SunShot
U.S. Department of Energy

Enabling 100s GW of Solar

@SunShot Solar Forecasting Workshop

energy.gov/sunshot

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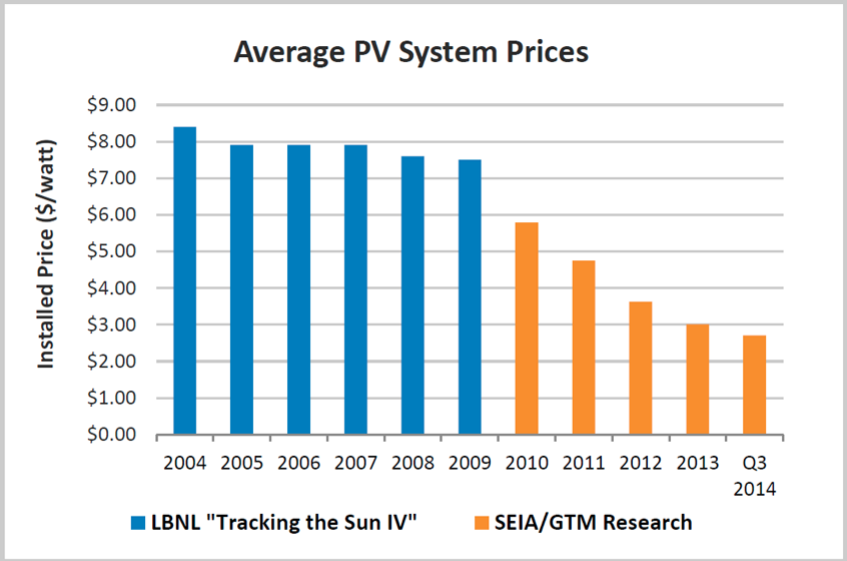
Growth of Solar in the U.S.

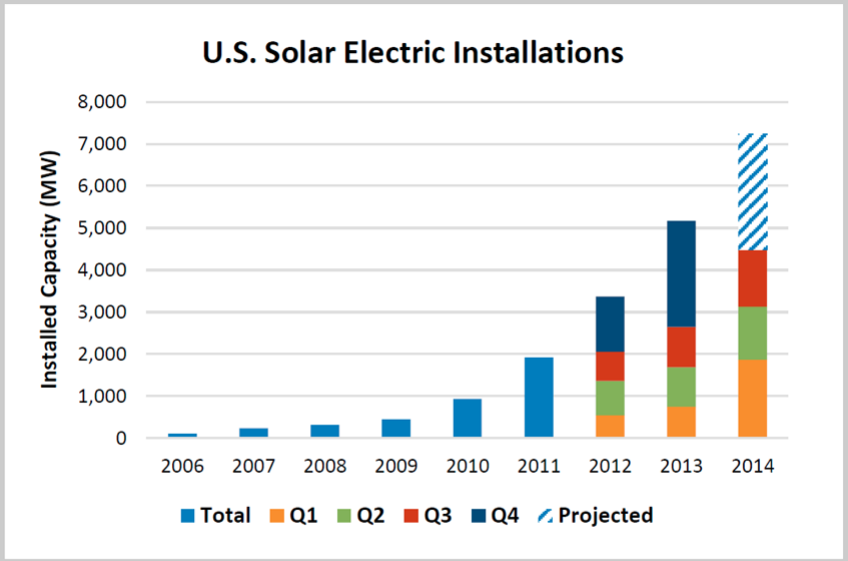
Installed cost of solar system rapidly decreasing

(> 60% drop since 2010)



Installed solar generation capacity rapid increasing

(>29 GW cumulative PV in H1 2016)
(> 1,000,000 PV systems installed)



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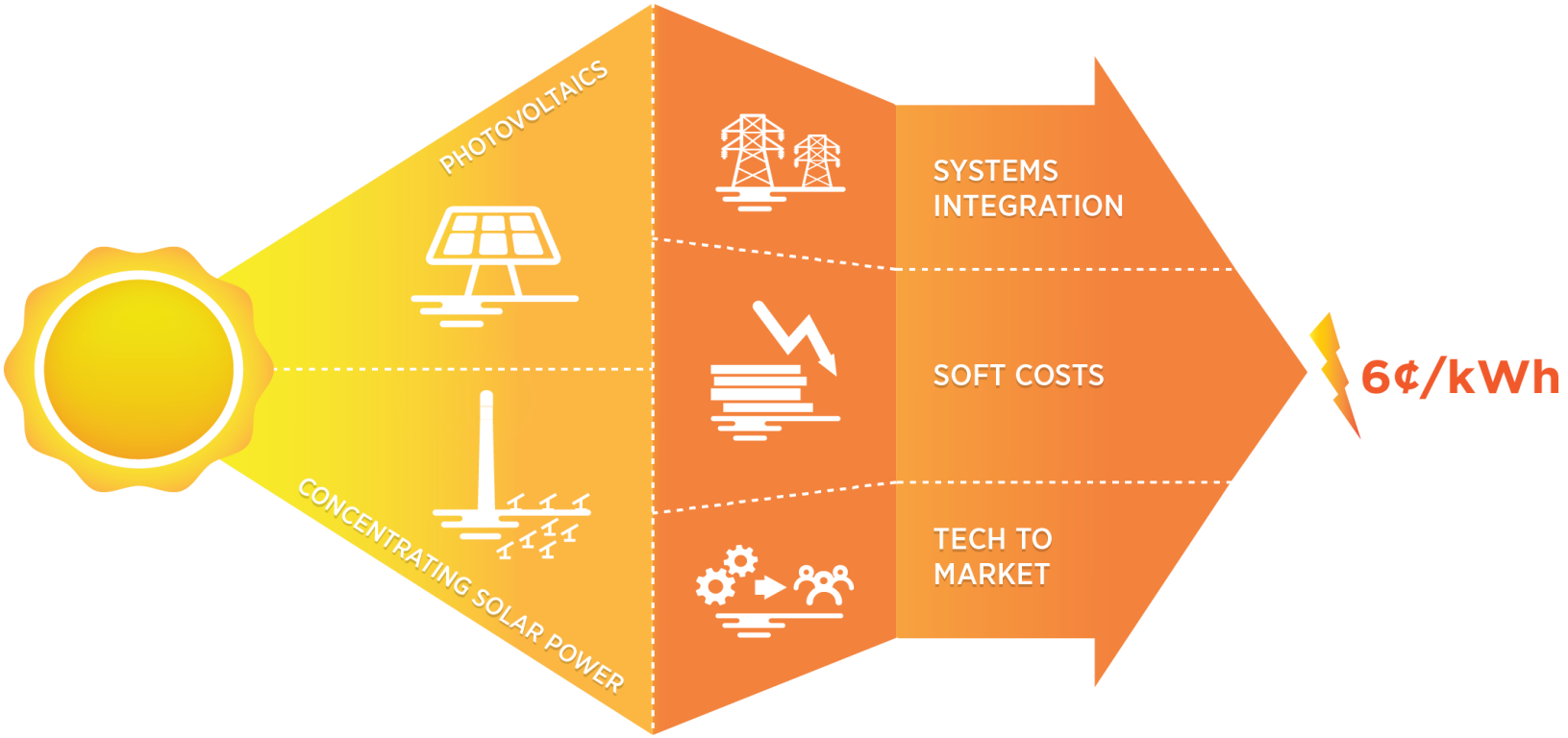
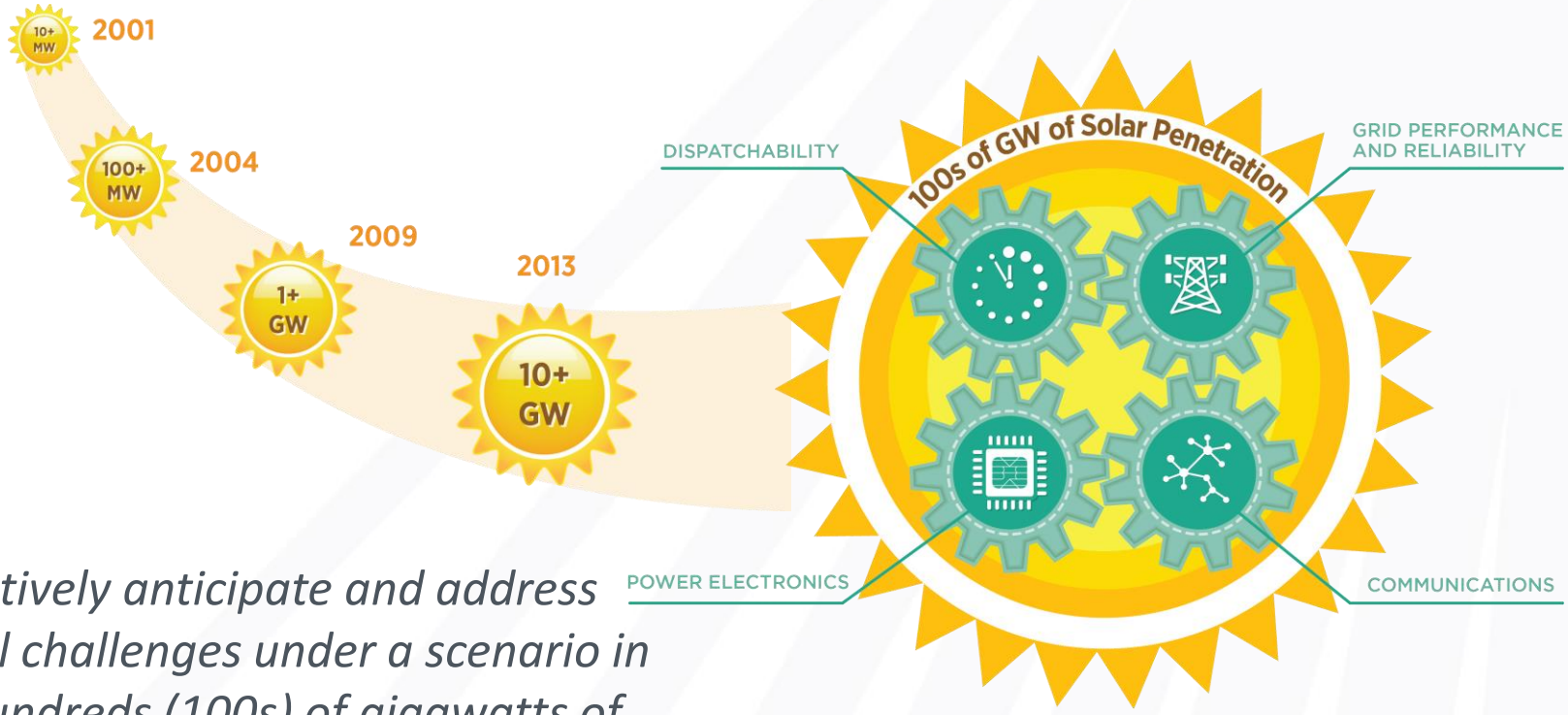
SunShot Initiative



SunShot Systems Integration Vision



To proactively anticipate and address potential challenges under a scenario in which hundreds (100s) of gigawatts of solar energy are interconnected to the electricity grid, the SI sub-program has identified the challenges to be addressed in four broad, inter-related areas:

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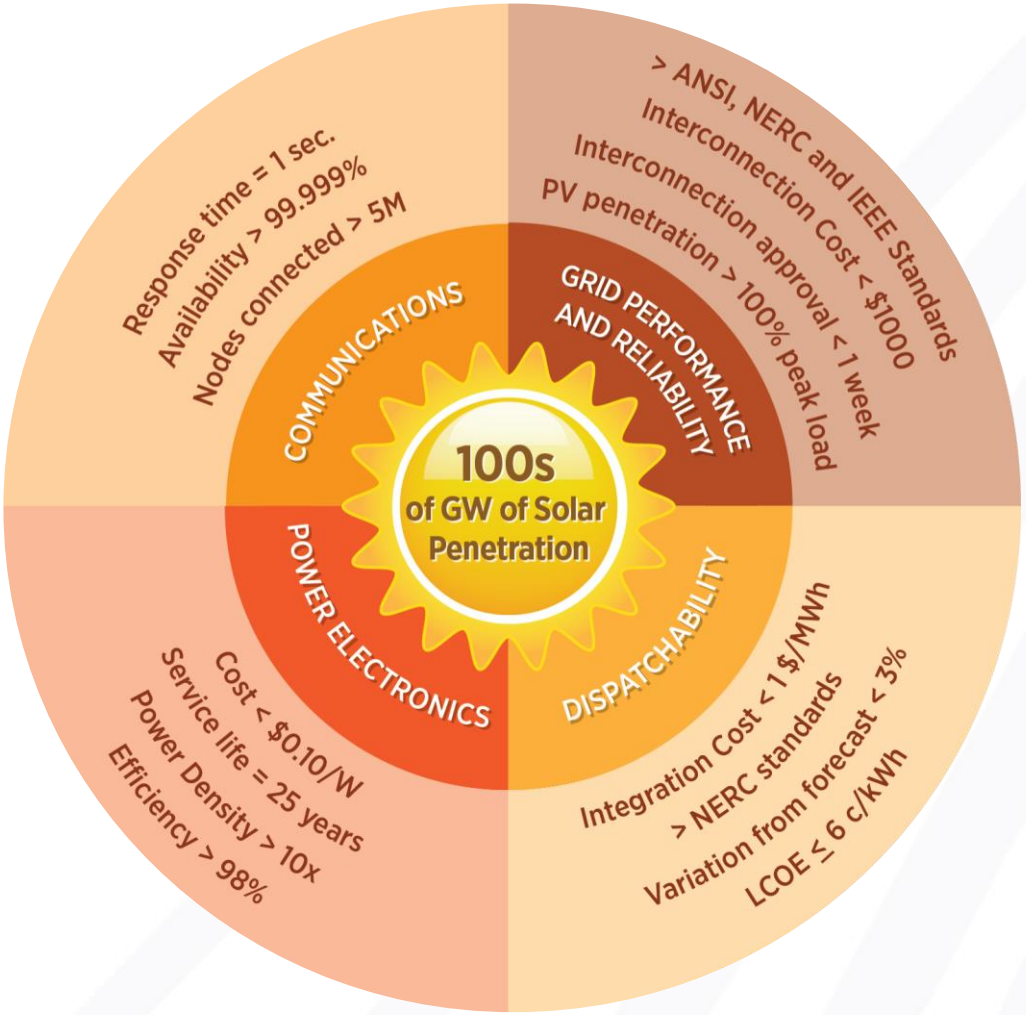
SunShot Systems Integration



ENERGISE* (2016)

SuNLaMP (2015)

SHINES (2015)

SUNRISE (2013)

National Lab R&D (2012)

Hi-Pen (2012)

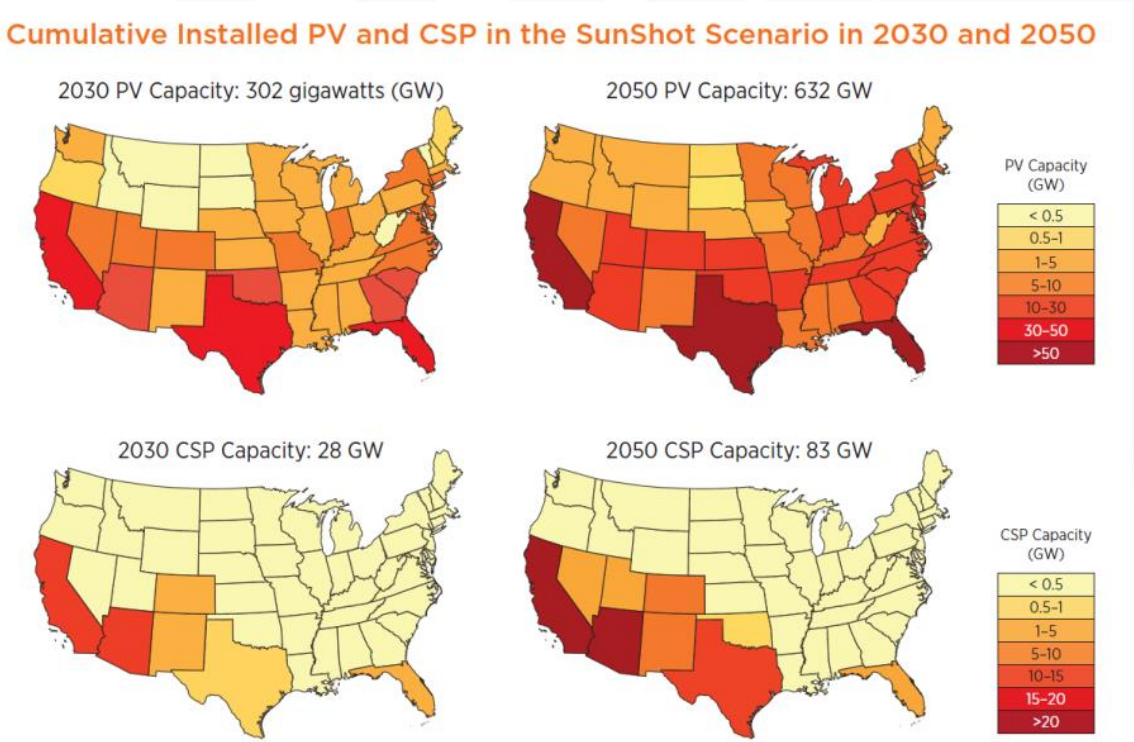
Plug and Play (2012)

Solar Forecasting (2012)

SEGIS-AC (2011)

Solar Integration Studies

- SunShot Vision Study (2012)
- Hawaii Solar Integration Study (2012)
- Western Wind Solar Integration Study (WWSIS, 2014)
- Eastern Renewable Generation Integration Study (ERGIS, 2016)



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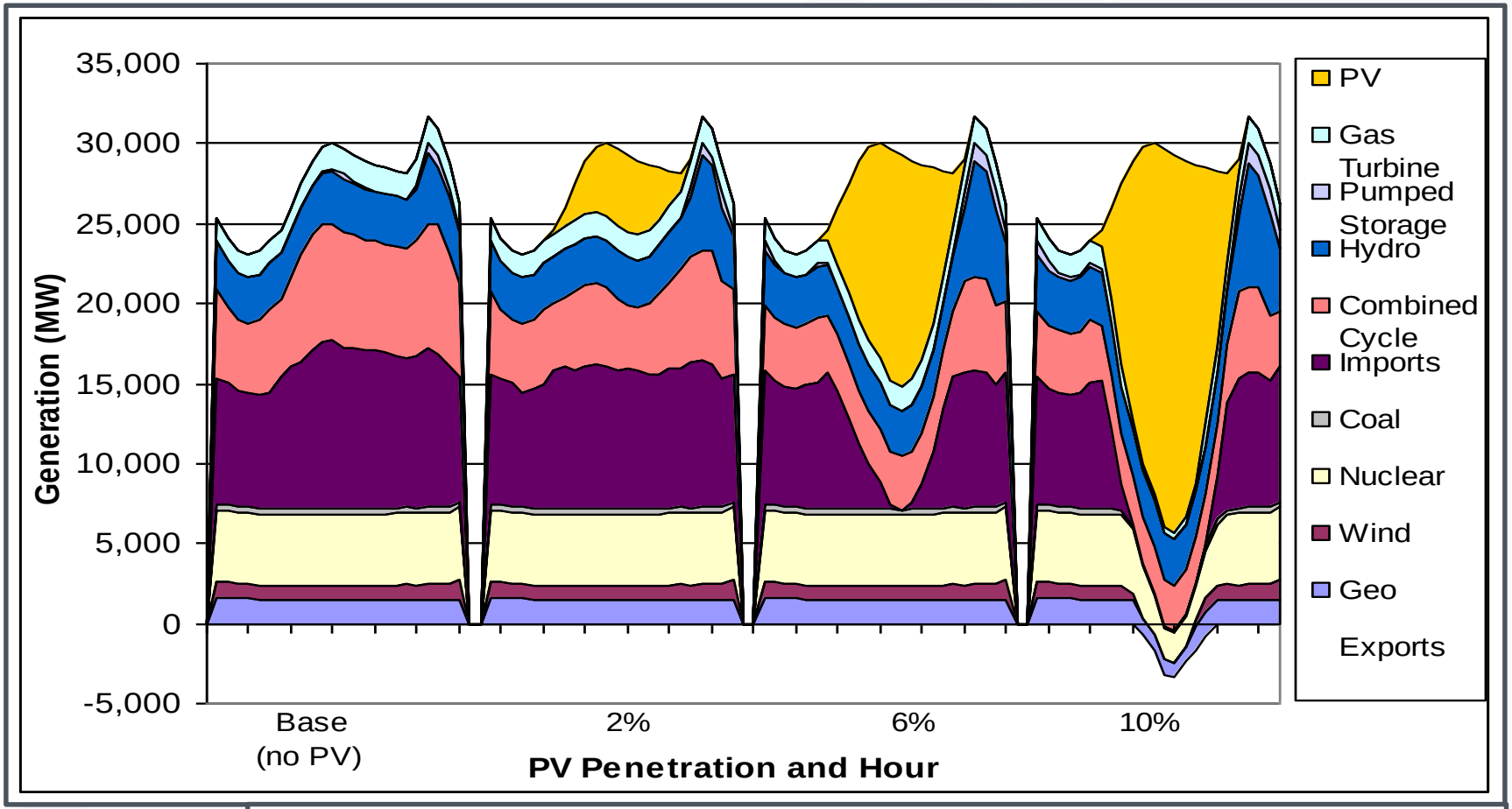
Impact to Generation Dispatch

How to enable dispatch of solar power plants in a fashion that is **economical and reliable**? Comparable to or better than conventional power plants?



Denholm et al. (2011). Simulated Dispatch in California for a Spring Day with PV Penetration from 0-10% by energy on annual basis

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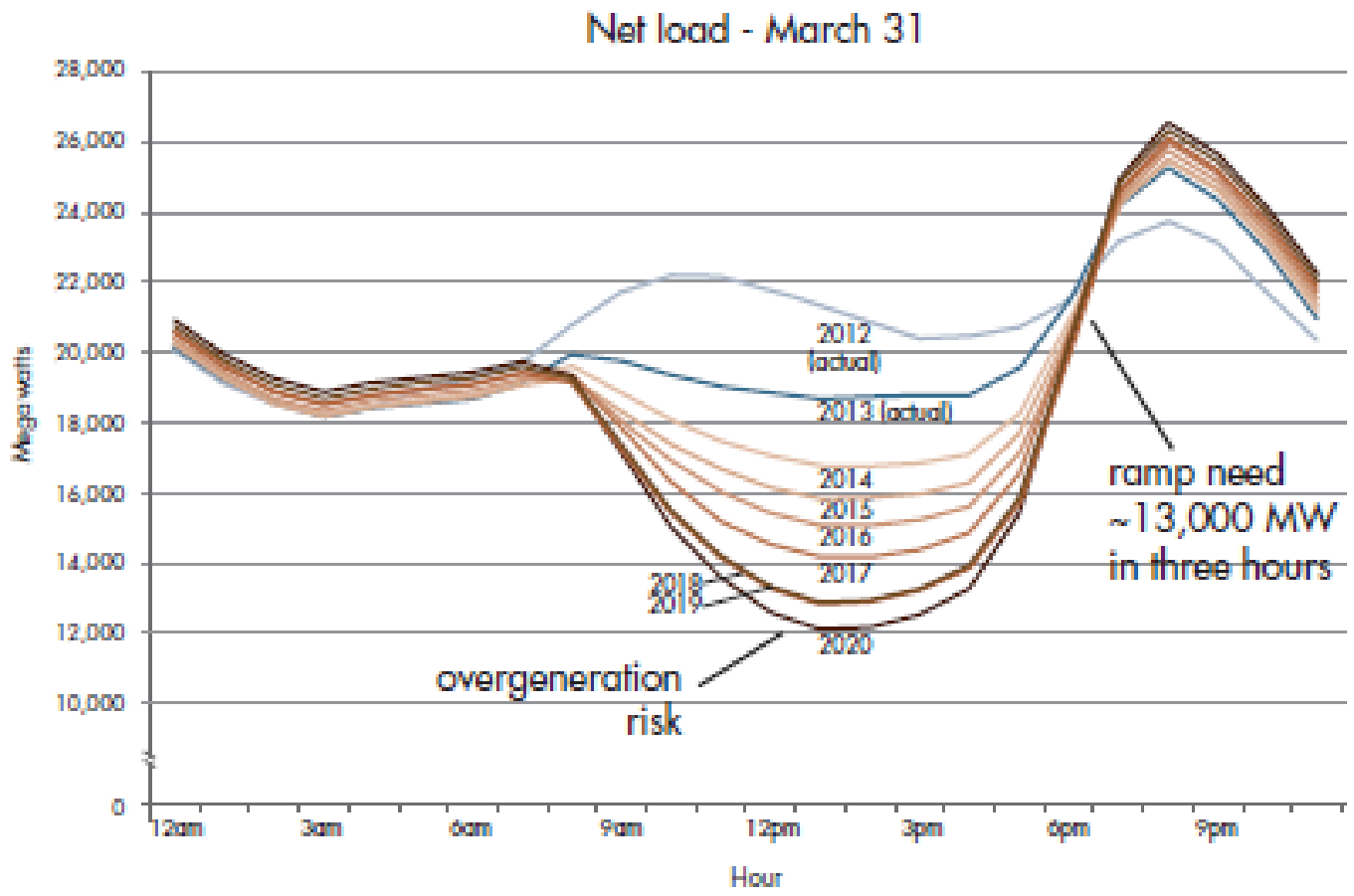
Variability of Solar and Net Load (1)



CAISO “Duck Curve”

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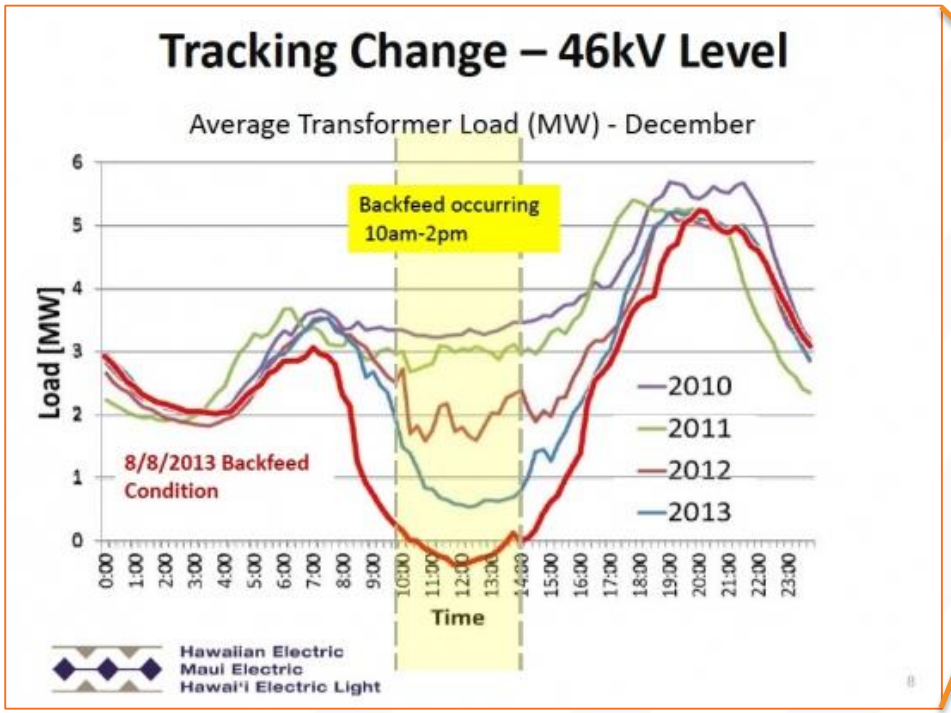
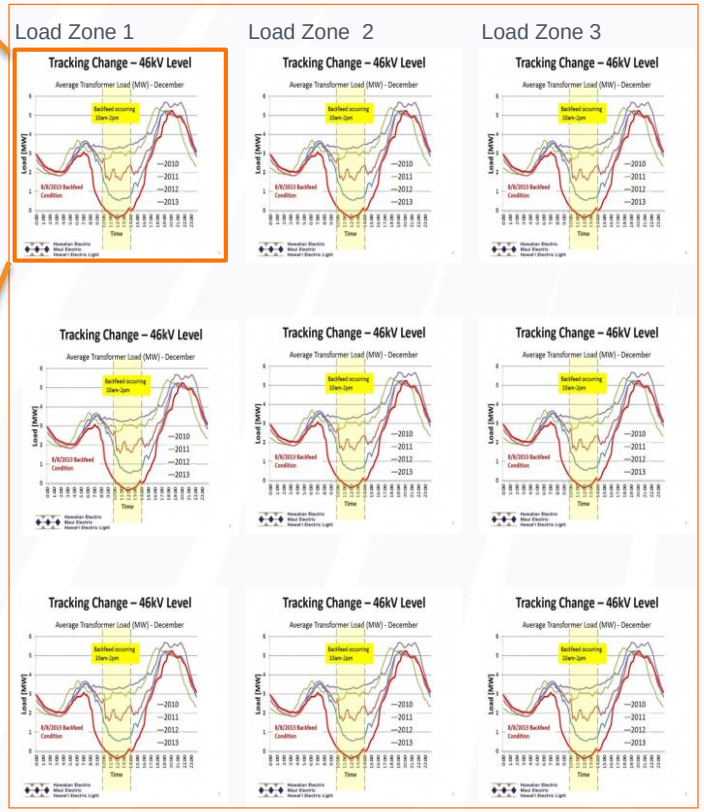
Variability of Solar and Net Load (2)



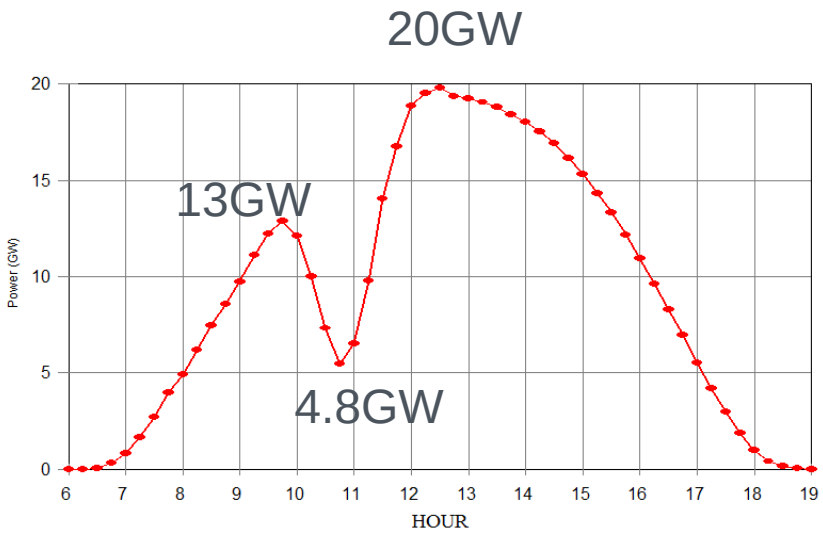
HECO “Nessie Curve”

Regional Supply and Demand Balances



Solar Eclipse – March 20,2015

(Photo credit cloudfront.net)



(Graph by Roger Andrews)

Electrical grids in Europe succeeded in keeping the lights on!!

Germany – call on extra reserves; Italy – turned off all large scale (>100kW) PV plants. However, it illustrates the big challenges ahead in grid operation with high penetration of solar.

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Solar Forecasting Past, Present, and Future