

# SOUTHERN CALIFORNIA EDISON SUMMER DISCOUNT PLAN 2022 LOAD IMPACT EVALUATION

MAY 1, 2023



## SDP PROGRAM DESCRIPTION

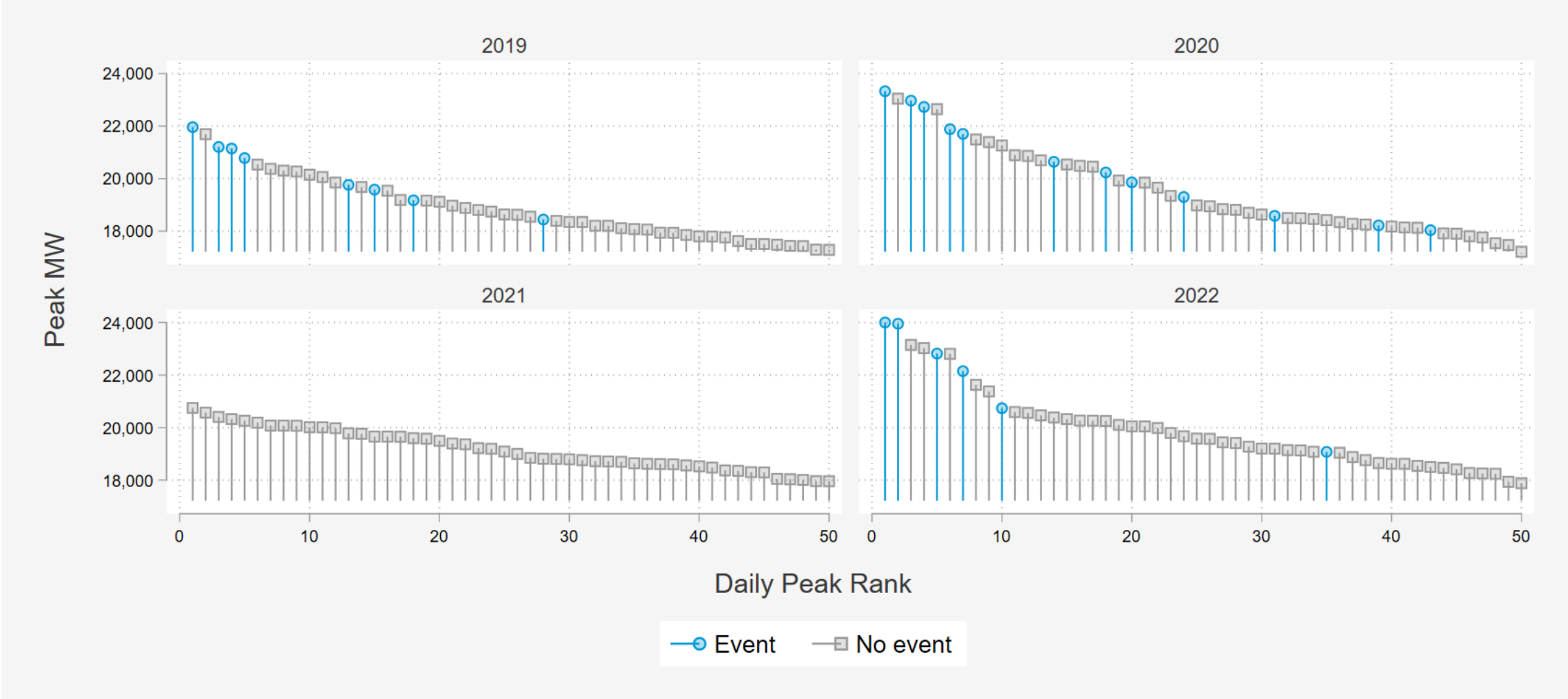
- SDP operates through temporary curtailment or reduction of participants' central air conditioners on days with high energy usage or high energy prices.
  - Participants have a load cycling switch installed on at least one air conditioner unit
  - Participants can elect to curtail load by 100%, 50%, or 30% (commercial only)
- SCE may dispatch SDP any month of the year, but total program dispatch is limited to 180 event hours annually.
- On a single day, dispatch of SDP is limited to a maximum of 6 hours.
- Evaluation objectives:
  - Estimate the demand reductions that were delivered via 2022 operations
  - Quantify the magnitude of reductions available during peaking conditions used for planning

# THE SDP PROGRAM IS AN AC CYCLING PROGRAM, WHERE EVENTS ARE DISPATCHED BY GEOGRAPHICALLY DEFINED REGIONAL SUBGROUPS

Load Control Group	30% Cycling		50% Cycling		100% Cycling	
	Residential	Commercial	Residential	Commercial	Residential	Commercial
SDP-C-1	-	31	4,371	184	21,556	469
SDP-C-2	-	112	3,511	241	14,986	540
SDP-C-3	-	18	1,312	41	6,771	114
SDP-C-4	-	74	5,752	293	24,748	687
SDP-HD	-	18	1,093	62	9,796	247
SDP-LD	-	1	31	2	147	11
SDP-N	-	53	3,432	145	18,115	638
SDP-NW	-	28	1,089	138	6,502	312
SDP-W-1	-	60	4,407	338	18,134	556
SDP-W-2	-	168	3,340	568	16,936	1,138
<b>TOTAL</b>	-	<b>563</b>	<b>28,338</b>	<b>2,012</b>	<b>137,691</b>	<b>4,712</b>

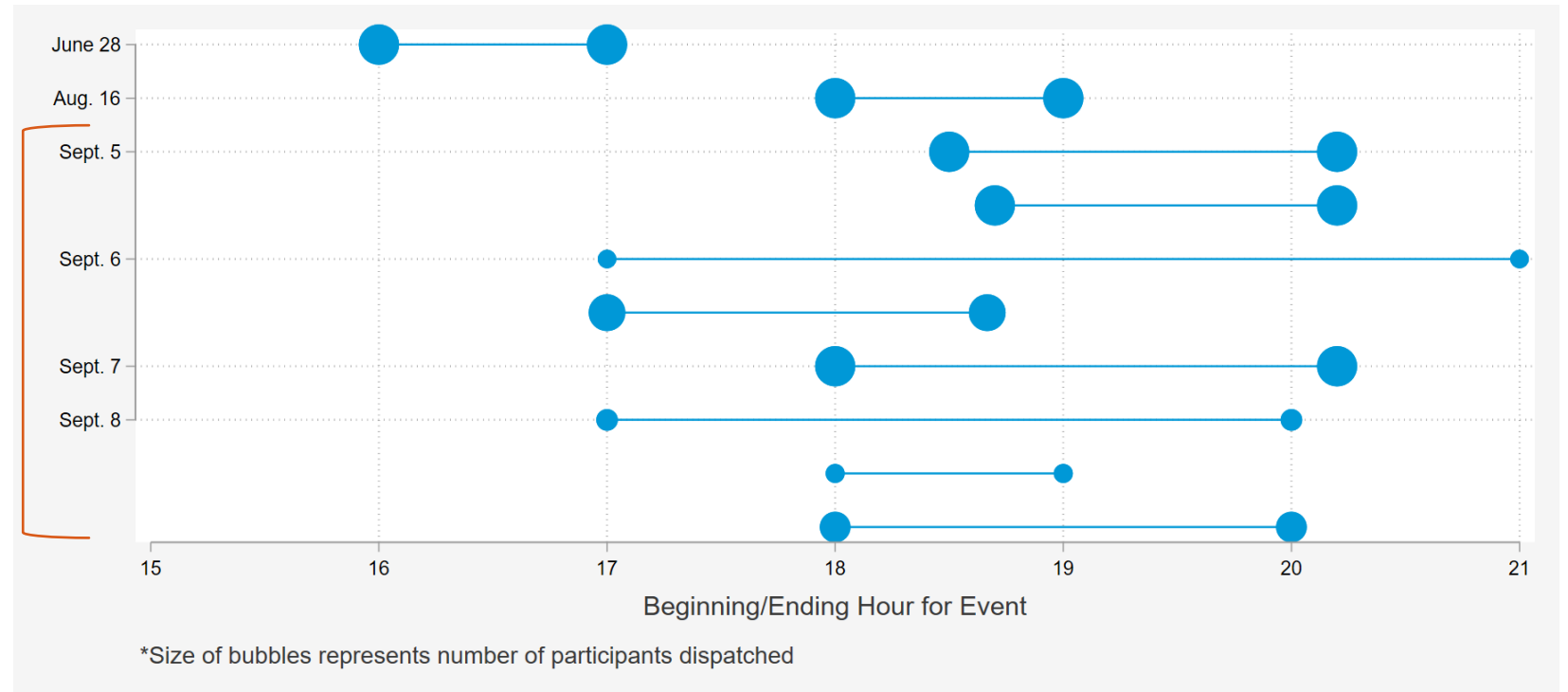
- ~80% of participants, tonnage, and devices are in 100% cycling
- ~50% of resources are in the SCE-Central SubLAP
- ~13% of participants have solar
- ~28% of SDP-R participants are low income (CARE or FERA)
- Schools and religious organizations account for ~81% of SDP-C tonnage

# 2022 SYSTEM PEAK LOADS WERE HIGHER THAN PREVIOUS YEARS



# EVENTS WERE CONCENTRATED IN EARLY SEPTEMBER

- Back-to-back events
- An event was called on the Labor Day holiday
- Overlapping interventions affected control customers, meaning our control customers were not unperturbed
  - FLEX Alert
  - ELRP
  - Emergency Notification (9/6)

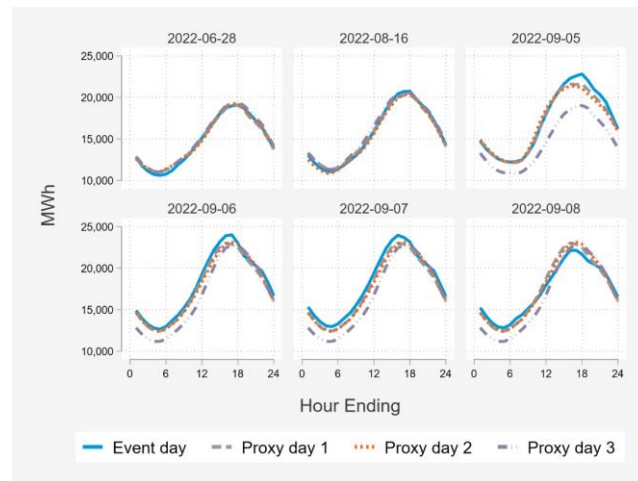




# ESTIMATING DEMAND REDUCTIONS DELIVERED VIA 2022 OPERATIONS

## Proxy Day Selection

- Three proxy days were selected for each event day based on SCE system load



## Matched Controls

- A single control customer was chosen for each participant based on individual load during proxy days
- Hard matching:
  - Residential – NEM, climate group, and size
  - Commercial – Industry + Size
- Propensity score matching with replacement

## Regression Analysis

- Difference-in-differences panel regression
- For each event day, the corresponding proxy event day was used to net out differences between the treatment and control group that were not due to the intervention.
- Hourly event impacts estimated by subcategory and across all customers

# QUANTIFYING THE MAGNITUDE OF REDUCTIONS AVAILABLE DURING PEAKING CONDITIONS USED FOR PLANNING

## Ex post Impacts

- What were the reductions delivered?
- Varies based on:
  - ✓ Temperature
  - ✓ Magnitude of resources dispatched
  - ✓ Hours of dispatch
  - ✓ Length of dispatch
  - ✓ Program/rate changes
  - ✓ Participant mix

## Adjustments

- Standardize weather
- Assume full dispatch of resources available
- Standardize hours and length of dispatch
- Incorporate program/rate changes
- Adjust for project enrollment changes

## Ex ante Impacts

- What is the magnitude of program resources available under planning conditions defined by weather?
- SCE and CAISO weather conditions
- 1-in-2 (normal) versus 1-in-10 (extreme) weather conditions
- Different day-types
  - Monthly peak day
  - Average month day
- By month

# 2022 SDP-R EVALUATION RESULTS

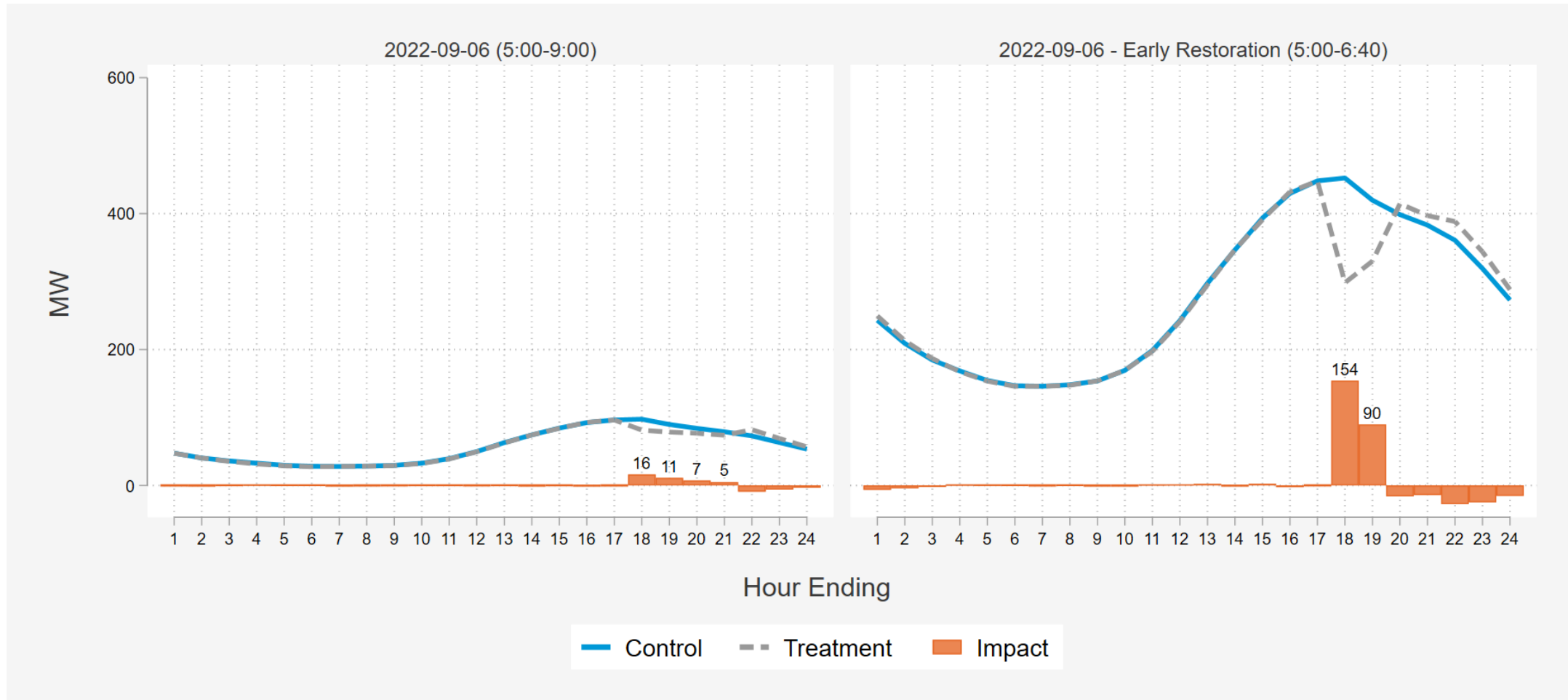


# SUMMARY OF IMPACTS FOR EACH EVENT – FULL EVENT HOURS

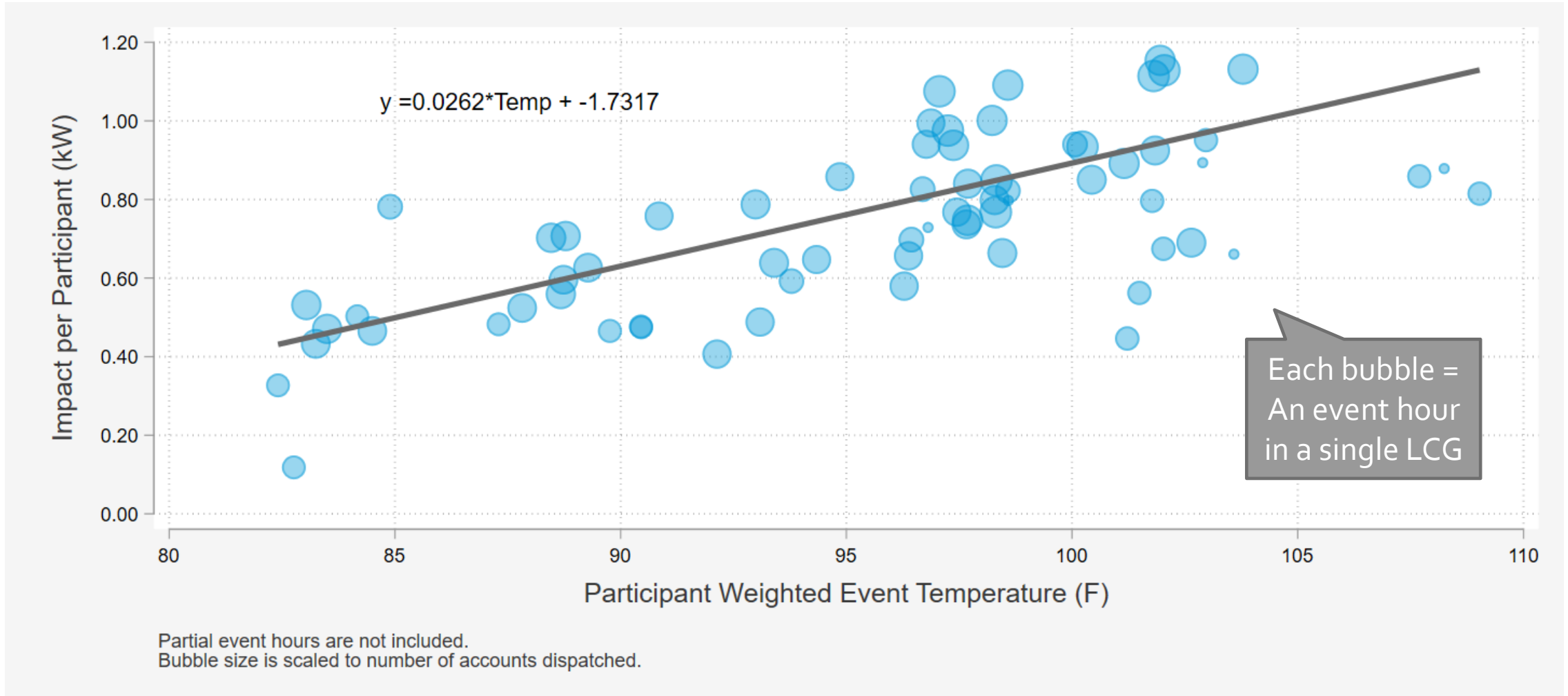
Date	Load Control Groups	Event start	Event end	Accts	MW Metric					Impact per ... (kW)			% Impact	Wght. Avg. Event Temp (F)
					Reference Load	Load with DR	Impact	90% Lower Bound	90% Upper Bound	Acct	Device	Ton		
6/28/2022	All	4:00 PM	5:00 PM	165,381	391	265	126	121	132	0.76	0.66	0.18	32.2%	93.6
8/16/2022	All	6:00 PM	7:00 PM	164,674	449	324	125	120	130	0.76	0.65	0.18	27.8%	92.0
9/5/2022*	Excl. LD	6:30 PM	8:12 PM	164,733	538	395	144	138	149	0.87	0.75	0.21	26.7%	98.1
9/6/2022*	All	5:00 PM	9:00 PM	28,134	88	78	10	9	11	0.35	0.32	0.09	11.3%	96.3
	All –Early Restoration	5:00 PM	6:40 PM	136,487	452	298	154	150	159	1.13	0.97	0.27	34.1%	99.0
9/7/2022*	All	6:00 PM	8:12 PM	164,550	498	362	136	131	141	0.83	0.71	0.20	27.3%	96.4
9/8/2022	W-1, W-2	5:00 PM	8:00 PM	40,290	107	83	25	23	26	0.61	0.55	0.15	22.9%	94.3
	C-1, C-2, C-3, C-4, NW	6:00 PM	8:00 PM	92,781	257	189	68	64	73	0.74	0.62	0.17	26.6%	97.4
	HD, LD, N	6:00 PM	7:00 PM	31,134	84	63	21	20	22	0.68	0.59	0.17	25.3%	96.4
<b>Avg. Event</b>		<b>First Event Hour</b>		<b>164,694</b>	<b>500</b>	<b>360</b>	<b>140</b>	<b>137</b>	<b>142</b>	<b>0.85</b>	<b>0.73</b>	<b>0.20</b>	<b>27.9%</b>	<b>96.7</b>

\* Only full hours are included in impact estimates; System peak day in blue

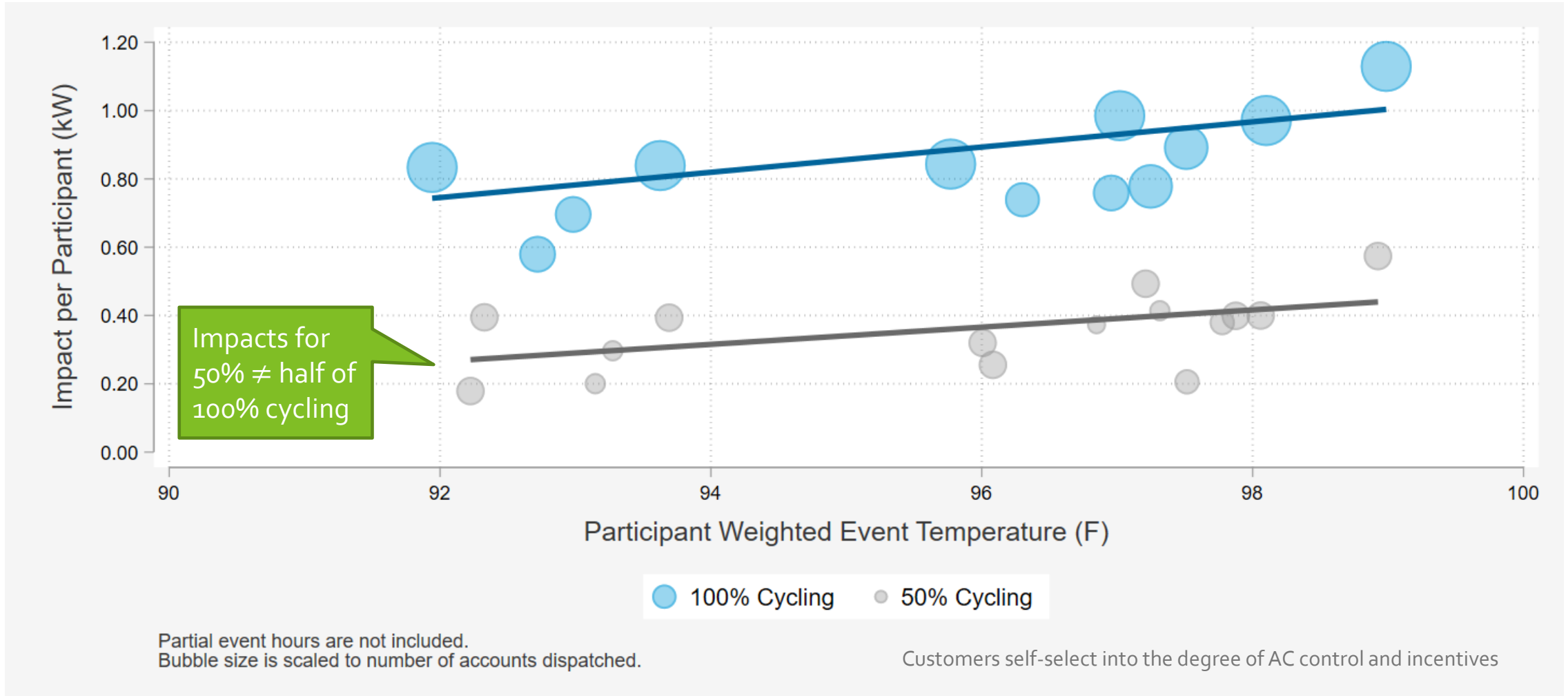
# SDP-R REDUCED DEMAND BY 170 MW DURING THE FULL EVENT HOUR ON THE PEAK DAY



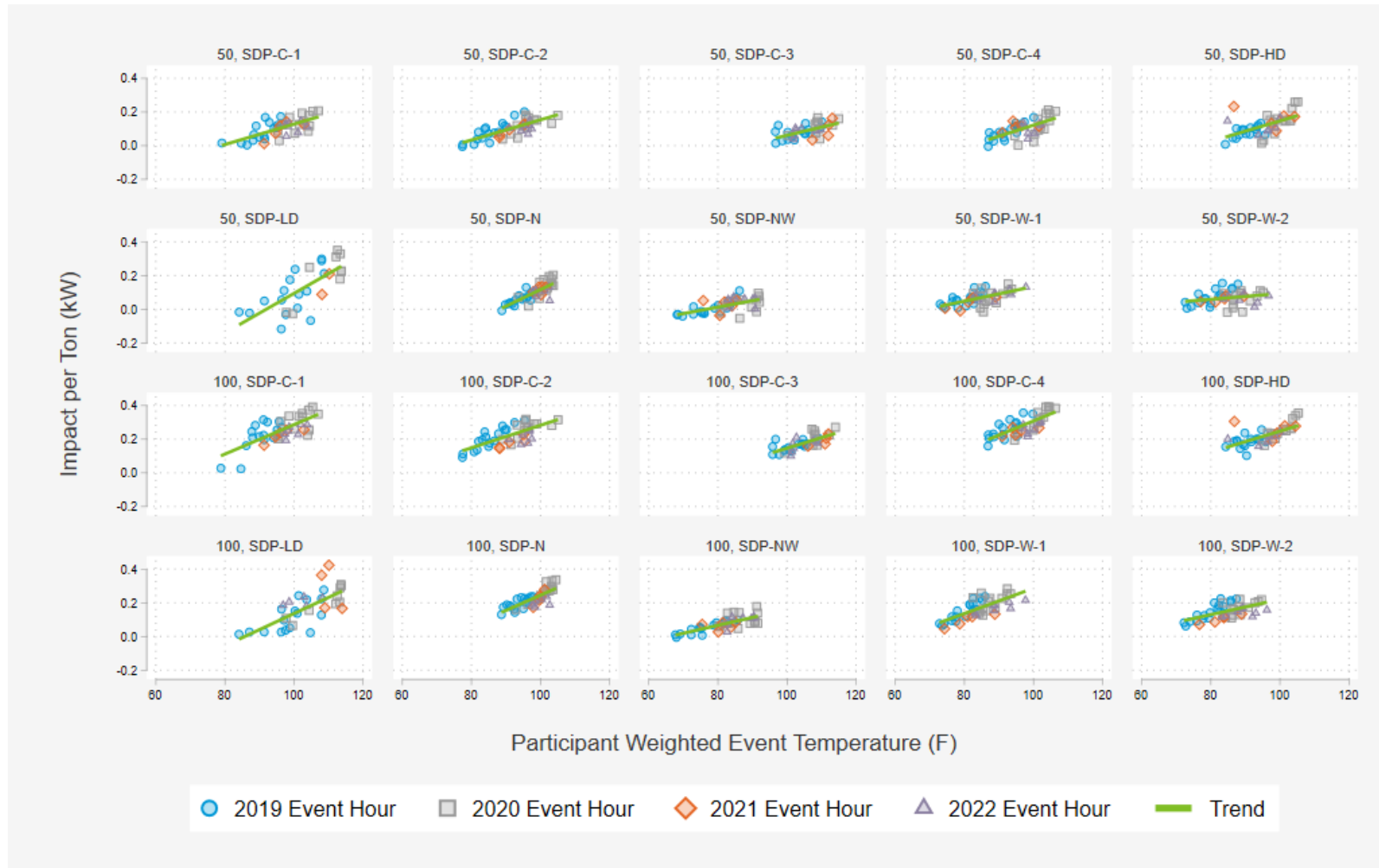
# RESIDENTIAL RELATIONSHIP BETWEEN REDUCTIONS AND WEATHER



# IMPACTS FOR KEY SEGMENTS – CYCLING STRATEGY



# WE USED PER TON IMPACTS FROM 2019-2022 TO MODEL REDUCTIONS AS FUNCTION OF TEMPERATURE AND HOUR



- Done by load control group and cycling strategy
- Population varies by load control group
- Load control groups have different event history
- At low end temperatures, impacts are flatten out to near zero impacts

# EX-ANTE IMPACTS – PROJECTED DEMAND REDUCTIONS UNDER STANDARDIZED WEATHER CONDITIONS

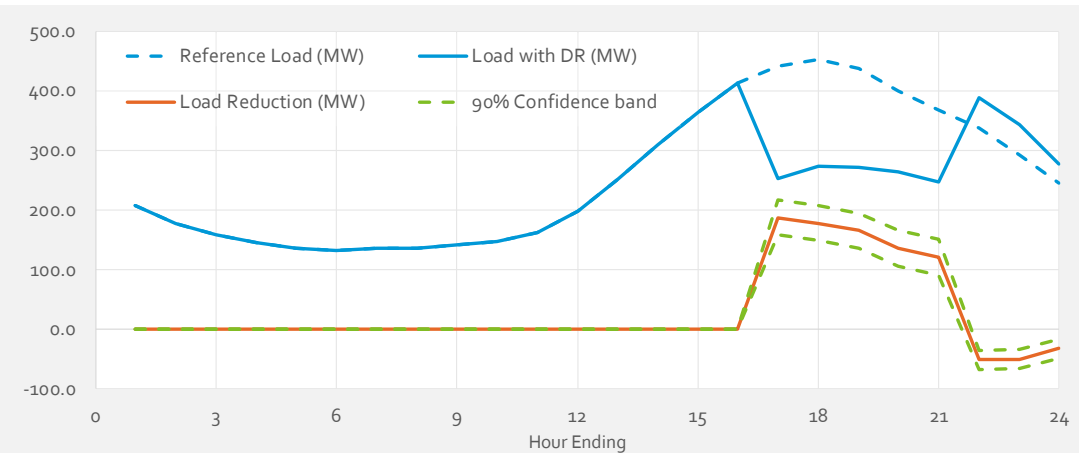
## Forecast Year 2023 Load Impacts on the 1-in-2 August Peak Day

Table 1: Menu options

Type of result	Aggregate
Category	All
Segment	All Customers
Weather Data	SCE
Weather Year	1-in-2
Day Type	August Monthly Peak Day
Forecast Year	2023
Portfolio Level	Program

Table 2: Event day information

Event start	4:00 PM
Event end	9:00 PM
Total sites	158,203
Total devices	184,721
Total cooling tons	671,727
Event window temperature (F)	91.1
Event window load reduction (MW)	157.29
% Load reduction (Event window)	37.5%
Redaction Information	Public

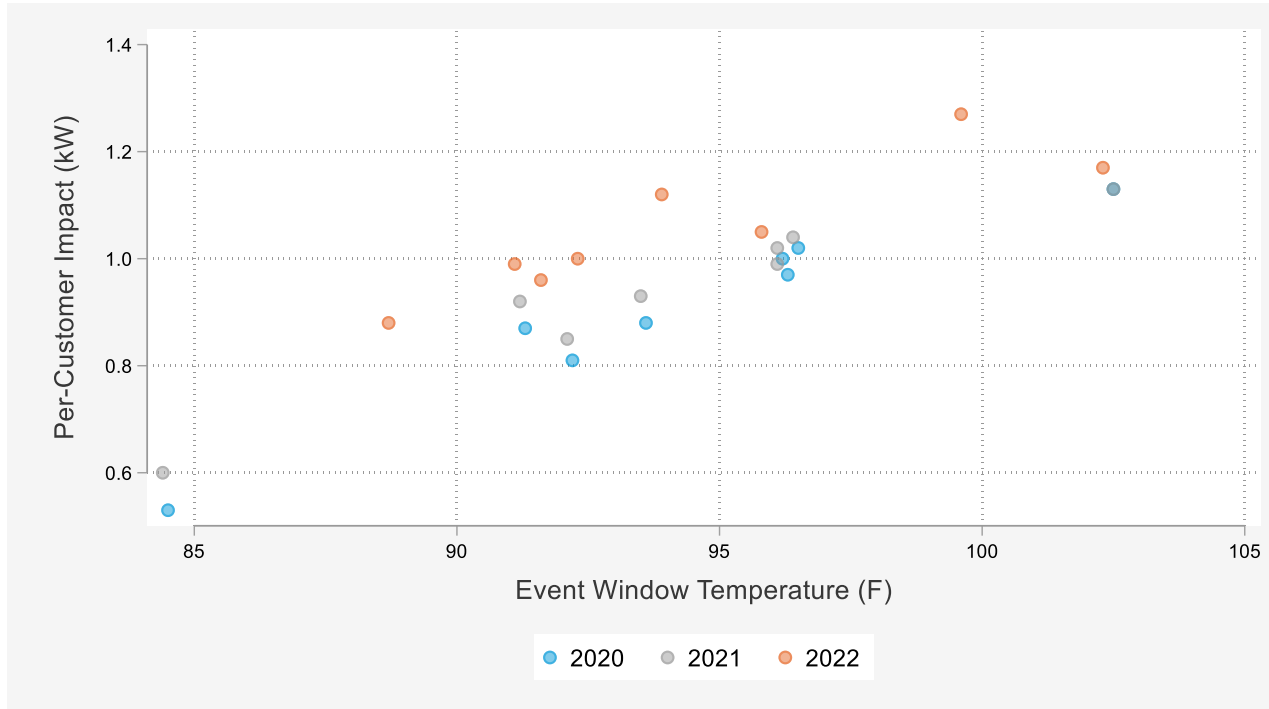


## August Peak Day Ex-Ante Aggregate Load Reductions

Forecast Year	Enrollment Forecast	SCE Weather		CAISO Weather	
		1-in-2	1-in-10	1-in-2	1-in-10
2023	158,203	157	177	148	173
2024	151,042	150	169	141	165
2025	144,316	143	161	135	157
2026	137,998	137	154	129	150



# SCE PER CUSTOMER IMPACTS COMPARISON TO PRIOR YEARS



- Data Leveraged
  - PY 2022
    - Reference Loads: 2021 and 2022
    - Impact Modelling: 2019-2022
  - PY 2021
    - Reference Loads: 2019 and 2021
    - Impact Modelling: 2019-2021
  - PY 2020
    - Reference loads and impact modelling from 2018-2020
- Ex-ante weather was updated in 2022

Month	Vintage Year 2020		Vintage Year 2021		Vintage Year 2022	
	1-in-2	1-in-10	1-in-2	1-in-10	1-in-2	1-in-10
June	0.53	0.97	0.60	0.99	0.88	1.05
July	0.81	1.13	0.85	1.13	0.96	1.17
August	0.87	1.00	0.92	1.02	0.99	1.12
September	0.88	1.02	0.93	1.04	1.00	1.27

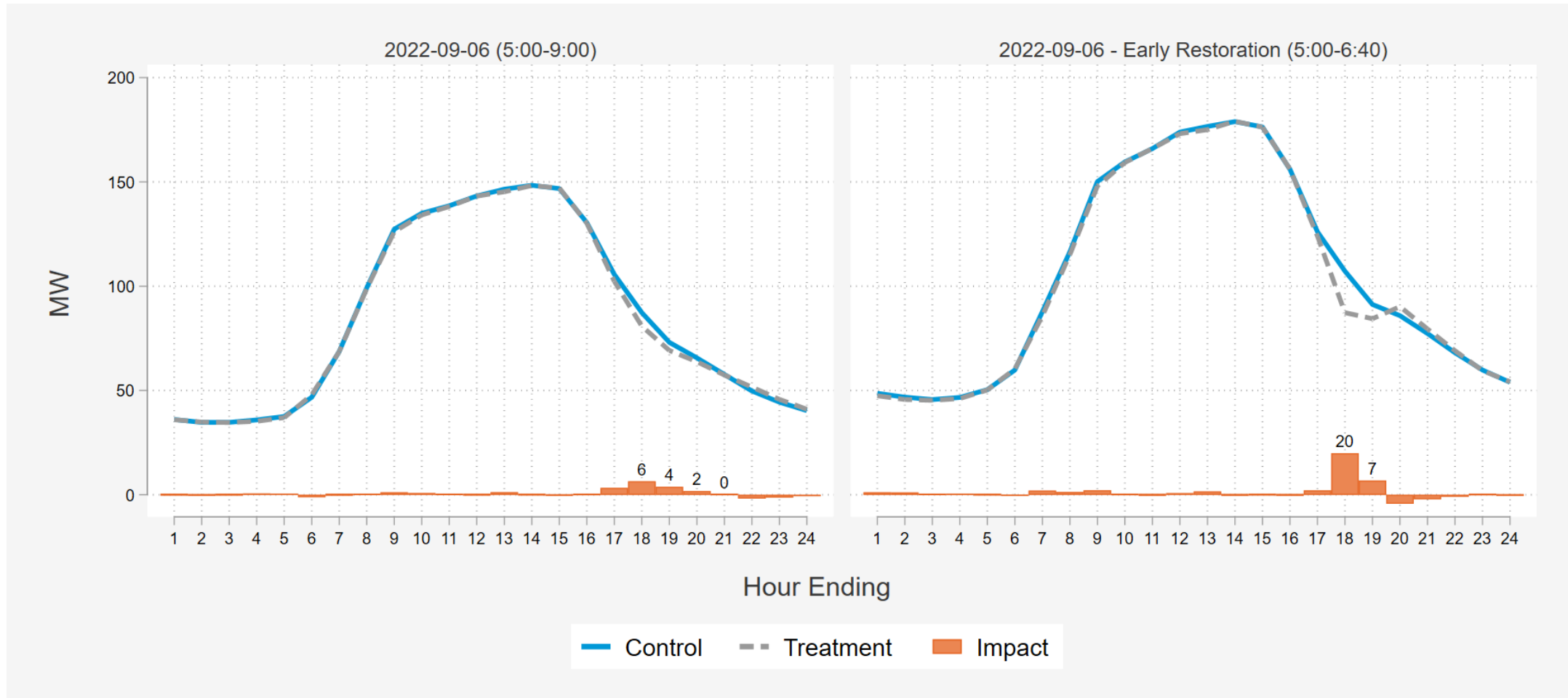
# 2022 SDP-C EVALUATION RESULTS

# SUMMARY OF IMPACTS FOR EACH EVENT – FULL EVENT HOURS

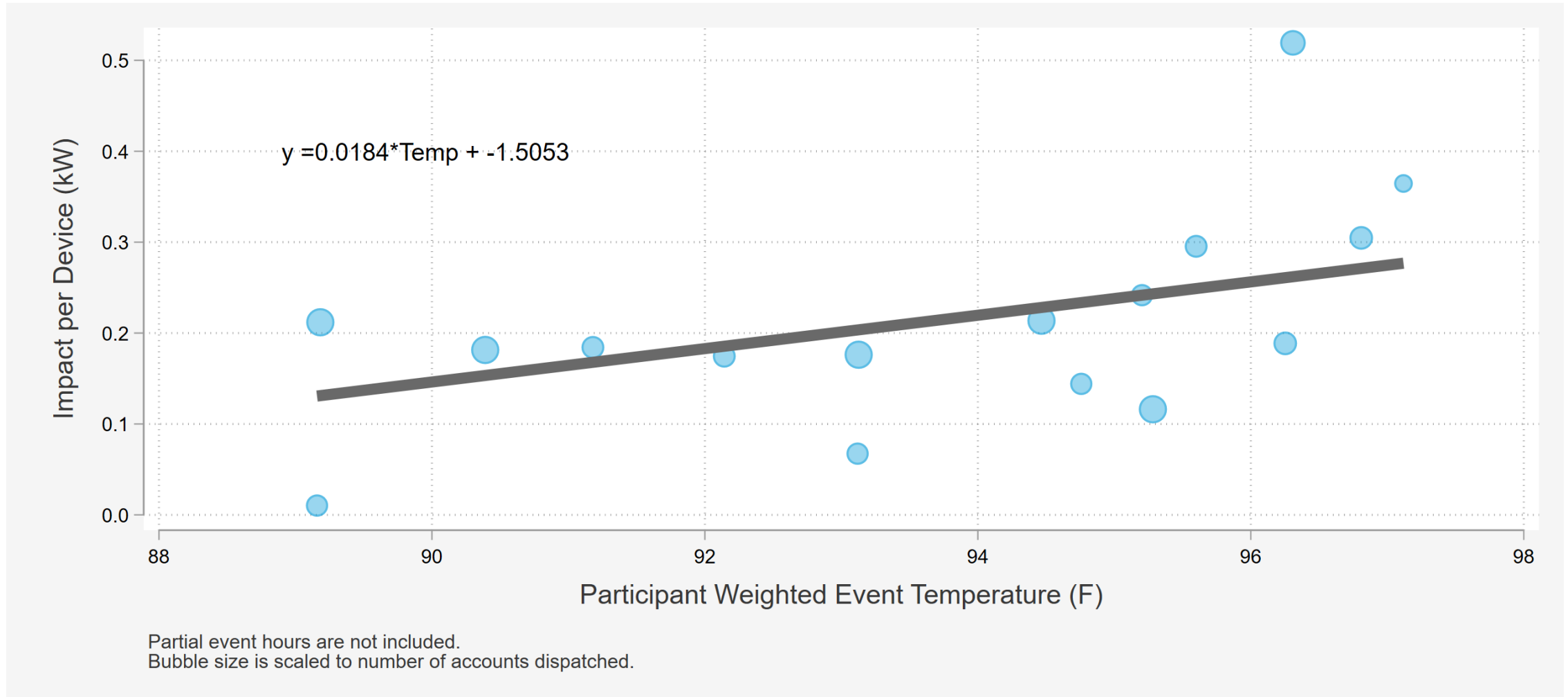
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8/16/2022	All	6:00 PM	7:00 PM	7,193	137	124	14	8	20	1.92	0.21	0.04	10.1%	89.2
9/5/2022*	Excl. LD	6:30 PM	8:12 PM	7,171	115	108	8	4	11	1.06	0.12	0.02	6.6%	95.3
9/6/2022*	All	5:00 PM	9:00 PM	2,545	71	68	3	0	6	1.22	0.12	0.02	4.4%	93.1
	All – Early Restoration	5:00 PM	6:40 PM	4,624	107	87	20	15	24	4.30	0.52	0.10	18.5%	96.3
9/7/2022*	All	6:00 PM	8:12 PM	7,169	160	148	13	6	19	1.77	0.19	0.04	7.9%	93.8
9/8/2022	W-1, W-2	5:00 PM	8:00 PM	2,848	74	69	5	2	9	1.83	0.22	0.05	7.0%	93.0
	C-1, C-2, C-3, C-4, NW	6:00 PM	8:00 PM	3,235	70	62	7	3	12	2.30	0.25	0.05	10.7%	96.5
	HD, LD, N	6:00 PM	7:00 PM	1,084	24	20	4	2	6	3.68	0.36	0.07	16.4%	97.1
<b>Avg. Event</b>		<b>First Event Hour</b>		<b>7,186</b>	<b>158</b>	<b>143</b>	<b>15</b>	<b>12</b>	<b>19</b>	<b>2.14</b>	<b>0.24</b>	<b>0.05</b>	<b>9.7%</b>	<b>94.2</b>

\* Only full hours are included in impact estimates; System peak day in blue

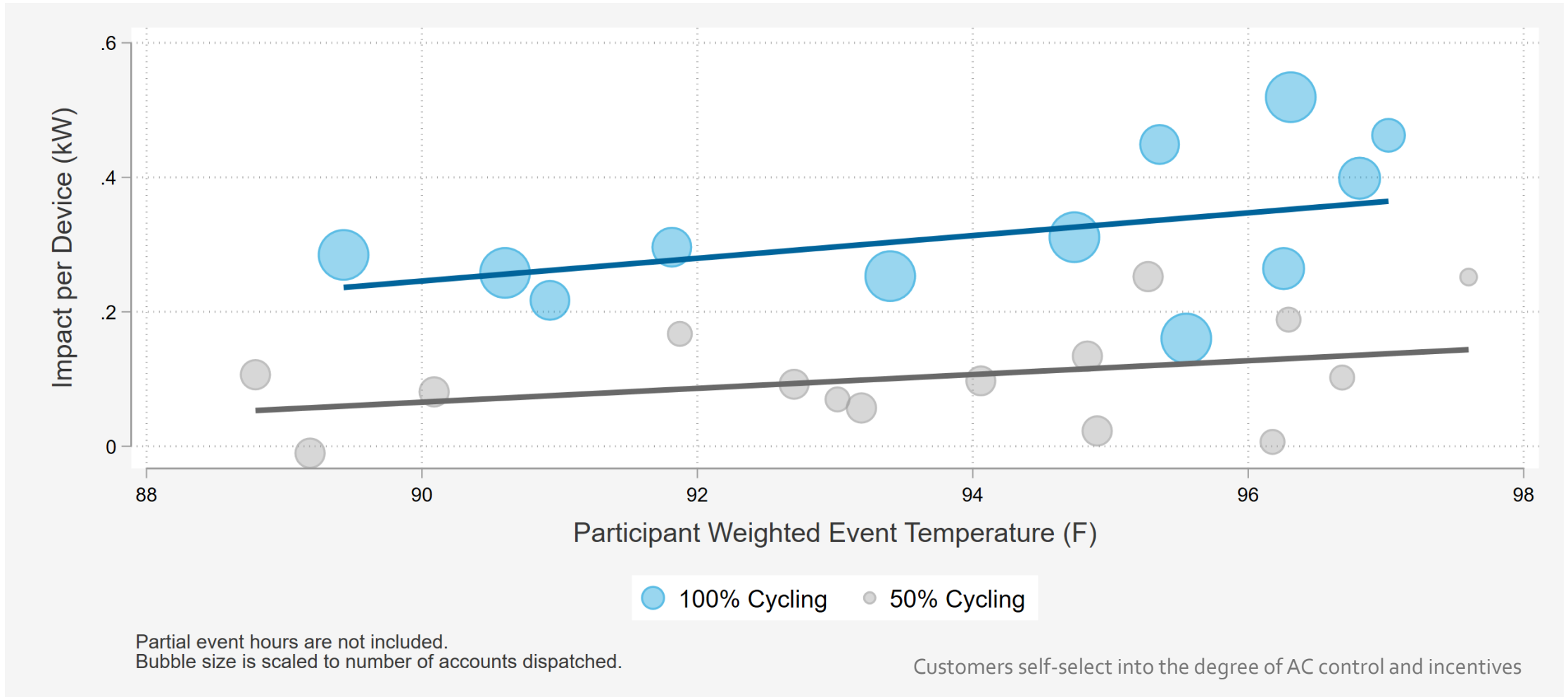
# SDP-C REDUCED DEMAND BY 26 MW DURING THE FULL EVENT HOUR ON THE PEAK DAY



# COMMERCIAL RELATIONSHIP BETWEEN REDUCTIONS AND WEATHER

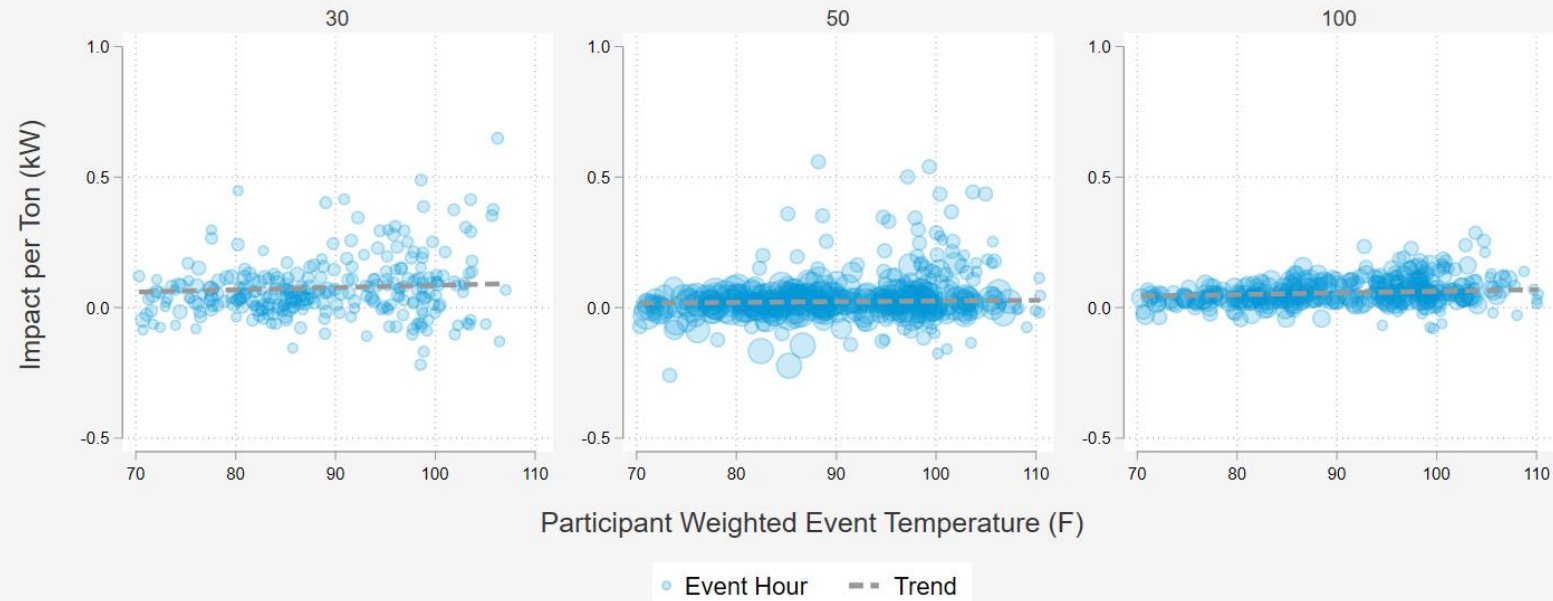


# IMPACTS FOR KEY SEGMENTS – CYCLING STRATEGY





# WE USED PER TON IMPACTS FROM 2018, 2019, AND 2022 TO MODEL REDUCTIONS AS FUNCTION OF TEMPERATURE AND HOUR



Each bubble represents an event hour. Bubble sizes are proportional to the number of devices dispatched. Only full event hours between 4-9 PM and where more than 100 customers were dispatched are included in the plot.

- Removed the years most affected by COVID-19
- Done by load control group and cycling strategy
- Population varies by cycling strategy
  - 64% of devices are in the 100% cycling group, 28% and 8% for 50% cycling and 30% cycling respectively
  - 50% cycling has the lowest average tonnage per device

# EX-ANTE IMPACTS – PROJECTED DEMAND REDUCTIONS UNDER STANDARDIZED WEATHER CONDITIONS

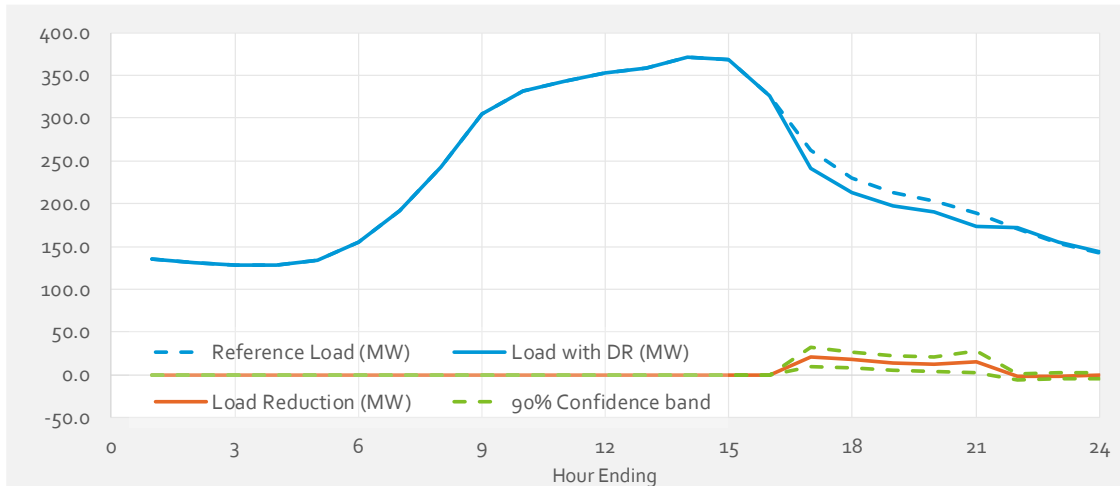
## Forecast Year 2023 Load Impacts on the 1-in-2 August Peak Day

Table 1: Menu options

Type of result	Aggregate
Category	All
Segment	All Customers
Weather Data	SCE
Weather Year	1-in-2
Day Type	August Monthly Peak Day
Forecast Year	2023
Portfolio Level	Program

Table 2: Event day information

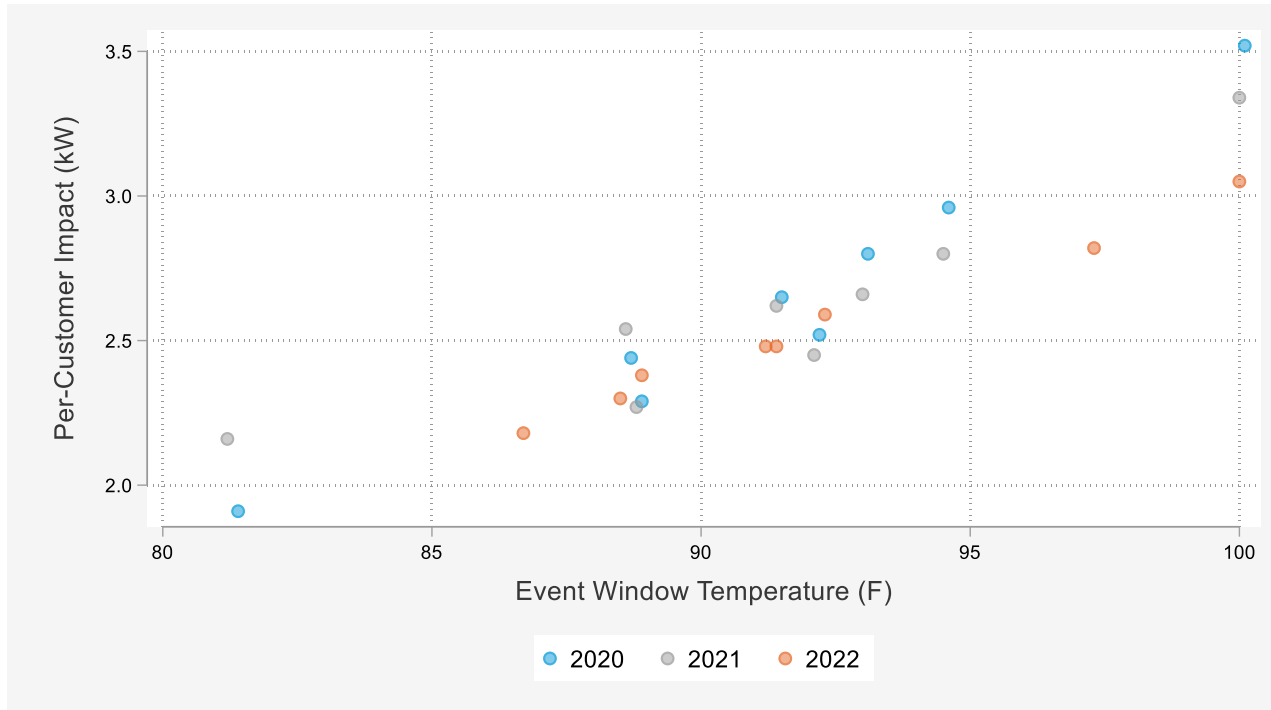
Event start	4:00 PM
Event end	9:00 PM
Total sites	6,815
Total devices	61,377
Total cooling tons	305,565
Event window temperature (F)	88.9
Event window load reduction (MW)	16.21
% Load reduction (Event window)	7.4%
Redaction Information	Public



## August Peak Day Ex-Ante Aggregate Load Reductions

Forecast Year	Enrollment Forecast	Total Devices	SCE Weather		CAISO Weather	
			1-in-2	1-in-10	1-in-2	1-in-10
2023	6,815	61,377	16.2	16.9	15.4	16.7
2024	6,510	58,631	15.5	16.1	14.7	15.9
2025	6,220	56,019	14.8	15.4	14	15.2
2026	5,944	53,533	14.1	14.7	13.4	14.5

# SCE PER CUSTOMER IMPACTS COMPARISON TO PRIOR YEARS



## Data Leveraged

- **PY 2022**
  - Reference Loads: 2022
  - Impact Modelling: 2018, 2019, 2022
- **PY 2021**
  - Reference Loads: 2019 and 2021
  - Impact Modelling: 2018-2021
- **PY 2020**
  - Reference loads and impact modelling from 2018-2020

- Refined the placebo day selection in 2021
- Ex-ante weather was updated in 2022

Month	Vintage Year 2020		Vintage Year 2021		Vintage Year 2022	
	1-in-2	1-in-10	1-in-2	1-in-10	1-in-2	1-in-10
June	1.91	2.52	2.16	2.45	2.18	2.59
July	2.44	3.52	2.54	3.34	2.30	3.05
August	2.29	2.80	2.27	2.66	2.38	2.48
September	2.65	2.96	2.62	2.80	2.48	2.82

# DISCUSSION & RECOMMENDATIONS

## Discussion

- SDP has the capability to deliver large magnitudes of flexible loads at very fast ramp rates, delivering larger reductions when the weather is more extreme and resources are needed most.
  - Comprised of ~1 million tons of air conditioning
- The magnitude of SDP resources has been declining in recent years.
  - Increased attrition has coincided with lower incentives and a higher number of events

## Recommendations

- Develop a time-temperature matrix to address differences between operations and planning conditions
- Add weekend days to the load impact protocol ex-ante tables and include weekend "test" events
- Include "test" event operations to fully assess the load reduction capability
  - Facilitates comparison between ex post and ex ante results
- Make sure to dispatch "test" events that include enough variation to understand program performance
  - Acknowledges the various population groupings

# QUESTIONS?



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