

Improving DER Participation in Organized Markets

ESIG

2024 Forecasting & Markets Workshop

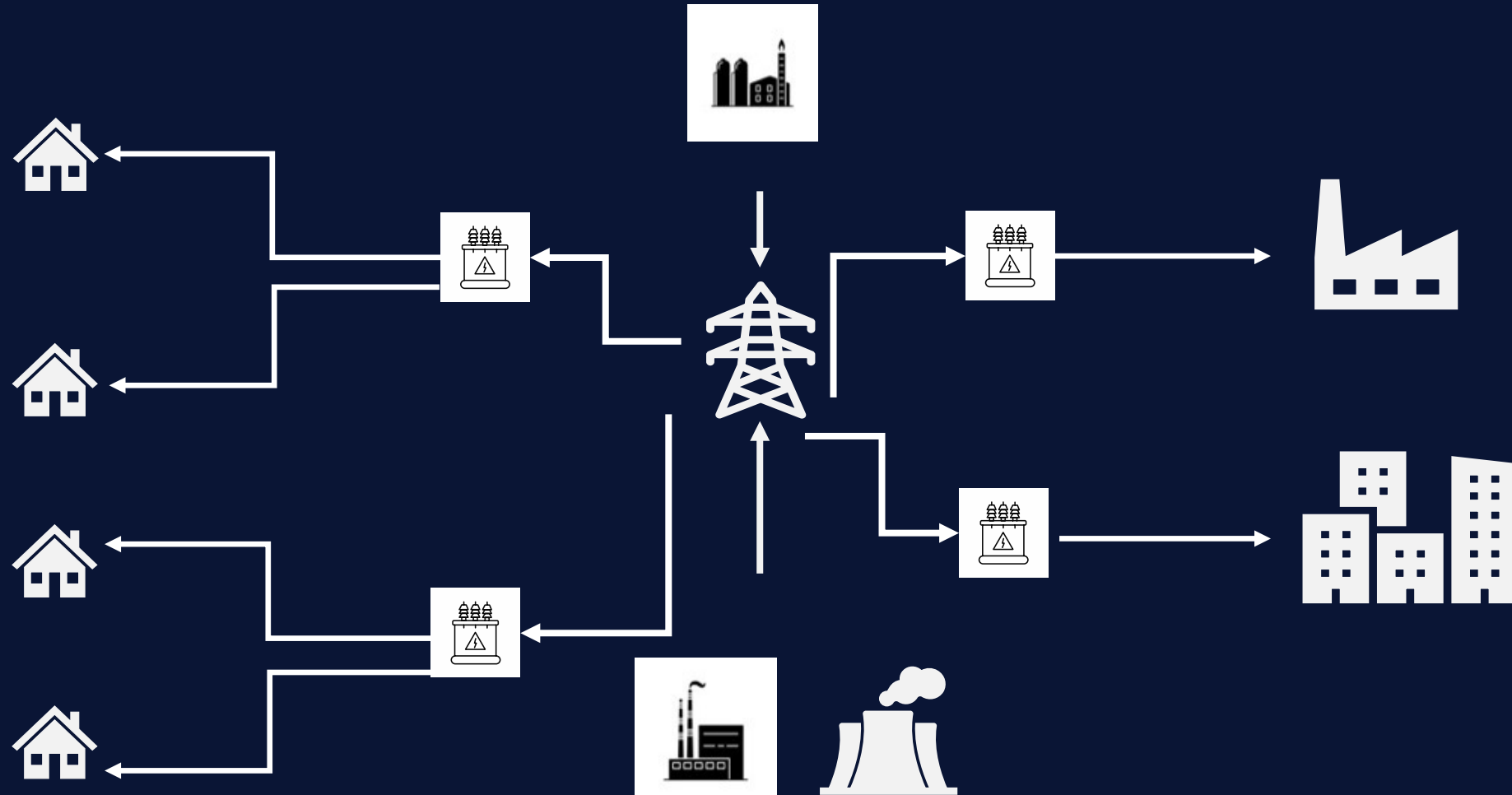
Geoff Ferrell

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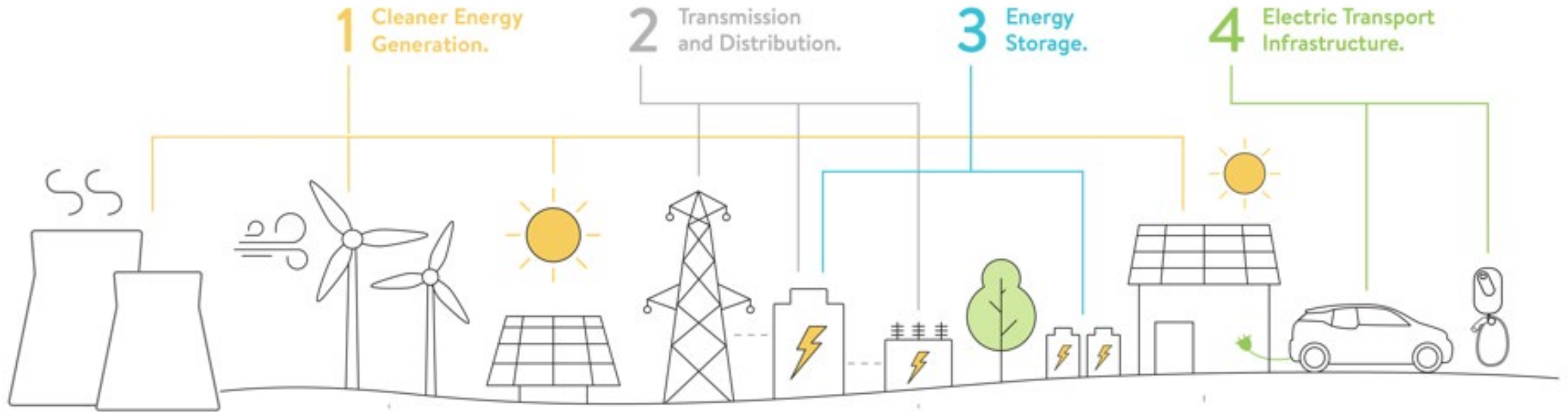
The Energy Transition



The Energy Grid of the Past



Tomorrow's Energy System



The State of California is dedicated to a Virtual Power Plant future for California's Energy System

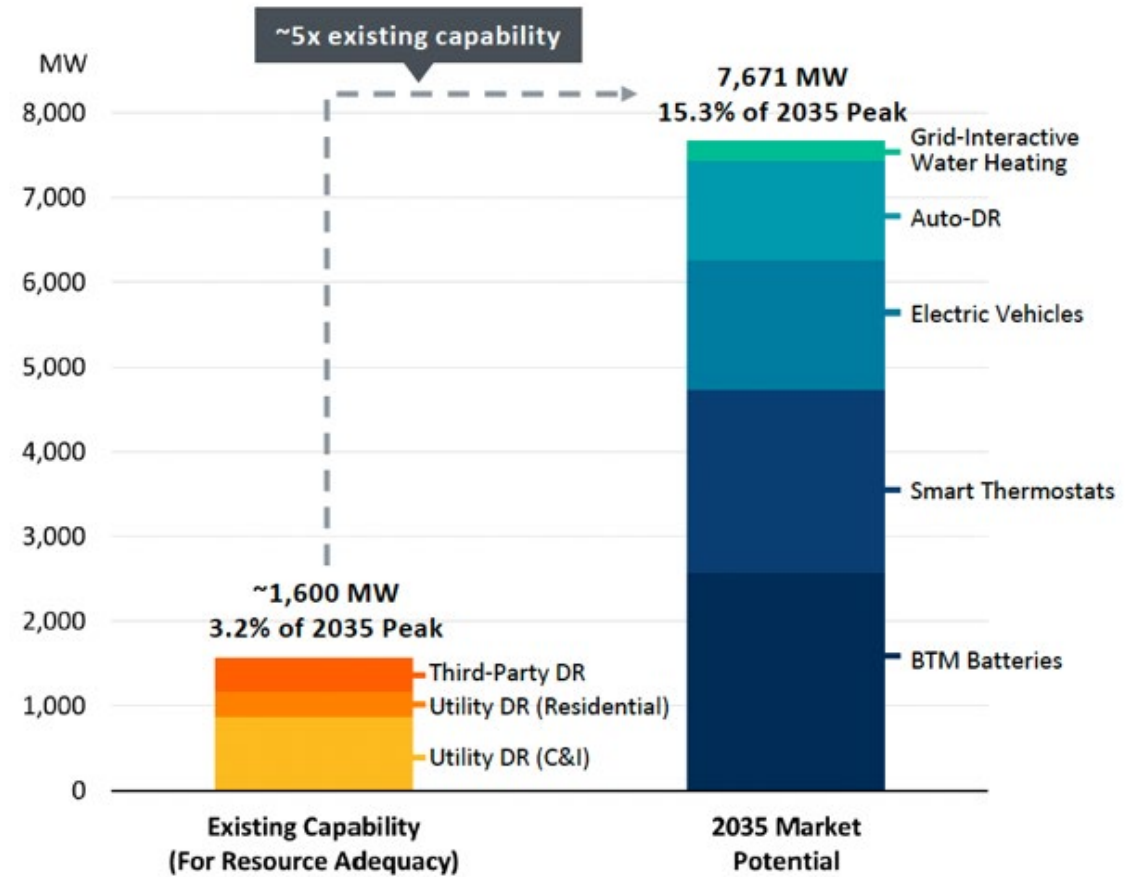
- Brattle Report recommends 6GW of additional VPP generation and load flexibility for California, by 2035



- Study is likely to be utilized the California Public Utilities Commission, for system planning

[Utility Dive Article Highlighting Brattle VPP Report for California](#)

2035 California Statewide VPP Market Potential



NOTE: VPP capacity is presented as a percentage of maximum system peak demand during the resource adequacy window of 6 to 11 p.m. (March–July) and 5 to 10 p.m. (other months).

Four Levels of Behind-the-Meter Energy Storage Applications, from the sonnen perspective - Note: Levels “build” on each other, towards the objective of an overall symbiotic energy system

Level 4: Dynamic VPP Grid Services

Battery swarm dispatch for specific Utility, ISO wholesale market, or retail electric provider market grid services, designed to provide value to society’s energy system. Go beyond personal backup power and energy management by providing greater GHG reduction, resiliency and a multitude of energy transition benefits – including lower costs, for all of society. In return, receive compensation for the value stack of the energy storage device, serving as part of a greater grid scale solution.

Level 3: Proactive Bill Management

Precise Battery Steering – Optimizing the Solar Battery Daily Cycle in order to achieve a specific load shape. Harness and Direct stored energy to respond to price signals embedded in a TOU rate. Deploy solar time shift + grid load shift charge patterns. Deploy discharge patterns which offset load or inject during specific peak timeframes. This technique level alone, will benefit society’s entire energy system.

Level 2:

Simple Solar Battery Daily Cycle for Solar Self-Consumption

Level 1:

Backup Power Resiliency, Energy Security



Aggregator Value Proposition: battery networking technology to perform grid services as dispatchable clusters that provide real grid scale value (“the VPP”)

- sonnen is proud to have developed the largest and longest running residential ESS based VPP in Europe, performing authentic grid services
 - sonnenCommunity launched in 2016
 - Full VPP launched in 2018
- Co-Developed the landmark Wattsmart Battery Grid Management System with Rocky Mountain Power in Utah in 2019, **the largest direct utility dispatched behind-the-meter battery network in the United States, performing a full stack of grid services, dispatched daily – scaled service territory wide**



Aggregated VPP 1 – Mandalay Homes Arizona

Optimized TOU Bill Management with Mandalay Homes and APS



The Mandalay Homes VPP – “The Ion Series Home” (Deep experience with the Optimized TOU application)



US011476693B2

(12) United States Patent
Restrepo

(10) Patent No.: US 11,476,693 B2
(45) Date of Patent: Oct. 18, 2022

(54) SYSTEM AND METHOD FOR OPTIMIZING STORAGE AND CONSUMPTION OF POWER ACCORDING TO TIERED TIME-BASED CRITERIA

(71) Applicant: Sonnen, Inc., Tucker, GA (US)
(72) Inventor: Carlos Restrepo, Atlanta, GA (US)
(73) Assignee: Sonnen, Inc., Stone Mountain, GA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 212 days.

(21) Appl. No: 16/841,228
(22) Filed: Apr. 6, 2020

(65) Prior Publication Data
US 2020/073776 A1 Nov. 26, 2020

Related U.S. Application Data
(66) Provisional application No. 62/850,389, filed on May 20, 2019.

(51) Int. Cl.
H02J 7/00 (2006.01)
H02J 3/38 (2006.01)
(Continued)

(52) U.S. Cl.
CPC : H02J 7/00712 (2020.01); G05B 19/042 (2013.01); H02J 3/32 (2013.01); H02J 3/381 (2013.01); H02J 7/0048 (2020.01); H02J 7/0071 (2020.01); G05B 2219/24136 (2013.01); G05B 2219/2619 (2013.01); H02J 2/0021 (2020.01)

(58) Field of Classification Search
CPC : H02J 7/00712; H02J 3/32; H02J 3/381;

(10) References Cited
U.S. PATENT DOCUMENTS
2009/0326729 A1* 12/2009 Itakim G06Q 40/06 700,295
2011/0210608 A1* 9/2011 Sakai H04L 18/12 320,109
(Continued)

(74) Attorney, Agent, or Firm: Clive McClintock

(57) ABSTRACT
Systems and methods of improving storage and consumption of electricity according to time-based tiered criteria are disclosed. An energy storage system controlled by a processor is optionally connected to a utility power grid, a photovoltaic (PV) power source, and/or electrical loads. Time-of-use (TOU) rates (or similar tiered criteria) are input into the processor, which sets charge and discharge profiles according to the criteria, the arrangement of time windows, and the user's preferences. Energy is stored or discharged according to these profiles. Additionally, the energy storage system may record the production and consumption patterns of the user over time, and use this information to modify the profiles for enhanced performance by allowing discharge during non-peak windows. Benefits include reduced electrical cost to the user, reduced strain on the utility power grid during peak consumption hours, and enhanced performance with regard to any other criteria input into the processor.

10 Claims, 7 Drawing Sheets

sonnen's patented Time of Use Algorithm deployed to provide value to the end-user, as well as to the APS energy grid

Aggregated VPP 2 – Soleil Lofts & Wattsmart Utah (our signature accomplishment)

Wattsmart Battery Grid Management System
Operated by sonnen and Rocky Mountain Power



Wattsmart BGMS Grid Services Value Stack

Grid Service	Technical Summary	Primary Purpose
Non-Wires-Alternative or “NWA” - Locational Value, Congestion Management (sub-station level)	Dispatchable load shed, based on local congestion conditions. (Herriman Ut)	Local load pocket decongestion, infrastructure investment deferral. (application can be T&D systemwide, as opposed to localized)
DR – Load Shedding	Dispatchable load shed, based on specific system conditions and events	System decongestion and stabilization. Peaking Power plant mitigation.
Capacity Planning	Firm dispatchable capacity for system requirements. Considering both load shed and injection. (MW not MWh)	System planning / capacity forecasting.
Energy	Dispatchable energy, by way of load shed + potential injection, in order to meet energy system (grid) load requirements. (MWh over X time)	Peaking Power plant mitigation.
Frequency Response (secondary)	Dispatched by RMP based on system frequency imbalance. a) Regulation UP - Frequency has dipped, excess load, insufficient generation. Rapid battery swarm discharge to load + inject. Future Consideration: b) Regulation DOWN – excess generation, insufficient load. c) Local Primary or “Self-Dispatched” Frequency Response (FCR – Frequency Containment Reserve – like sonnenVPP in Germany)	Aide in grid frequency stabilization.
Daily Cycle Mitigation of the Duck Curve Effect, Precise Load Shaping	Solar time-shift on the daily cycle, preventing low-value, un-dispatched grid injection, and voltage imbalance / grid stress, during PV window (“belly”). Time-shift through battery, battery ultimately offsets peak period (load following), preventing congestion and expensive, high CO2 peaking power plant utilization (“neck and head”). (Grid charge can also be utilized by Daily Cycle, in the event of insufficient solar. See “Swarm Grid Charge”)	Reduce duck curve effect, enable greater renewables penetration into the grid, aka “renewable grid harmonization.” Eliminate the duck’s 1) belly (harness PV), 2) neck and 3) head. Ultimately, deliver “Firm Fixed” Load Shape.
Resiliency	BGMS Nodes (single-family-homes, apartments and buildings) form individual solar battery nano-grids in the even of an outage, providing local backup power. Further, DR and FR add system level resiliency (grids scale), preventing outages for the entire community.	Energy security, peace-of-mind.
Dispatched Swarm Grid Charge (Short-Term Aspirational – Not Yet Implemented)	Grid charge battery network as a dispatchable load during times of excess generation and lite grid load (especially as a result of excess grid-scale renewable production – i.e. wind, solar). Battery network acts as a giant load sink. Time shift and offset peak periods. AKA “grid load shift” or “reverse demand response.”	Demand meets supply as opposed to supply meeting demand. Grid balancing mechanism. Enable greater utility scale renewables penetration by “soaking up” excess utility scale renewables like a “solar and wind sponge.” RMP may also deploy this technique in order to better utilize low cost, clean base load generation during other super-off-peak periods, “in the middle of the night” for instance, again, as a grid balancing lever. Time shift to offset peak-period, decongesting the grid and off-setting peaking power plant usage.
Spinning and Non-Spinning Reserves	Reserve capacity that can provide emergency stabilization power for the energy system (grid) in less than 10 minutes. (RMP has three dispatch thresholds for this use case: 50 seconds, 7 minutes or 20 minutes) This is really already happening in Wattsmart, by way of Frequency Response. That said, there are additional use cases around power / energy to explore.	Spin and Non-Spin are utilized primarily to protect against contingencies, notably unplanned outages of major facilities such as transmission lines or generators.

Aggregated VPP 3 - sonnenConnect California

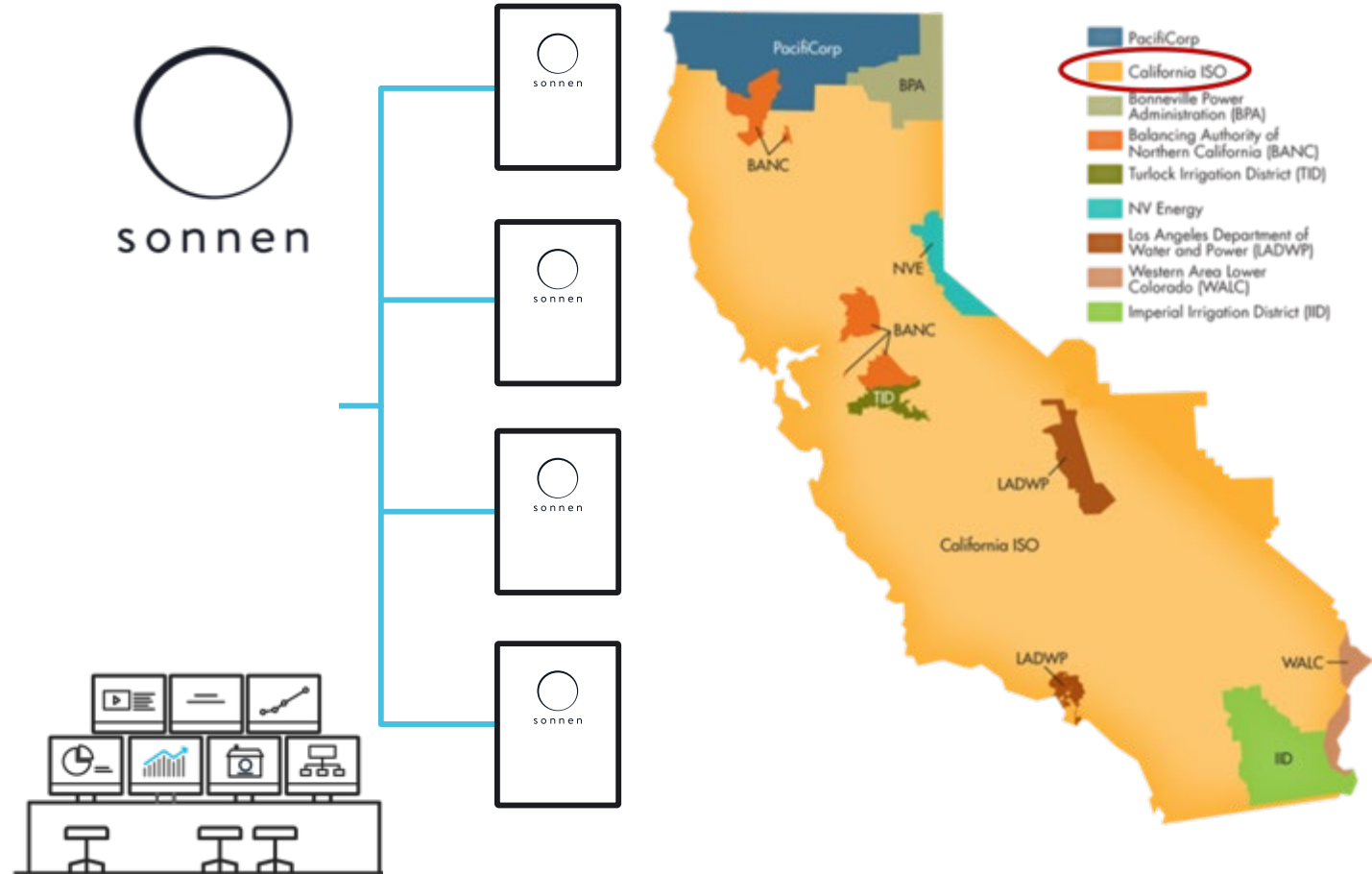
The Unrivaled Leading Solution to NEM3.0 in California, and beyond!



sonnenConnect California – Five Key Value Centers

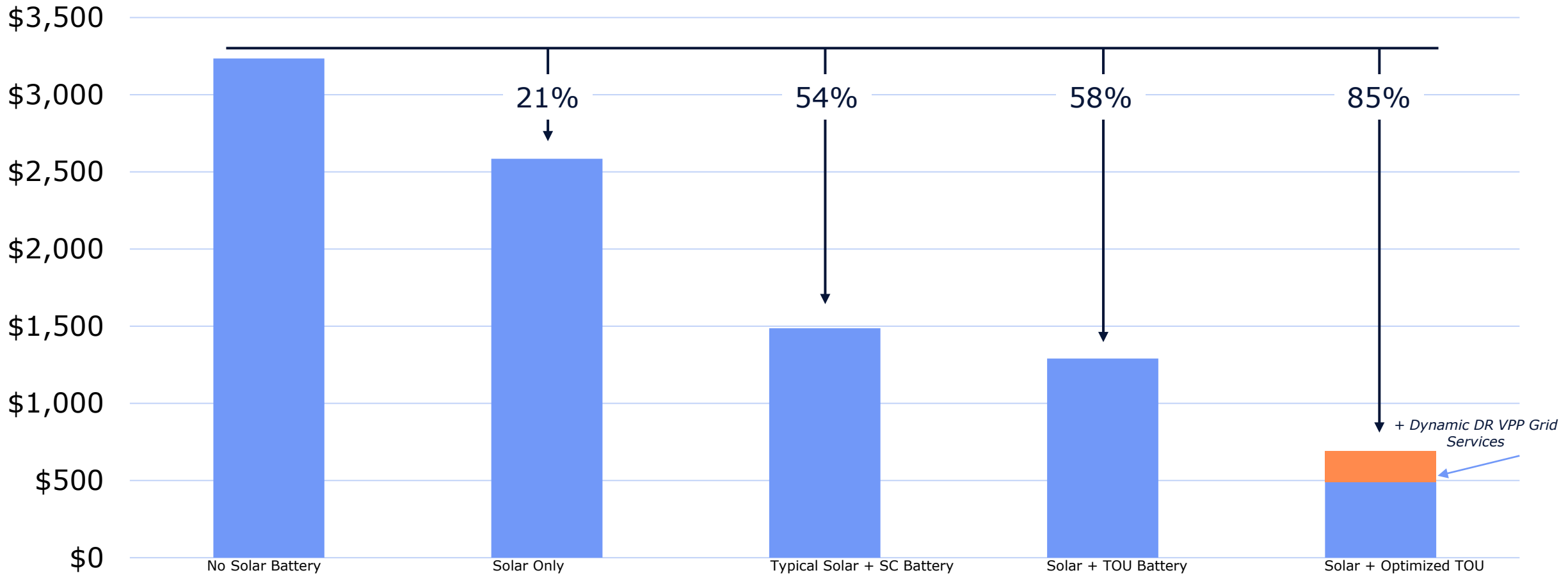
Beyond Net Metering™, Beyond Backup Power™, NEM Proof™

1. Proactive TOU Bill Management Service
2. Dynamic VPP Grid Services
3. Proactive Backup Power (peace of mind)
4. Proactive Service / Fleet Monitoring (peace of mind)



Customer Benefits via Grid Services & Optimized TOU / NBT

Illustrative NBT sonnenConnect California Results: based on actual sample data (2023)



Note: Graph does not account for the cost of PV+ Battery



Aggregated VPP 4 – sonnenConnect Puerto Rico

Partnership with Luma's "CBES" Program



sonnenConnect Puerto Rico

- Simple battery network demand response mechanism
- Important first VPP step for the Puerto Rican market
- Recruiting existing 2,500-unit sonnen battery network
- Objective: 8,000 batteries by EOY 2025

del Sol
foundation for energy security

In the News



sonnenConnect Puerto Rico

Proactive Management of the Backup Power Reservation = True Peace of Mind.

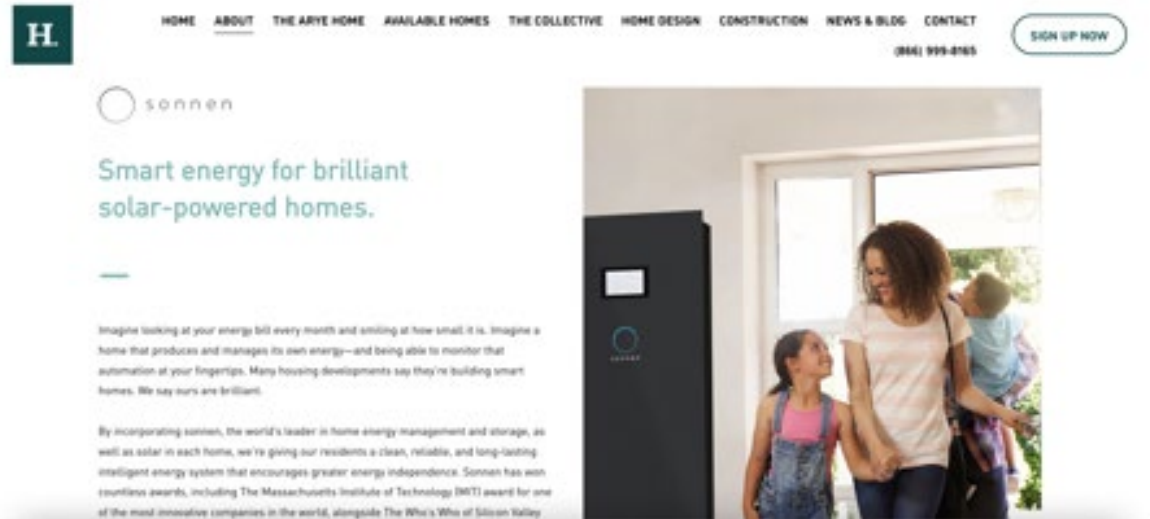
1. sConnect VPP team in Stone Mountain receives extreme weather or PSPS outage alert
2. sConnect VPP team in Stone Mountain will terminate the Daily Cycle / TOU Algorithm as well as all Grid Services, while deploying an immediate Full Charge request to 100% SoC Battery Reserve (by way of solar or grid energy, whatever is immediately available)
3. HOLD CHARGE – await potential outage!
4. Post outage or major threat of outage, the VPP team RELEASES Battery back to normal VPP operations



Hunters Point - Florida, Pearl Homes

Nation's first "Residential LEED Platinum+ Net Zero" Master Planned Community – including a standard sonnen in every home

<https://hunterspointfl.com/>



The screenshot shows the top navigation bar of the Hunters Point website with links for HOME, ABOUT, THE ARYE HOME, AVAILABLE HOMES, THE COLLECTIVE, HOME DESIGN, CONSTRUCTION, NEWS & BLOG, and CONTACT. A 'SIGN UP NOW' button and the phone number (888) 999-0165 are also visible. The main content area features the Sonnen logo and the headline 'Smart energy for brilliant solar-powered homes.' Below this, there is a paragraph of text: 'Imagine looking at your energy bill every month and smiling at how small it is. Imagine a home that produces and manages its own energy—and being able to monitor that automation at your fingertips. Many housing developments say they're building smart homes. We say ours are brilliant.' A second paragraph follows: 'By incorporating sonnen, the world's leader in home energy management and storage, as well as solar in each home, we're giving our residents a clean, reliable, and long-lasting intelligent energy system that encourages greater energy independence. Sonnen has won countless awards, including The Massachusetts Institute of Technology (MIT) award for one of the most innovative companies in the world, alongside The Who's Who of Silicon Valley.' The background image shows a family of three standing next to a black Sonnen solar panel mounted on a wall.



Veridian at the County Farm – Ann Arbor Michigan

Likely the most health and wellness centric, ecologically restorative master planned community currently under construction in the United States.

A blueprint for a better future.

<https://www.veridian.community/>





Our Vision

**Clean and affordable
energy for everyone.**

