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R.17-07-007

# 288-Value Limited Generation Profiles

Limited Generation Workshop #4 per Res. E-5230

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# Overview

- Summary
- Review of data and methods
- Updated results
- Observations
- Exploration of the results

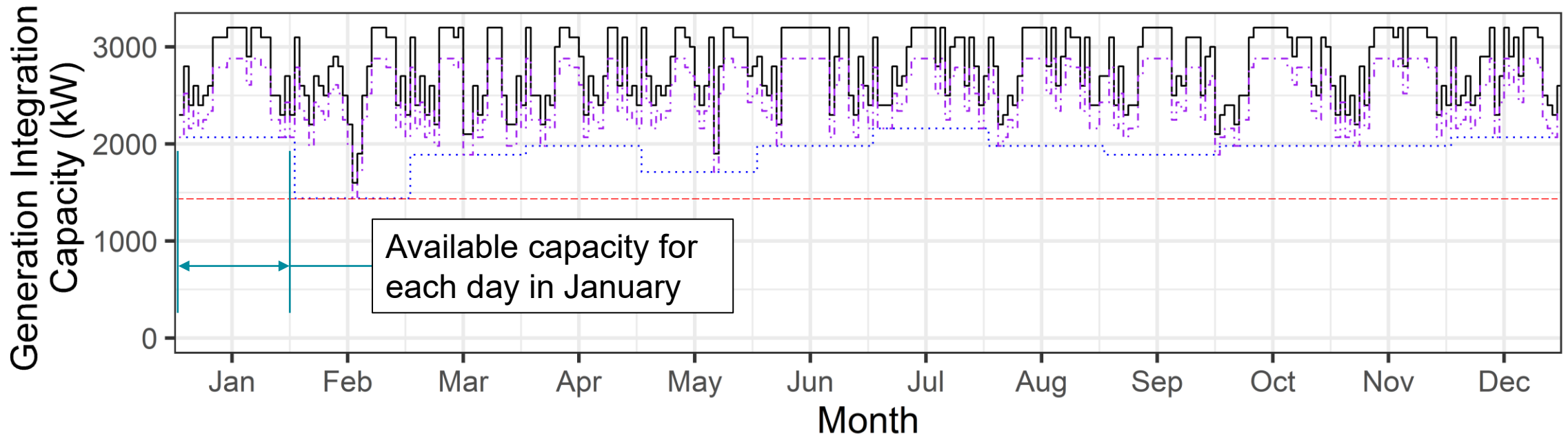
# 288-Value LGPs - Summary

- Cal Advocates presented slides showing the potential value of 288-value limited generation profiles (LGPs) based upon a small sample of integration capacity analysis (ICA) data in February.
- Since then, all three utilities have provided larger samples of ICA data.
  - Cal Advocates scaled calculated benefits on supplied feeders by the ratio of total feeders (approximate) to sample size for each utility.
- Cal Advocates also integrated pricing data in this analysis.
- The following slides provide a view into the potential value of LGP with a more robust data set.
- Note: As with the prior analysis, we did not compare to typical photovoltaic (PV) profiles.

# LGPs – Circuit Example

- ICA (generation, static grid)
- - - Minimum annual value\*
- ..... Minimum monthly value\*
- . - . Minimum hourly value\*

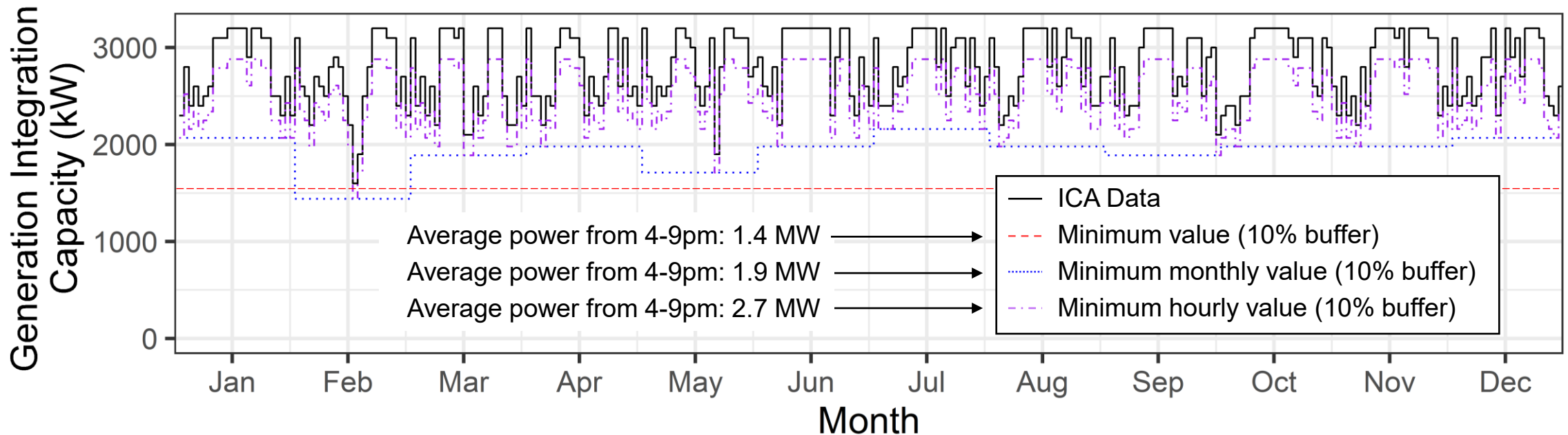
Note that, at present, non-LGP interconnections can only interconnect up to the OpFlex limit, which is generally below the static grid limit (therefore below the red dashed line).



\*With 10% buffer

# LGPs – Circuit Example

- The 12-value LGP, wherein the integration capacity is set by the minimum monthly static grid value enables more energy and power capacity but is not particularly beneficial during the times of greatest need (4~9pm).
  - Average power from 4-9 pm increases from 1.4 to 1.9 MW with 12-value LGP.
- A monthly-hourly (288-value) profile enables more exports during peak hours: to 2.7 MW.



# Data Used

- ICA Data

<b>Utility</b>	<b>Node Location on Feeder</b>	<b>Number of Useable Feeders in Sample</b>	<b>Total Number of Feeders</b>
Pacific Gas and Electric (PG&E)	Random Node	984	2,971
Southern California Edison (SCE)	First Node	556	4,166
San Diego Gas & Electric (SDG&E)	Random Node	645	827

- Energy Value

- 2022 avoided cost calculator (ACC).
- 2022 CAISO hourly day-ahead market energy prices.
- Lower limit set to zero for all pricing (i.e., resources economically curtail).

# Results

IOU	Limit Type	Exports Possible (TWh/year)	Average Power (4-9pm, GW)	Energy Value, \$ Billion		Ratios			
				CAISO	ACC	Energy	Power	CAISO	ACC
PG&E	Yearly (1)	57	6.5	\$5.1	\$4.9	-	-	-	-
	Monthly (12)	70	7.9	\$6.2	\$5.9	123%	123%	123%	120%
	Monthly-Hourly (288)	77	8.7	\$6.9	\$6.6	136%	135%	136%	134%
SCE	Yearly (1)	196	22	\$18	\$17	-	-	-	-
	Monthly (12)	294	34	\$27	\$26	150%	150%	152%	153%
	Monthly-Hourly (288)	381	46	\$35	\$34	194%	204%	198%	202%
SDG&E	Yearly (1)	7.7	0.9	\$0.7	\$0.7	-	-	-	-
	Monthly (12)	15	1.7	\$1.4	\$1.2	194%	194%	197%	180%
	Monthly-Hourly (288)	25	3.0	\$2.3	\$2.2	327%	345%	331%	327%

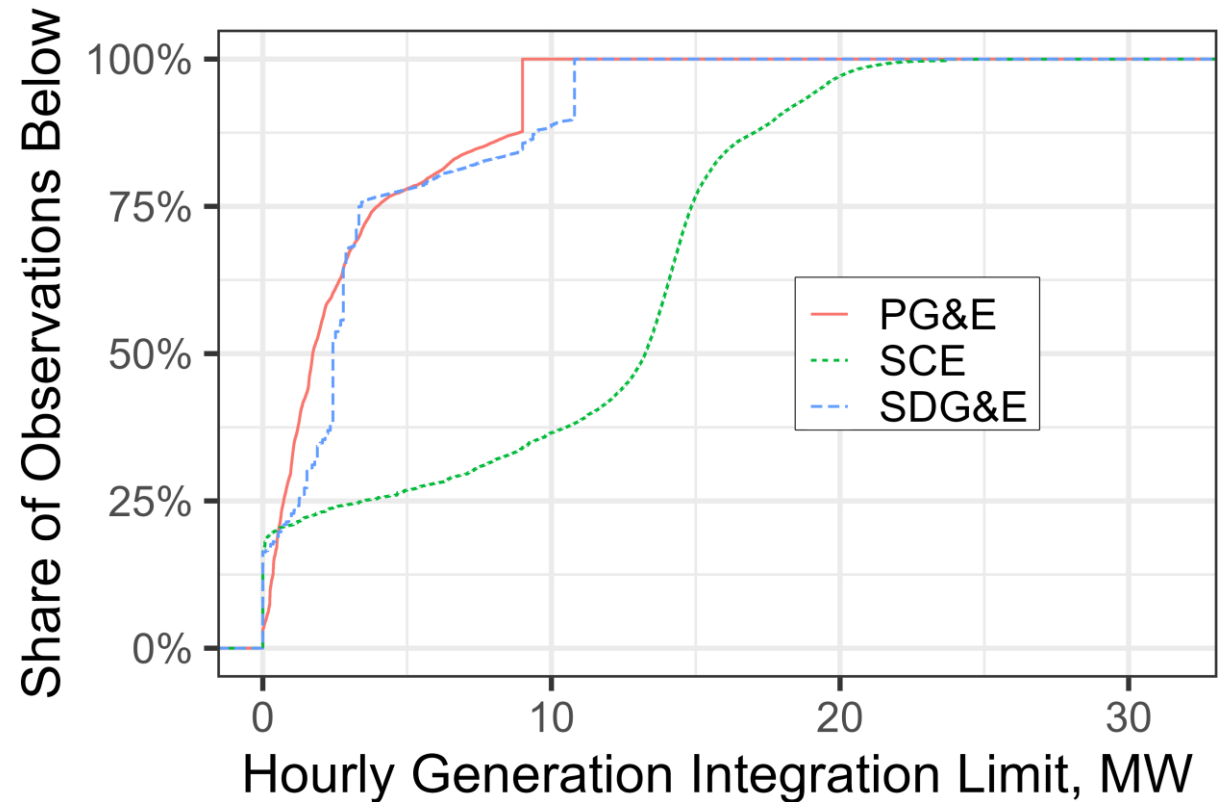
# Observations

- LGP unlocks significant power and energy self-generation and/or export capability on the distribution grid. This energy is valuable.
- PG&E and SDG&E have significantly less capacity per feeder than SCE.
- LGP provides significantly less benefit for PG&E – at both 12 values and 288 values – compared to SDG&E and SCE. SDG&E sees the largest relative gain.
- Energy, power, and value in CAISO and ACC track closely. This indicates that:
  - The avoided cost from the ACC is close to the CAISO market price.
  - The average value of exported energy is about the same (\$85-\$91 per MWh) regardless of profile and market are used.
  - LGP *does not* tend to unlock extra-valuable (peak-hour) exports as one might expect. The benefits appear to be distributed across hours of the year.



# Exploring Differences

- Why do PG&E and SDG&E have 1/3 of the energy/power capacity per feeder of SCE?
- Many of SCE's lines have voltages above 12 kV and, correspondingly, power capacities well above 10 MW.
- Why do PG&E's data show significantly less benefit than the other IOUs'?
- Taking the standard deviation of the hourly generation integration limit for each IOU follows the cumulative distribution function result.
- Taking the standard deviation of the hourly generation integration limit for each feeder and then averaging shows that PG&E's feeders have less hour-to-hour variation within each feeder than the other IOUs.



IOU	Standard deviation of hourly integration capacity, kW	
	across all records	for each feeder, then averaged
PG&E	2,800	410
SCE	6,700	2,600
SDG&E	3,000	1,300

# Exploring Differences

Note that y axes differ between plots.

