



i-PCGRID Workshop 2017

Potential Impacts of Flexible Ramping Need on Transmission Planning

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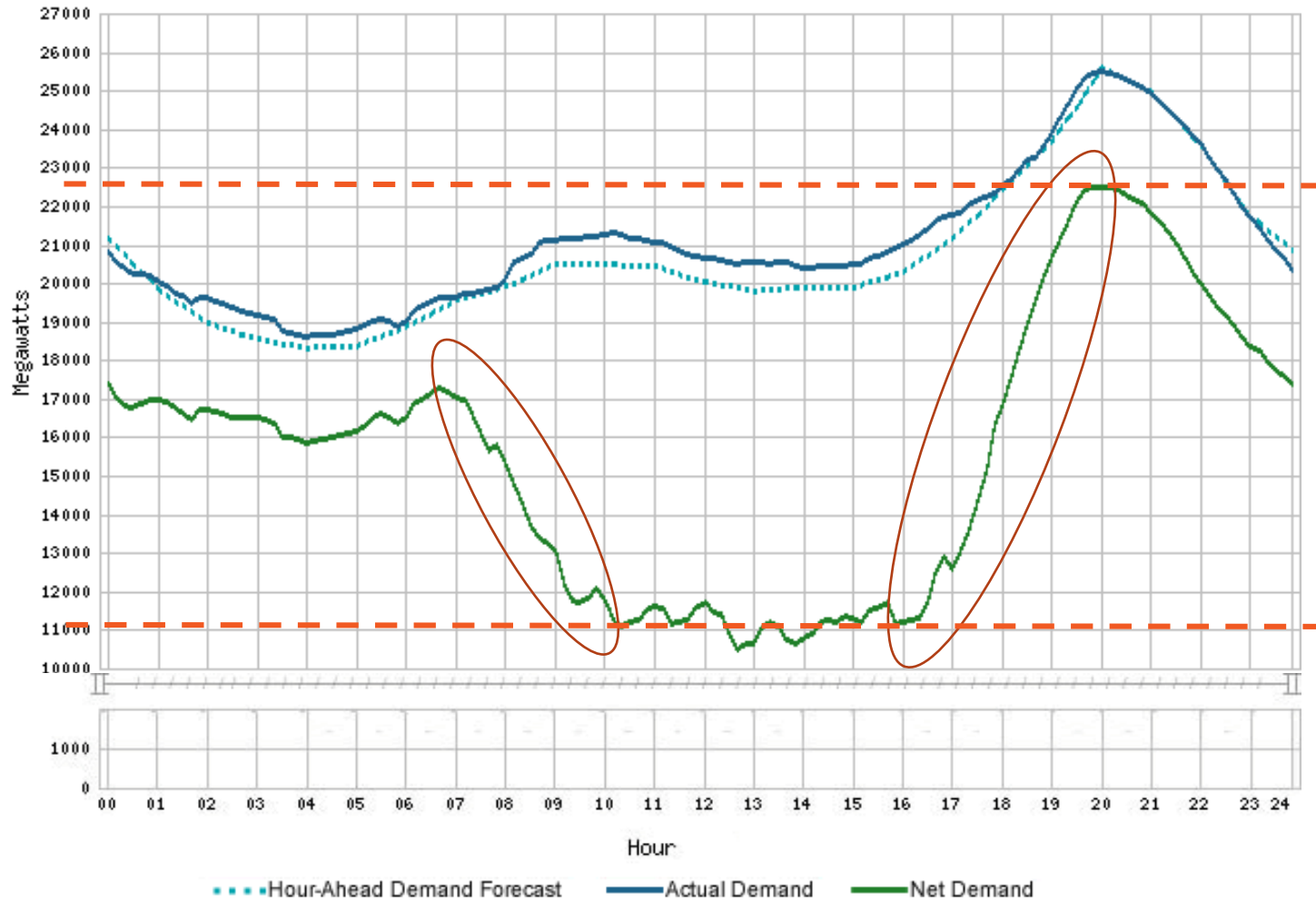
USA

Flexible Capacity Needs to support renewables integration

- Flexible Capacity resources - needed to support the morning and evening ramp due to the changes in customer load combined with the availability of solar generation and wind generation.
- These ramps can be significant,
 - For example, the CAISO's The CAISO's Report on Final Flexible Capacity Needs Assessment for 2017 shows the calculated average Flexible Capacity Need to be between ~10,000 MW and ~15,000 MW in 3 hours.
- In addition to frequency response, other challenges?

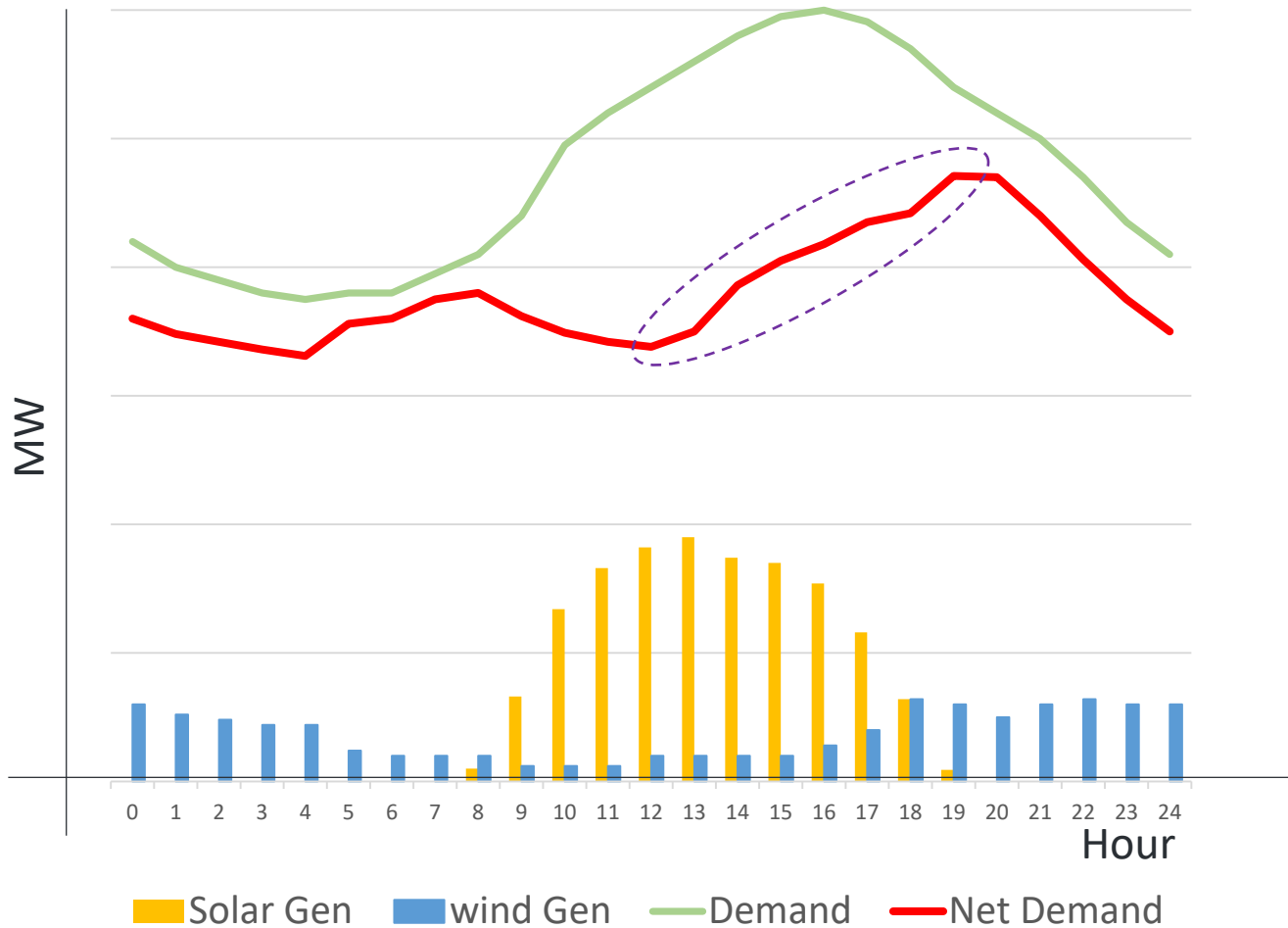
Net Demand Curve for one day in March 2017

Net Demand for March 26, 2017



Source: <http://www.caiso.com/Pages/TodaysOutlook.aspx#Renewables>

Sample Summer Demand Curves



Transmission Planning Assumptions

“Traditional Summer Peak” = 4-5 p.m. on a weekday in August

“New Paradigm Summer Peak” = 8-9 p.m. on a weekday in August

- “Lighter Load” period = 11 a.m. – 4 p.m.
- Ramping starts somewhere around 5 p.m. or earlier
- By 8 p.m. peak, the generation pattern assumes that the generators have completed ramping.
- New Issues, looking back a few hours before the net peak:
 - Generators needed to support ramping cannot be used to support load before the ramping starts
 - The resources with flexibility to support ramping are (for now) hydro, pumped storage and combustion turbines (CTs).
- This leads to a new dispatch pattern = significant impact on power flows in the system

- Hydro: Fast-acting; BUT many restrictions to support ramping:
 - Availability of water
 - Water flow along the entire river system
 - Contractual commitments to irrigation, recreational use, etc.,
 - Others
- CTs: Fast start and fast acting; BUT expensive, may have restrictions:
 - Air quality
 - Contractual issues
 - Economic dispatch
- Storage:
 - Pumped storage: Depends on whether the unit has already been dispatched to support local system reliability
 - Distributed storage: visibility? Controllability?

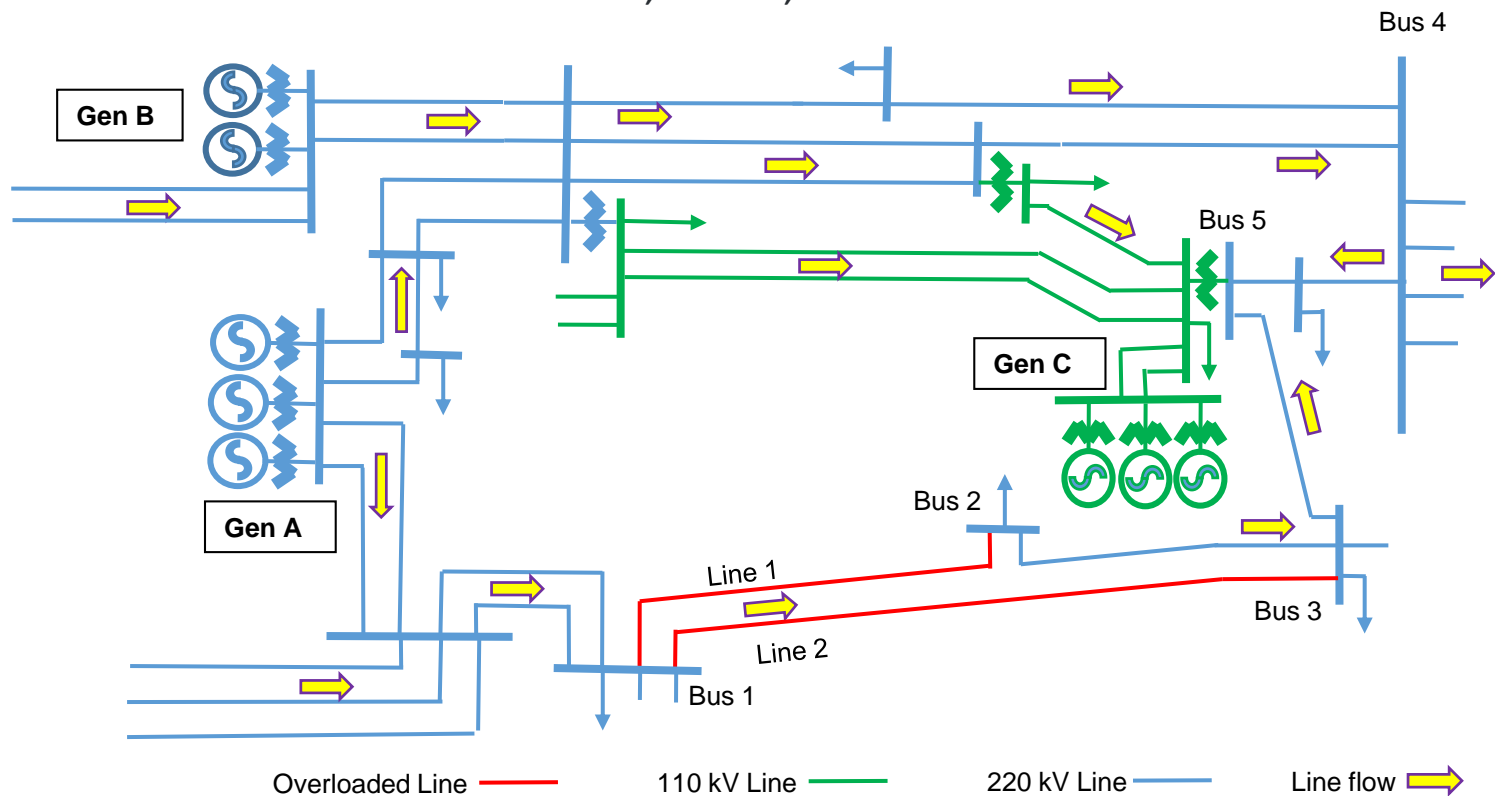
Case Study for a system with 30,000 MW

Need: Dispatch to provide ~5,300 MW ramping capability

Load centers: East of Bus 4 and at Bus 5

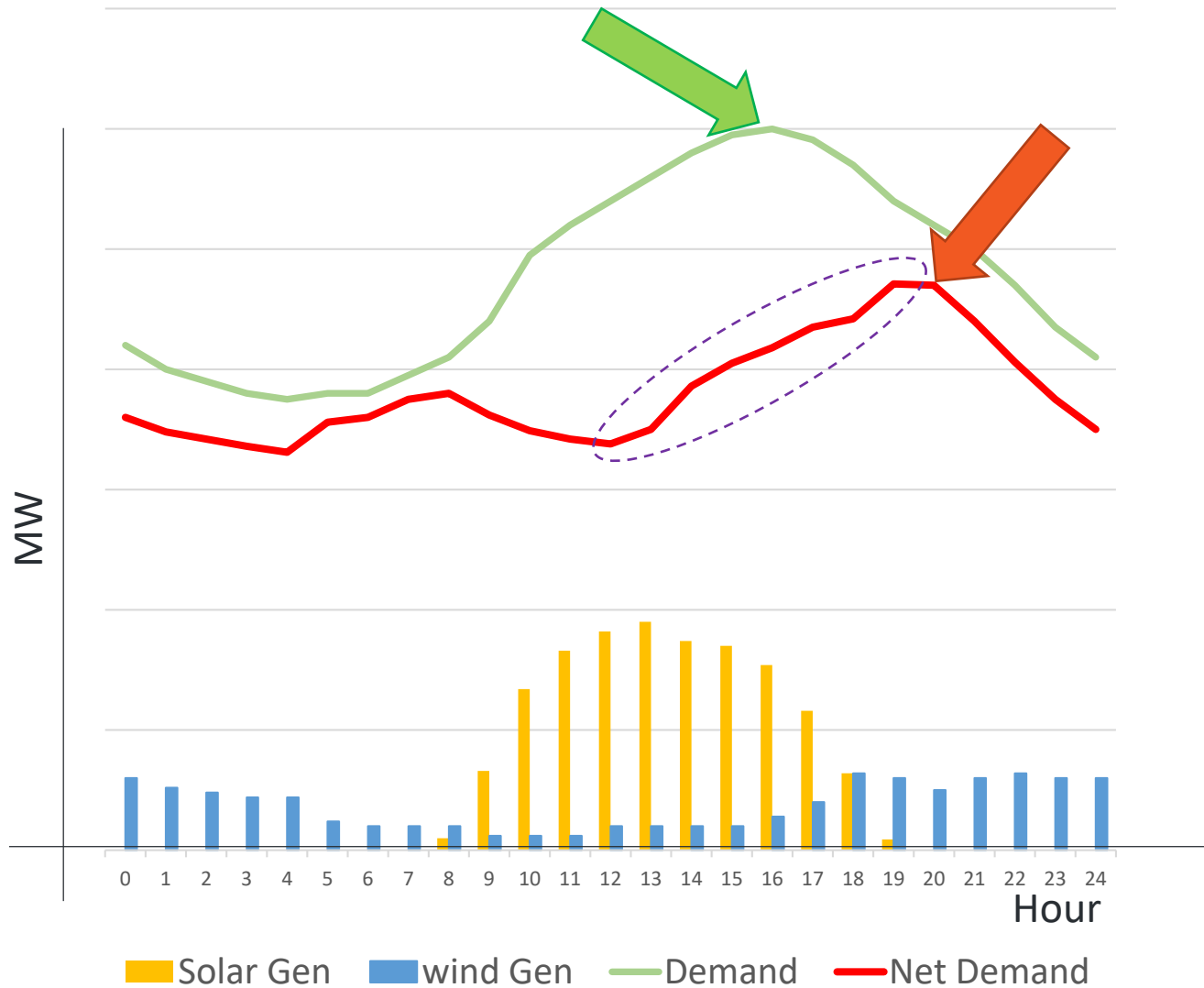
System Generation on line available to support ramping: ~4,300 MW - ~4,800 MW

In-area base load Generation: Gen A, Gen B, Gen C



Local Area System

Sample Summer Demand Curves



Case Study

Ramping completed at 8 p.m.

Generators used to provide ramping cannot be used to also support load.

Looking back at generators used to provide ramping –

What would the dispatch look like at 4-5 p.m.?

Spread the generation reduction to all base load generators based on the following steps:

- Thermal generators (starting with the older and presumably more costly generators)
- ID total number (Y) of generators where reduction should happen.
- Spread the X MW of reduction over Y generators
- For generators that have < X/Y MW on line, the generator will be shut down and the remaining generation spread to the larger generators

Resources for Ramping	Installed Capacity	Scenario 1 8 p.m.		Scenario 2 8 p.m.		Scenario 3 8 p.m.		Scenario 4 8 p.m.	
	MW	% of on-line gen	MW	% of on-line gen	MW	% of on-line gen	MW	% of on-line gen	MW
CTs on line	3,320	100%	3,320	100%	3,320	100%	3,320	100%	3,320
Shift timing of generation from Storage	500	90%	450	25%	125	50%	250	70%	350
Shift timing of generation from Hydro	5,760	15%	864	17%	979	12%	691	20%	1,152
Add off-line CTs in system			642		918		1055		555
Total resources available for ramping			5,275		5,341		5,315		5,376
Need to reduce base load unit generation to balance increases at CTs (X MW)			642		918		1055		555

Sample Results

Generation Reduction for Load/Resource Balance

Reduce Generation at	Scenario 1	Scenario 2	Scenario 3	Scenario 4
System Generators	381	508	625	329
Gen A	27	36	44	23
Gen B	40	53	66	34
Gen C	195	321	321	169
	642	918	1055	555

Results

Facilities	Summer Peak (4-5 p.m.)	Summer Net Peak (8-9 p.m.)							
		Scenario 1		Scenario 2		Scenario 3		Scenario 4	
Line 1 (Loss of Line 2)	96.9%	104.3%	465 MW	106.7%	475 MW	106.5%	475 MW	104.6%	464 MW
Line 2 (Loss of Line 1)	92.0%	99.3%	443 MW	101.7%	453 MW	101.4%	453 MW	99.6%	444 MW

Many challenges to come!

Questions?
