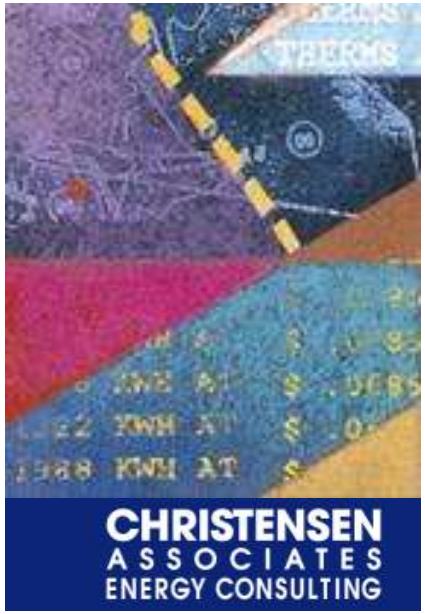


Load Impact Evaluation: *Non-residential Critical Peak Pricing*

Dan Hansen
Mike Clark
Nick Crowley
Corey Lott
Christensen Associates Energy Consulting

DRMEC Spring Workshop

May 4, 2018

Presentation Outline

1. Program Description
2. *Ex-post* Methodology
3. *Ex-post* Load Impacts
4. *Ex-ante* Methodology
5. Enrollment Forecast
6. *Ex-ante* Load Impacts

1. CPP Program Description

- Critical Peak Pricing (CPP) is a price-based demand response (DR) program
  - Called Peak Day Pricing (PDP) at PG&E
- Customers receive a discount on most days in exchange for facing high ("critical") prices on event days
  - *E.g.*, PG&E's E-19 Secondary critical price = 1.20 $/kWh; demand credits of $5.70 in Peak Summer and $1.41 in Part-Peak Summer
- Customers receive day-ahead notification of CPP events
- PG&E and SCE events were from 2 to 6 p.m. while SDG&E events were from 11 a.m. to 6 p.m.
  - SDG&E's event window changed to 2 to 6 p.m. in PY2018

1. CPP Program Description (2)

- CPP is the default rate for large (over 200kW) customers
  - At PG&E, default onto PDP happens after 12 months on a TOU rate
- Transitioning to CPP and the default C&I rate for small and medium business (SMB) customers
  - PG&E began in 2014; SDG&E began in 2015; and SCE will begin in Oct. 2018
  - CPP has been available as a voluntary rate to SMB customers
- The table below shows average event-day enrollments in PY2017 by utility and size group

Size Group	PG&E	SCE	SDG&E
Large (Over 200kW)	1,982	2,292	1,281
Medium (20 to 199kW)	45,177	735	11,808
Small (Under 20kW)	158,006	82 (133 NEM)	Separate Study

2. *Ex-post* Methodology

- Load impacts are estimated using matched control groups with difference-in-differences panel regression models
  - Matching conducted by utility, size group, industry group (combining some groups to increase the sample size), and climate zone
  - Within group, performed Euclidean distance matching using two 24-hour load profiles
    - PG&E and SCE used the hottest event-like days and the remaining event-like days
    - SDG&E used weekday and weekend event-like days (1 of 3 event days occurred on a weekend)
  - Preliminary matching on billing data and characteristics was performed where the pool of eligible control-group customers is large (SCE's SMB customers)

2. *Ex-post* Methodology (2)

- Eligible pool of control-group customers consists of customers who opted out of CPP or have yet to be defaulted
  - Pool gets smaller as the default process proceeds
  - Despite shrinking pool of customers, match quality tends to be good (with some exceptions)
  - Estimated load impacts are not very sensitive to using customer-specific models in place of panel models for the largest + worst-matched customers

3. *Ex-post* Load Impacts: *Events*

Date	Day of Week	PG&E	SCE	SDG&E
6/16/2017	Friday	X		
6/19/2017	Monday	X	X	
6/20/2017	Tuesday	X	X	
6/22/2017	Thursday	X		
6/23/2017	Friday	X		
7/6/2017	Thursday		X	
7/7/2017	Friday	X	X	
7/27/2017	Thursday	X	X	
7/31/2017	Monday	X	X	
8/1/2017	Tuesday	X	X	
8/2/2017	Wednesday	X		
8/28/2017	Monday	X	X	
8/29/2017	Tuesday	X	X	
8/31/2017	Thursday	X	X	X
9/1/2017	Friday	X		X
9/2/2017	Saturday	X		X
9/5/2017	Tuesday		X	
9/12/2017	Tuesday		X	

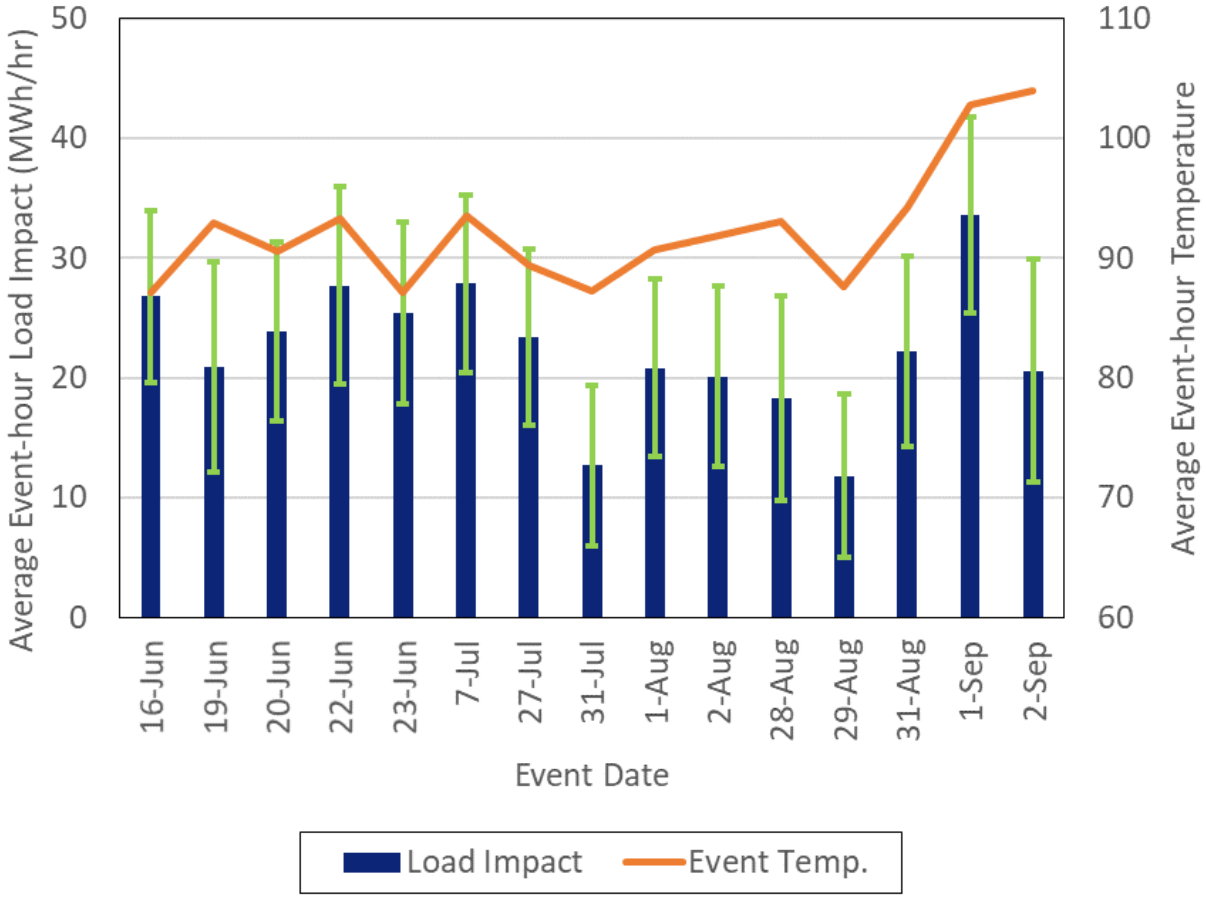
Notes:

- The PG&E, SDG&E, and CAISO peak day was 9/1/2017. The SCE peak day was 8/30/2017.

3. *Ex-post* Load Impacts: *Events (2)*

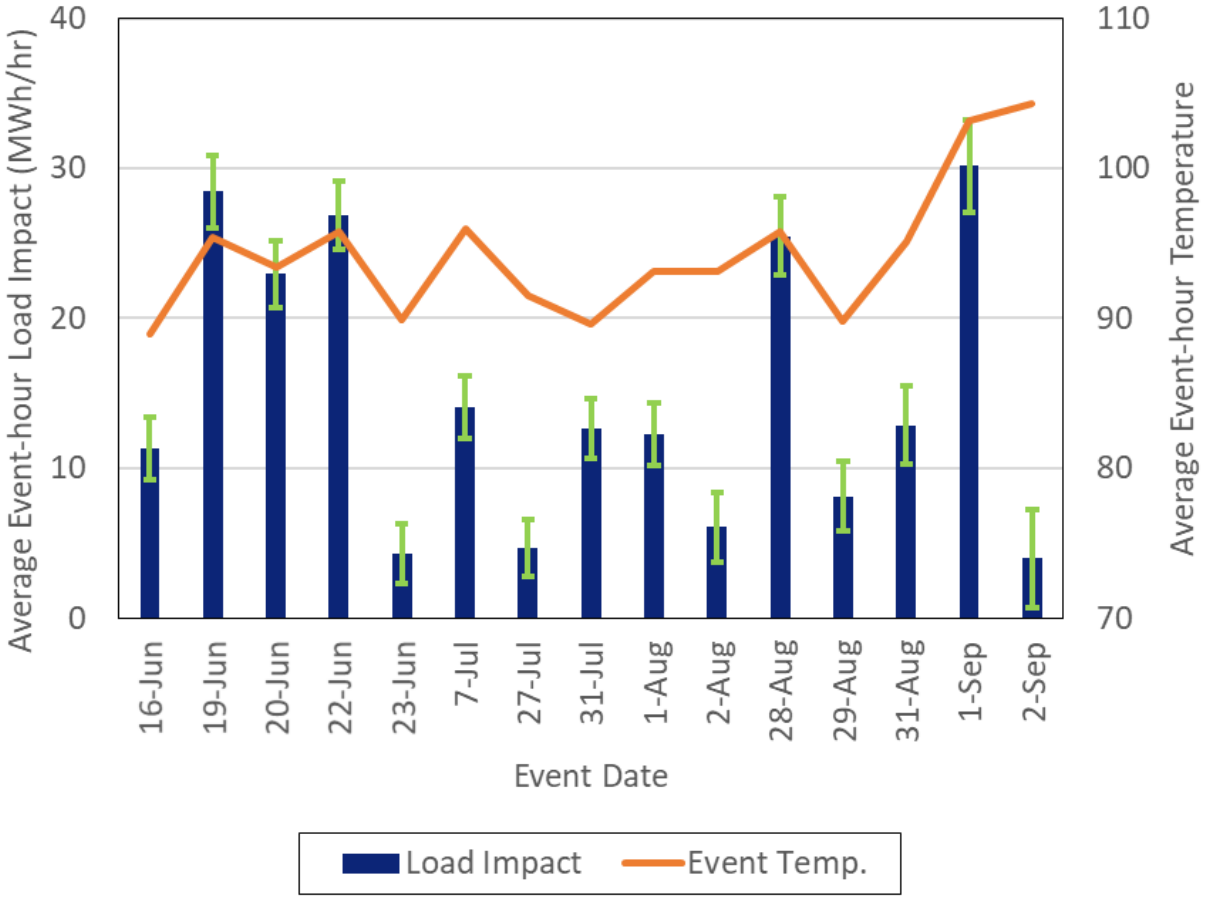
Utility	Hours of Availability	Hours of Actual Use	No. of Available Dispatches	No. of Actual Dispatches
PG&E	60	60	15	15
SCE	48	48	12	12
SDG&E	126	21	18	3

3. *Ex-post* Load Impacts:
PG&E Large C&I



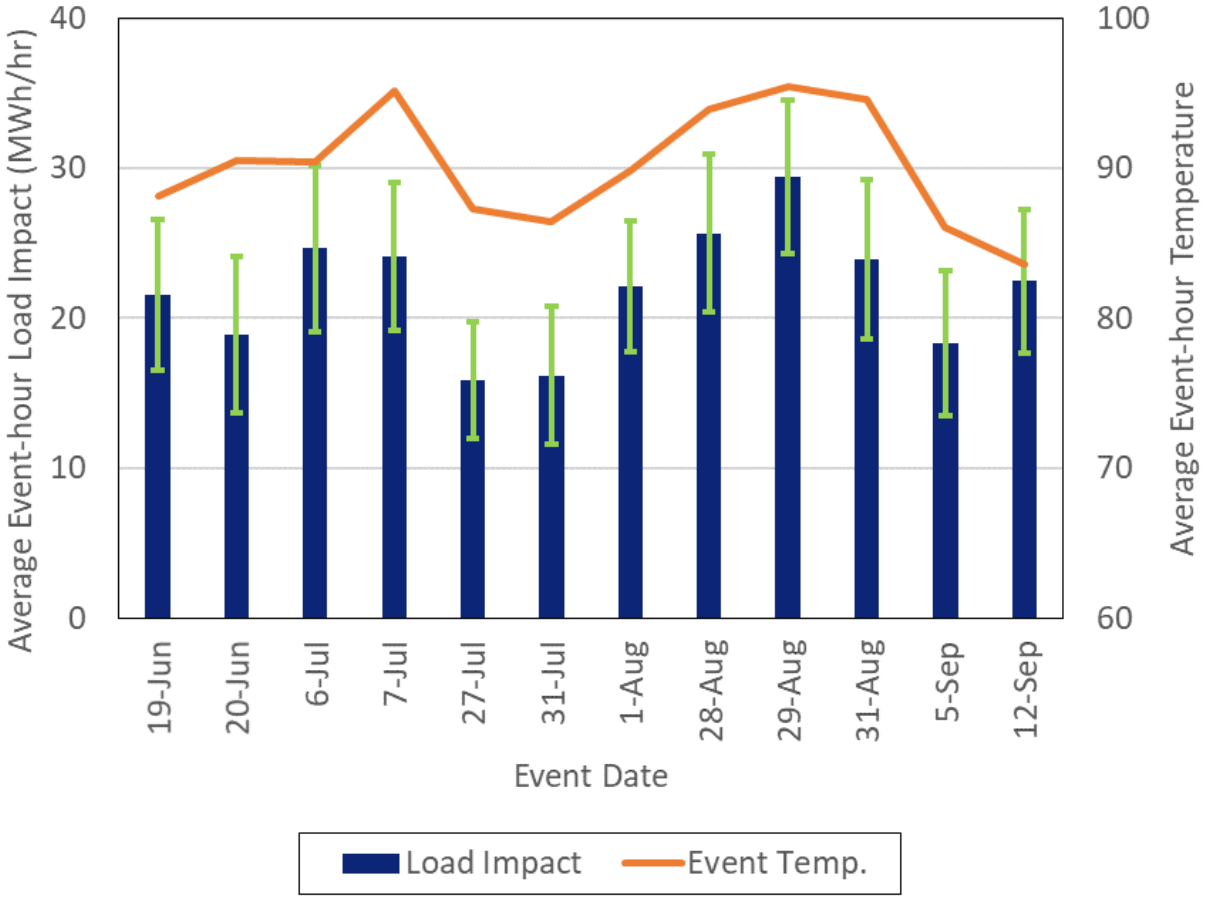
- Average load impact = 22.4 MW, or 4.2% of ref. load
- 9/2 event was the hottest, but was also the only weekend event
- Aggregate load impact is ~27% lower than PY2016 (6% fewer customers, 22% lower per-customer load impact)
- PG&E peak hour load impact (9/1, HE 18) = 29.3 MW for large customers and 50.3 MW for the entire program
- CAISO peak hour load impact (9/1, HE 16) = 34.3 MW for large customers and 74.2 MW for the entire program

3. *Ex-post* Load Impacts:
PG&E SMB



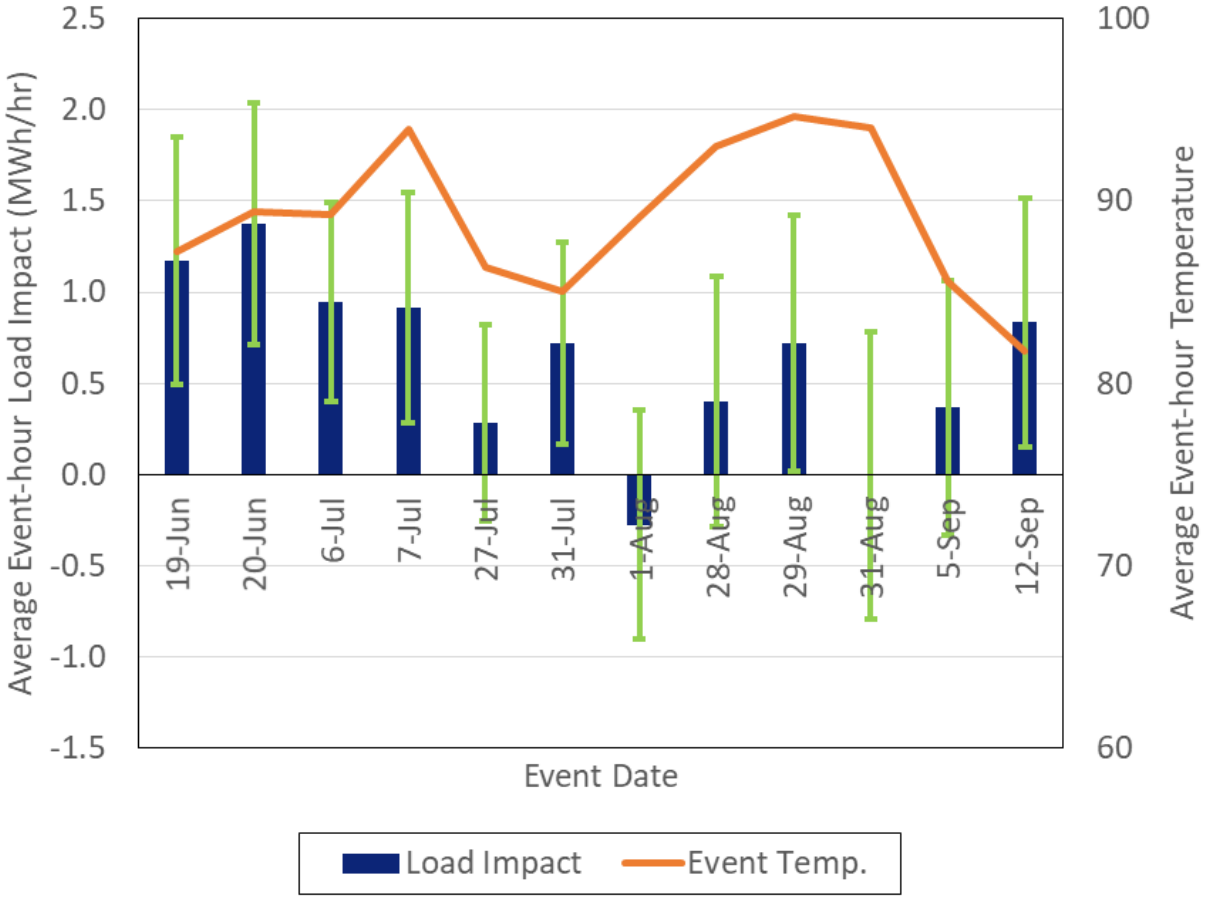
- Average load impact = 15.0 MW, or 1.1% of ref. load
- Load impacts are quite variable across events (high = 30 MW; low = 4 MW)
- High variability of load impacts + low % impacts may indicate that estimates are affected by noise / omitted variables

3. *Ex-post* Load Impacts:
SCE Large



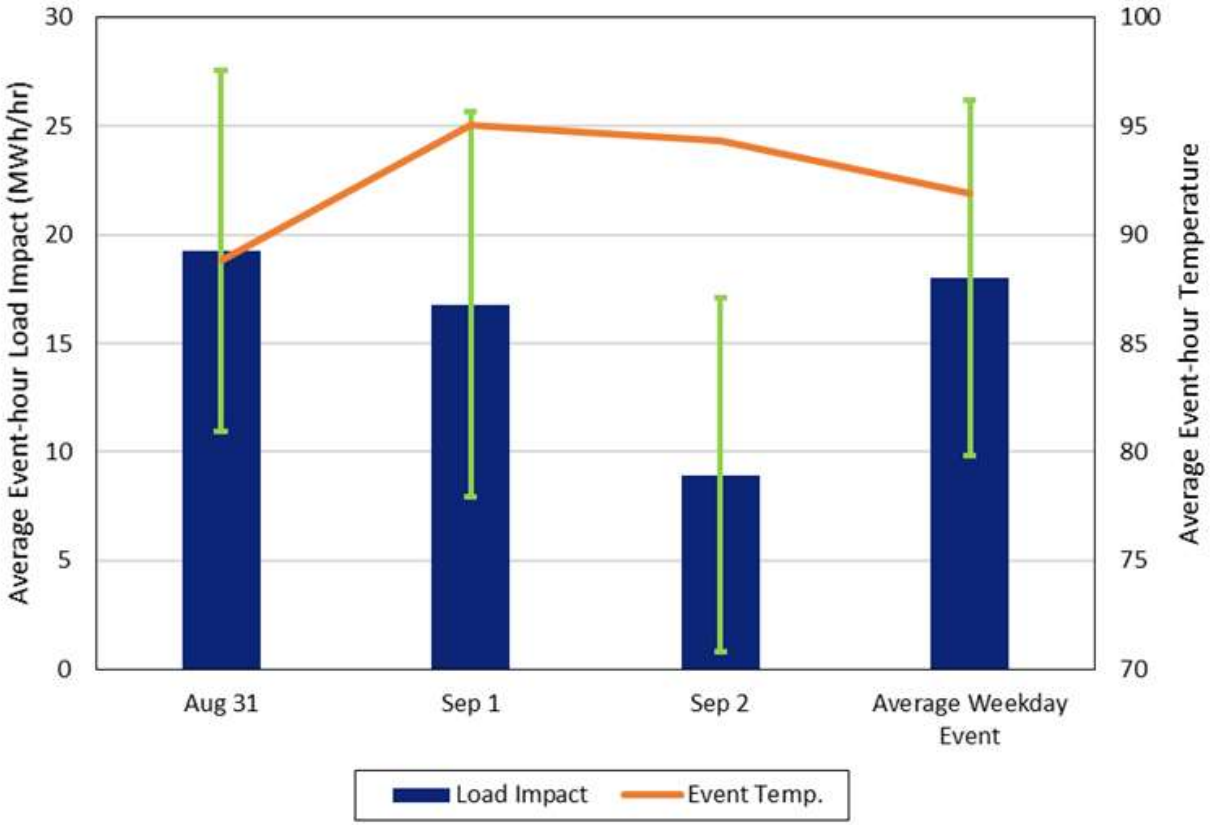
- Average load impact = 21.9 MW, or 3.9% of ref. load
- PY2016 average load impact was higher, at 34.4 MW (enrollment down 10%; per-customer load impact down 29%)
- SCE did not call an event on either the SCE or CAISO peak day

3. *Ex-post* Load Impacts:
SCE SMB



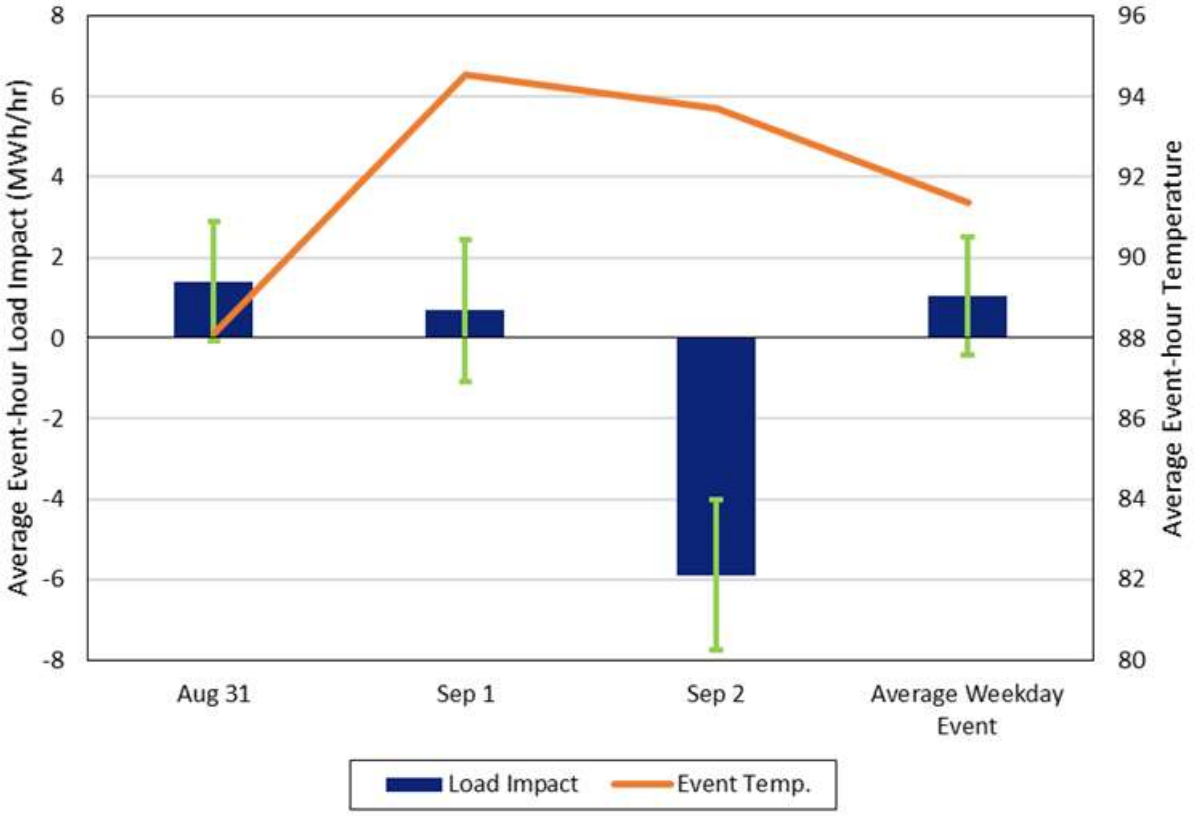
- Average load impact = 0.9 MW, or 1.0% of ref. load
- One day with wrong-signed load impact; another with a zero load impact
- Large uncertainty bands compared to other groups

3. *Ex-post* Load Impacts:
SDG&E Large



- Three events called on consecutive days, with the third event taking place on a Saturday
- Average weekday load impact = 18.0 MW, or 4.3% of ref. load
- Weekend load impact = 8.9 MW, or 2.9% of ref. load
- Load impact is substantially higher than the lone event in PY2016 (7.3 vs. 18.0 MW), with a higher per-customer load impact explaining the difference
- SDG&E and CAISO peak hour load impact (9/1, HE 16) = 16.3 MW for large customers and 17.4 MW including medium

3. *Ex-post* Load Impacts: *SDG&E Medium*



- Average weekday load impact = 1.0 MW, or 0.2% of ref. load (uncertainty band includes negative load impacts)
- Weekend load impact = -5.9 MW, or -1.6% of ref. load
- Wrong-signed weekend load impact likely due to lack of comparable non-event days (comparatively few weekend dates + event was very hot compared to other days)
- Weekday load impact was higher in 2016 (1.7% vs. 0.2%)

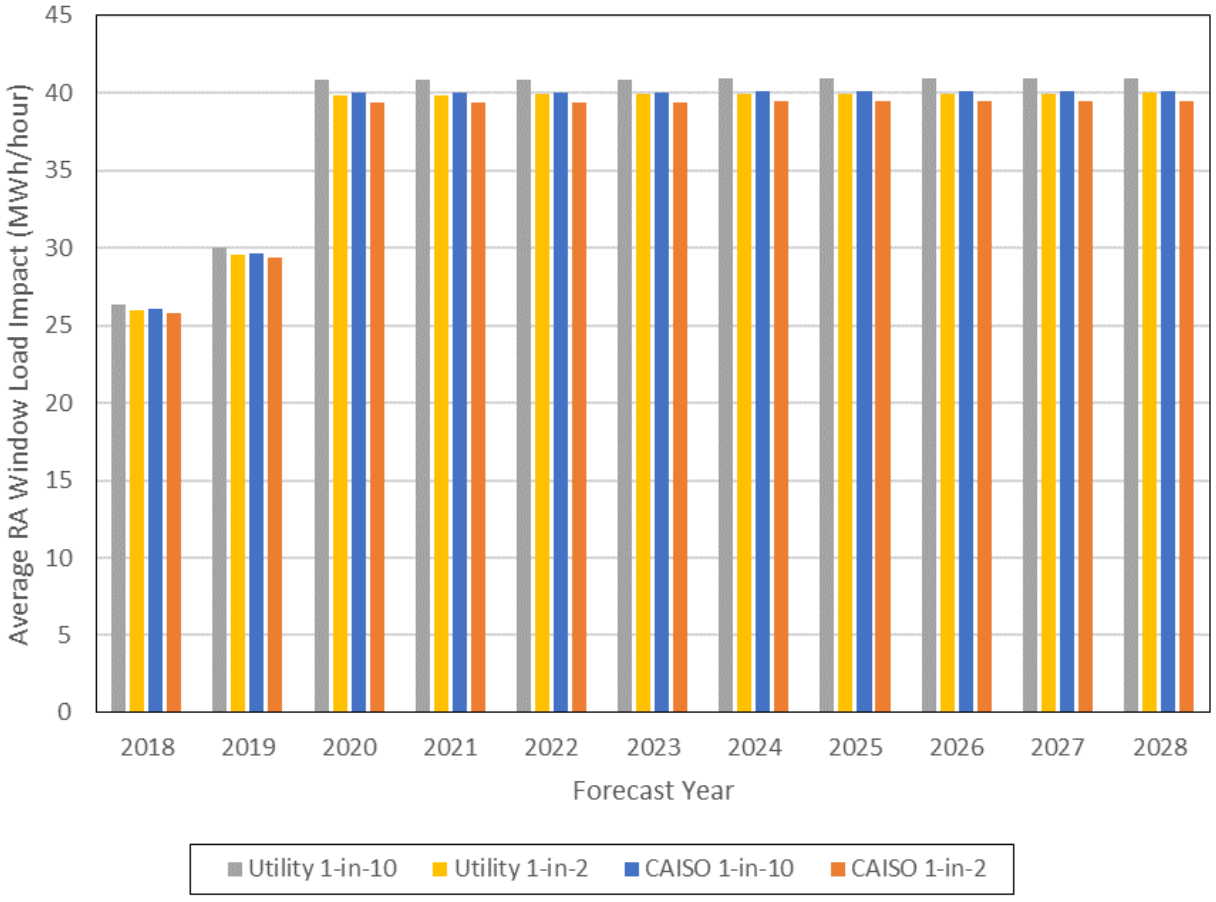
4. *Ex-ante* Methodology

- *Ex-ante* load impacts are based on *ex-post* estimates at the group level (*e.g.*, size and LCA for PG&E)
- We examined the relationship between weather and load impacts, but did not find consistent relationships
- *Ex-ante* % load impact = *ex-post* average weekday % load impact, by hour and group
- Reference loads are simulated using the following:
  - Group-level average per-customer regressions to obtain effect of weather and time-period indicators on usage
  - *Ex-ante* day types and weather conditions (*e.g.*, August peak month day in a utility-specific 1-in-2 weather year)
- SCE's SMB forecast is based on the previous evaluation's per-customer forecast scaled to the current enrollment forecast

5. Enrollment Forecast

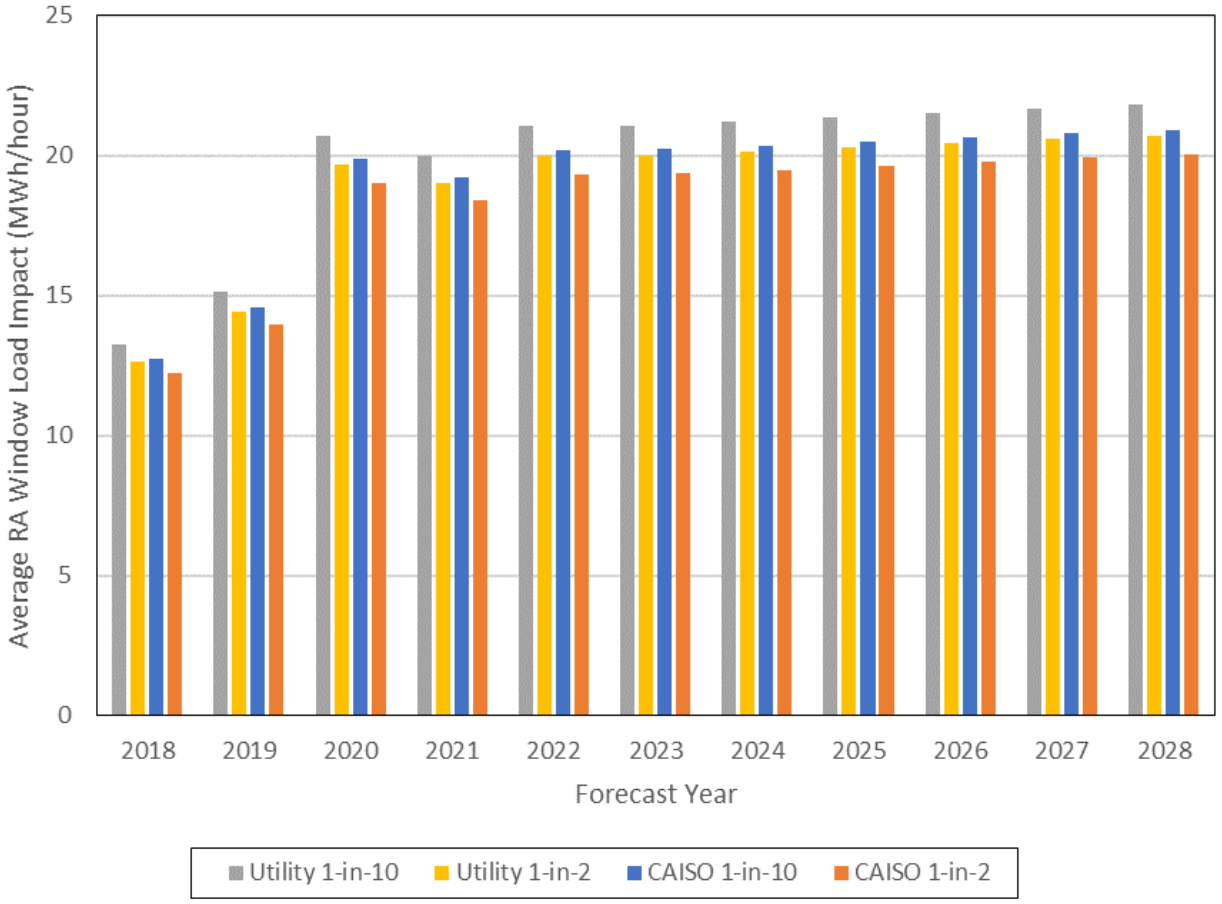
Utility	Size Group	2018 Enrollment	2019 Enrollment	2028 Enrollment
PG&E	Large	3,154	3,845	5,764
	Medium	53,798	61,496	94,354
	Small	181,295	203,633	291,644
SCE	Large	3,300	3,310	3,400
	Medium	0	34,795	13,915
	Small	0	215,205	86,082
SDG&E	Large	1,422	1,470	1,791
	Medium	10,879	10,770	9,839

6. *Ex-ante* Load Impacts:
PG&E Large C&I



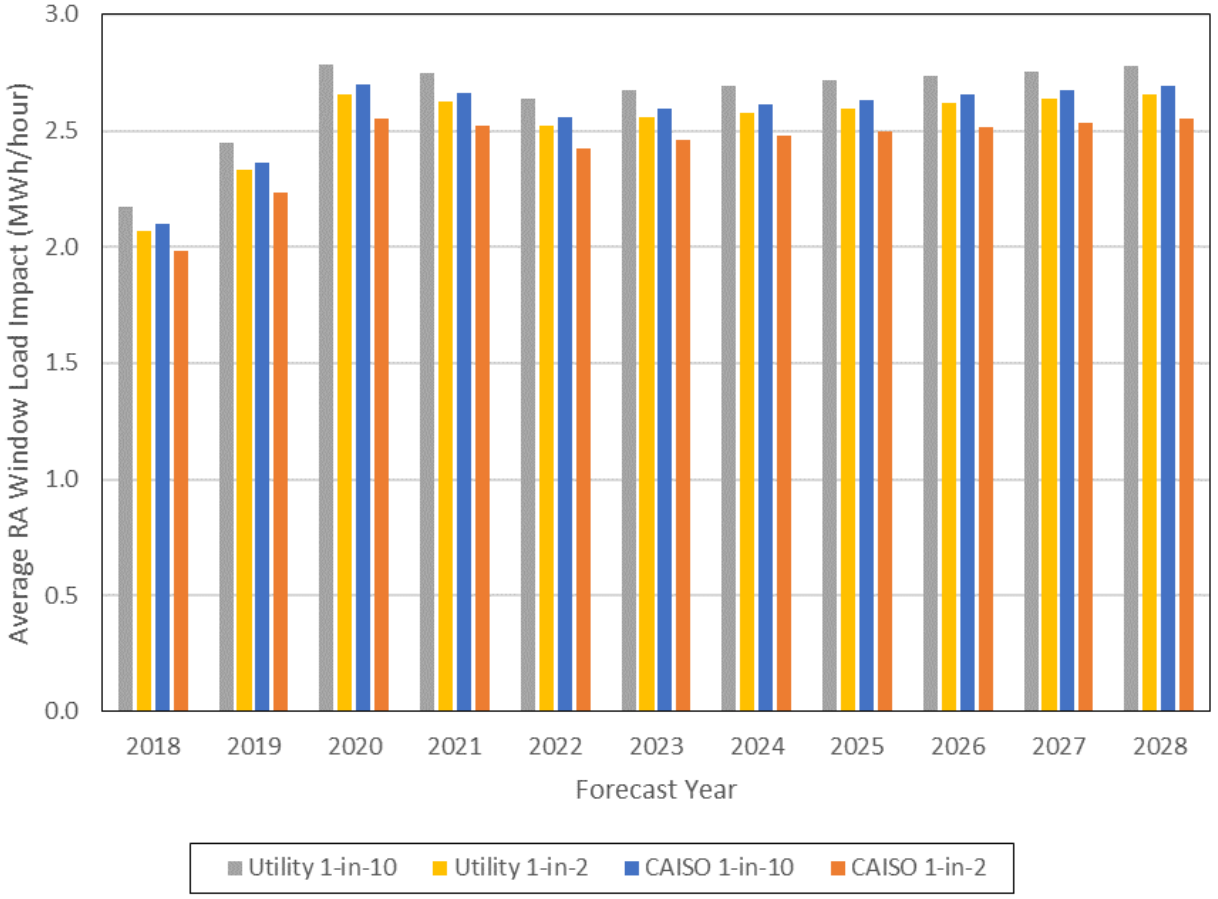
- Figure shows program-specific August average RA-window load impacts
- RA window includes a non-event hour, so the RA average is somewhat lower than the average event hour
- Changes in load impacts follow changes in enrollments across years
- 1-in-10 load impacts are somewhat higher than 1-in-2 load impacts
- Load impacts rise to around 40 MW in 2020 and remain there through 2028

6. *Ex-ante* Load Impacts:
PG&E Medium



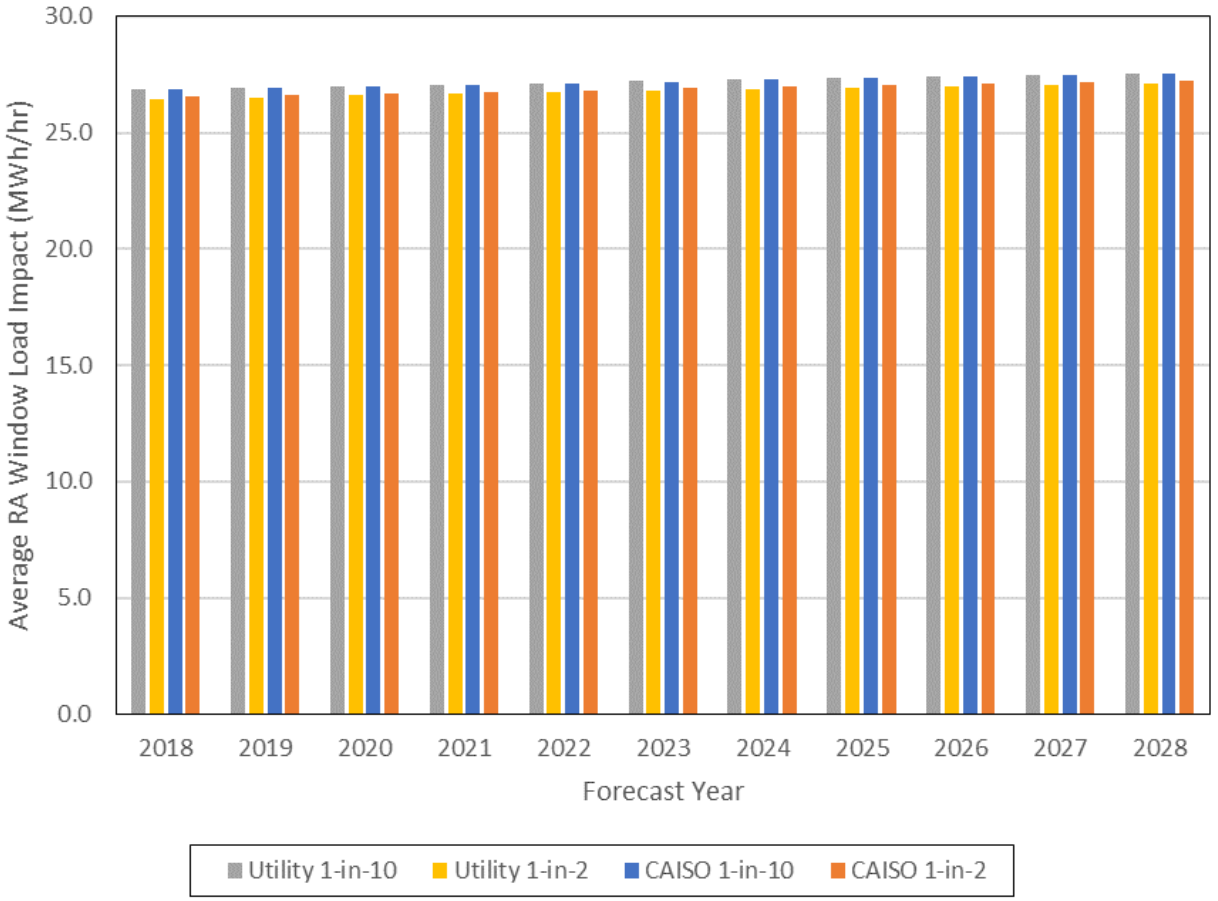
- Medium customer load impacts are somewhat more weather sensitive than large customer load impacts
- Load impacts rise to around 20 MW by 2020 and increase slowly through 2028

6. *Ex-ante* Load Impacts:
PG&E Small



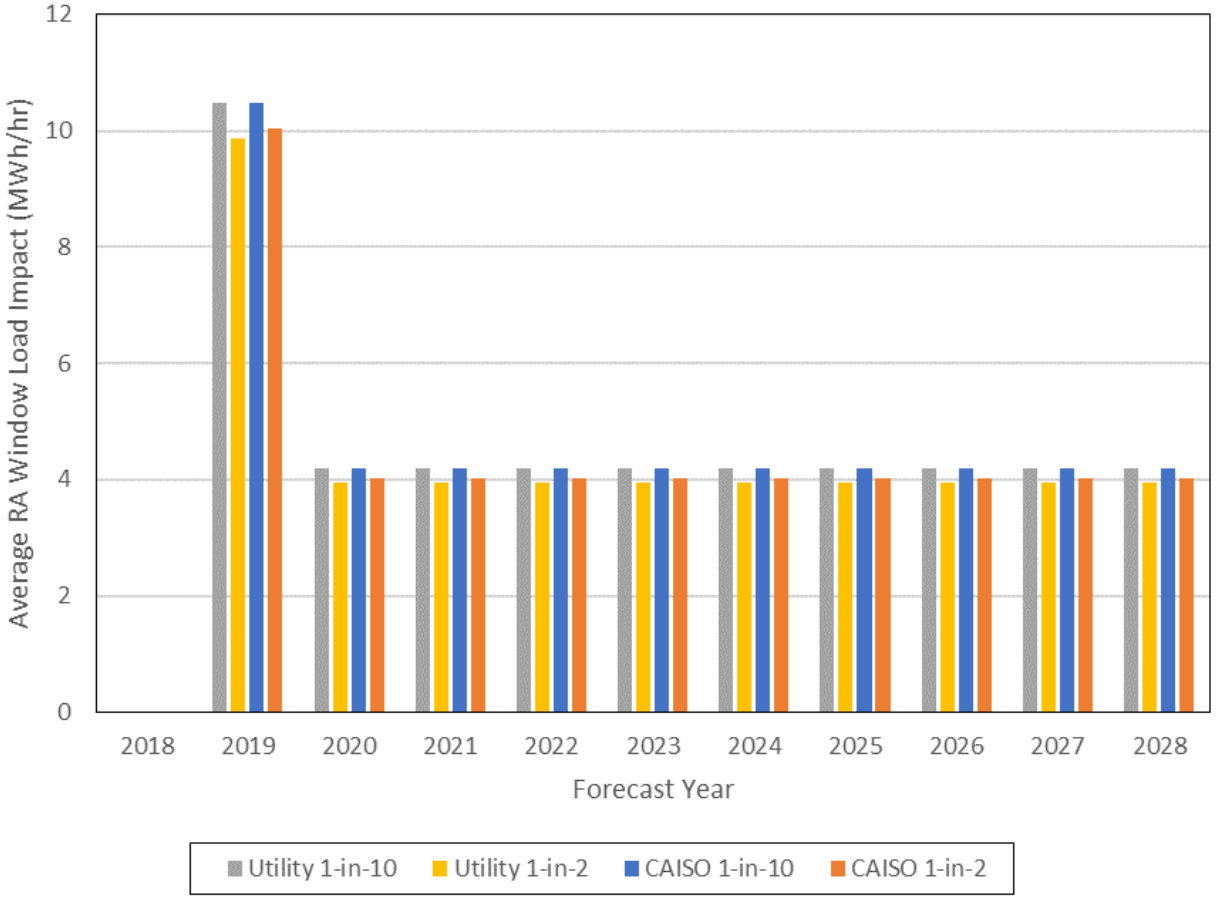
- Small customer impacts are forecast to rise more modestly over time, from around 2 MW to roughly 2.7 MW

6. *Ex-ante* Load Impacts:
SCE Large



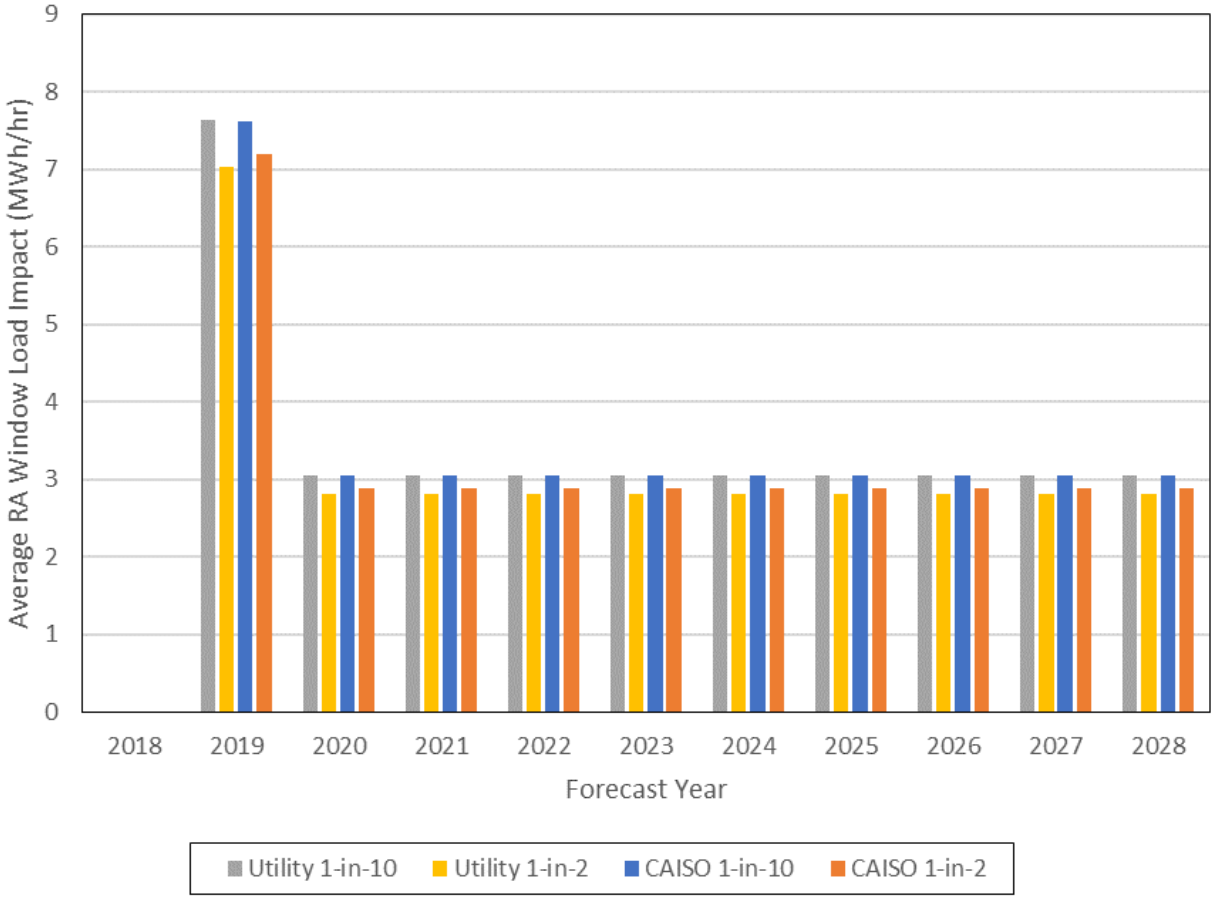
- As with PG&E, the RA window includes one non-event hour, reducing the average load impact
- The load impacts are quite stable throughout the forecast period, reflecting the stable enrollment forecast
- Not much weather sensitivity in their load impacts
- Load impact = ~27 MW

6. *Ex-ante* Load Impacts:
SCE Medium



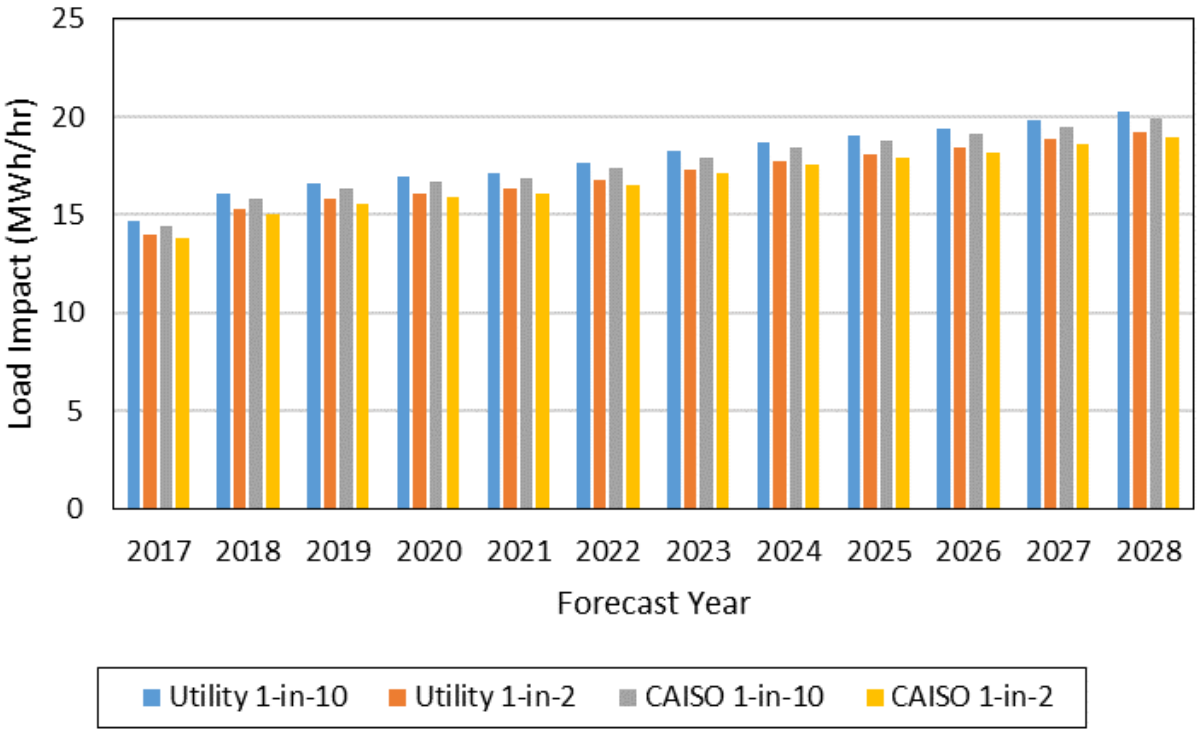
- The large reduction in load impacts between 2019 and 2020 reflects the underlying enrollment forecast
- After default in October 2018, SCE assumes 50% opt out in the first year and an additional 30% in the second year due to expiring bill protection
- Load impact stabilizes at approximately 4 MW in 2020-2028

6. *Ex-ante* Load Impacts:
SCE Small



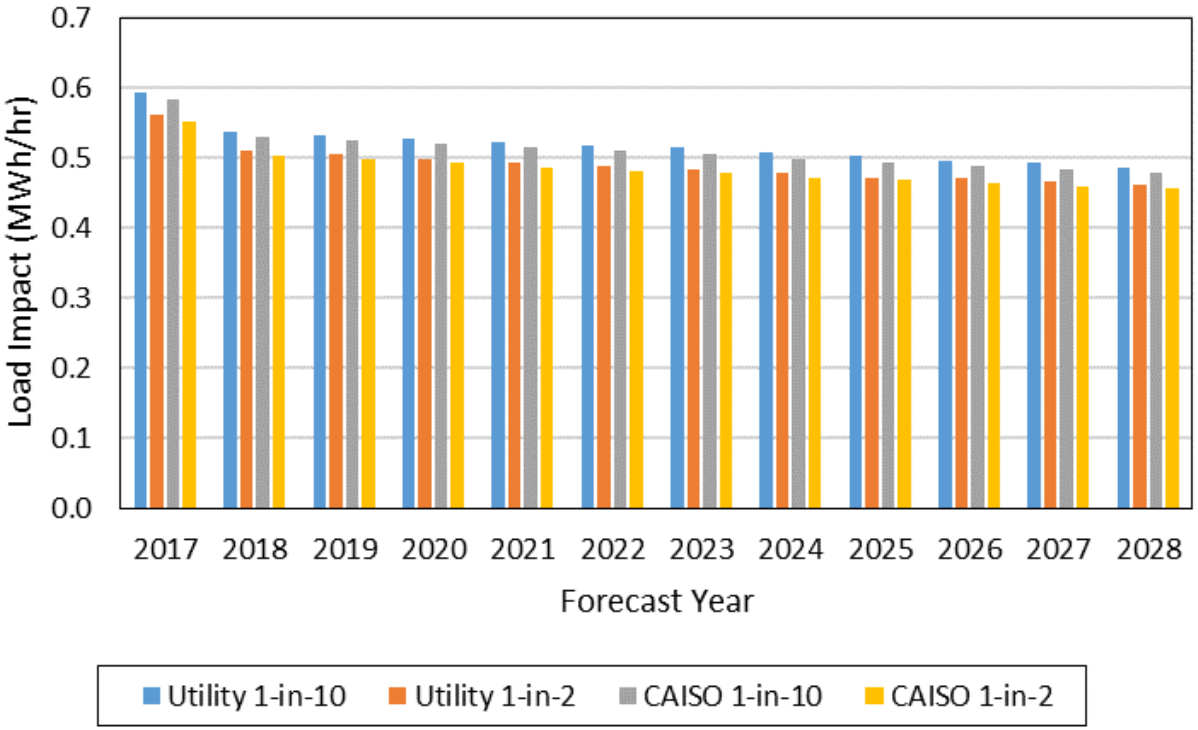
- The small customer enrollment forecast has the same opt-out assumptions as the medium customer enrollment forecast
- Load impact from 2020-2028 is approximately 3 MW

6. *Ex-ante* Load Impacts:
SDG&E Large



- SDG&E changed its event hours at the end of 2017, so the *ex-ante* event window matches that of PG&E and SCE
- We adapted the *ex-post* impacts to the new event window for the *ex-ante* study
- The figure shows RA window impacts, which include a non-event hour
- Load impacts grow steadily over the forecast period, consistent with the forecast ~2% increase in enrollments
- Load impacts reach 20 MW by 2028

6. *Ex-ante* Load Impacts: *SDG&E Medium*



- SDG&E forecasts medium customer enrollment to fall ~1% per year during the forecast period
- Total load impact falls approximately 10% from 2018 to 2028

6. *Ex-ante* Load Impacts:

Ex-post vs. Ex-ante Load Impacts

Utility	Size Group	Load Impact (MW)		Enrollment		% LI	
		Ex-post	*Ex-ante*	*Ex-post*	*Ex-ante*	*Ex-post*	*Ex-ante*
PG&E	Large	22.4	30.1	1,982	3,154	4.2%	3.5%
	SMB	15.0	16.5	203,183	235,093	1.1%	1.1%
SCE	Large	21.9	29.8	2,292	3,300	3.9%	3.7%
SDG&E	Large	18.0	18.5	1,281	1,422	4.3%	4.3%
	Medium	1.0	0.8	11,808	10,879	0.2%	0.2%

Reduced % LI is due to a change in the distribution of customers across LCAs

- *Ex-post* impacts represent average event-hour (weekday only for SDG&E)
- *Ex-ante* impacts represent the average event hour in August 2018 peak day under utility-specific 1-in-2 weather conditions
- *Ex-ante* forecast is consistent with the *ex-post* estimates
- Changes in total load impacts are largely driven by changes in enrollment

Questions?

- Contact – Dan Hansen,
  Christensen Associates Energy Consulting
  Madison, Wisconsin
  - dghansen@CAEnergy.com
  - 608-231-2266