

Challenges Integrating Solar Generation to the Electric Grid

THE COAL INSTITUTE
EDUCATION & ENGINEERING SEMINAR
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South Carolina Electric & Gas (SCE&G)

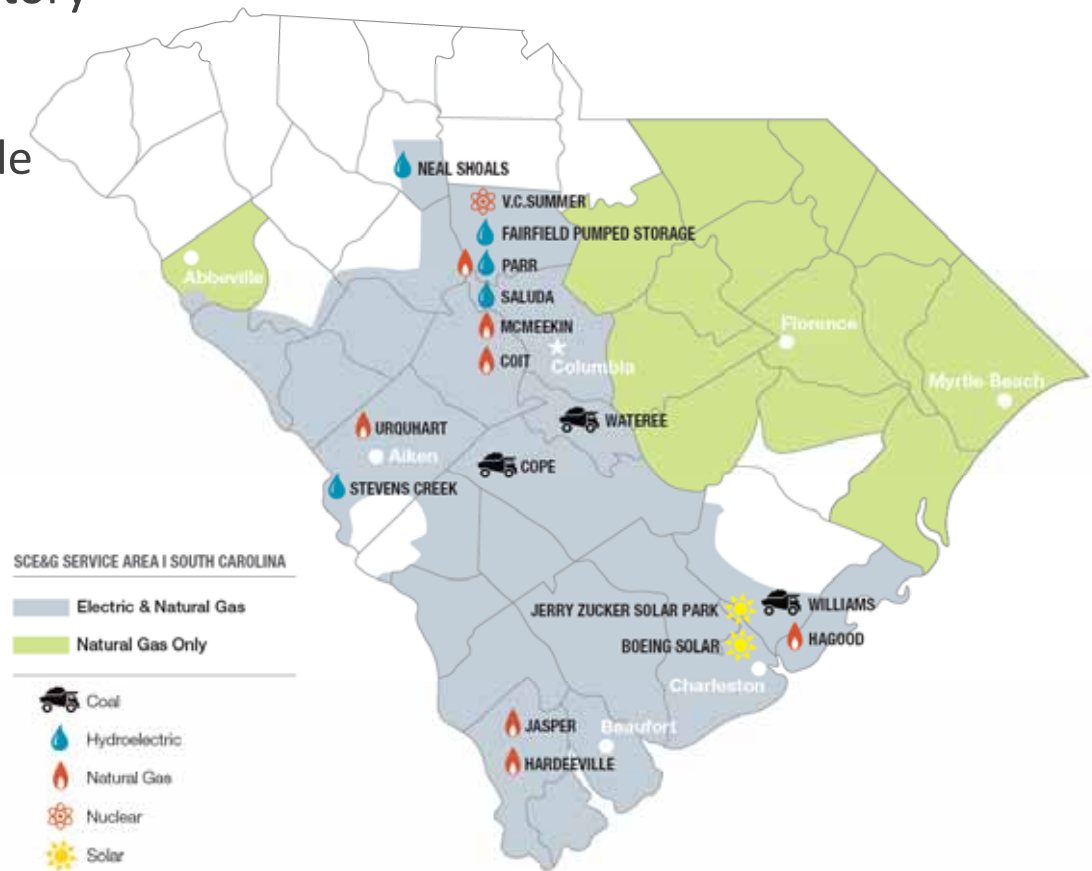
Over 22,000 Square Miles of Territory
Spanning 35 counties

706,000 electric retail and wholesale
customers

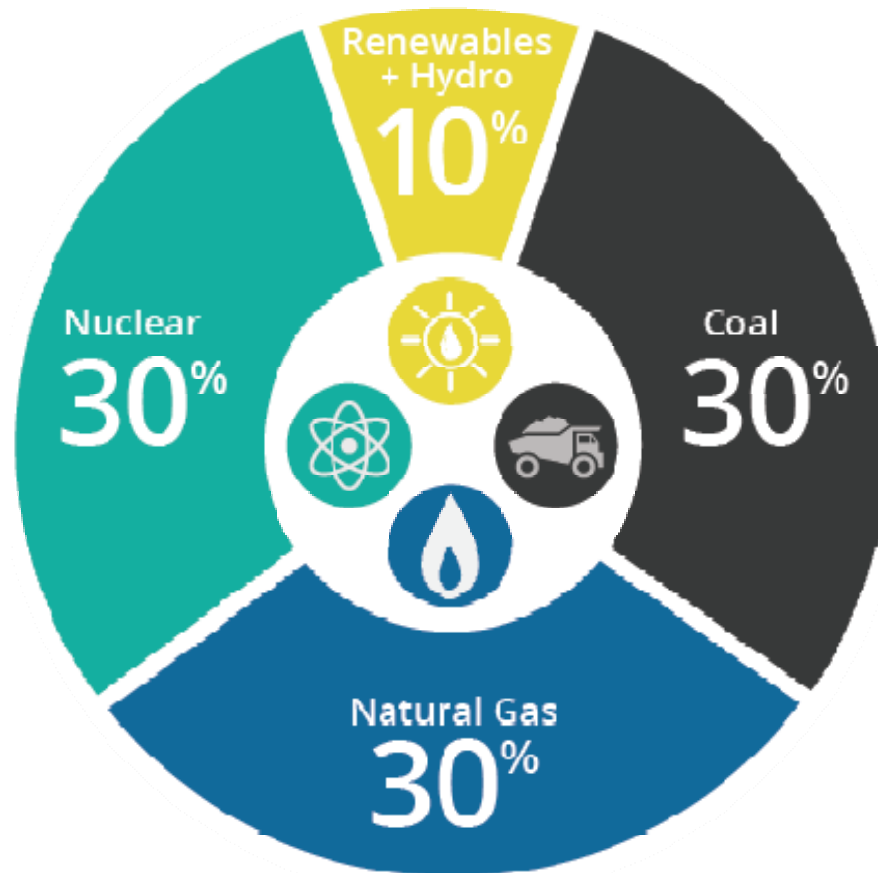
352,000 natural gas customers

18 generation plants

- 1 nuclear (+2 in 2019, 2020)
- 3 fossil fuel (coal)
- 5 hydroelectric
- 7 natural gas
- 2 solar farms (+8 in 2016)



Balanced Energy Portfolio



Overview

Balancing Supply and Demand

Power Quality

Queueing and the Interconnection Process

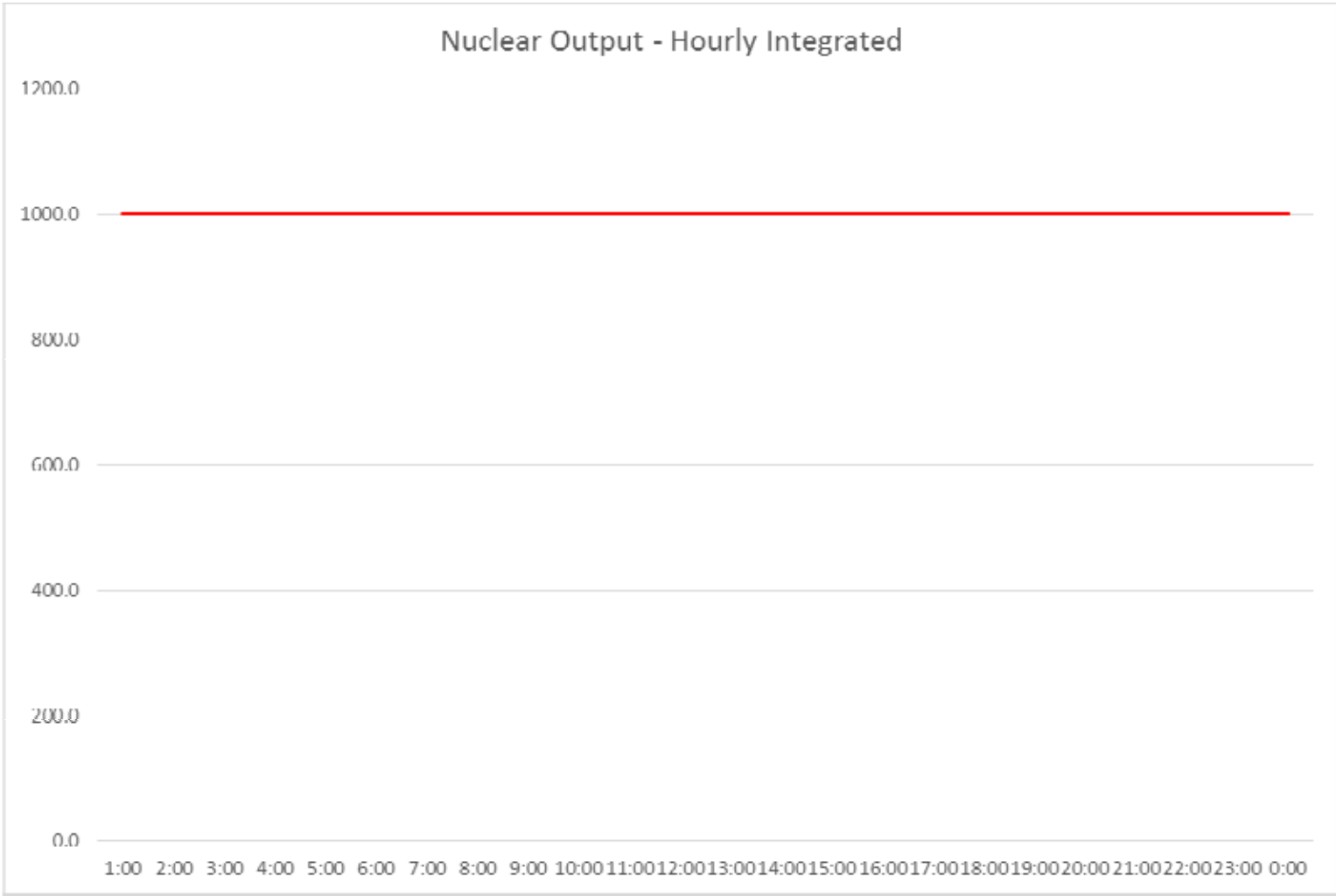
Balancing Supply and Demand

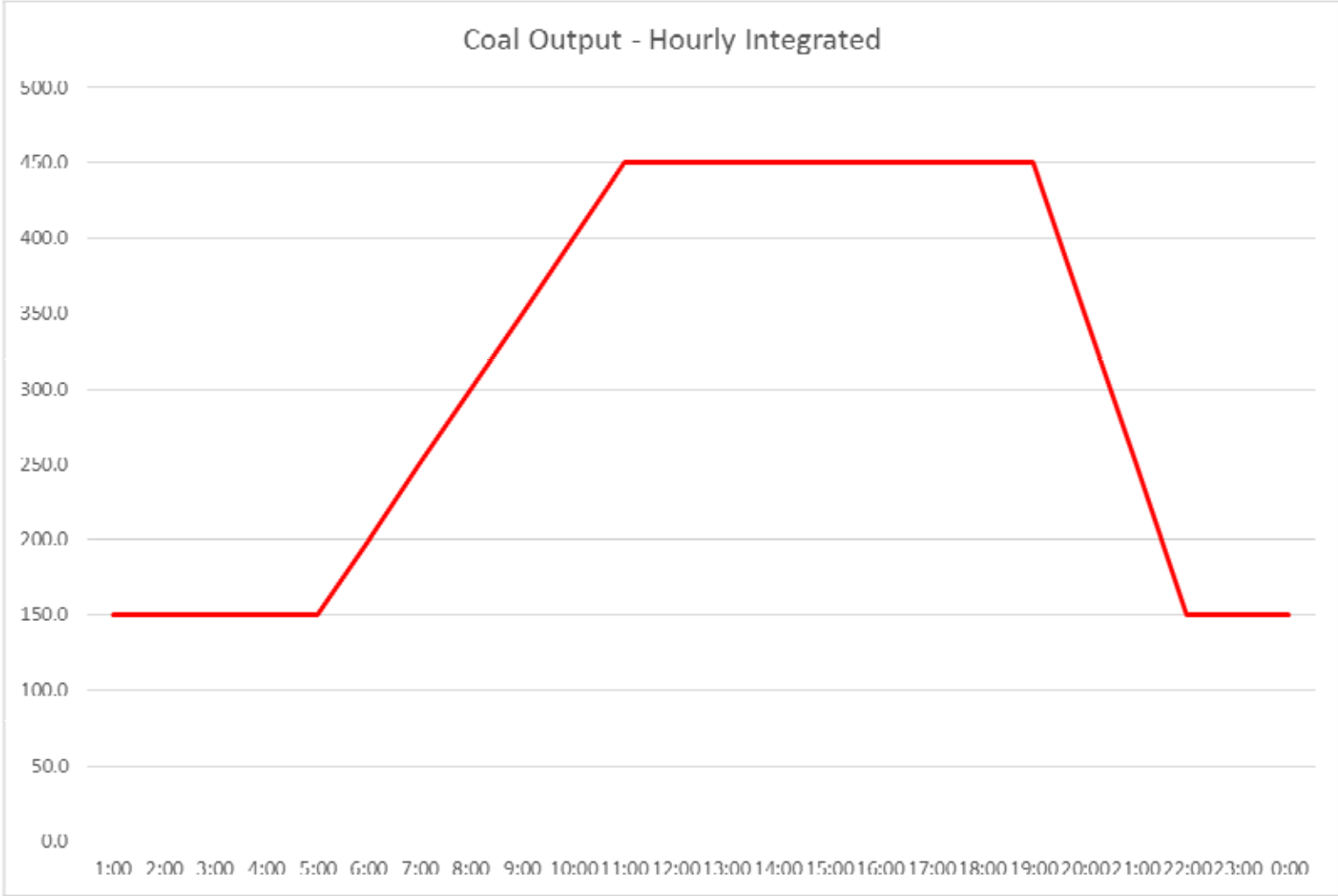
SCE&G plans its system in several time horizons

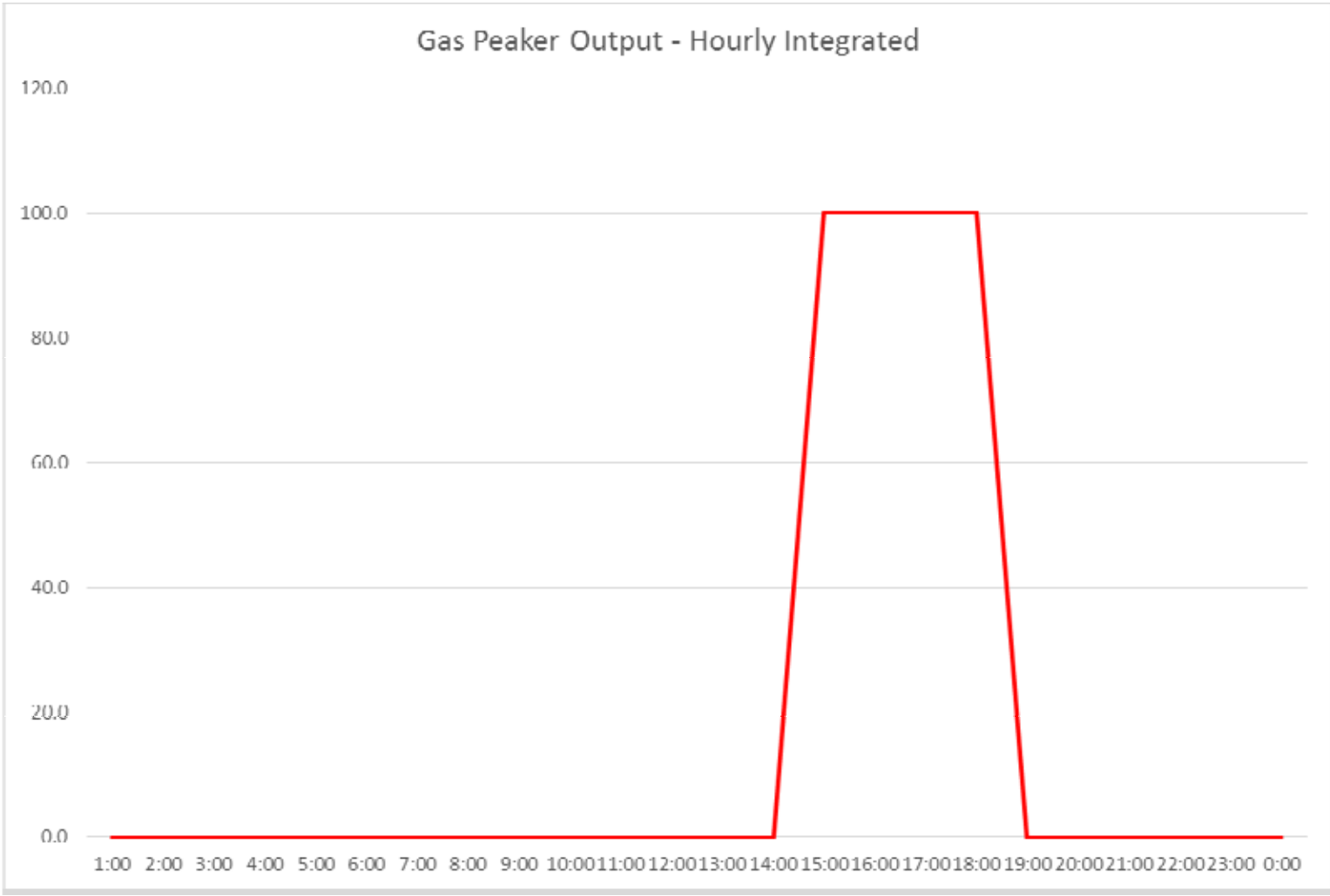
- Long Term – A year or two out to many years
- Mid Term – Seasonal for the next few seasons
- Short Term – Weekly to monthly
- Intra Day – Planning for today and tomorrow
- Instantaneous and Hourly – Reacting to operational issues

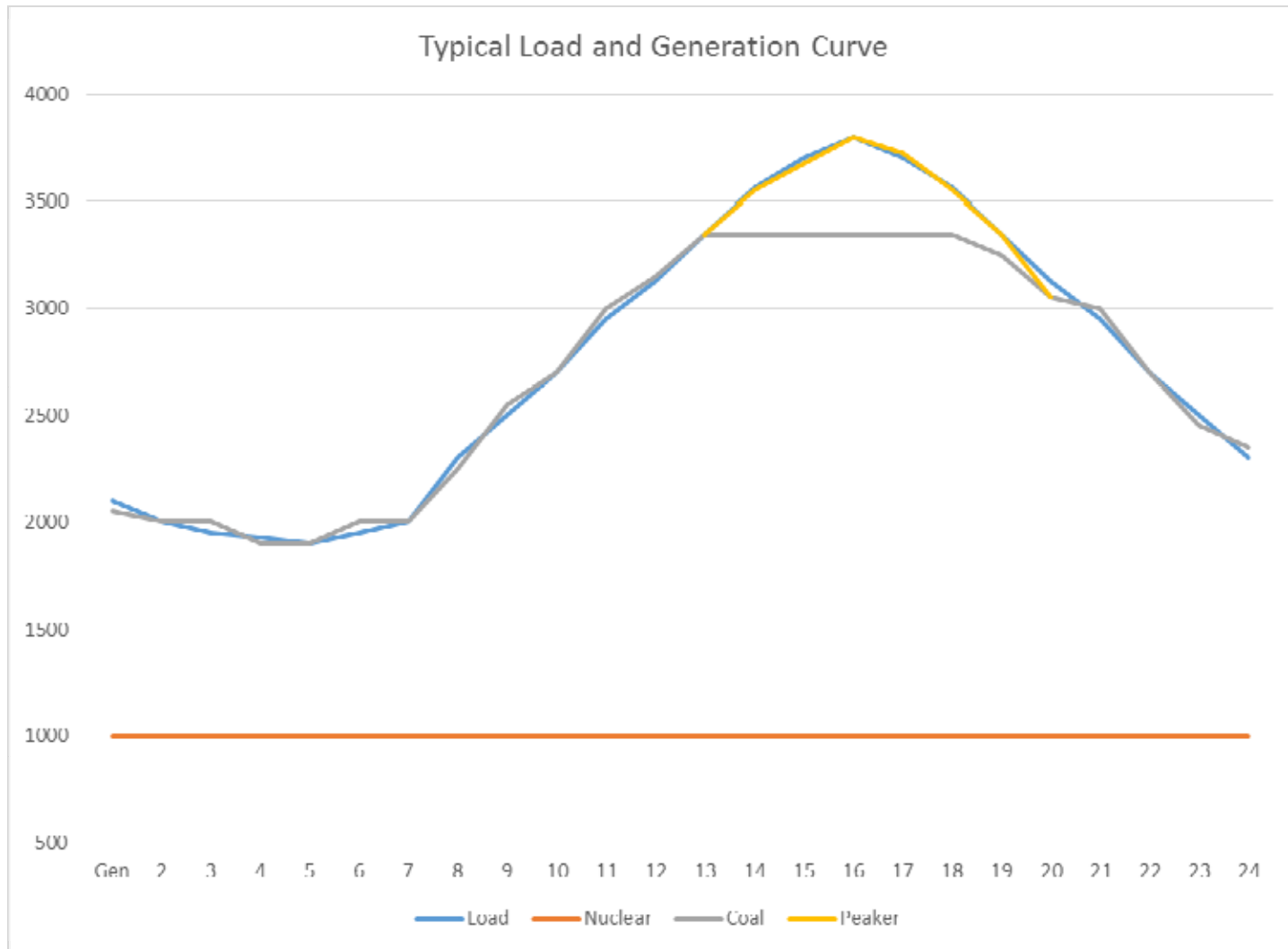
As a Balancing Authority, SCE&G must balance electric supply and demand on a real-time basis, approximately every 6 seconds.

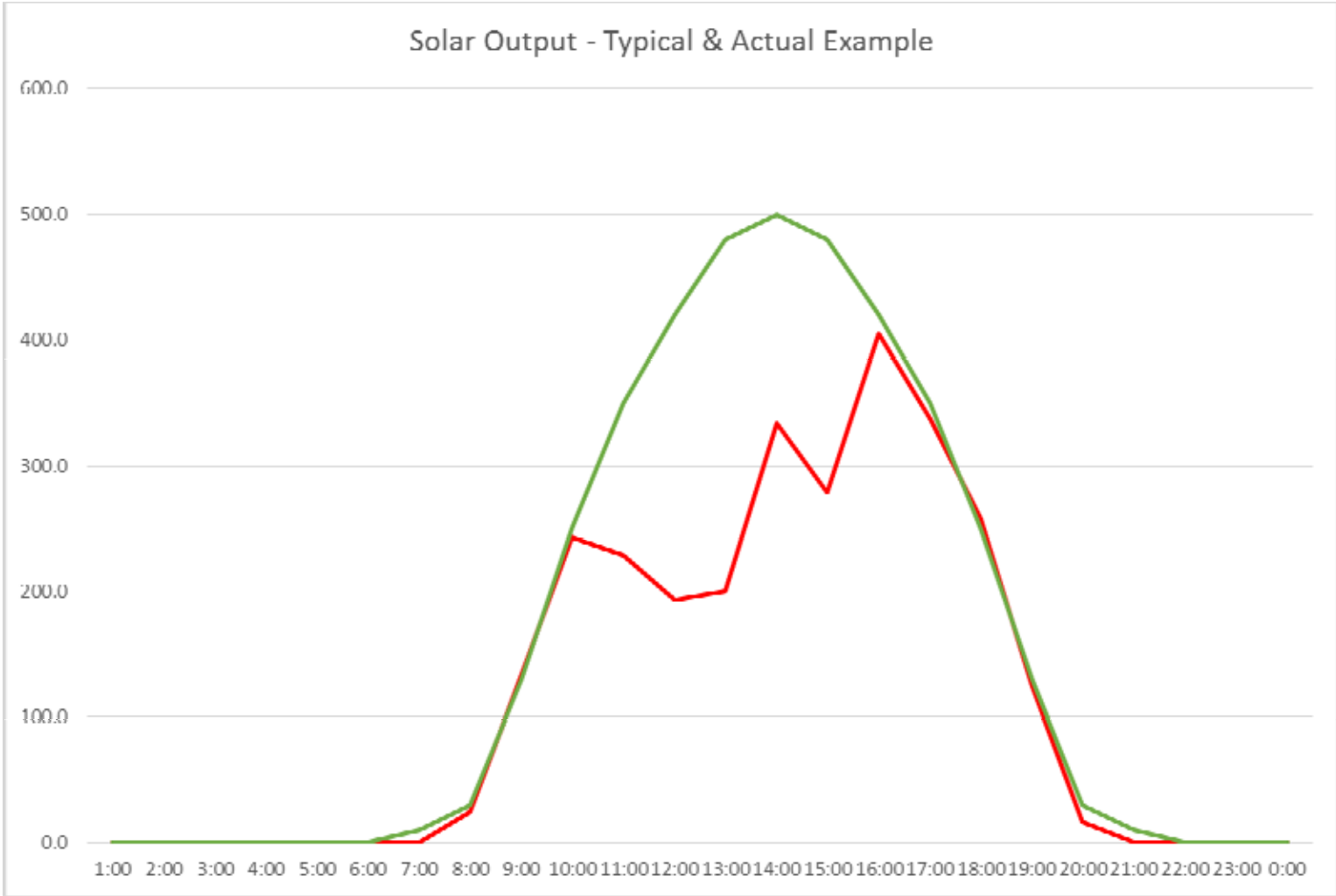
We have a predefined band we can operate within known as ACE – Area Control Error. Deviations outside of the ACE require action and can lead to problems like fines.



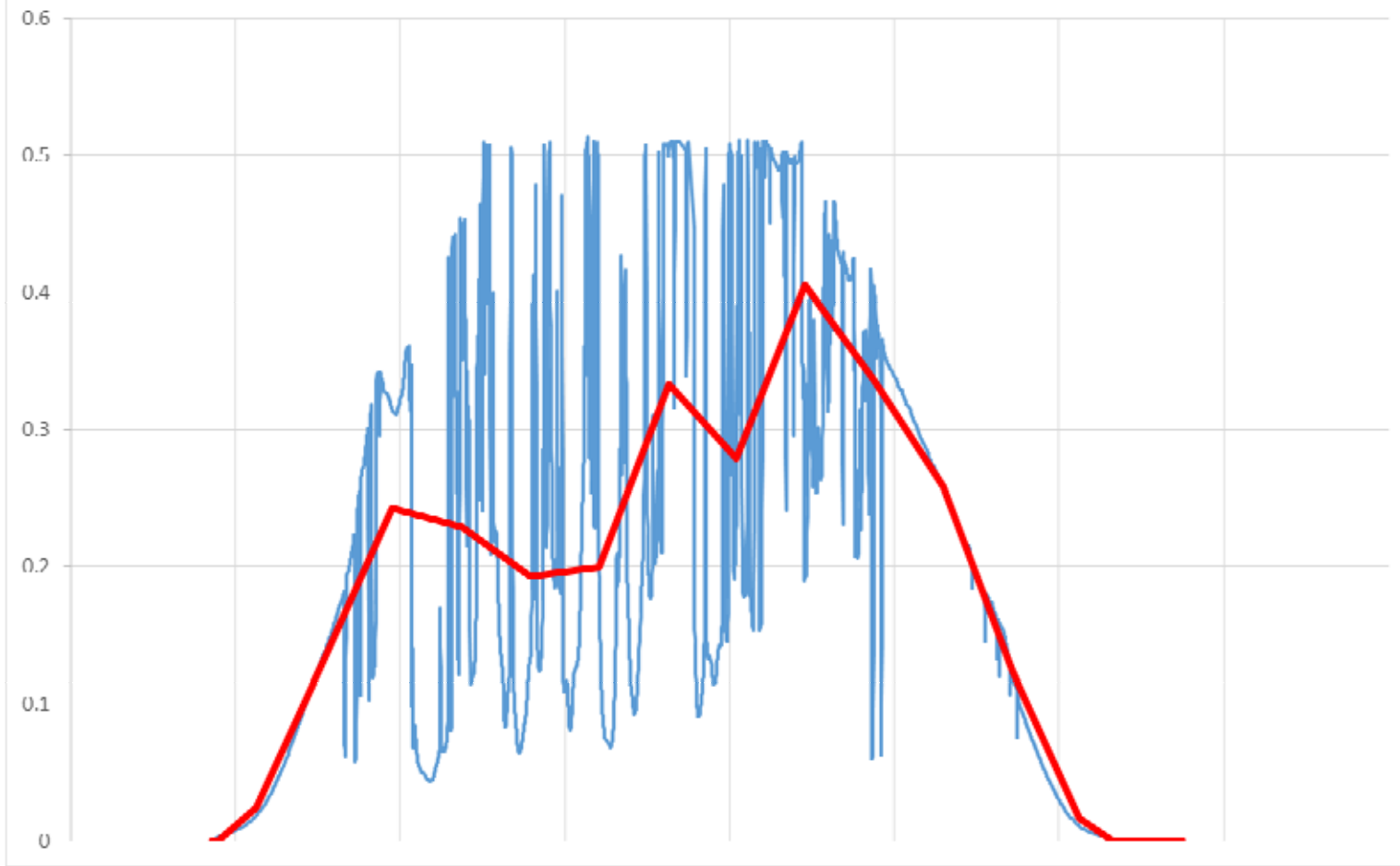


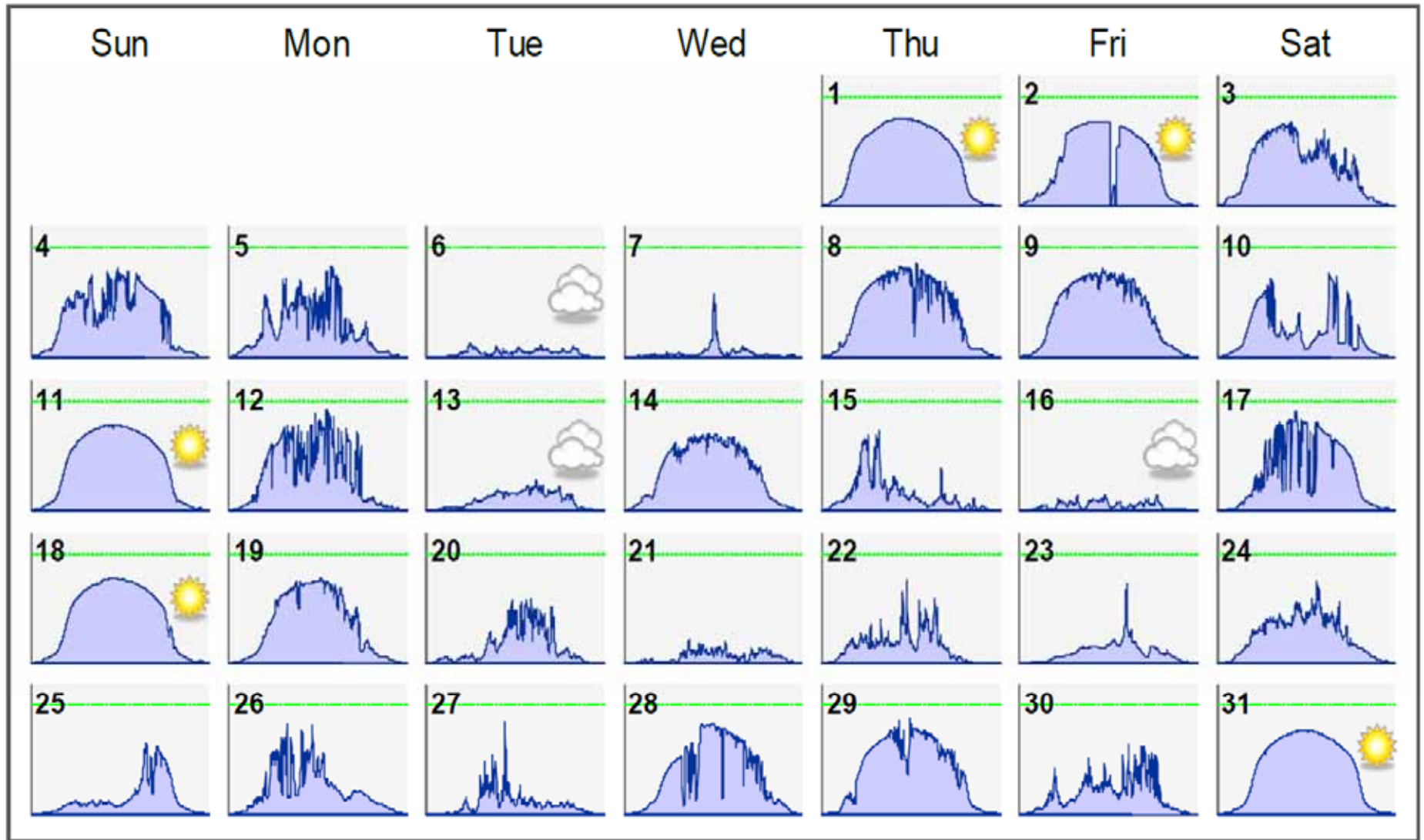




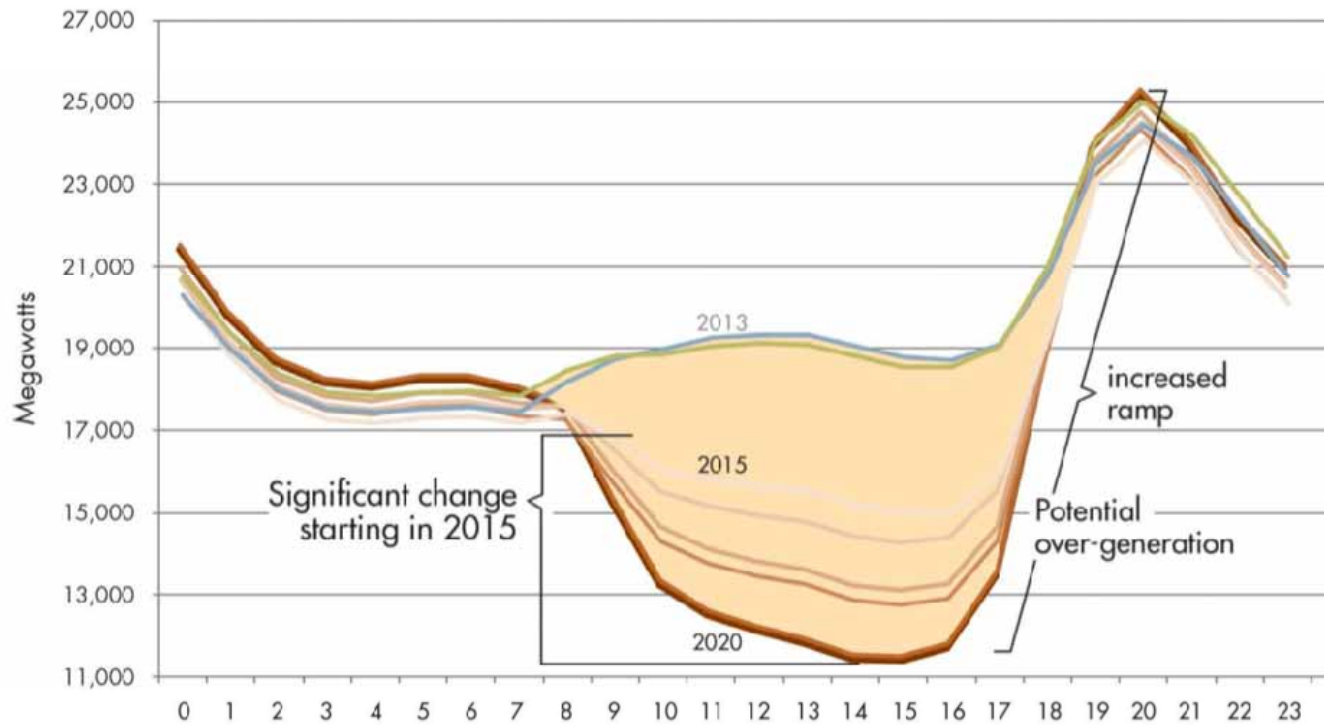


Solar Facility - Instantaneous Output Compared to Hourly Integrated Output



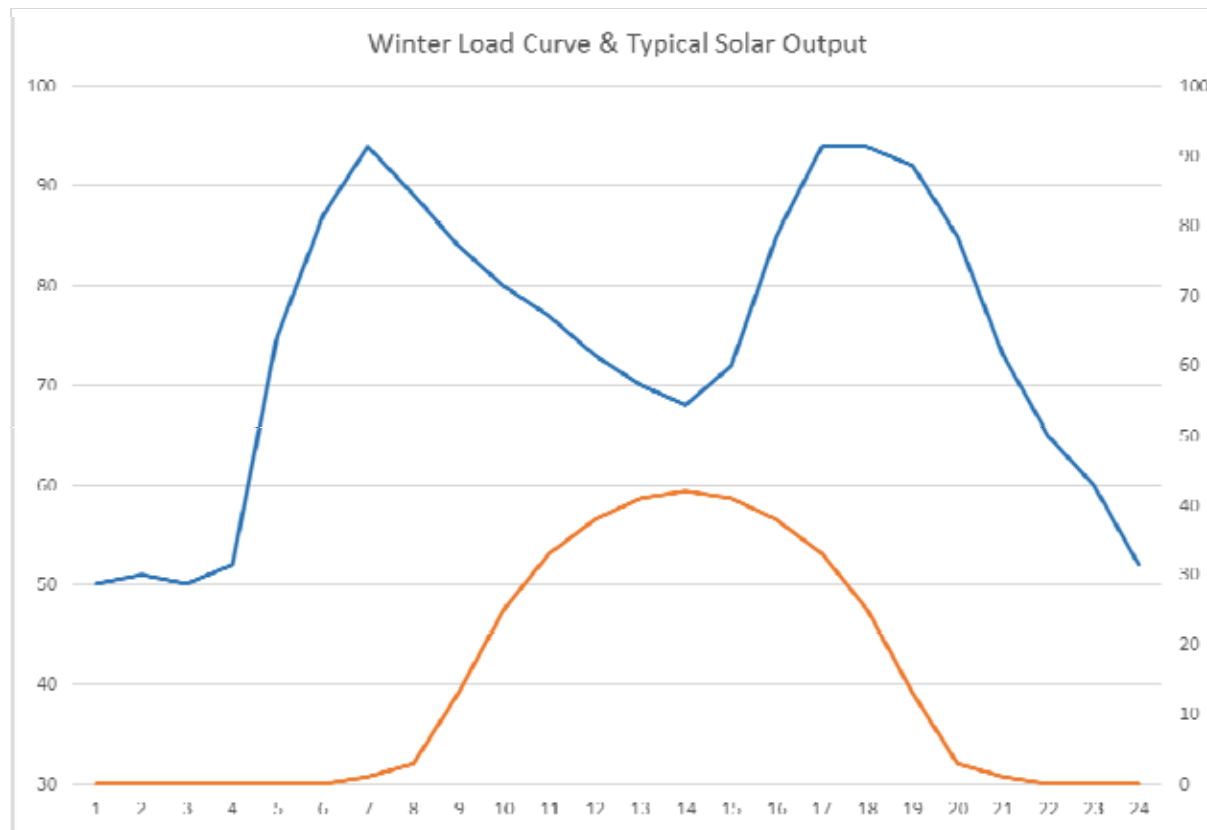


The Duck Curve



Source: California ISO

How Much does Solar Contribute to the Winter Morning Peak?



Challenges

Responding to the moment-by-moment changes in output that aren't typical of traditional generation.

Changes in ramping need of other generation sources.

Hidden increases in operating costs.

Still need backstand generation for cloudy days and winter peaks.

Power Quality Considerations

Solar introduces VARS to the system which can help, but the impacts must be quantified and accounted for or power quality will suffer.

Voltage fluctuation – especially when the project is toward the end of a line.

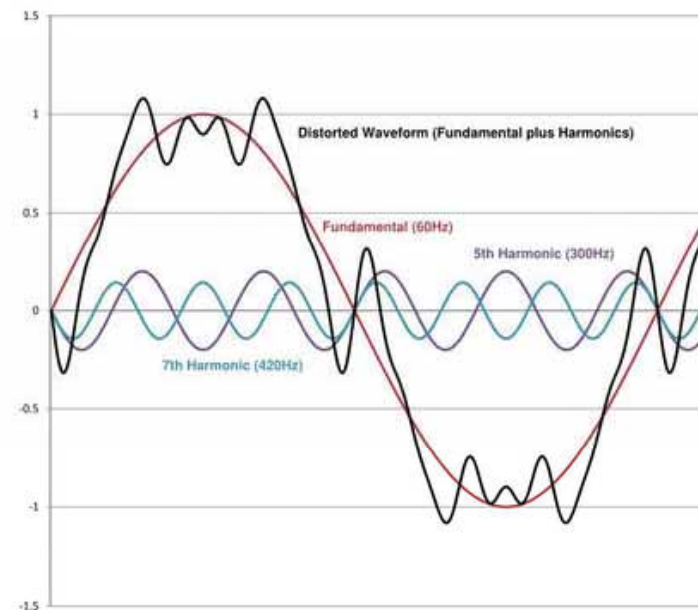
Coordination with other utility devices like voltage regulators and capacitors.

Harmonics / Flicker

Construction quality

In-rush currents

Protective trips by other customers.
(Particularly industrial customers with sensitive processes)



Queueing and the Interconnection Process

With solar, getting in queue first or second is important. Later entrants typically see prohibitive upgrade costs.

Projects lingering in queue (without moving forward to completion) can negatively affect other projects.

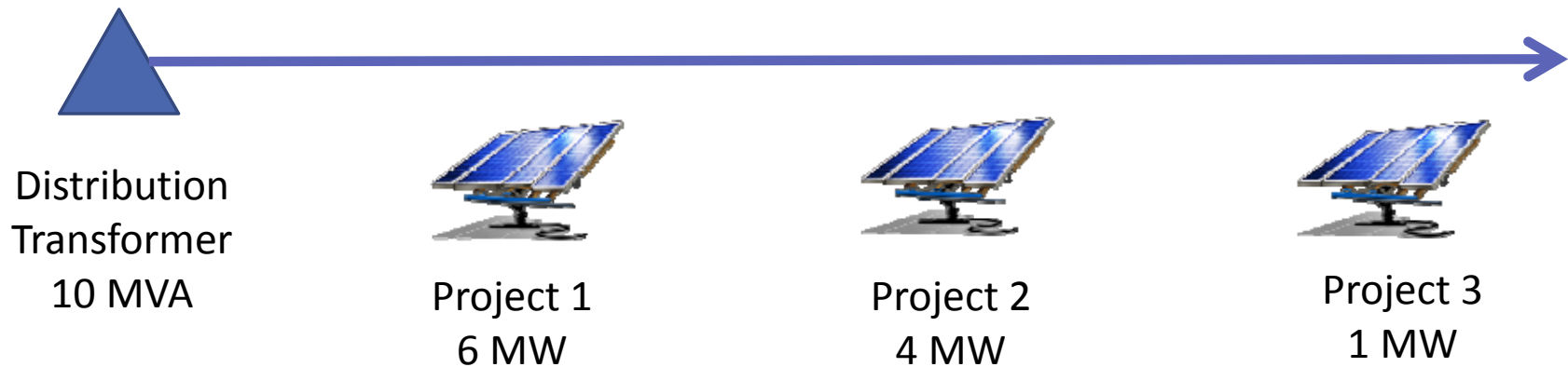
All projects want cheap land. Cheap land means less load and comparably weaker electrical system.

Several variables contribute to these uncertainties:

- Power pricing, upgrade costs,
- Other projects in queue, land issues,
- Tax treatment, financing,
- Projects being bought and sold.



Interconnection Example



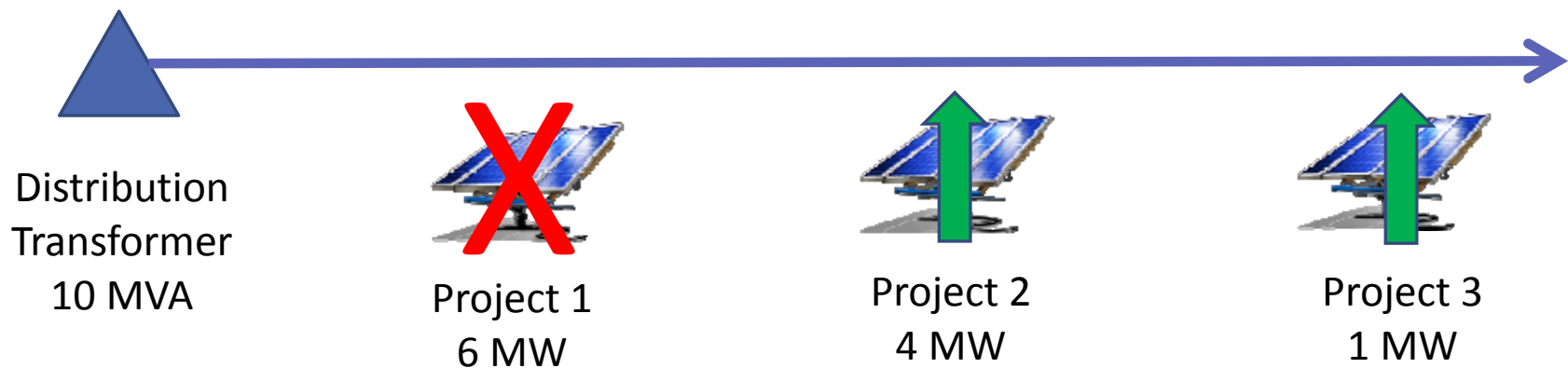
Project 1: First in queue – Interconnection costs total \$150,000 for substation upgrades to accommodate reverse power flow + \$75,000 for direct facilities.

Project 2: Second in queue – Interconnection costs total \$75,000 for direct facilities.

Project 3: Third in queue – Interconnection costs total \$2,000,000 for a new distribution transformer + \$75,000 for direct facilities.

Interconnection Example

Project 1 Misses a Deadline!



Project 1: Drops from Queue – If they resubmit, Interconnection costs total \$2,000,000 for a new distribution transformer + \$75,000 for direct facilities. Project may be successful at 5MW.

Project 2: First in queue – Substation upgrades shift to this customer. Interconnection costs total \$150,000 for substation upgrades + \$75,000 for direct facilities. Project may want to increase its size.

Project 3: Second in queue – Project may now be viable. Interconnection costs total \$75,000 for direct facilities.

Thank You

