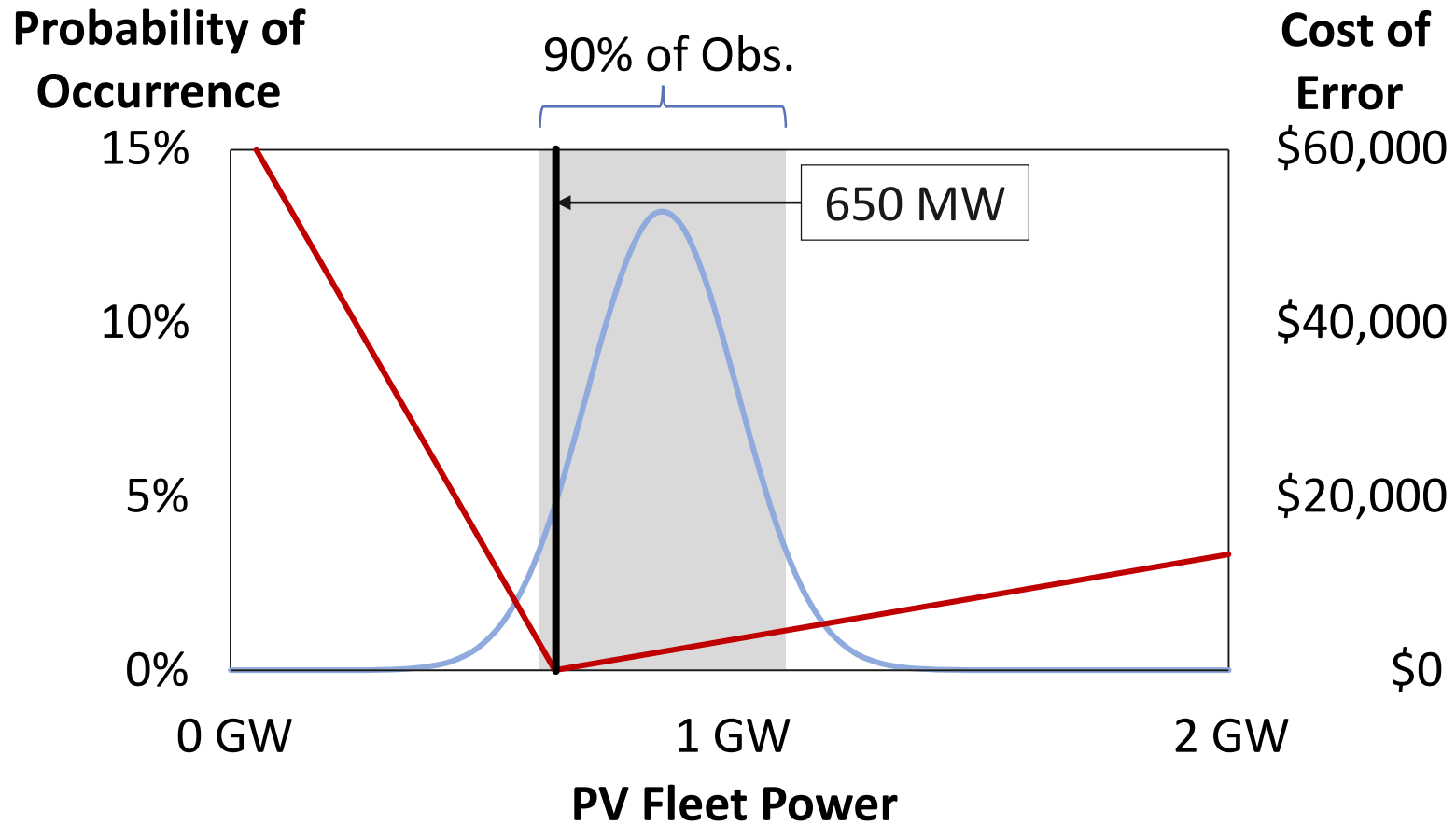
Expected Forecast for 1 hour

Expected Error Cost: \$6,600



Risk-Adjusted Forecast: Reduces Error Cost by 60%

Expected Error Cost: \$2,700



Conclusions

- PV fleet simulation introduces an issue that individual plant simulations do not encounter
- Fleet forecasts may reflect artificially high correlation (higher fleet variability) when plants share same solar resource data
- CPR has developed an approach that addresses this issue

Thank you



Connect via:

✉ tomhoff@cleanpower.com

