NON-RESIDENTIAL BTM STORAGE CHARGE/DISCHARGE PROFILES

Demand Analysis Working Group (DAWG)

Brian McAuley | Verdant Associates

VERDANT

PRESENTATION OBJECTIVES

- Introductions
  - Brian McAuley, William Marin – Verdant Associates
- Acknowledgements
  - Gabe Petlin, Justin Galle, Fang Yu Hu – CPUC
- Overview of Verdant's role in Measurement and Evaluation
- Published reports and current evaluation activity
- Summarize 2021-2022 SGIP storage composition and approach
- Review non-residential storage discharge (+) charge (-) profiles
  - By facility type

EVALUATION REPORT LIFECYCLE

Research questions / objectives

Research Plan

Data Collection and Analysis

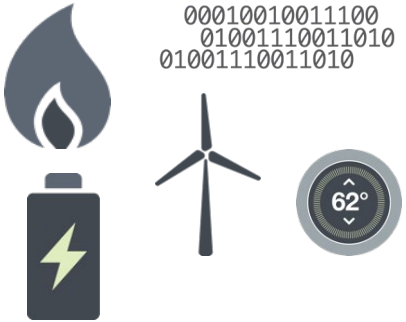
Draft and Final Reporting

Our 2021 – 2022 study is currently here in this process

IMPACT EVALUATION REPORT PROCESS

Review program data

Initial IOU Data Request – Rates, Outage data



Additional Data Requests – DER Data, AMI Data

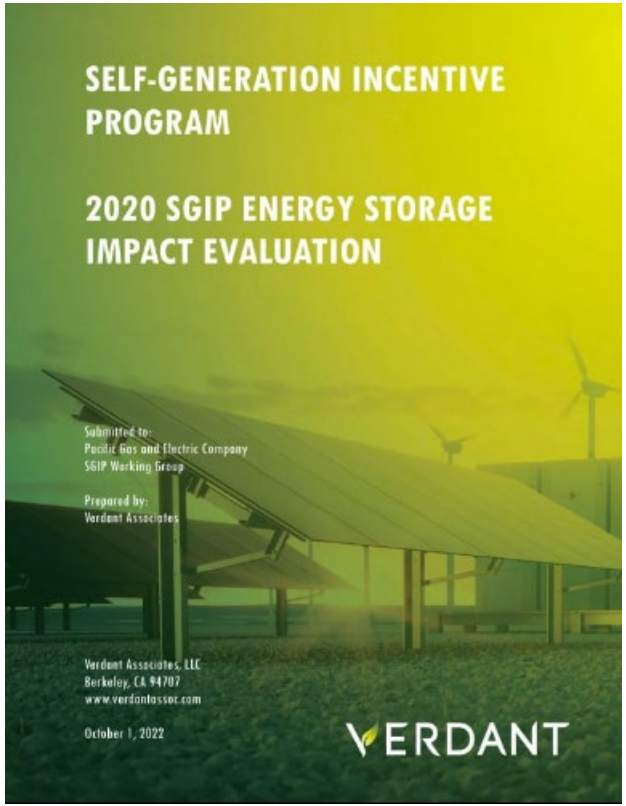
Analysis and Reporting

Sample Design

MOST RECENT PUBLIC STUDY

2020 SGIP Energy Storage Impact Evaluation

- Report includes:
  - Greenhouse gas (GHG) emissions analyses
  - Storage utilization and efficiency metrics
  - Storage performance throughout critical CAISO net and gross peak hours
  - Customer bill impact analyses
  - Utility avoided cost analyses
  - **Storage behavioral differences by** customer rate**, facility type, presence of on-site solar**



Source: Self Generation Incentive Program Evaluation Reports

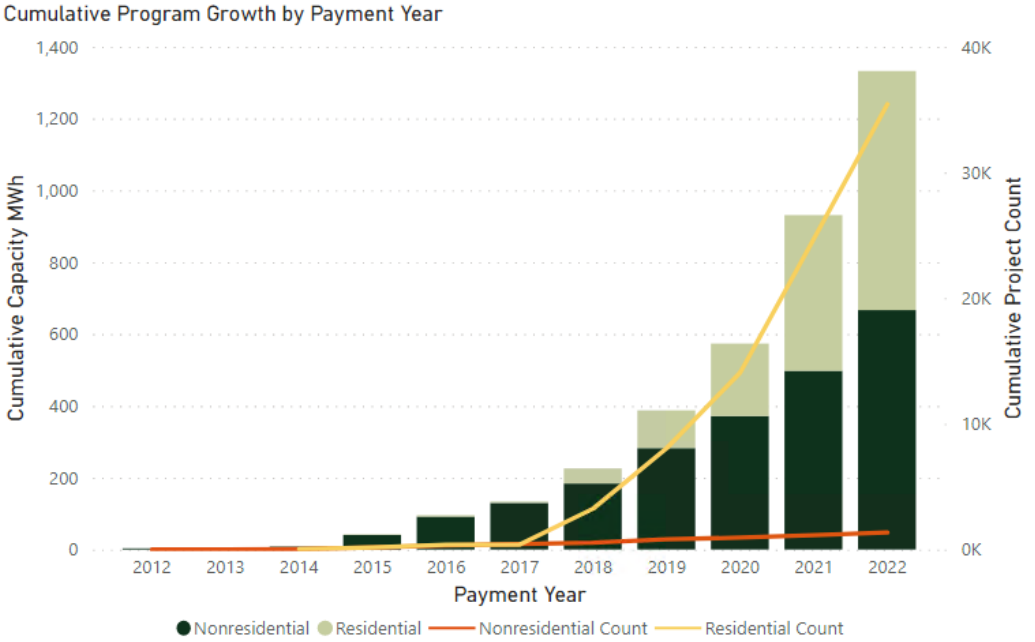
CURRENT IMPACT EVALUATION

2021-2022 Energy Storage Impact Evaluation

- Quantify the customer, environmental, and grid benefits of SGIP rebated technologies
- Combined 2021-2022 program impact evaluation report currently being completed
- Requires significant metered data collection across multiple sectors
- Much larger population of projects subject to evaluation

2021-2022 ENERGY STORAGE POPULATION

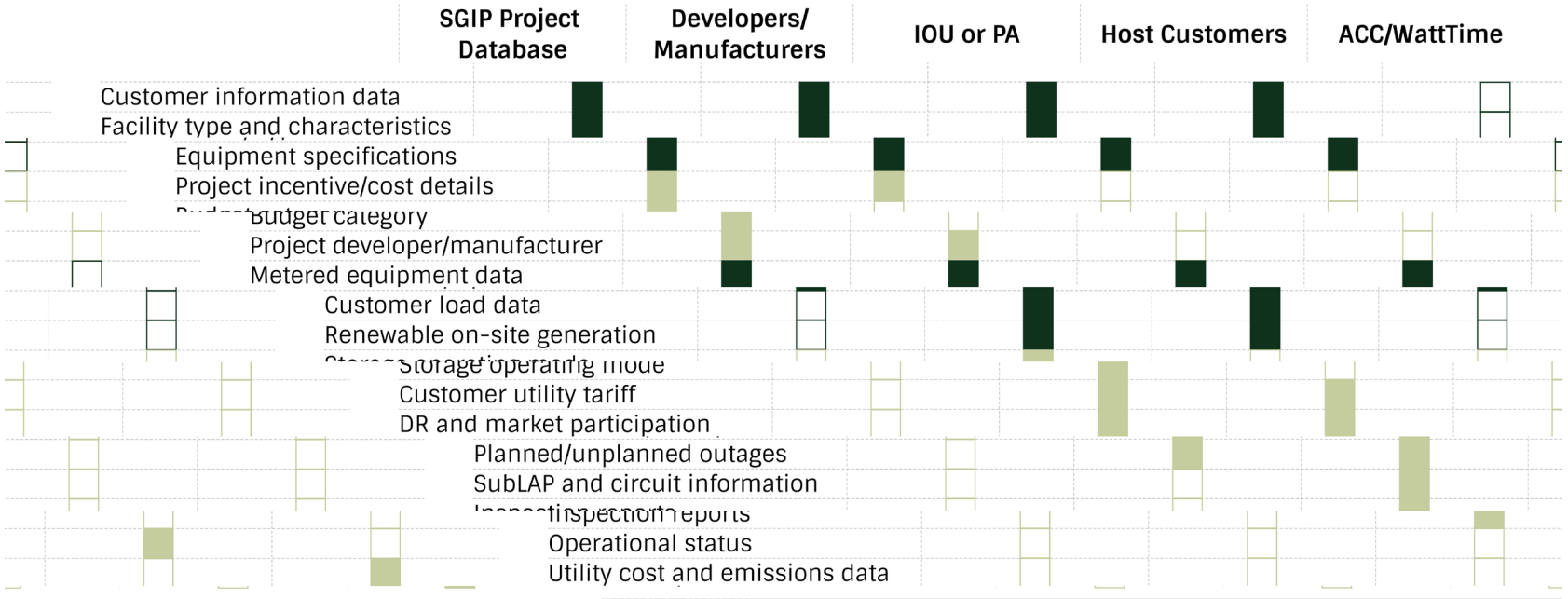
- Program Count
  - 1,355 nonresidential
  - 35,426 residential
- Program Capacity
  - 667 MWh nonresidential
  - 666 MWh residential
- Incentives paid since last impa evaluation completed (CY202
  - 22,000 projects paid
  - 759 MWh paid



Source: Verdant Associates

DATA SOURCES

Dark blocks relevant to this Ad Hoc request



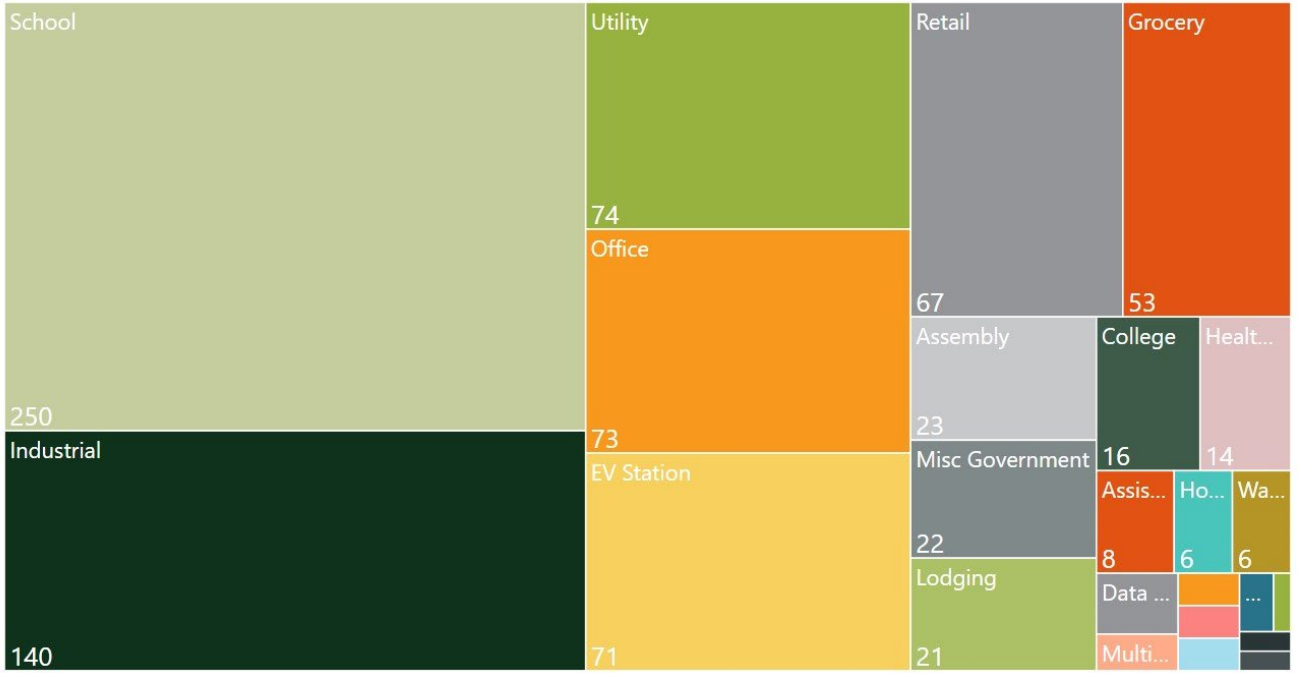
Source: Verdant Associates

METHODOLOGY

- Metered load and storage data undergo extensive QA/QC
  - data spikes/sign convention/completeness of data
- Determination of data integrity – data attrition is normal
- Merge AMI, storage charge/discharge, PV generation (where available)
- Project facility type classification
- Develop average normalized hourly discharge (+) charge (-) profiles by:
  - Facility type, month, hour, weekend/weekday, PV/no-PV
  - Normalization – Sum Hourly kWh / kW capacity of system
- 2022 observed impacts only

SAMPLE SIZES

- Schools and Industrial facilities largest segments
- Profiles further disaggregated by PV pairing
- Sample sizes of 15 projects or more are included

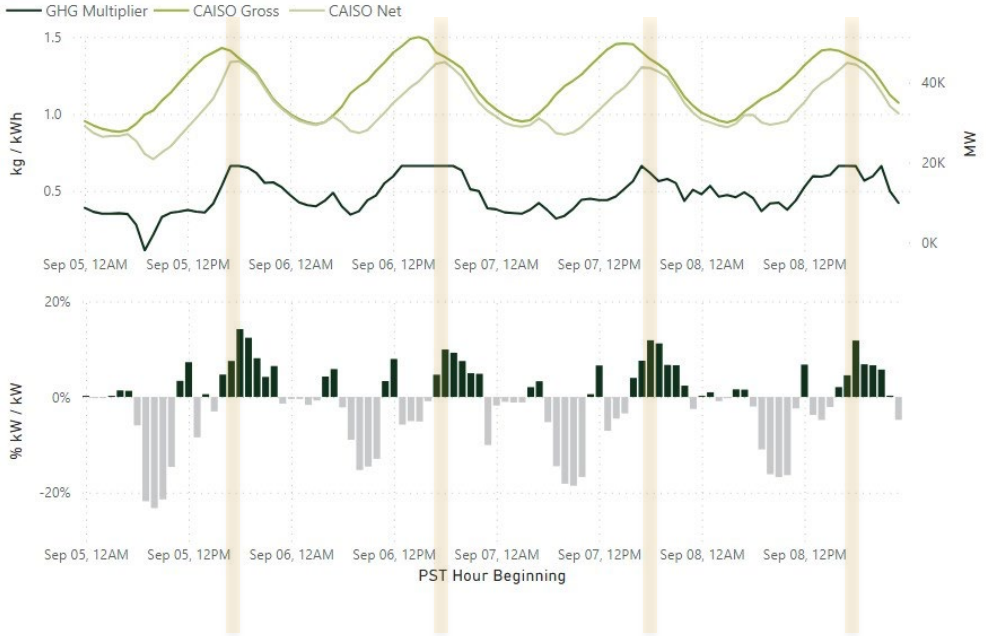


Source: Verdant Associates

STORAGE BEHAVIOR DURING GRID CONSTRAINTS

Primary and Secondary Schools

- Evidence of charging from solar (light gray)
- On-site solar generation coincident to bulk grid solar generation & lower marginal emissions
- Discharging begins *after* gross peak and during net peak (5 – 6 pm PDT) (dark gray)
- Peak hourly discharge ~ 15% of capacity (kW)

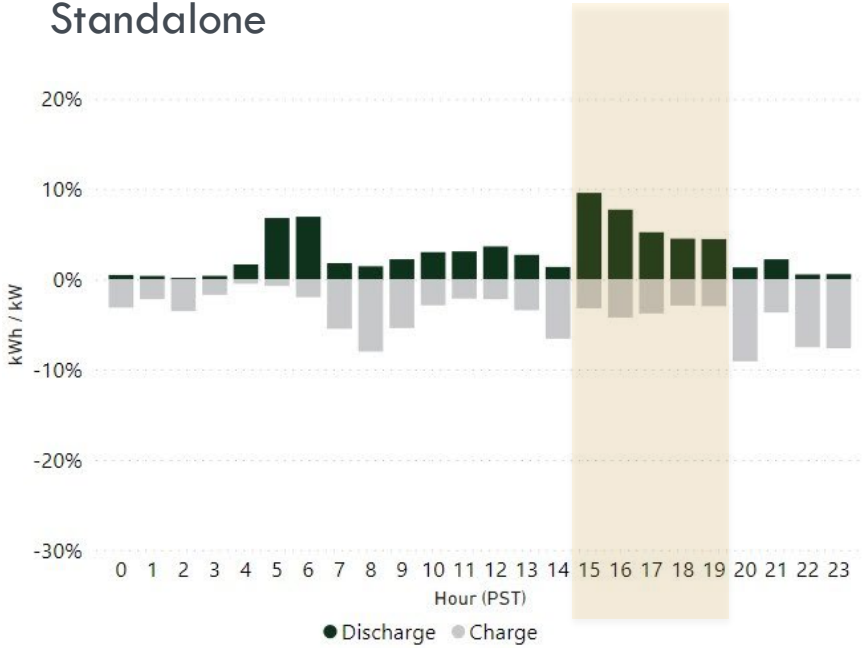


Source: Verdant Associates

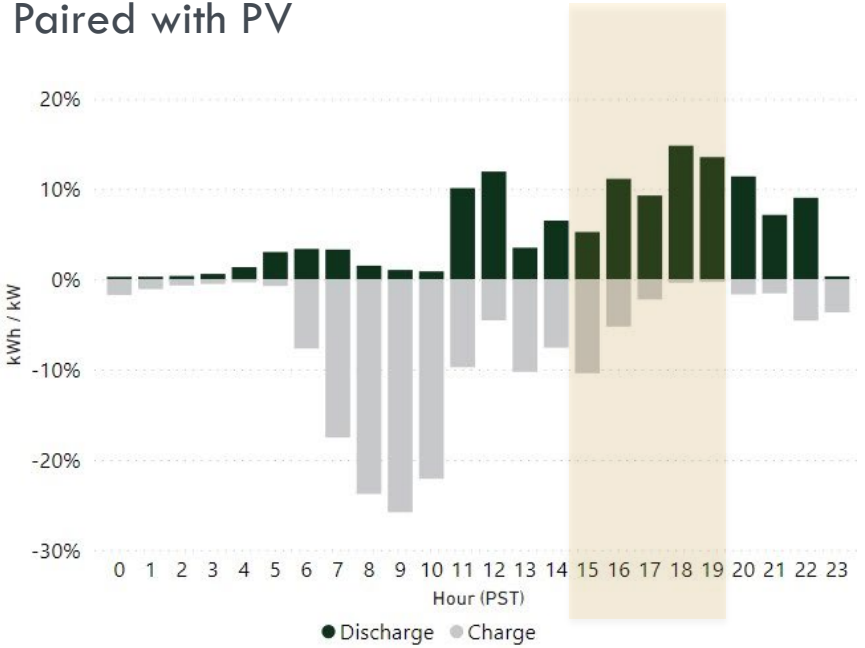
SCHOOLS – DISCHARGE AND CHARGE KWH / KW

Storage paired with PV versus standalone storage (September 2022)

Standalone



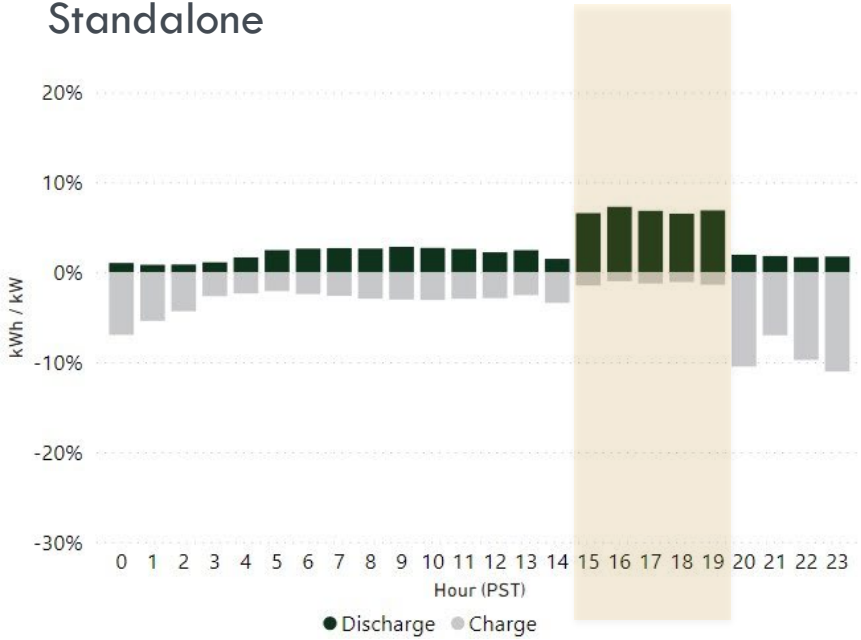
Paired with PV

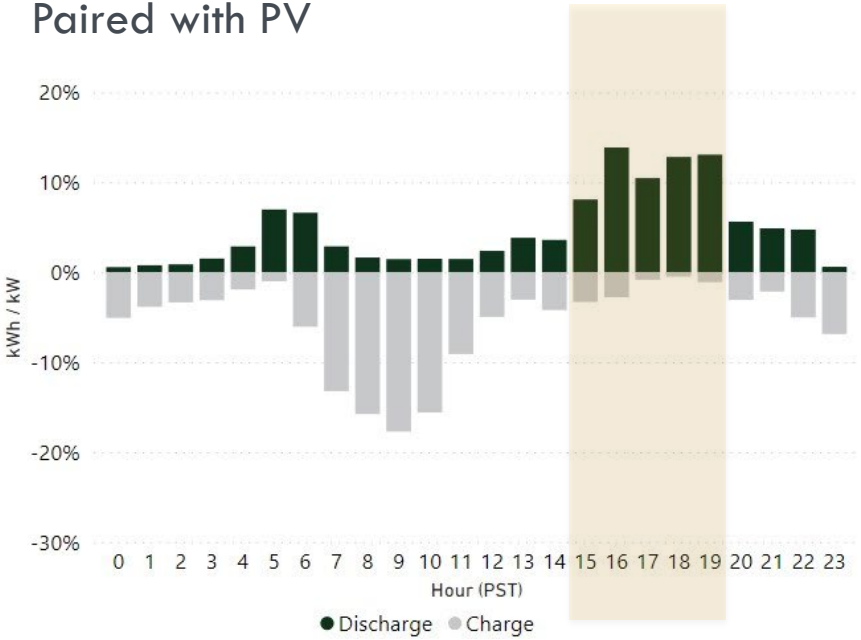


Source: Verdant Associates

INDUSTRIAL – DISCHARGE AND CHARGE KWH / KW

Storage paired with PV versus standalone storage (September 2022)





Source: Verdant Associates

NET DISCHARGE KWH / KW – WEEKDAYS ONLY

Storage paired with PV versus standalone storage (all projects)

Standalone

Month | Hr	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
January	-6%	-4%	-3%	-3%	-2%	-1%	1%	1%	-3%	-4%	-3%	-3%	-2%	-1%	-1%	-1%	5%	6%	5%	4%	4%	-6%	-5%	-3%
February	-6%	-4%	-4%	-3%	-2%	-1%	2%	2%	-4%	-5%	-4%	-3%	-2%	-1%	-1%	-1%	6%	6%	5%	4%	5%	-6%	-4%	-3%
March	-6%	-4%	-3%	-2%	-1%	1%	2%	-2%	-5%	-7%	-5%	-3%	-2%	-1%	-1%	-3%	6%	6%	6%	5%	0%	-3%	-3%	-5%
April	-5%	-4%	-3%	-2%	-1%	1%	2%	-5%	-8%	-8%	-5%	-4%	-2%	-0%	-1%	7%	6%	6%	7%	7%	-4%	-3%	-2%	-7%
May	-5%	-4%	-3%	-2%	-1%	1%	-0%	-5%	-8%	-7%	-5%	-4%	-2%	0%	-1%	7%	6%	6%	8%	8%	-4%	-4%	-3%	-8%
June	-8%	-6%	-6%	-4%	-1%	-1%	-4%	-4%	-6%	-5%	-4%	-2%	-1%	2%	1%	12%	11%	8%	9%	9%	-8%	-6%	-8%	-11%
July	-8%	-7%	-6%	-5%	-2%	-1%	-3%	-3%	-6%	-6%	-4%	-3%	-2%	2%	1%	11%	11%	9%	9%	9%	-4%	-5%	-7%	-11%
August	-10%	-8%	-7%	-5%	-3%	-0%	-2%	-4%	-6%	-5%	-4%	-3%	-0%	3%	1%	12%	12%	9%	8%	8%	-5%	-5%	-7%	-13%
September	-8%	-7%	-7%	-5%	-2%	-0%	-1%	-3%	-6%	-5%	-4%	-3%	-2%	1%	0%	10%	11%	9%	8%	7%	-5%	-4%	-6%	-11%
October	-5%	-5%	-5%	-3%	-1%	1%	2%	-5%	-8%	-8%	-7%	-5%	-3%	-1%	-1%	10%	10%	9%	6%	6%	-4%	-3%	-2%	-6%
November	-7%	-6%	-5%	-4%	-2%	-0%	2%	1%	-5%	-7%	-7%	-7%	-6%	-4%	-3%	0%	10%	11%	8%	6%	5%	-3%	-2%	-3%
December	-9%	-8%	-6%	-5%	-3%	-2%	0%	2%	-5%	-7%	-6%	-6%	-5%	-3%	-2%	-2%	11%	12%	9%	8%	7%	-3%	-2%	-1%

Paired with PV

Month | Hr	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
January	-1%	-1%	-0%	-0%	-0%	2%	6%	6%	-8%	-21%	-26%	-25%	-8%	-0%	-10%	-1%	4%	13%	12%	13%	11%	4%	-1%	3%
February	-1%	-1%	-0%	-0%	-0%	2%	7%	1%	-15%	-25%	-27%	-23%	-5%	2%	-9%	-1%	1%	12%	14%	14%	13%	5%	2%	4%
March	-1%	-0%	-0%	1%	2%	6%	6%	-6%	-18%	-26%	-24%	-11%	-1%	-5%	-5%	-4%	2%	9%	15%	13%	9%	4%	4%	1%
April	-0%	-0%	1%	1%	3%	6%	1%	-12%	-22%	-25%	-20%	-4%	1%	-9%	-3%	-5%	2%	7%	16%	15%	8%	4%	6%	-1%
May	-0%	-0%	1%	2%	4%	4%	-6%	-14%	-20%	-23%	-18%	-3%	2%	-8%	-2%	-5%	3%	6%	15%	17%	8%	4%	6%	-1%
June	-1%	-0%	-0%	1%	4%	2%	-10%	-18%	-22%	-21%	-14%	-1%	4%	-8%	-1%	-2%	5%	4%	13%	16%	10%	5%	3%	-2%
July	-1%	-0%	-0%	1%	3%	3%	-8%	-16%	-22%	-22%	-15%	-1%	4%	-7%	-1%	-2%	5%	5%	13%	16%	9%	5%	4%	-2%
August	-2%	-2%	-1%	-0%	2%	3%	-4%	-12%	-18%	-21%	-17%	-2%	3%	-5%	-1%	-2%	5%	6%	13%	14%	8%	4%	2%	-4%
September	-2%	-1%	-1%	-0%	1%	3%	-3%	-12%	-19%	-22%	-19%	-3%	3%	-6%	-1%	-1%	9%	9%	15%	14%	8%	3%	2%	-4%
October	-2%	-1%	-1%	-0%	1%	3%	2%	-9%	-17%	-23%	-22%	-8%	0%	-9%	-3%	-1%	10%	15%	15%	14%	6%	1%	3%	-2%
November	-2%	-1%	-1%	-0%	1%	2%	5%	-4%	-17%	-24%	-24%	-18%	-4%	0%	-7%	-0%	6%	13%	12%	13%	11%	5%	2%	3%
December	-2%	-2%	-1%	-1%	-0%	1%	3%	1%	-9%	-21%	-25%	-22%	-7%	-0%	-7%	-0%	5%	11%	11%	12%	12%	5%	1%	4%

Source: Verdant Associates

INITIAL OBSERVATIONS

Nonresidential storage behavior in 2022 compared to 2020

- Performance metrics – RTE, CF, and cycling – in line with previous evaluations
- Increased storage utilization during on-peak and grid constrained hours
  - Likely due to increased attachment rates with solar PV
  - Likely due to increased share of longer duration batteries in the Equity Resiliency Budget category
    - Incentives reserved for critical facilities
  - Greater TOU arbitrage than previously
    - Historically almost exclusively non-coincident demand charge use case
- Final report is being completed in Q4 of 2023

THANK YOU

Brian McAuley
Verdant Associates
brian@verdantassoc.com

VERDANT