2022 SDG&E AC Saver Day Of Load Impact Evaluation

IOU 2023 Load Impact Protocol Workshop

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05 • 01 • 2023

Agenda

- Program overview

- Ex post methodology

- Ex post results and comparison to 2019-2021

- Enrollment forecast

- Ex ante methodology

- Ex ante results and comparison

- Conclusions

AC Saver Day Of

- Day-of demand response program offered to residential and commercial customers
  - Direct load control of central air conditioning (CAC)
  - Switches with one-way communication

- Events can be called from April – October
  - 2 to 4 hours in length
  - 12 PM to 9 PM
  - Maximum of 20 events

Customer Type	Cycling Strategy	Enrolled Customers (Oct. 2022)	% CAC Tonnage Enrolled	Incentive per Ton Enrolled
Residential	50%	5,652	71%	$10.35
	100%	2,454	29%	$27.00
	Total	8,106		
Commercial	30%	547	25%	$4.50
	50%	1,810	75%	$7.50
	Total	2,357		
Total		10,463		

PY 2022 Event Dates and Times

- 11 events
  - Called for 29 hours total
  - 5 events from 6 to 8 PM
  - 3 weekend/holiday events (all occurred during Labor Day Weekend)
  - Mean17* temperatures ranged from 74°F to 87°F
  - Maximum event window temperatures ranged from 74°F to 93°F

| Event #	Event Date	Hour Ending						Mean17 (°F)	Max Event Window Temp (°F)
		17	18	19	20	21	22		
1	8/16/2022			x	x			75	80
2	8/30/2022			x	x			75	82
3	8/31/2022			x	x			79	86
4	9/1/2022			x	x	x		80	86
5	9/3/2022			x	x			85	93
6	9/4/2022			x	x			87	87
7	9/5/2022		x	x	x	x		81	90
8	9/7/2022		x	x	x	x		83	93
9	9/8/2022		x	x	x	x		81	88
10	9/9/2022		x	x				82	74
11	9/26/2022		x	x				74	83

*Mean17 is the average temperature during the first 17 hours of the day

Ex Post Methodology

- Residential and commercial reference loads were estimated using a matched control group (in previous years a RCT design was used for the residential segment)
  - Matches were found using a dissimilarity statistic incorporating:
    - Peak demand on 2022 proxy days
    - Demand before and after event hours
    - Matched on industry (in the case of commercial), climate zone, and NEM status

Load Comparison Using 2022 Proxy Days

— Treatment Group

— Matched Control Group

Residential
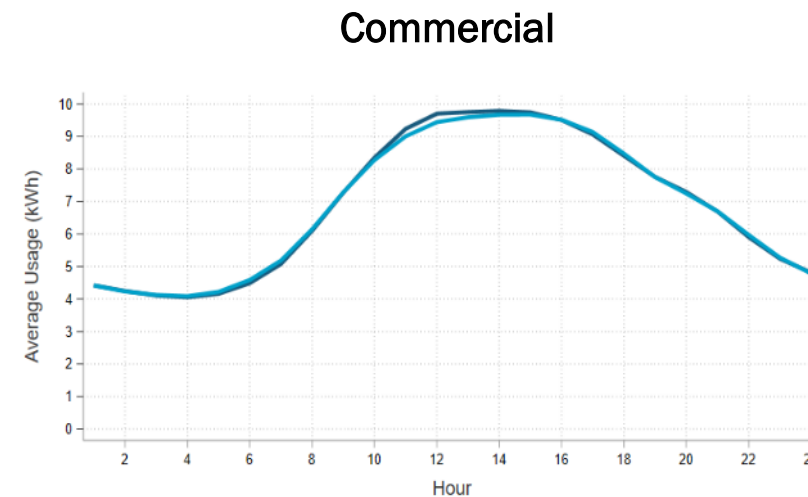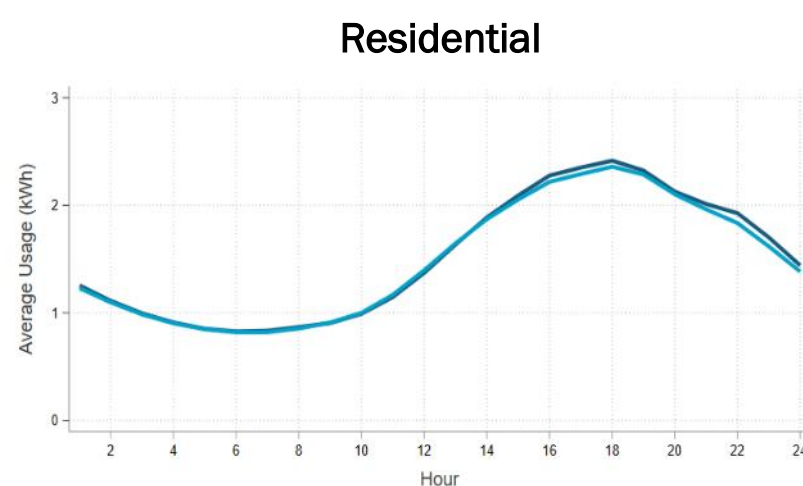
Commercial

Ex Post Methodology (Cont'd)

- Regressions were used to estimate impacts for residential and commercial customers

  - In contrast to previous evaluations, a difference-in-differences methodology was used to control for inherent behavioral differences between treatment and control customers and inherent differences between proxy and event days

  - This methodology was necessary for the 2022 evaluation because of large differences in temperature between proxy and event days

Difference-in-differences regression equation

$$kWh_{i,t} = \alpha_i + \delta\text{treat}_i + \gamma\text{post}_t + \beta(\text{treat}*\text{post})_{i,t} + u_t + v_i + \varepsilon_{i,t}$$

Residential Ex Post Results

- Per site impacts range from 0.05 kW to 0.30 kW

- All event days have statistically significant impacts

- Impacts generally increase as the temperature increases

Event Date	Impact		Mean17 (°F)	Max Event Window Temperature (°F)	Event Hours	Statistically Significant at 90% Level
	Per Site (kW)	Aggregate (MW)				
8/16/2022	0.18	1.48	75	80	6pm - 8pm	Yes
8/30/2022	0.14	1.18	75	82	6pm - 8pm	Yes
8/31/2022	0.29	2.37	79	86	6pm - 8pm	Yes
9/1/2022	0.21	1.71	80	86	6pm - 9pm	Yes
9/3/2022	0.30	2.46	85	93	6pm - 8pm	Yes
9/4/2022	0.27	2.19	87	87	6pm - 8pm	Yes
9/5/2022	0.28	2.26	81	90	5pm - 9pm	Yes
9/7/2022	0.30	2.44	83	93	5pm - 9pm	Yes
9/8/2022	0.15	1.25	81	88	5pm - 9pm	Yes
9/9/2022	0.05	0.38	82	74	5pm - 7pm	Yes
9/26/2022	0.16	1.33	74	83	5pm - 7pm	Yes
Average**	0.20	1.68	76	86	6pm - 8pm	Yes

**Light blue rows indicate the weekday 6-8 PM events used in the average event calculation
*** Dark blue rows indicate weekend and holiday events

Commercial Ex Post Results

- Per site impacts range from - 0.09 kW to 0.36 kW

- 4 event days have statistically significant impacts

Event Date	Impact		Mean17 (°F)	Max Event Window Temperature (°F)	Event Hours	Statistically Significant at 90% Level
	Per Site (kW)	Aggregate (MW)				
8/16/2022	0.36	0.88	74	79	6pm - 8pm	Yes
8/30/2022	0.02	0.04	75	81	6pm - 8pm	No
8/31/2022	-0.09	-0.23	78	85	6pm - 8pm	No
9/1/2022	0.08	0.20	79	84	6pm - 9pm	No
9/3/2022	-0.05	-0.12	84	93	6pm - 8pm	No
9/4/2022	0.23	0.56	87	86	6pm - 8pm	Yes
9/5/2022	0.24	0.60	81	89	5pm - 9pm	Yes
9/7/2022	-0.01	-0.02	82	91	5pm - 9pm	No
9/8/2022	-0.05	-0.12	81	88	5pm - 9pm	No
9/9/2022	0.01	0.02	82	73	5pm - 7pm	No
9/26/2022	0.15	0.37	74	82	5pm - 7pm	Yes
Average**	0.10	0.23	76	85	6pm - 8pm	Yes

**Light blue rows indicate the weekday 6-8 PM events used in the average event calculation
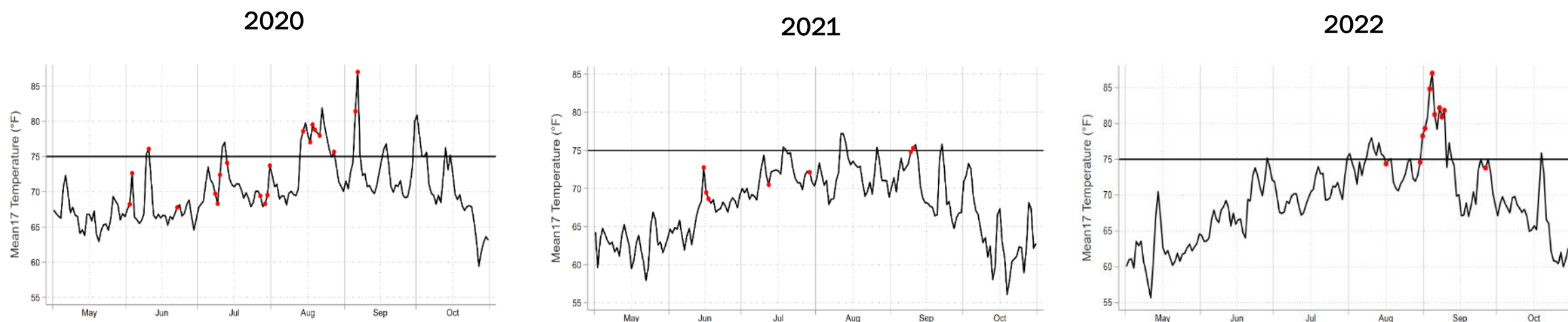*** Dark blue rows indicate weekend and holiday events

PY2022 vs. 2021 & 2020 Events

- In 2020, 9 events (out of 20) were called with a mean17 over 75 °F

- In 2021, 2 events (out of 7) were called with a mean17 over 75 °F

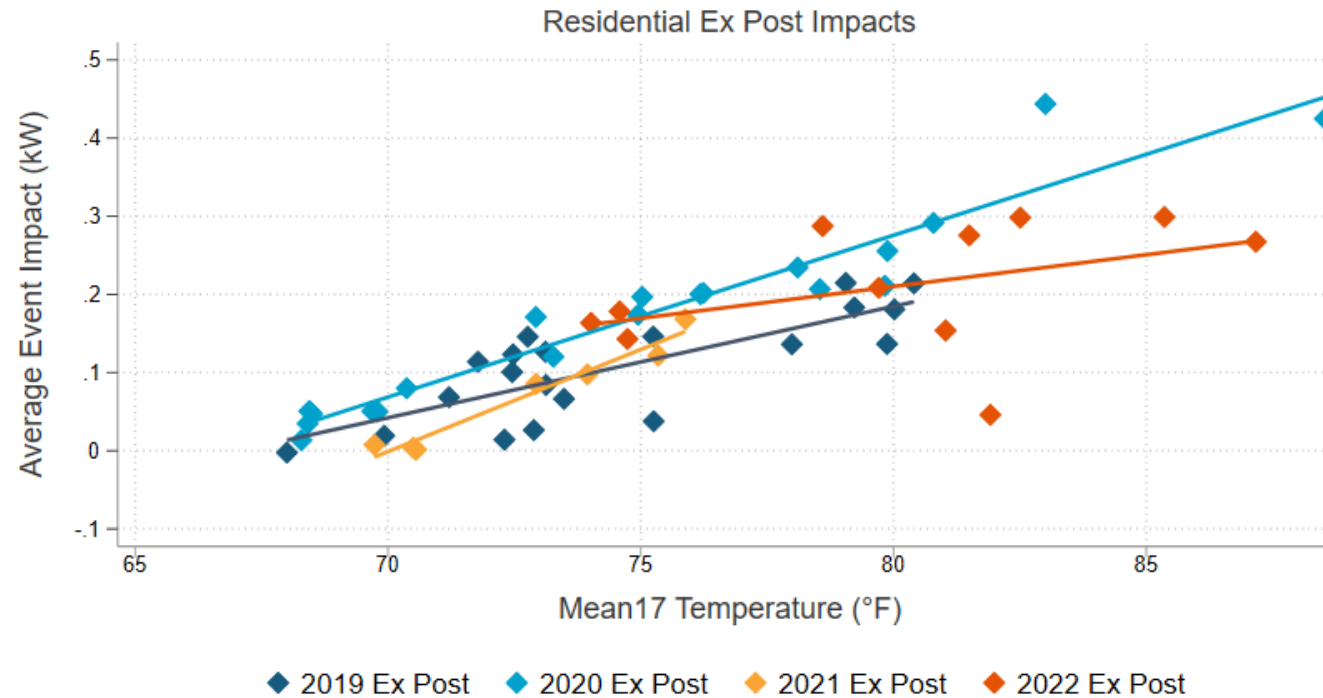- In 2022, 8 events (out of 11) were called with a mean17 over 75 °F

Comparison of AC Saver Day Of Event Days and Mean17 Temperatures   ● Event Days
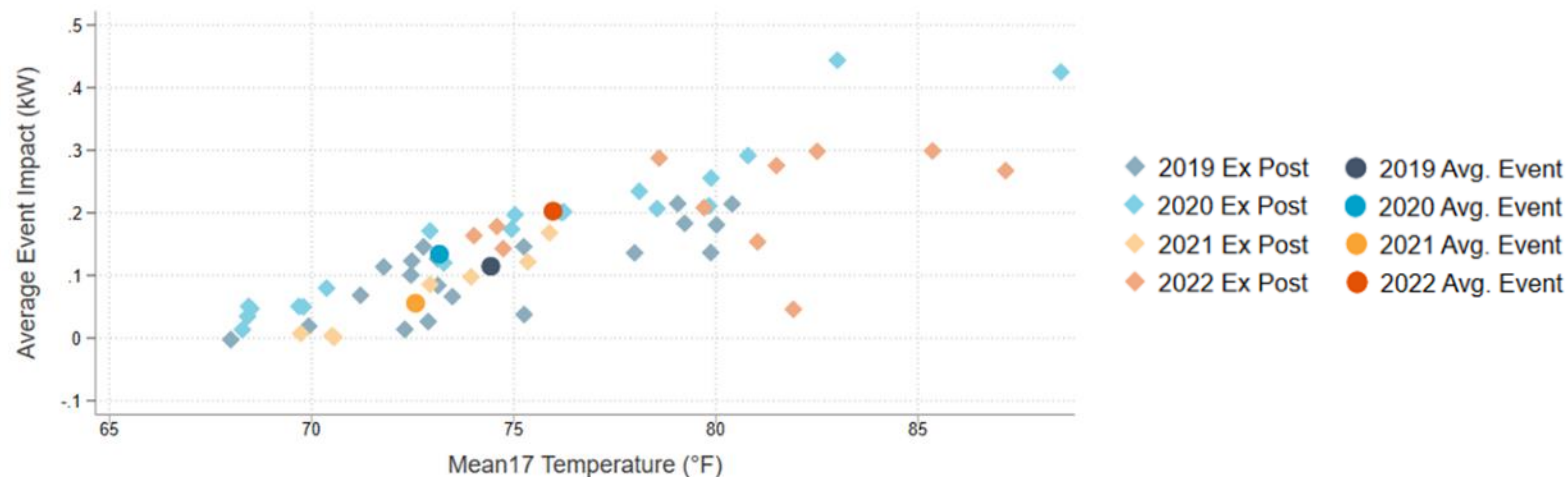
PY2022 vs. 2019-2021 Ex Post - Residential

- Impacts were greater in 2022 relative to 2021 owing to higher temperatures
  - Impacts were more like those observed in 2019 and 2020 in terms of magnitude

Residential Ex Post Impacts

PY2022 vs. 2019-2021 Ex Post - Residential

- The average residential event impact in 2022 was greater than in previous years due to high temperatures
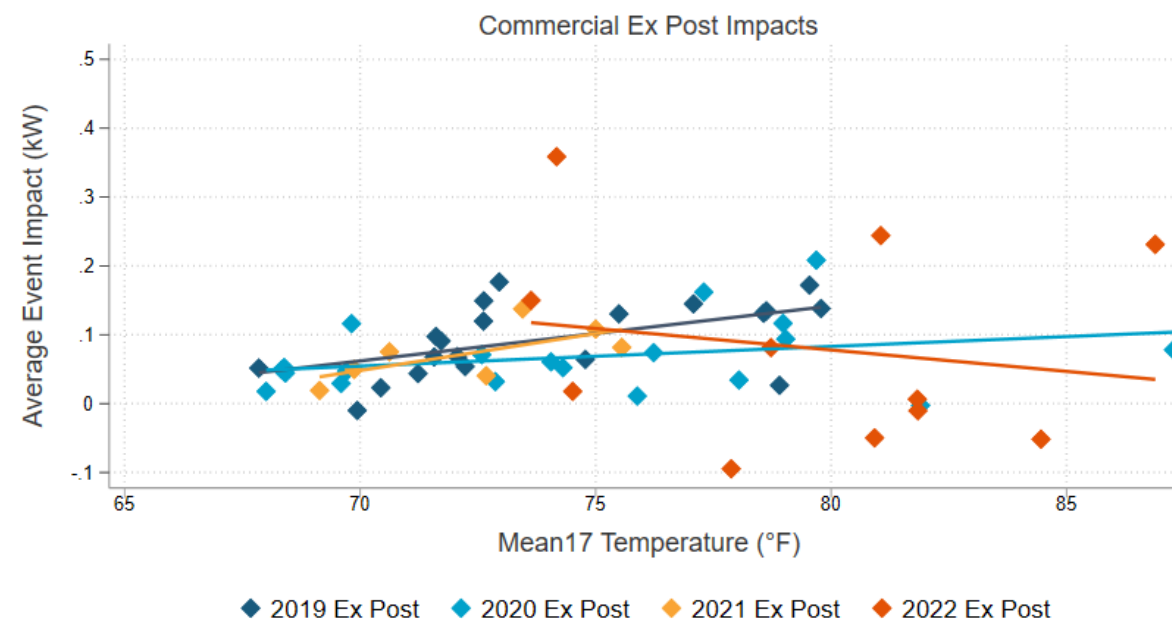
| Year	Avg. Event Hours	Customers Called	Mean17 Avg. Temp. (°F)	Avg. Reference Load (kW)	Avg. Load w/DR (kW)	Impact (kW)	Impact (%)	Aggregate Impact (MW)
2019	6PM - 8PM	7,913	74	1.29	1.18	0.11	8.9%	0.91
2020	6PM - 8PM	6,975*	73	1.44	1.31	0.13	9.3%	0.94
2021	6PM - 8PM	7,798	73	1.37	1.31	0.06	4.1%	0.44
2022	6PM - 8PM	8,241	76	2.15	1.95	0.20	9.4%	1.68

PY2022 vs. 2019-2021 Ex Post - Commercial

- 2022 commercial impacts were inconsistent in magnitude and statistical significance

- The events with the largest and most significant impacts included August 16, September 4, and September 5

- Like in previous years, there was not a meaningful relationship between increased temperature and higher load impacts

Commercial Ex Post Impacts

PY2021 vs. 2020 & 2019 Ex Post - Commercial

- 2022 commercial average event impacts are comparable to 2019 and 2021 in magnitude

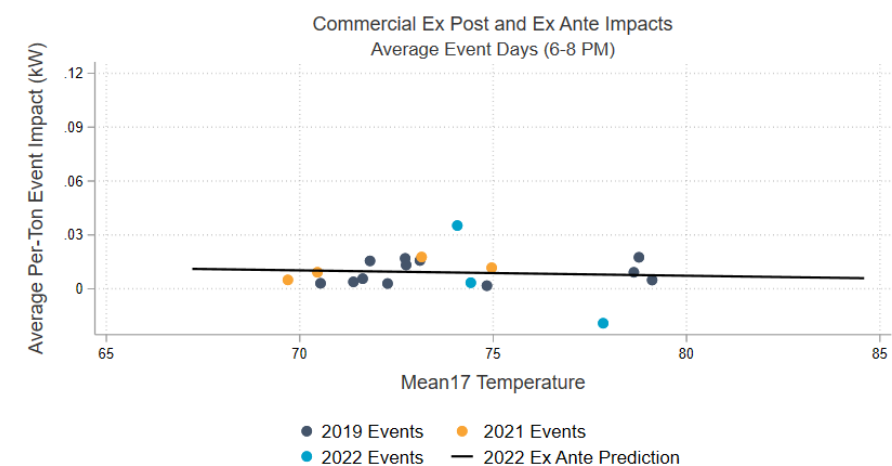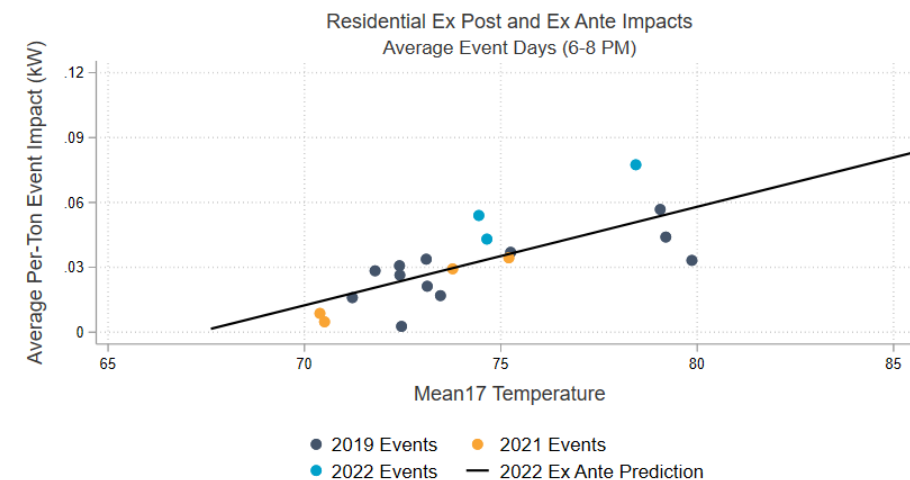| Year	Avg. Event Hours	Customers Called	Mean17 Avg. Temp. (°F)	Avg. Reference Load (kW)	Avg. Load w/DR (kW)	Impact (kW)	Impact (%)	Aggregate Impact (MW)
2019 Average Event Day	6PM - 8PM	3,707	74	6.09	6.00	0.09	1.5%	0.33
2020 Average Event Day	6PM - 8PM	3,124	73	4.98	4.93	0.05	1.0%	0.15
2021 Average Event Day	6PM - 8PM	2,312	72	5.85	5.75	0.09	1.6%	0.22
2022 Average Event Day	6PM - 8PM	2,377	76	7.83	7.76	0.10	1.2%	0.23
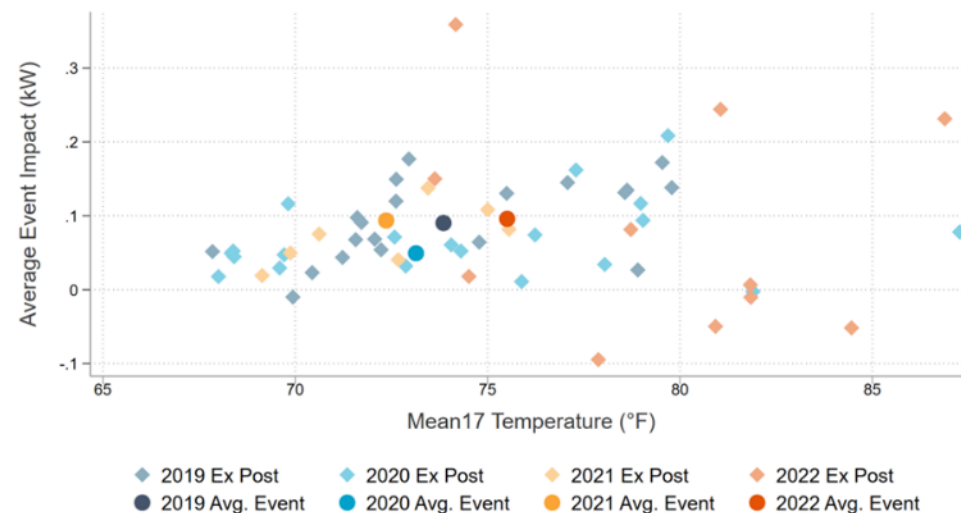
Enrollment Forecast

- Both residential and commercial enrollments are expected to decline

- Enrollment forecast is static in 2027 and beyond

- Program is not being actively marketed
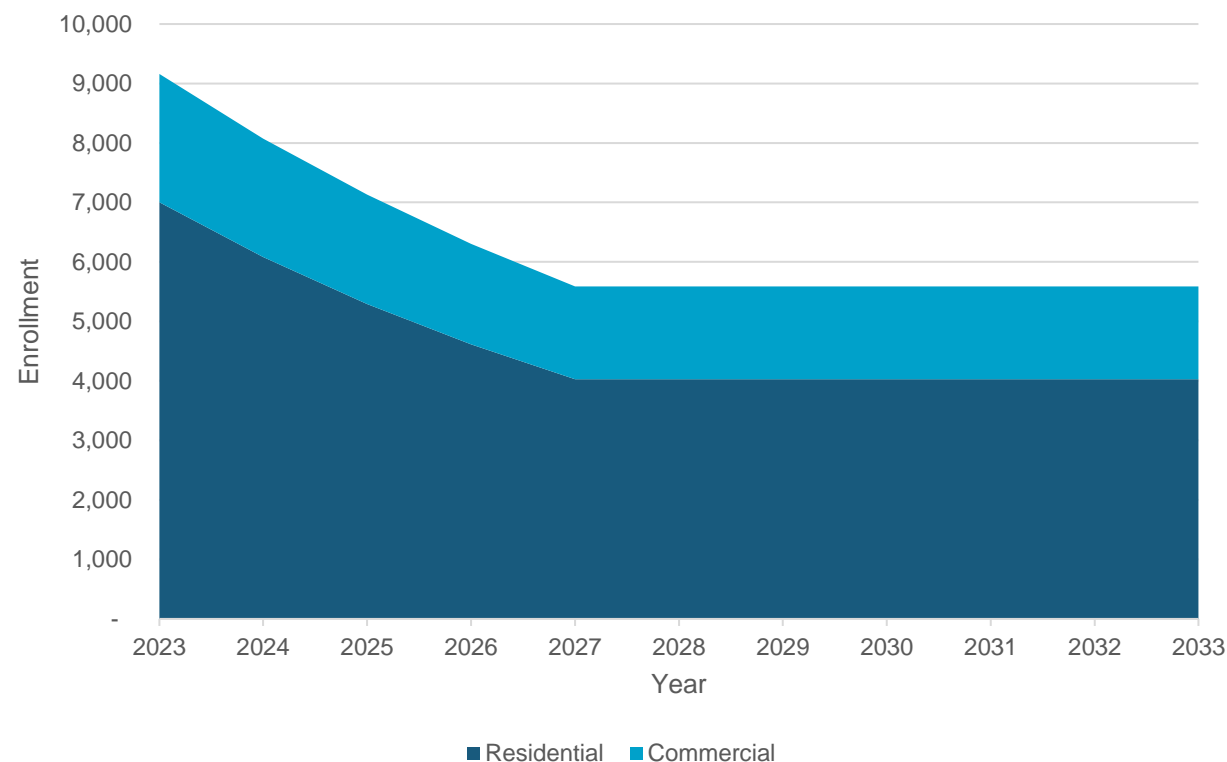
Ex Ante Methodology

- Average event day impacts (6-8 PM) and reference loads are modeled as a function of mean17

- Shaping ratios are applied to extend the 2-hour event over the RA window

- Ex post impacts from 2019, 2021 and 2022 are included in producing the ex ante model

- Due to COVID effects, 2020 is once again excluded from the ex ante methodology

Residential Ex Post and Ex Ante Impacts
Average Event Days (6-8 PM)

2019 Events   2021 Events
2022 Events   — 2022 Ex Ante Prediction

Commercial Ex Post and Ex Ante Impacts
Average Event Days (6-8 PM)

2019 Events   2021 Events
2022 Events   — 2022 Ex Ante Prediction

2022 Ex Ante Results – SDG&E Peaking Conditions

- Aggregate residential and commercial ex ante impacts peak in September

- Ex ante predictions for residential customers are more weather sensitive than commercial, consistent with behavior observed in the ex post analysis

Weather Year	Day Type	Residential Average (MW)	Commercial Average (MW)
1-in-2	Typical Event Day	1.2	0.2
	September Monthly Peak	1.7	0.2
1-in-10	Typical Event Day	1.6	0.2
	September Monthly Peak	1.9	0.2

Ex Ante PY2021 vs. PY2022 Comparison for 2023

- In 2022, new ex ante weather forecasts were produced and used for the ex ante predictions

- Ex ante predictions for 2022 between PY2022 and PY2021 are generally comparable

Weather Year	Day Type	Residential Average (MW)		Commercial Average (MW)	
		PY2021	PY2022	PY2021	PY2022
1-in-2	Typical Event Day	1.1	1.2	0.3	0.2
	September Monthly Peak	2.0	1.7	0.4	0.2
1-in-10	Typical Event Day	1.9	1.6	0.3	0.2
	September Monthly Peak	2.5	1.9	0.4	0.2

Ex Ante PY2021 Impact Prediction for 2022 vs. PY2022 Ex Post

- The table compares the average 6-8 PM event day ex post from PY2022 to the 2022 ex ante CAISO-specific typical August 1-in-2 event day prediction from PY2021

- Although not an apples-to-apples comparison, the per premise impacts are somewhat comparable, with temperatures and impacts being slightly lower during actual 2022 events than last year's forecasted 1-in-2 predictions

Customer Type	Forecast Year	Evaluation Year	Mean17 (°F)	2022 Per Premise Impact (kW)
Residential	Ex post	2022	76	0.20
	Ex ante	2021	81	0.25
Commercial	Ex post	2022	76	0.10
	Ex ante	2021	80	0.17

Conclusions

- Ex post

  - In a departure from previous evaluations, this year a matched control group was utilized for both segments. Differences in weather between event and proxy days motivated switching to a difference-in-difference methodology for this year's evaluation

  - Average residential impacts in 2022 were larger compared to previous years due to high event temperatures

  - Average commercial impacts were consistent on average with previous years due to less weather sensitivity in the segment

- Ex ante

  - New ex ante weather forecasts through 2033 were produced for the 2022 evaluation

  - Changes in future ex ante MW predictions will largely be driven by enrollment

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