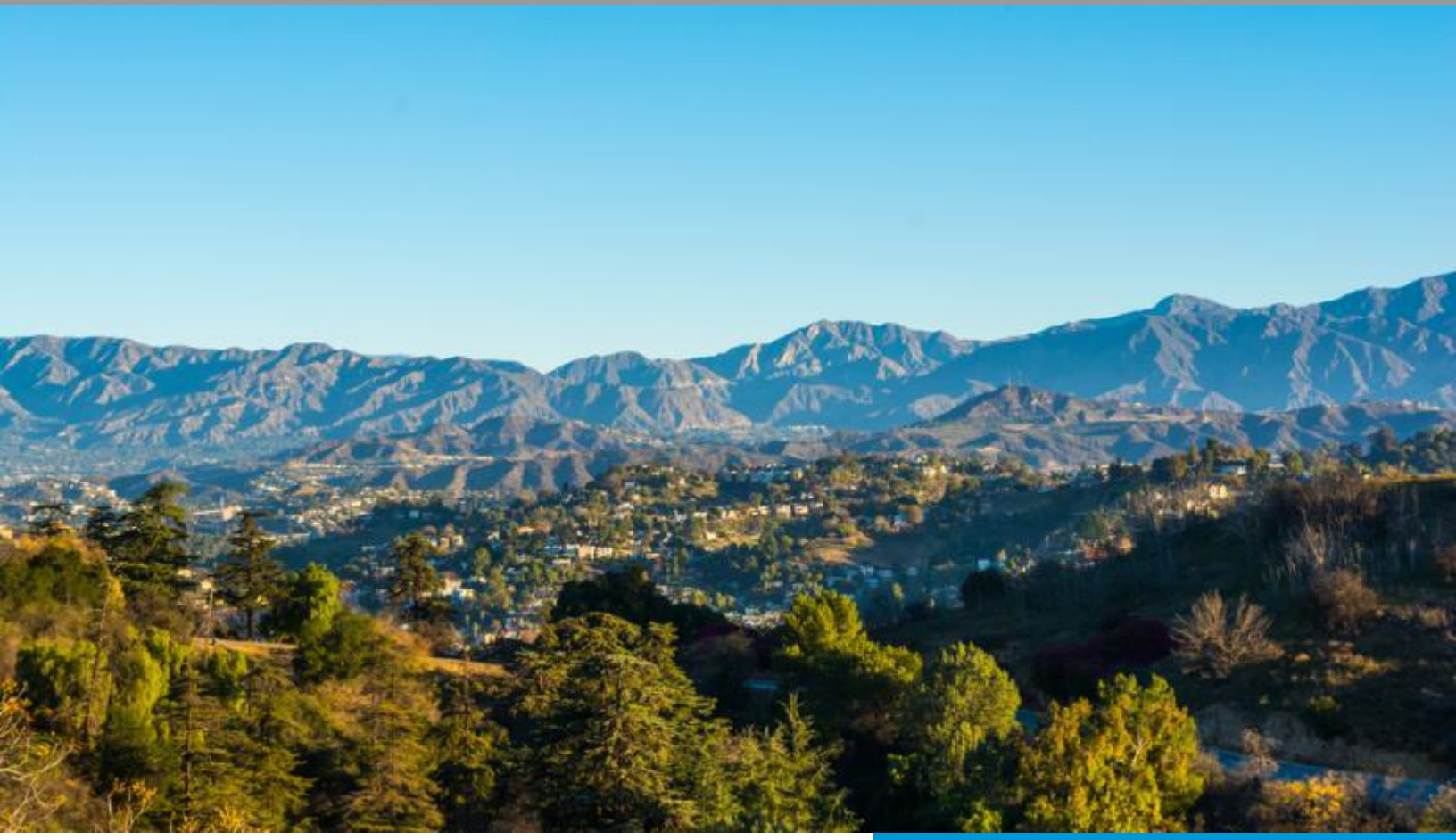
Demand Side Analytics
DATA DRIVEN RESEARCH AND INSIGHTS

Program Year 2021 Southern California Edison Summer Discount Plan Impact Evaluation



Confidential information is redacted and denoted with black highlighting: [redacted]

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ABSTRACT

This study analyzes the impact of Southern California Edison's Summer Discount Plan program for a range of weather conditions and dispatch hours. Summer Discount Plan is a voluntary demand response program that provides incentives to residential and non-residential customers who allow SCE to manage the use of their air conditioner when grid conditions require additional resources. The impacts were evaluated using a quasi-experimental design where a matched control customer was identified for each participant. The load impacts were calculated via difference-in-differences by comparing the energy use of participants and the control customer during event and hot non-event days. The SDP program has approximately 180,000 residential customers enrolled and includes nearly 204,000 control devices and 774,000 tons of air conditioner load. Approximately 84% of residential customers elect the higher incentive option, allowing SCE to curtail air conditioner demand (100% cycling) during SDP demand response events. On the commercial side, there are approximately 7,700 customers enrolled with about 69,000 control devices and nearly 350,000 tons of air conditioner load. Roughly 65% of customers elect the higher incentive, accounting for 62% of the total commercial air conditioner load. During the system peak day, the SDP program reduced demand by 166 MW on the first and only event hour. Compared to prior years, 2021 was a substantially cooler year, with lower air conditioner loads, and lower SCE system demand.

During normal (1-in-2) August peak day planning conditions, participants can reduce demand by 166 MW across the five-hour 4:00–9:00 PM peak window. In practice, program resources are dispatched by grid location, with varying event times and under different weather conditions.

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1 EXECUTIVE SUMMARY

This report presents the load impacts of the program year 2021 Summer Discount Plan (SDP). SDP is a voluntary demand response program that provides incentives to customers who allow Southern California Edison to curtail or reduce the use of their central air conditioner on summer days with high energy usage or high energy prices. The report has two primary objectives: estimate the demand reductions that were delivered via 2021 operations and quantify the magnitude of reductions available during peaking conditions used for planning over the next eleven years (2022 – 2032).

1.1 SDP RESIDENTIAL KEY FINDINGS

The SDP Residential (SDP-R) program has approximately 180,000 customers enrolled and includes nearly 204,000 control devices and 774,000 tons of air conditioner load. Approximately 84% of customers elect the higher incentive option, which allows SCE to fully curtail air conditioner demand (100% cycling) during SDP demand response (DR) events. During normal (1-in-2) peaking conditions, participant loads peak at 462 MW, and participants can curtail demand by 150 MW on average during the 4–9 PM peak window. For extreme planning conditions (1-in-10), participant loads peak at 514 MW, and participants can reduce demand by 166 MW on average during the 4–9 PM peak window.[1]

Figure 1 summarizes the per participant demand reductions for each event hour as a function of temperature. Demand reductions grow larger in magnitude when temperatures are hotter and resources are needed most. Table 1 summarizes the reductions attained during full event hours for each event in the evaluation period (from October 2020 through September 2021). For full event hours, average impacts were in the neighborhood of 0.75 kW per participant, and percent impacts were generally around 29%.

[1] August Monthly Peaky Day using SCE Weather for 1-in-2 and 1-in-10 Peaking conditions.

Figure 1: Relationship between SDP-R Demand Reductions and Weather (R^2 = 0.83)

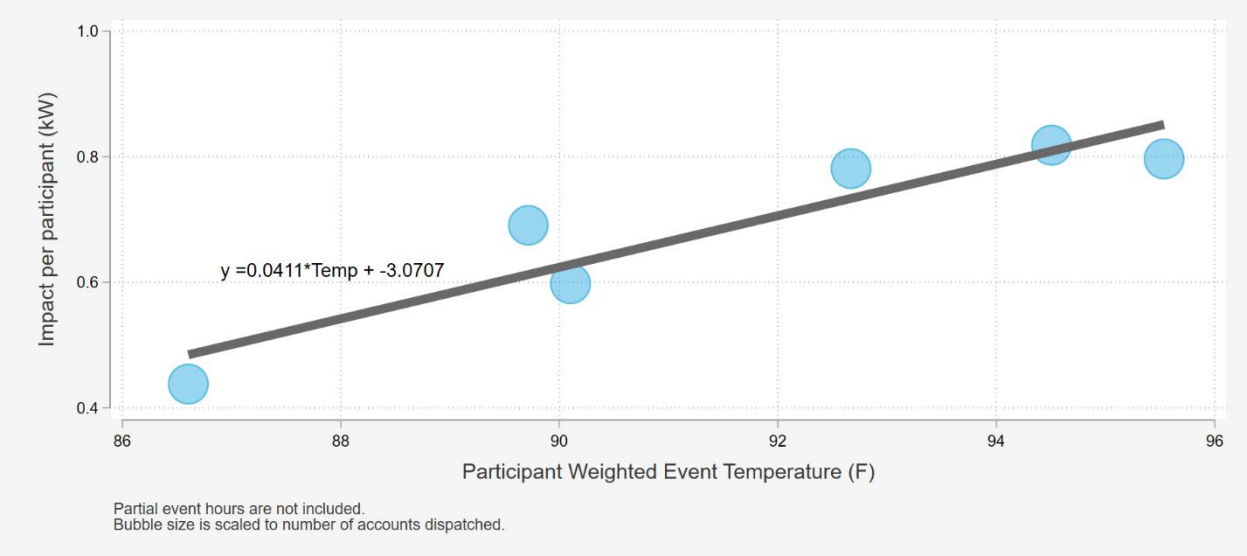

Table 1: SDP-Residential Event Summary, 2021

Date	Event start	Event end	Accts	Aggregate Impacts (MW)			Impact per … (kW)			% Impact	Wght. Temp (F)
				Impact	90% Lower Bound	90% Upper Bound	Acct	Device	Ton		
10/14/2020	6:00 PM	7:00 PM	202	0.07	0.02	0.12	0.35	0.33	0.09	20.6%	97.8
10/15/2020	6:00 PM	7:00 PM	202	0.04	-0.03	0.11	0.22	0.20	0.05	13.5%	99.6
6/17/2021	5:00 PM	6:00 PM	168,129	116	111	121	0.69	0.60	0.16	29.3%	89.7
7/9/2021*	5:50 PM	8:50 PM	175,532	121	116	126	0.69	0.60	0.16	26.5%	91.4
8/27/2021	6:00 PM	7:00 PM	175,588	140	134	145	0.80	0.69	0.19	29.0%	95.5
9/9/2021*	3:58 PM	5:00 PM	175,962	144	138	150	0.82	0.71	0.19	30.1%	94.5
Avg. Event	**First Event Hour**		**173,803**	**132**	**129**	**135**	**0.76**	**0.66**	**0.18**	**29.0%**	**93.1**

* Only full event hours are included in impacts

Table 2: SDP-Residential Summary of Key Findings

Topic	Findings
How did SDP-R perform on the SCE system peak day (September 9th)?	During the system peak day (September 9th, 2021), SDP-R participants reduced demand by an average of 144 MW between 4:00 PM and 5:00 PM. The average demand reductions per customer, per device, and per ton for this event were 0.82 kW, 0.71 kW, and 0.19 kW, respectively.
Did performance differ for the 100% cycling and 50% cycling options?	The per-participant demand reductions for customers signed up for the 100% cycling were more than twice as large as demand reductions for those on 50% cycling. For customers in the 50% cycling group, demand reductions were negligible when temperatures are below 85° F, as there simply isn't enough cooling load to curtail.
How did 2021 weather influence the magnitude of demand reductions?	Residential air conditioner loads are highly weather-sensitive. As a result, demand reductions are larger in magnitude when temperatures are hotter, and resources are needed most. Compared to prior years, 2021 was a substantially cooler year, with lower air conditioner loads and lower SCE system demand. The range of temperatures was lower in 2021, even on peak days. As a result, the program can expect larger demand reductions with hotter temperatures.
Did the COVID pandemic affect the magnitude of demand reductions?	By the summer of 2021, the typical energy use of residential customers and residential demand reductions aligned with pre-pandemic conditions.
What is the magnitude of demand reduction capability under planning conditions?	Given current enrollments, the resource can deliver reductions of 150 MW during the peak period under 1-in-2 weather planning conditions and 166 MW under 1-in-10 weather planning conditions (August monthly peak day).

1.2 SDP COMMERCIAL KEY FINDINGS

The SDP Commercial (SDP-C) program has approximately 7,700 customers enrolled and includes about 69,000 control devices and nearly 350,000 tons of air conditioner load. Roughly 65% of customers elect the higher incentive option, which allows SCE to entirely curtail air conditioner demand (100% cycling) during SDP-C DR events. During normal peaking conditions (1-in-2 weather conditions), participant loads peak around 381 MW, and participants can curtail demand by 16 MW on average during the 4–9 PM peak window. During extreme planning conditions (1-in-10 weather conditions), participant loads peak at 397 MW, and participants can reduce demand by 19 MW on average during the 4–9 PM peak window.

Figure 2 summarizes the per-device demand reductions for each individual event hour as a function of temperature. This figure includes all full event hours in the peak period (4–9 PM). Impacts are shown per device due to the large variability in customer size. As expected for a load control program, the magnitude of demand reductions is larger when temperatures are hotter.

Table 3 summarizes the reductions attained during each event in 2021. Impacts per device were generally in the neighborhood of 0.20 kW, with a few exceptions.

Figure 2: Relationship between SDP-C Demand Reductions and Weather (R^2 = 0.81)

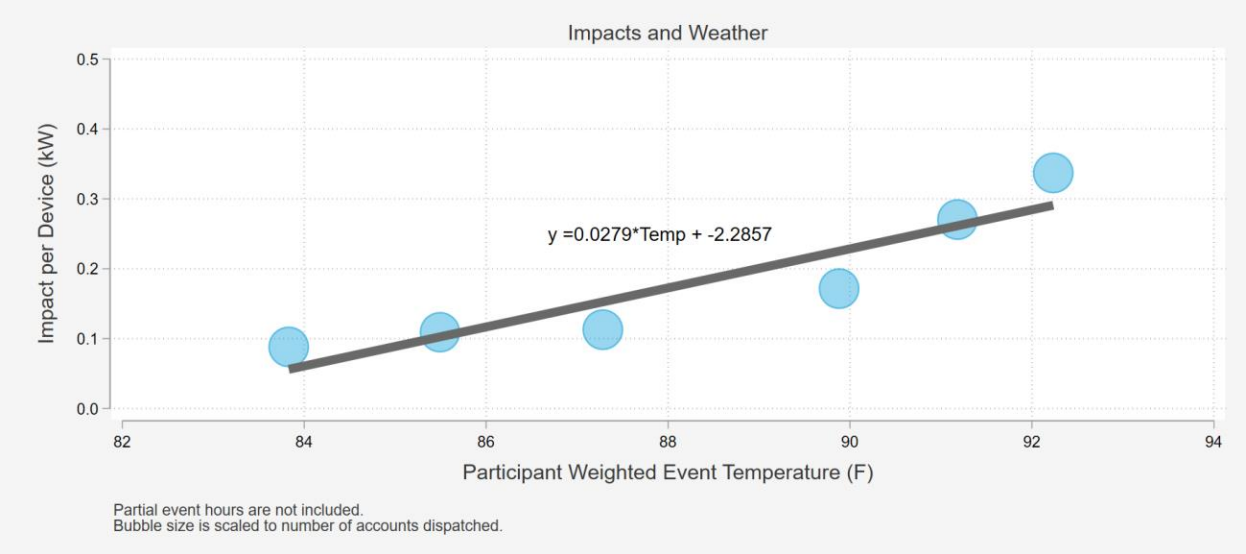

Table 3: SDP-Commercial Event Summary, 2021

Date	Event start	Event end	Accts	Aggregate Impacts (MW)			Impact per … (kW)			% Impact	Wght. Temp (F)
				Impact	90% Lower Bound	90% Upper Bound	Acct	Device	Ton		
10/14/2020	6:00 PM	7:00 PM									
10/15/2020	6:00 PM	7:00 PM									
6/17/2021	5:00 PM	6:00 PM	7,418	7	3	12	1.00	0.11	0.02	6.6%	85.5
7/9/2021*	5:50 PM	8:50 PM	7,567	10	6	13	1.27	0.14	0.03	8.5%	88.6
8/27/2021	6:00 PM	7:00 PM	7,514	18	13	22	2.36	0.27	0.05	11.6%	91.2
9/9/2021*	3:58 PM	5:00 PM	7,517	22	18	26	2.94	0.34	0.07	11.1%	92.2
Avg. Event	First Event Hour		7,504	15	13	17	2.00	0.23	0.04	10.3%	89.7

* Only full hours are included in impacts

Table 4: SDP-Commercial Summary of Key Findings

Topic	Findings
How did SDP-C perform on the SCE system peak day (September 9th)?	During the system peak day (September 9th, 2021), SDP-C participants reduced demand by an average of 22 MW between 4:00 PM and 5:00 PM. The average demand reductions per customer, per device, and per ton for this event were 2.94 kW, 0.34 kW, and 0.07 kW, respectively.
How does the customer mix impact performance?	SDP-C is a very top-heavy program, as 10% of the program participants account for more than 60% of the total AC tonnage. In other words, a small handful of customers account for a majority of the AC tonnage. Schools also account for about 68% of the SDP-C AC tonnage, so demand reductions are tied to whether or not schools are in session and whether AC units are in operation. School whole building and air conditioner loads drop off considerably after 3 PM, leaving limited controllable AC loads during the 4–9 PM peak hours.
Did performance differ for the 100% cycling and 50% cycling options?	On average, percent impacts in the 100% cycling strategy group are more than two times larger than percent impacts in the 50% cycling group.
Did the COVID pandemic affect the magnitude of demand reductions?	Roughly 81.2% of the non-residential load control devices are at schools and religious institutions (often private schools). The pandemic substantially affected schools, leading to remote learning, lower facility use, and lower air conditioner loads. In 2021, the effect of the COVID pandemic largely subsided, since nearly all schools in Southern California returned to in-person learning for the 2021-2022 school year. However, there are several business types that are still experiencing lower energy use compared to pre-pandemic patterns.
What is the magnitude of demand reduction capability under planning conditions?	Given current enrollments, the resource can deliver reductions of 16 MW during the peak period under 1-in-2 weather planning conditions and 19 MW under 1-in-10 weather planning conditions (August monthly peak day).