Clean Coalition

Green Rebuild Initiative

Super Green building & retrofits for an unparalleled trifecta of economic, environmental, and resilience benefits

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Clean Coalition (nonprofit)

Mission

To accelerate the transition to renewable energy and a modern grid through technical, policy, and project development expertise.

Renewable Energy End-Game

100% renewable energy; 25% local, interconnected within the distribution grid and ensuring resilience without dependence on the transmission grid; and 75% remote, fully dependent on the transmission grid for serving loads.

Green Rebuild Initiative (GRI)

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GRI overviview

The Green Rebuild Initiative (GRI) aims to help ensure that the homes that get rebuilt in Pacific Palisades and Altadena (and beyond) will be done in a Super Green fashion. The target audiences are property owners, architects & designers, and builders. Super Green homes are 100% electric and feature enough solar to achieve Net Zero Energy (NZE) -- and are configured with energy storage to benefit from the unparalleled resilience delivered by Solar Microgrids.

GRI website

https://clean-coalition.org/programs/green-rebuild-initiative/

Green Rebuild Initiative

Mission:

The Green Rebuild Initiative (GRI) aims to facilitate sustainable and resilient rebuilds through "Super Green" home designs that are all-electric, Net Zero Energy (NZE), and supported by Solar Microgrids for unparalleled resilience. The GRI also encourages homes to be designed for high energy efficiency and low embedded carbon, while being engineered to withstand extreme weather events and built with non-toxic materials.

Actions:

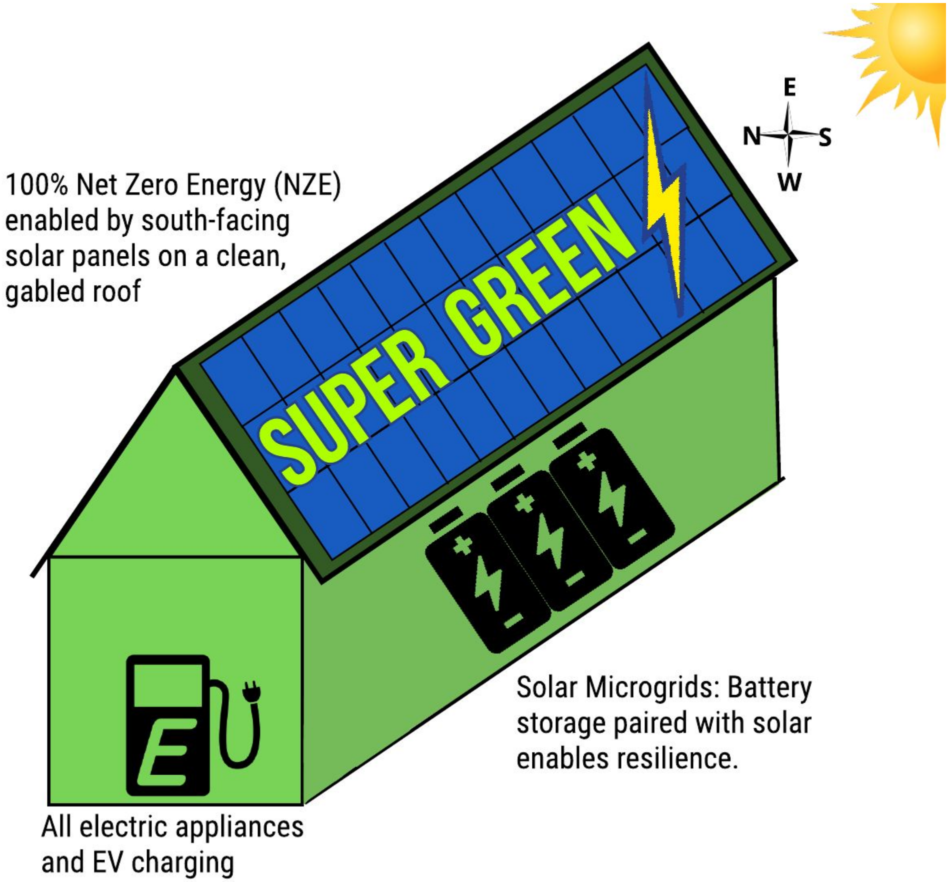
1. Educate property owners, architects, builders, policymakers, lenders, insurers, and everyone else about the superiority of Super Green homes.
2. Illuminate the economic benefits of Super Green designs, including the associated tax benefits and other incentives.
3. Provide easy access to specifications associated with Super Green designs.
4. Share showcase Super Green home designs.
5. Connect parties for Super Green outcomes, including property owners, architects, builders, and associated experts.

What is Super Green?

1. 100% Electric: No gas service to the home and ideally an all-EV household.

2. Net Zero Energy (NZE): Onsite solar energy production at least equals the annual energy consumption across the premise, including to cover home EV charging.

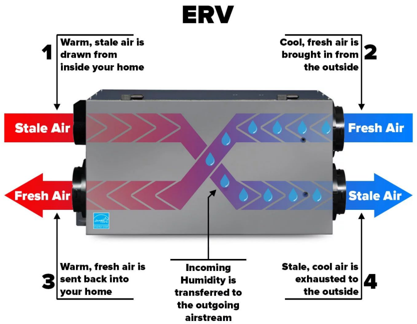
3. Solar Microgrid: Combines a battery to the solar for economic optimization and achieving unparalleled energy resilience.

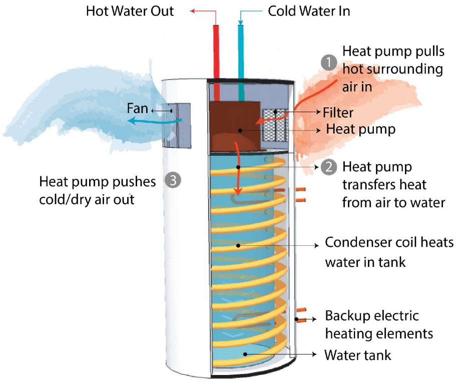


Super Green: 100% Electric

Specifications

- **Mechanical and Plumbing**
    - Heat Pump HVAC
    - Heat Pump Water Heater
    - ERV: Energy Recovery Ventilator
    - E-Fireplace: Napoleon Alluravision 60” [Optional]
    - Heat Pump Pool Water Heater [Optional]





- **Electrical**
    - LED Light Bulbs
    - Occupancy/Vacancy Sensors
    - Dimming Switches

Appliances

- Induction Cooktop
- EnergyStar Refrigerator
- EnergyStar Dishwasher
- EnergyStar Washing Machine
- Energy Efficient Microwave
- Heat Pump Dryer
- EV Charging Outlet and/or Charger (Level 2 capable)

Induction Cooktops

100% Electric

Energy Efficient

Super Green: Net Zero Energy (NZE)

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NZE requires the solar to produce at least as much energy as the home consumes over the course of a year. Solar needed to achieve NZE for homes with Title 24 levels of energy efficiency and two EVs (22,000 miles of home EV charging per year):

- 1,500sf home requires 9.8kW of solar (24 solar panels).
- 2,500sf home requires 14.8kW of solar (36 solar panels).

California Energy Code Title 24 (Part 6) falls far short of NZE:

- 1,500sf home only requires 2kW (5 solar panels)
- 2,500sf home only requires 3kW of solar (7 solar panels).

Super Green: Solar to achieve 1,500sf NZE home

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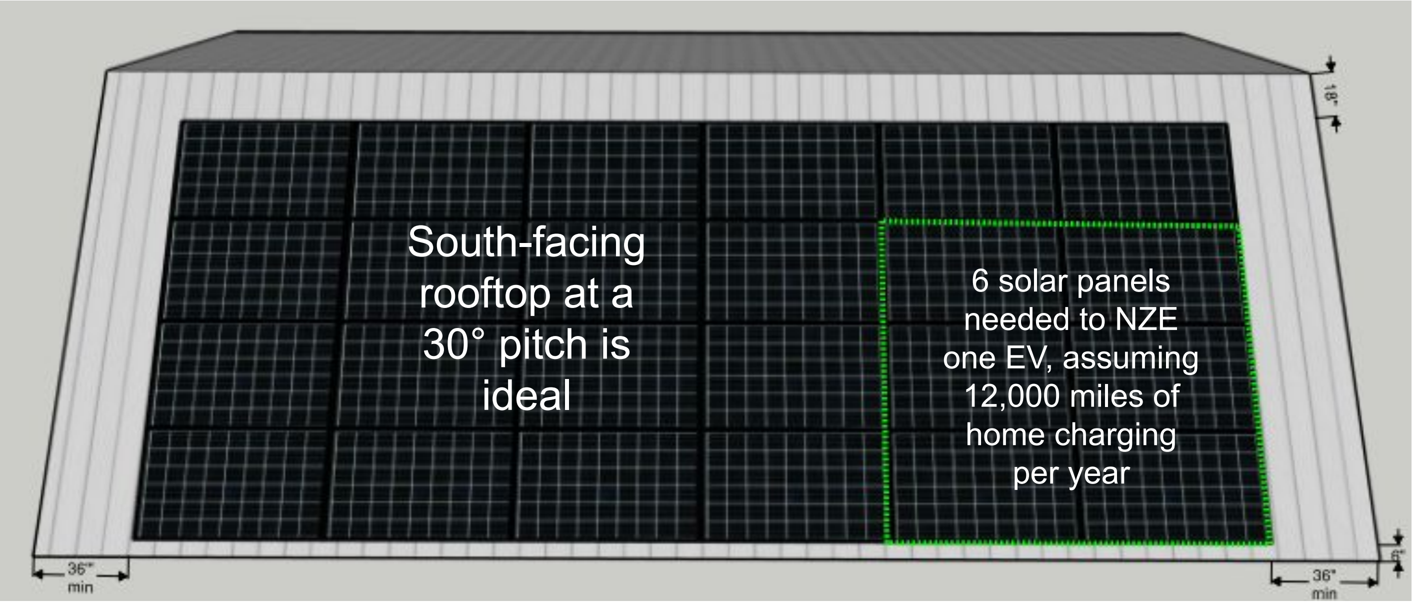
Total single roof area required to achieve NZE for a 1,500 sf house is 700 sf, to accommodate 507 sf of solar (9.8 kW) plus setbacks

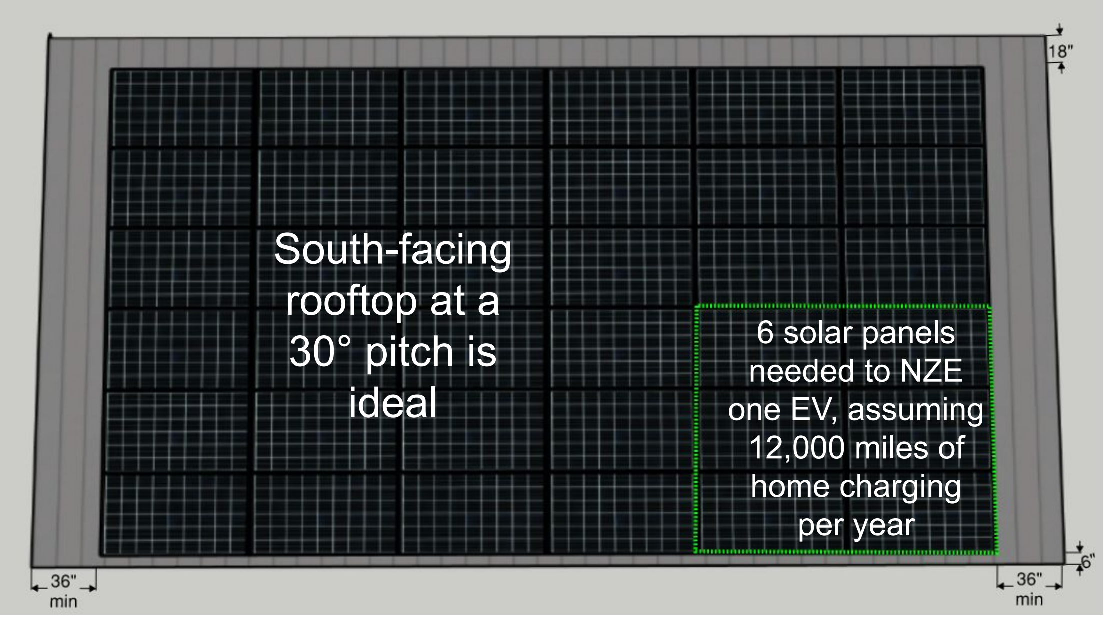


- 14,600 kWh per year is the estimated energy consumption for a typical 4-person household in a 1,500sf home.
- A 9.8kW solar array (assuming 1,512kWh/kW-yr) is required to achieve Net Zero Energy (NZE), which includes charging two EVs
- Note: an EV driving 12,000 miles per year will require 3,600kWh of energy per year to charge, which can be offset by 6 solar panels. This model also assumes there is a second EV using 10,000kWh per year.
- Assumes QCELL 410W solar panels, each with dimensions of 6.2 ft x 3.4 ft (21.1 sf per panel).
- 24 solar panels required to achieve NZE, requiring 507 sf for the solar layout, and producing 14,808 kWh per year.

Super Green: Solar to achieve 2,500sf NZE home

Clean Coalition

Total single roof area required to achieve NZE for a 2,500 sf house is 1,000 sf, to accommodate 760 sf of solar (14.8 kW) plus setbacks



- 21,221 kWh per year is the estimated energy consumption for a typical 2,500sf 4-person household
- A 14.8kW solar array (assuming 1,512kWh/kW-yr) is required to achieve Net Zero Energy (NZE), which includes charging two EVs
- Note: an EV driving 12,000 miles per year will require 3,600kWh of energy per year to charge, which can be offset by 6 solar panels. This model also assumes there is a second EV using 10,000kWh per year.
- Assumes QCELL 410W solar panels, each with dimensions of 6.2 ft x 3.4 ft = 21.1 square feet
- 36 solar panel required to achieve NZE, requiring 760 sf for the solar layout, and producing 22,223 kWh per year.

Solar should be as close to south-facing as possible

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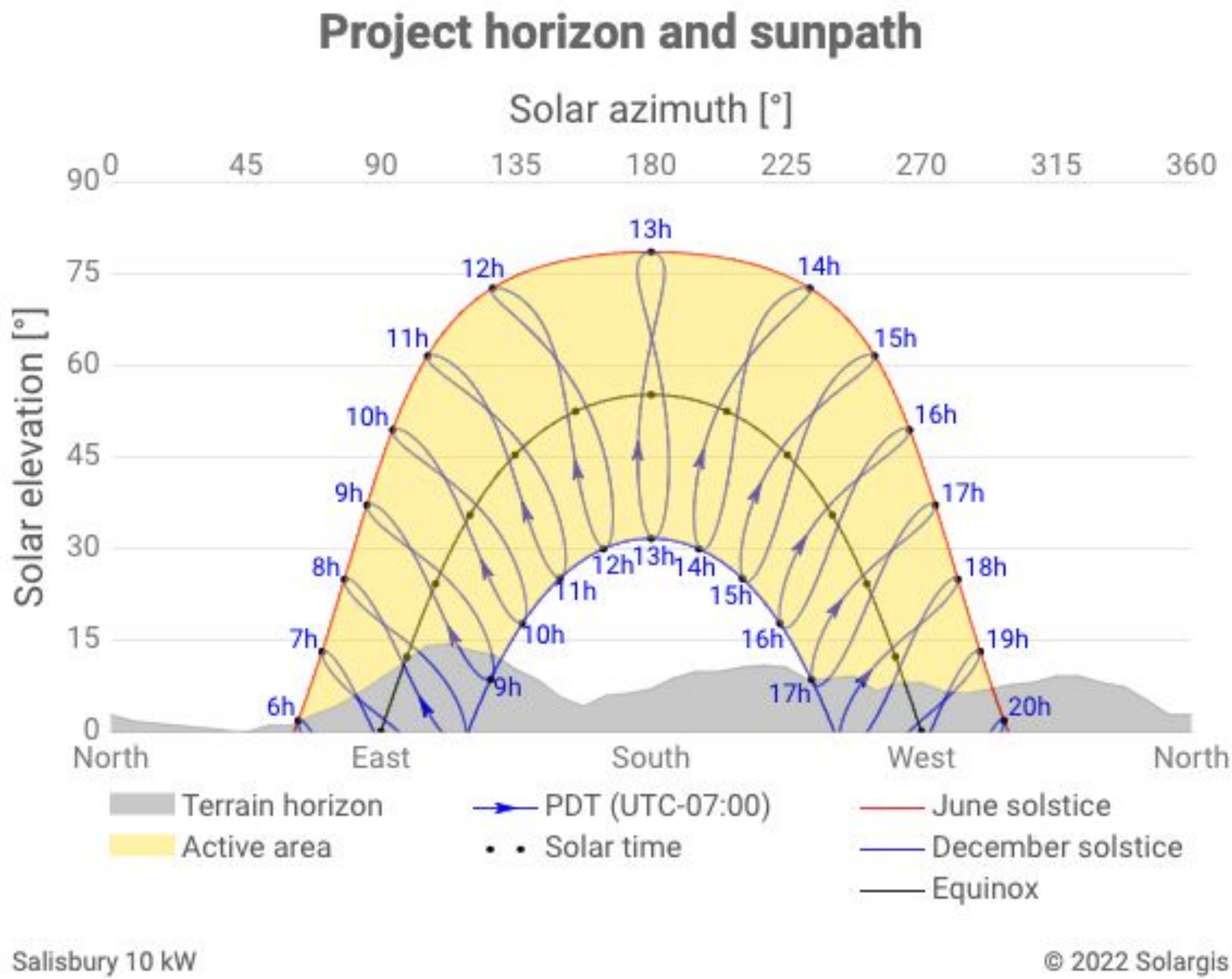


Value-of-Resilience (VOR) details

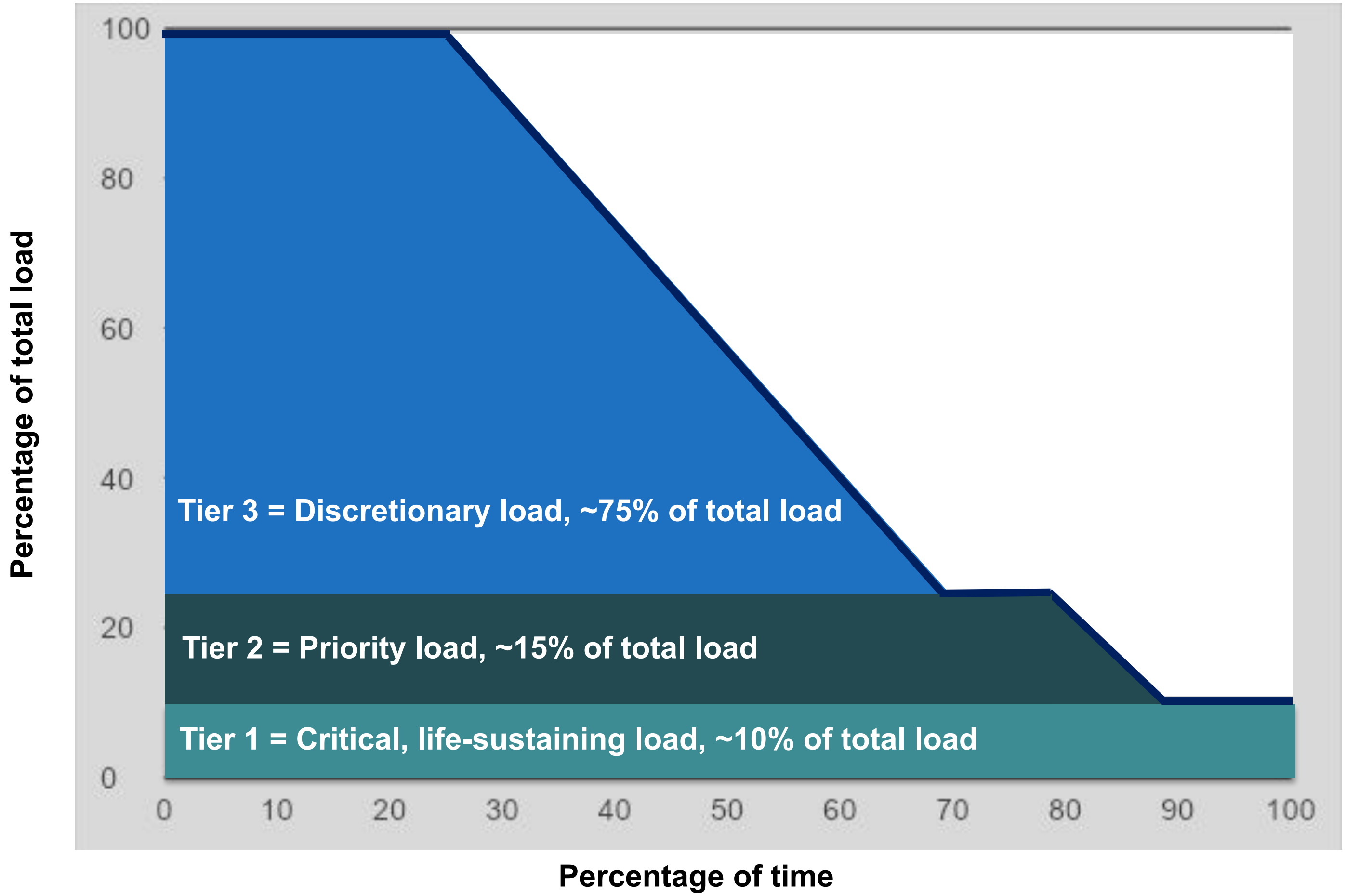
VOR123

VOR123 is the value-of-resilience (VOR) from Solar Microgrids methodology that the Clean Coalition has developed to normalize VOR across all types of facilities & geographies. The VOR normalization is founded in tiering loads into three categories: Tier 1 (critical), Tier 2 (priority), and Tier 3 (discretionary). Since each Tier has its own resilience requirement and VOR, this methodology is called VOR123.

VOR123 webinar

https://clean-coalition.org/news/webinar-valuing-resilience-solar-microgrids-thursday-5-nov-2020/

Typical load tier resilience from Solar Microgrids



Percentage of time online for Tier 1, 2, and 3 loads for a Solar Microgrid designed for the University of California Santa Barbara (UCSB) with enough solar to achieve net zero and 200 kWh of energy storage per 100 kW solar.

Diesel generators are designed for limited resilience

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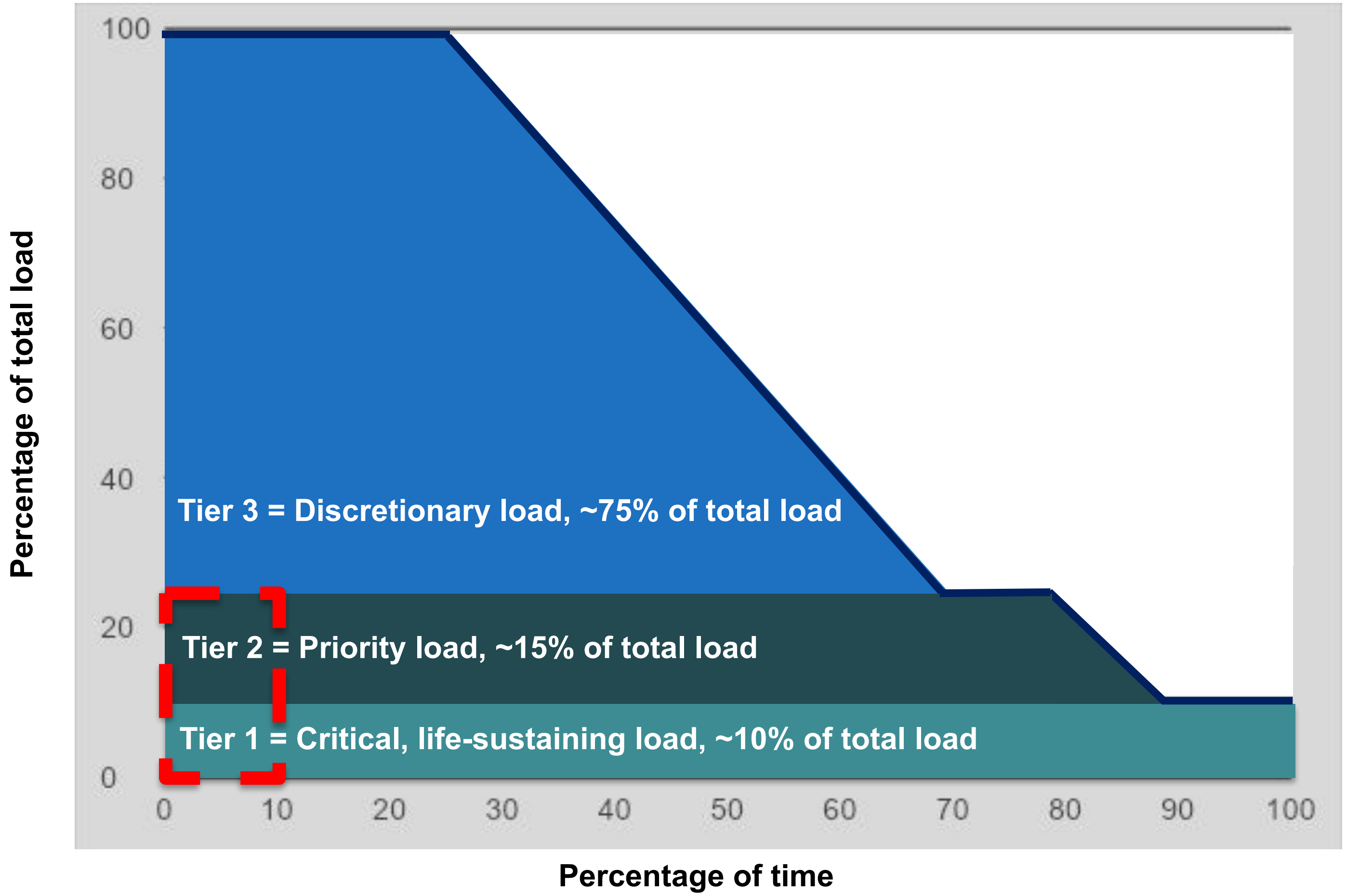

A typical diesel generator is configured to maintain 25% of the normal load for two days. If diesel fuel cannot be resupplied within two days, goodbye. This is hardly a solution for increasingly necessary long-term resilience. In California, Solar Microgrids provide a vastly superior trifecta of economic, environmental, and resilience benefits.

Load Management is key to Solar Microgrids

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SPAN Panels are king of residential Load Management

- Control circuits from anywhere

Real-time on/off control over every circuit in the home from the SPAN Home App + scheduling with Amazon Alexa.

- Learn from deep energy insights

360-degree view of your home's energy from a smartphone or tablet helps you save more.

- Save on energy bills

Quantify the impact of appliances on your energy bill, and make smarter decisions to save.

- Set a powerful foundation

Future-proof your home for upgrades such as EV, solar, battery storage, heat pumps, induction cooktops, and more.

https://www.span.io/

Solar Microgrids optimize daily economics

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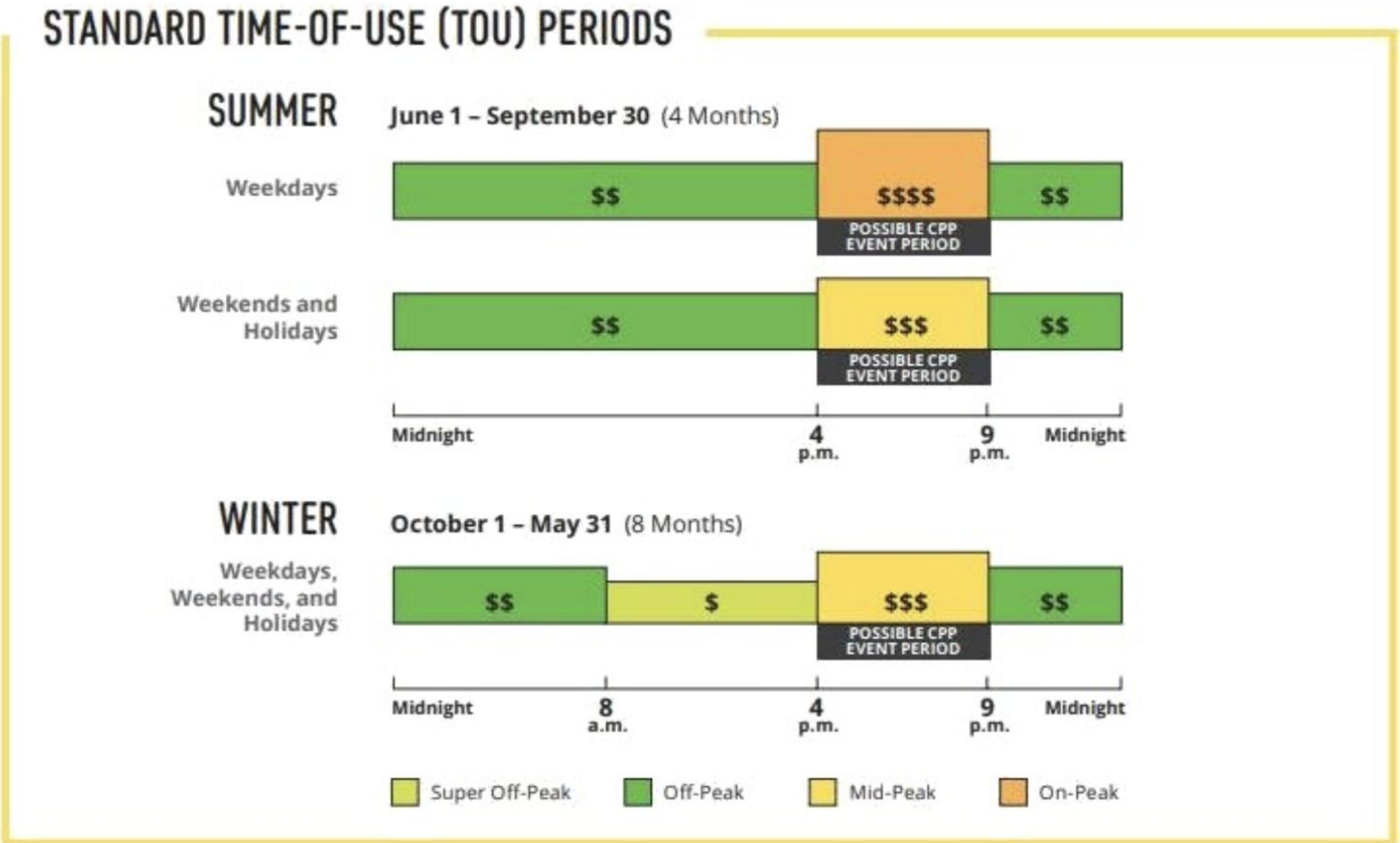
Time-shift solar for economic optimization to use during the super peak, which is increasingly in the mid-afternoon to late-night, as illuminated in this current time-of-use (TOU) rate chart from SCE:



Super Green is a lucrative personal investment

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- Achieving Super Green for a new 2,500 sq ft home adds approximately $50,000 to construction costs, compared to standard California requirements known as Title 24.
- Even without any tax benefits or other incentives, the investment in SCE territory yields a 10% annual, tax-free, risk-free return through reduced energy bills.
- This return is comparable to a long-term certificate of deposit (CD) offering a 15% annual percentage rate (APR), which is taxable. Hence, lucrative for mortgage rates up to 15%.

Super Green showcase for new construction and retrofit of 1920-vintage house at

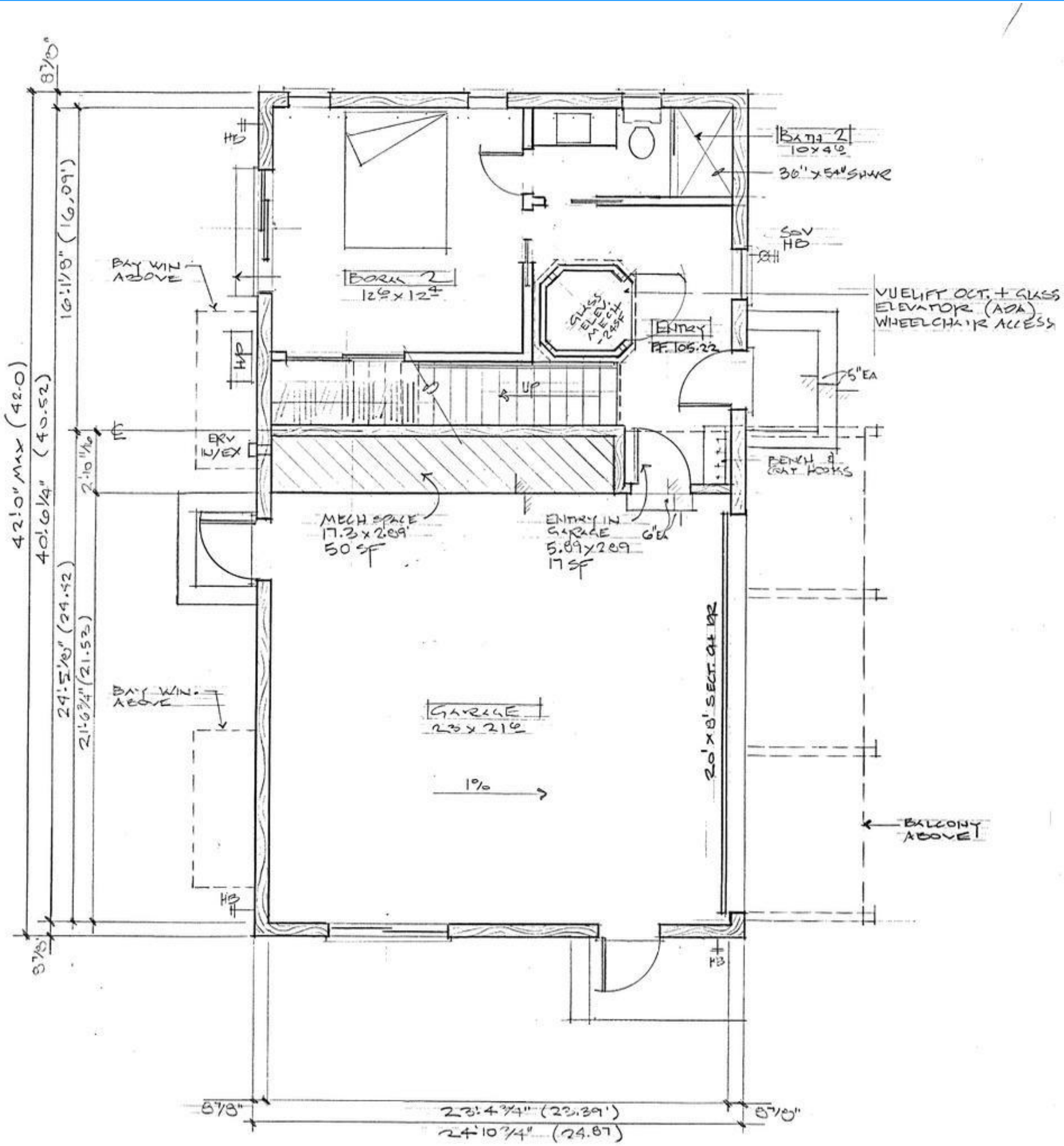
1221 Laguna St in Santa Barbara

New construction: ADU-over-garage

Retrofit: 1920s-vintage house

Planned site layout of 1221 Laguna St

1st floor Schematic Design of ADU-over-garage



2nd floor Schematic Design of ADU-over-garage

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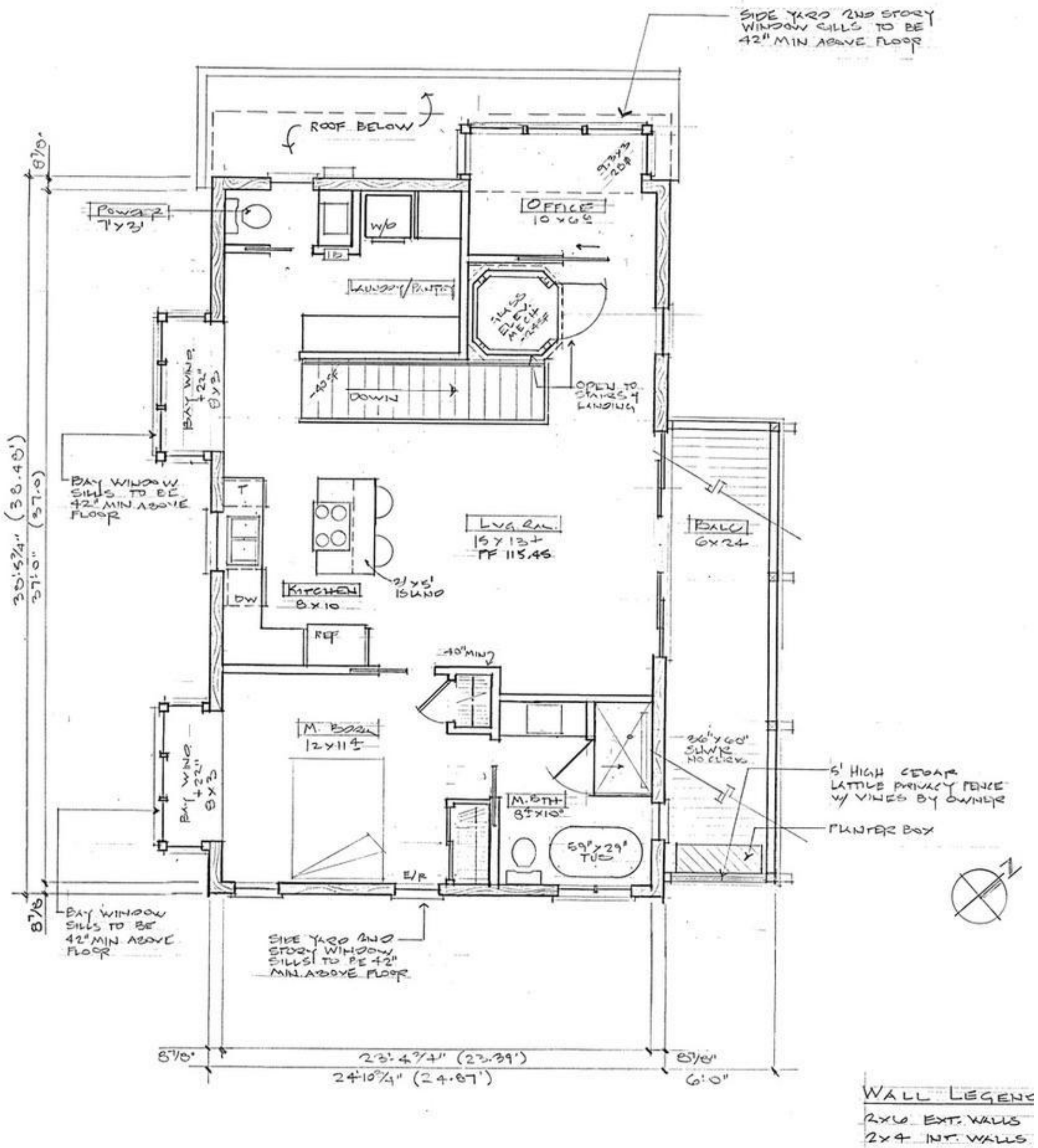

Solar Microgrid Methodology (SMM)

Step 1

Load Profiles

- Baseline: Historic site energy use
- Adjustment: Future anticipated loads (EVs, electrification)
- Master: Baseline + Adjustment Profiles
- Critical: Mission-critical, life-sustaining loads that warrant 100% resilience

Tools:

- Clean Coalition's Solar Microgrid Analysis Platform (SMAP)
- UtilityAPI

Step 2

Resource Scenarios

- Design & size solar and Battery Energy Storage Systems (BESS)
- Run shading analyses + energy modeling
- Determine resilience based on different resource scenarios

Tools:

- Helioscope
- Clean Coalition's SMAP

Step 3

Site Layouts

- Best practices when performing site walks
- Identifying critical load pathways
- Mapping site layouts

Tools:

- Clean Coalition's site walk checklist and photo instructions
- Site layout templates
- Google Slides/ PowerPoint

Step 4

Economic Analysis

- Analyze cash purchase vs. PPA economic transactions
- Apply financial incentives such as the Investment Tax Credit (ITC), Self Generation Incentive Program (SGIP), and depreciation.
- Assess the Value of Resilience

Tools:

- Energy Toolbase Developer
- Clean Coalition's SMAP

Step 5

Reporting & Recommendations

- Create final reports with key visuals and summary tables
- Present findings and propose next steps

Tools:

- Energy Toolbase Developer
- Google Slides/PowerPoint

Load profile types

Load Type	Definition
Baseline load profile	The historical annual usage of electrical loads per site that forms the basis for creating the master load profile.
Adjustments load profile	Adjustments for anticipated EV Charging Infrastructure (EVCI), electrification, energy efficiency, and new facilities.
Master load profile	The forecasted annual load profile used for this study's analysis, created from the baseline load profile plus adjustments for anticipated EV Charging Infrastructure (EVCI), electrification, energy efficiency, and new facilities.
Critical load profile	Annual load profile of the critical loads.
Critical loads	Electrical loads that are necessary to be provided with 100% energy resilience during grid outages

Load profiles used in this study

- **<u>Baseline Load Profile (BLP)</u>:** The utility data available for 1221 Laguna Street was obtained from the previous owners and spans from 2/11/2025 to 3/15/2026 in 1-hour intervals. For cleanliness, the data used for these profiles was chosen to start in March 2025 and go through the end of February 2026. This data was formatted to fit a typical calendar year, so all analyses and visuals will start in January but keep in mind the first two month's data is from 2026. Only the electricity usage is included in the BLP.
- **<u>Adjustments Load Profile (ALP)</u>:** The gas usage data was also obtained from the previous owners and makes up the ALP for this study. SoCal Gas provides usage in US therms, which was converted to kWh using 29.3 kWh/US therm. Finally, this usage was divided by 3 to account for improved efficiency of new electric appliances compared to their gas counterparts.
- **<u>Master Load Profile (MLP)</u>:** The load profile used to analyze the economics and resilience of a Solar Microgrid at this site. This load profile is the combination of the BLP and ALP at every 1-hour interval.
- **<u>Critical Load Profile (CLP)</u>**: The CLP is assumed to be 10% of the Master Load Profile.

Load profile energy summary

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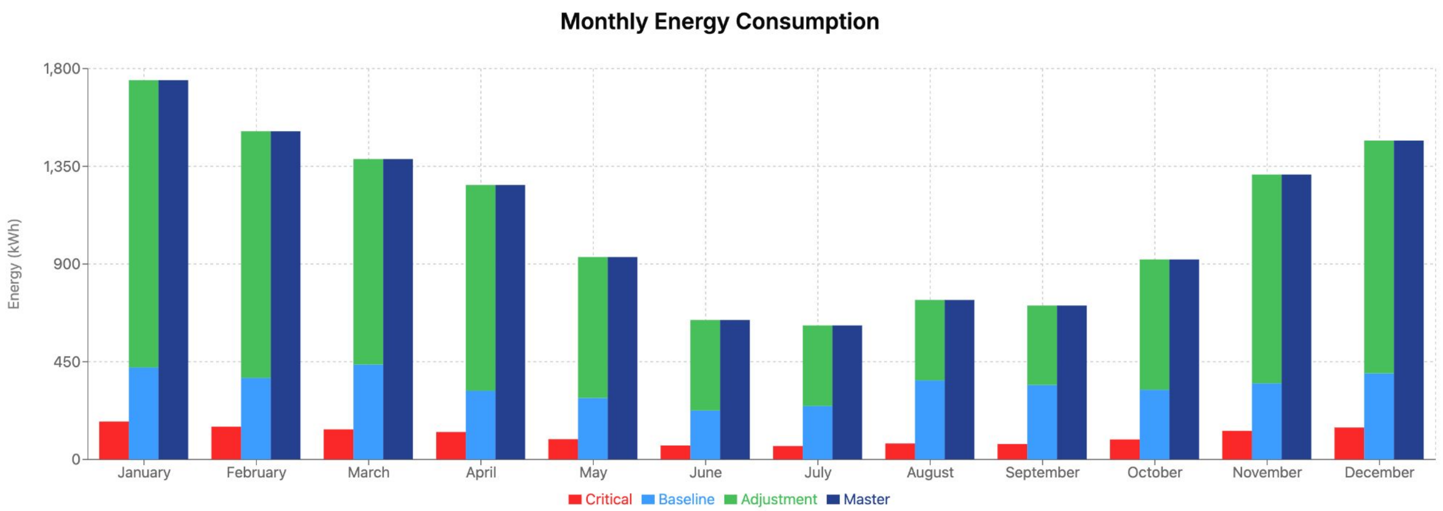

Daily Max, Average, Min and Monthly Total Electricity Usage by Profile Type

Month	Baseline				Adjustments				Master				Critical			
	Max Daily [kWh]	Average Daily [kWh]	Min Daily [kWh]	Monthly Total [kWh]	Max Daily [kWh]	Average Daily [kWh]	Min Daily [kWh]	Monthly Total [kWh]	Max Daily [kWh]	Average Daily [kWh]	Min Daily [kWh]	Monthly Total [kWh]	Max Daily [kWh]	Average Daily [kWh]	Min Daily [kWh]	Monthly Total [kWh]
January	32	14	7	424	67	43	13	1,323	98	56	25	1,747	10	6	2	175
February	23	13	8	375	80	41	20	1,136	97	54	28	1,511	10	5	3	151
March	33	14	4	437	62	31	4	947	89	45	7	1,384	9	4	1	138
April	18	11	6	316	67	32	13	948	81	42	25	1,264	8	4	2	126
May	18	9	5	283	50	21	10	649	62	30	18	932	6	3	2	93
June	11	8	5	225	27	14	9	417	35	21	16	642	3	2	2	64
July	13	8	5	247	18	12	7	370	25	20	13	617	3	2	1	62
August	25	12	8	364	17	12	9	370	34	24	18	734	3	2	2	73
September	17	11	8	343	18	12	8	366	31	24	18	709	3	2	2	71
October	17	10	7	320	32	19	7	601	45	30	17	921	5	3	2	92
November	22	12	9	350	56	32	18	962	79	44	27	1,313	8	4	3	131
December	24	13	8	396	65	35	17	1,072	89	47	29	1,469	9	5	3	147
Annual Total				**4,080**				**9,161**				**13,243**				**1,323**

Load profile demand summary

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Load Metric	Baseline Load Profile	Adjustments Load Profile	Master Load Profile	Critical Load Profile
Total Annual Load (kWh)	4,080	9,162	13,243	1,324
Peak Load (kW)	3	9	12	1

Varying the angle of tilt to optimize winter solar production for landscape and portrait in a given area

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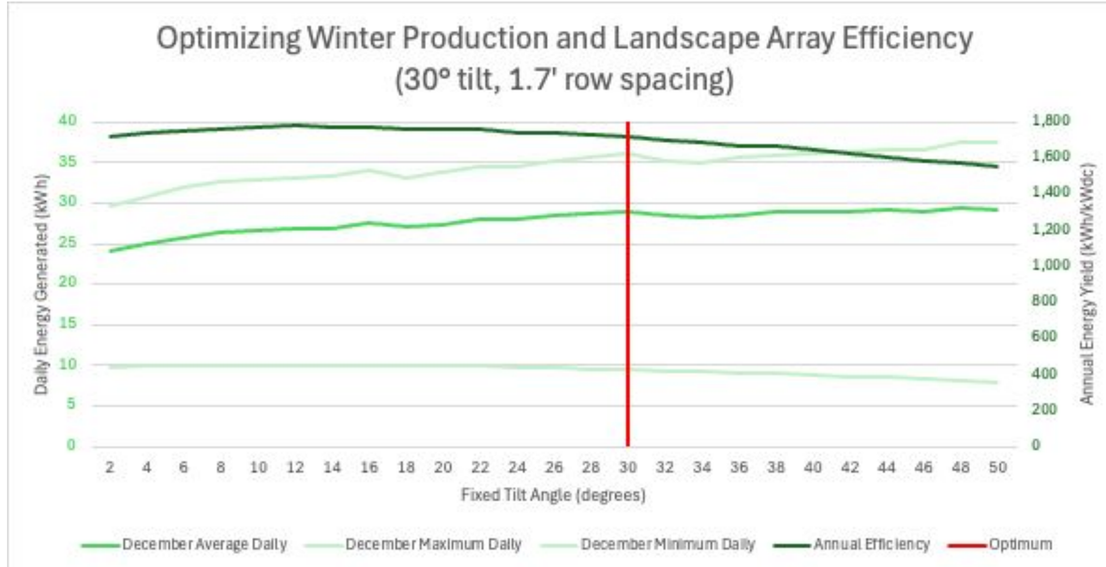

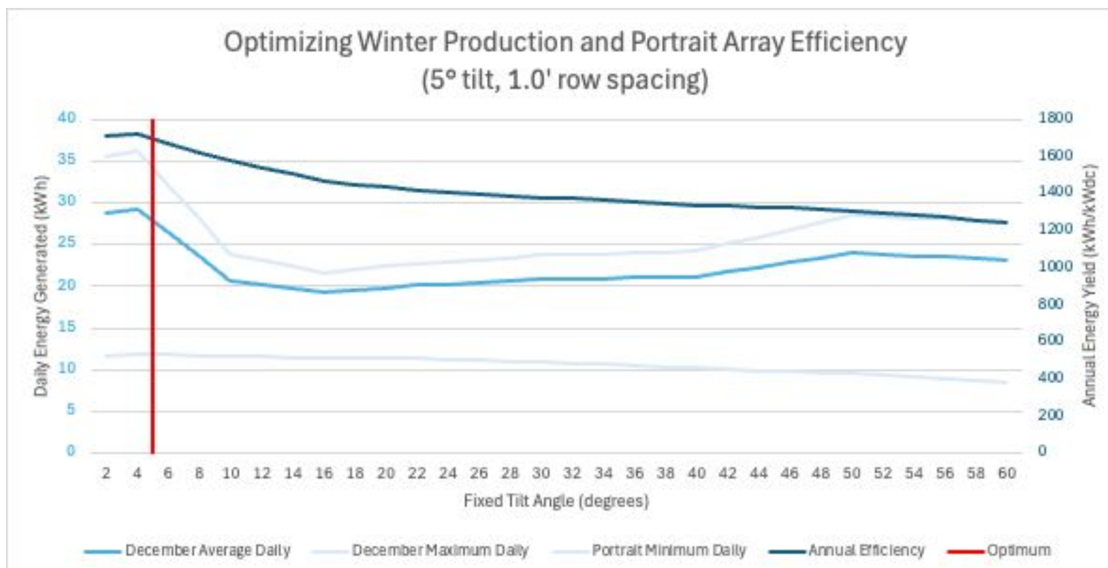

Modeling 5 solar microgrid scenarios

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The dimensions of the rooftop for siting solar resources is 38 feet by 25 feet. It is assumed that 3 foot setbacks will be required on all sides, making the usable space 32'x19'. Within this space, both residential and commercial solar module options were considered. However for a full array of commercial modules, 32.5' of usable width is required, so ideally the setback on one side can be reduced by 6". Scenarios #3, #4, and #5 are included in backup.

1. Scenario #1: Residential panels used are REC Solar, REC470AA Pure-RX (470W) in 3 rows of 5 panels each in landscape orientation.
2. Scenario #2: Residential panels used are REC Solar, REC470AA Pure-RX (470W) in 2 rows of 10 panels each, stacked in landscape orientation.
3. Scenario #3: *In back-up-* Commercial panels used are Q Cells, Q.PEAK DUO XL-G11S.3 / BFG 590 (590W) in 3 rows of 4 panels each in landscape orientation.
4. Scenario #4: *In back-up-* Commercial panels used are Q Cells, Q.PEAK DUO XL-G11S.3 / BFG 590 (590W) in 2 rows of 8 panels each in landscape orientation.
5. Scenario #5: *In back-up-* Residential panels used are REC Solar, REC470AA Pure-RX (470W) in 4 rows of 5 panels each in landscape orientation, first row is an overhang.

BESS sizing and resilience

BESS Sizing					
Scenario	MLP Peak Load (kW)	Solar System Size (kWdc)	Year 1 Standard Option BESS Power Charge/Discharge Capacity (kW)	Year 1 Standard Option BESS Energy Capacity (kWh)	Year 15 Standard Option BESS Energy Capacity (kWh)
#6: Tight rows landscape	12	9.4	23	27	17.6
#7: Tight rows portrait	12	11.3	23	27	17.6
#8: South panels portrait	12	9.9	23	27	17.6
#9: North panels portrait	12	9.9	23	27	17.6

Worst-case Solar Microgrid resilience results at year-15 (after 15 years of 0.5% solar & 3% BESS degradation)

- **Scenario #6:** Tight rows landscape
  - **MLP worst case resilience duration**: 4.25 hours
  - **MLP percentage of indefinite resilience**: 13%
- **Scenario #7:** Tight rows portrait
  - **MLP worst case resilience duration**: 4.25 hours
  - **MLP percentage of indefinite resilience**: 15%
- **Scenario #8:** South panels portrait
  - **MLP worst case resilience duration**: 4.25 hours
  - **MLP percentage of indefinite resilience**: 14%
- **Scenario #6:** North panels portrait
  - **MLP worst case resilience duration**: 4.25 hours
  - **MLP percentage of indefinite resilience**: 14%

Project resources

Scenario #6 tight rows landscape project resources (Year 1)

- **Solar PV:** 9.4 kWdc via 20x REC Solar, REC470AA Pure-RX (470W) modules
  - Racking: fixed tilt
  - Orientation: landscape
  - Tilt: 30 degrees
  - Azimuth: 220.7 degrees
- **Inverters:** 23 kW via 2x Tesla Powerwall 3s
- **Battery Energy Storage System:** 23 kW / 27 kWh via 2x Tesla Powerwall 3s

Scenario #7 tight rows portrait project resources (Year 1)

- **Solar PV:** 11.3 kWdc via 24x REC Solar, REC470AA Pure-RX (470W) modules
  - Racking: fixed tilt
  - Orientation: portrait
  - Tilt: 5 degrees
  - Azimuth: 220.7 degrees
- **Inverters:** 23 kW via 2x Tesla Powerwall 3s
- **Battery Energy Storage System:** 23 kW / 27 kWh via 2x Tesla Powerwall 3s

Scenario #8&9 south panels portrait and north panels portrait project resources (Year 1)

- **Solar PV:** 9.9 kWdc via 21x REC Solar, REC470AA Pure-RX (470W) modules
  - Racking: fixed tilt
  - Orientation: portrait
  - Tilt: 5 degrees
  - Azimuth: 220.7 degrees
- **Inverters:** 23 kW via 2x Tesla Powerwall 3s
- **Battery Energy Storage System:** 23 kW / 27 kWh via 2x Tesla Powerwall 3s

Scenario #6 tight rows landscape: 9.4 kWdc (122% NZE)

1221 Laguna St, Santa Barbara, CA 93101

Total annual load:
- BLP: 4,080 kWh
- ALP: 9,161 kWh
- MLP: 13,243 kWh
- CLP: 1,323 kWh (10% of MLP)

Peak Load (Meter# 6685926):
- BLP: 3 kW
- ALP: 9 kW
- MLP: 12 kW
- CLP: 1 kW (10% of MLP)

Solar system details (9.4kWdc)
- Area: 38' wide by 25' deep
- Setback: 3'
- Module: REC Solar, REC470AA Pure-RX (470W)
- Row spacing: 1.7'
- Azimuth: 220.7°
- Tilt: 30°
- Back edge height: 2.1'

Solar annual generation (9.4 kWdc)
- Year 1 total: 16,121 kWh
- Average daily production in worst month (Dec Y1): 29 kWh

Inverters and Battery Storage Sizing:
- Year 1: 23 kW / 27 kWh (via 2x Tesla Powerwall 3s)

Scenario #6 tight rows landscape: 9.4 kWdc (122% NZE)

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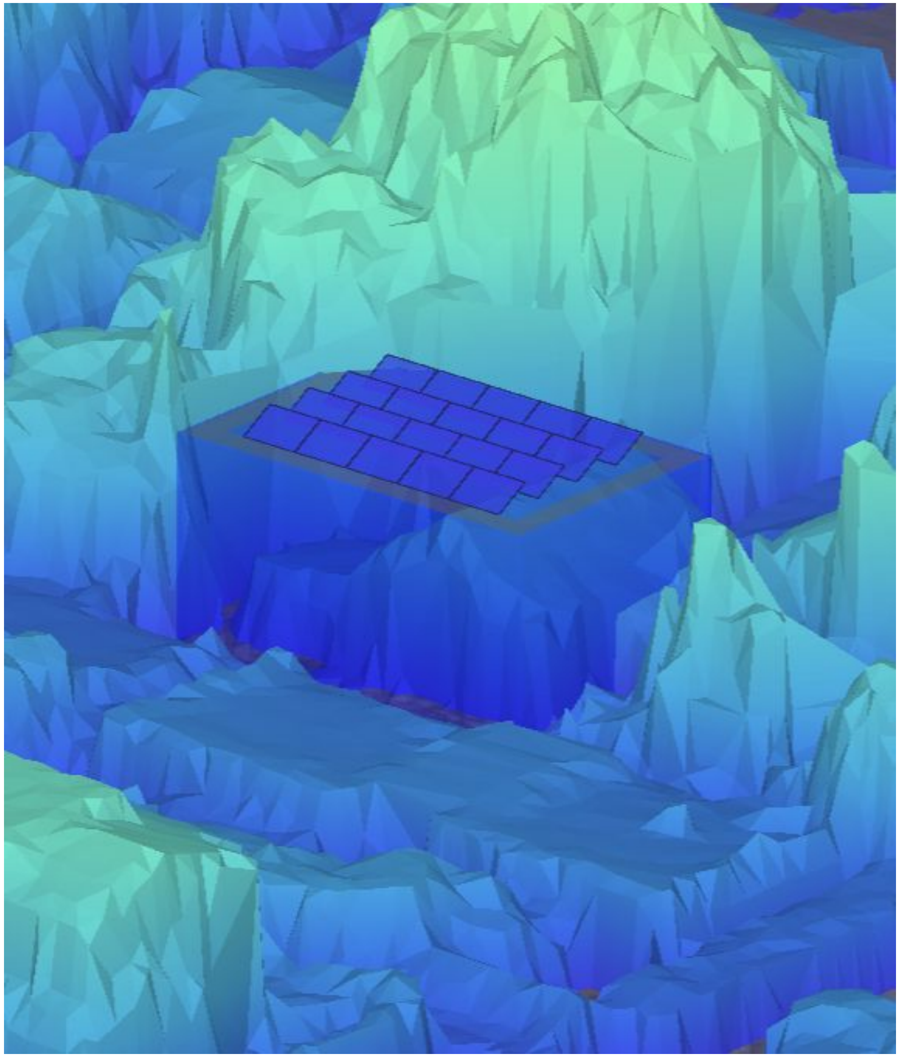
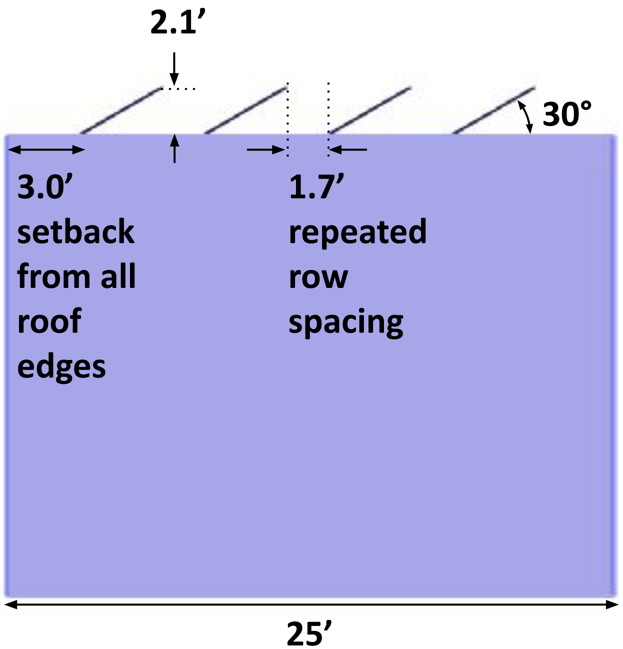


Lidar view from South



Side view from Southeast

Scenario #6 tight rows landscape: 9.4 kWdc (122% NZE)

MLP and Scenario #6 tight rows landscape (year 15) - 9.4 kWdc

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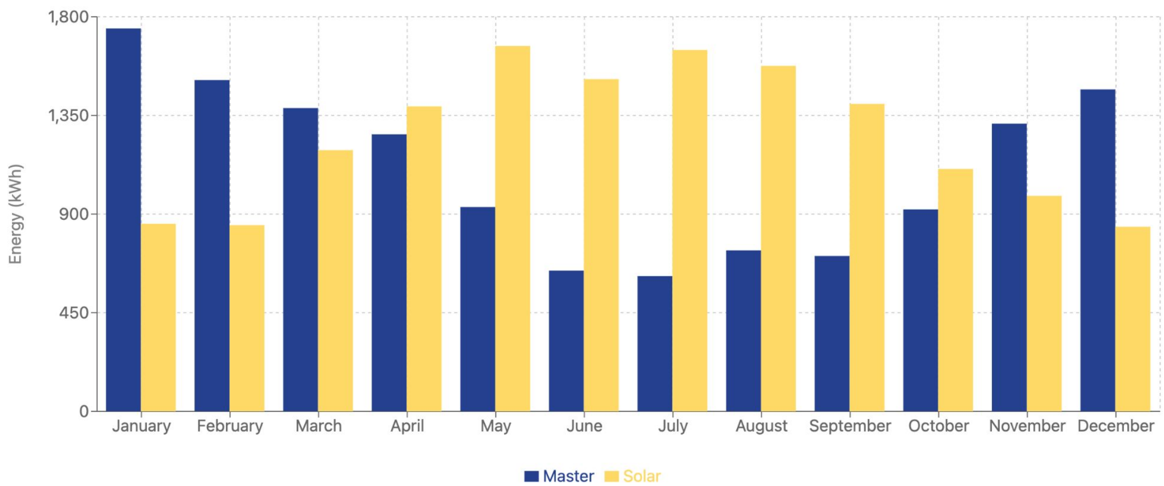

Total Monthly and Daily Max, Average, and Min Electricity Load and Solar Generation by Profile Type

Month	Master				Solar Generation			
	Max Daily [kWh/day]	Average Daily [kWh/day]	Min Daily [kWh/day]	Monthly Total [kWh]	Max Daily [kWh/day]	Average Daily [kWh/day]	Min Daily [kWh/day]	Monthly Total [kWh]
January	98	56	25	1,747	38	28	5	856
February	97	54	28	1,511	46	30	6	850
March	89	45	7	1,384	55	38	10	1,191
April	81	42	25	1,264	59	46	13	1,391
May	62	30	18	932	60	54	15	1,667
June	35	21	16	642	59	51	17	1,516
July	25	20	13	617	59	53	20	1,649
August	34	24	18	734	56	51	29	1,576
September	31	24	18	709	54	47	13	1,403
October	45	30	17	921	48	36	6	1,106
November	79	44	27	1,313	40	33	16	983
December	89	47	29	1,469	34	27	9	842
Annual Total				**13,243**				**15,030**

Energy Flow Diagram: Scenario #6 tight rows landscape (year 15)

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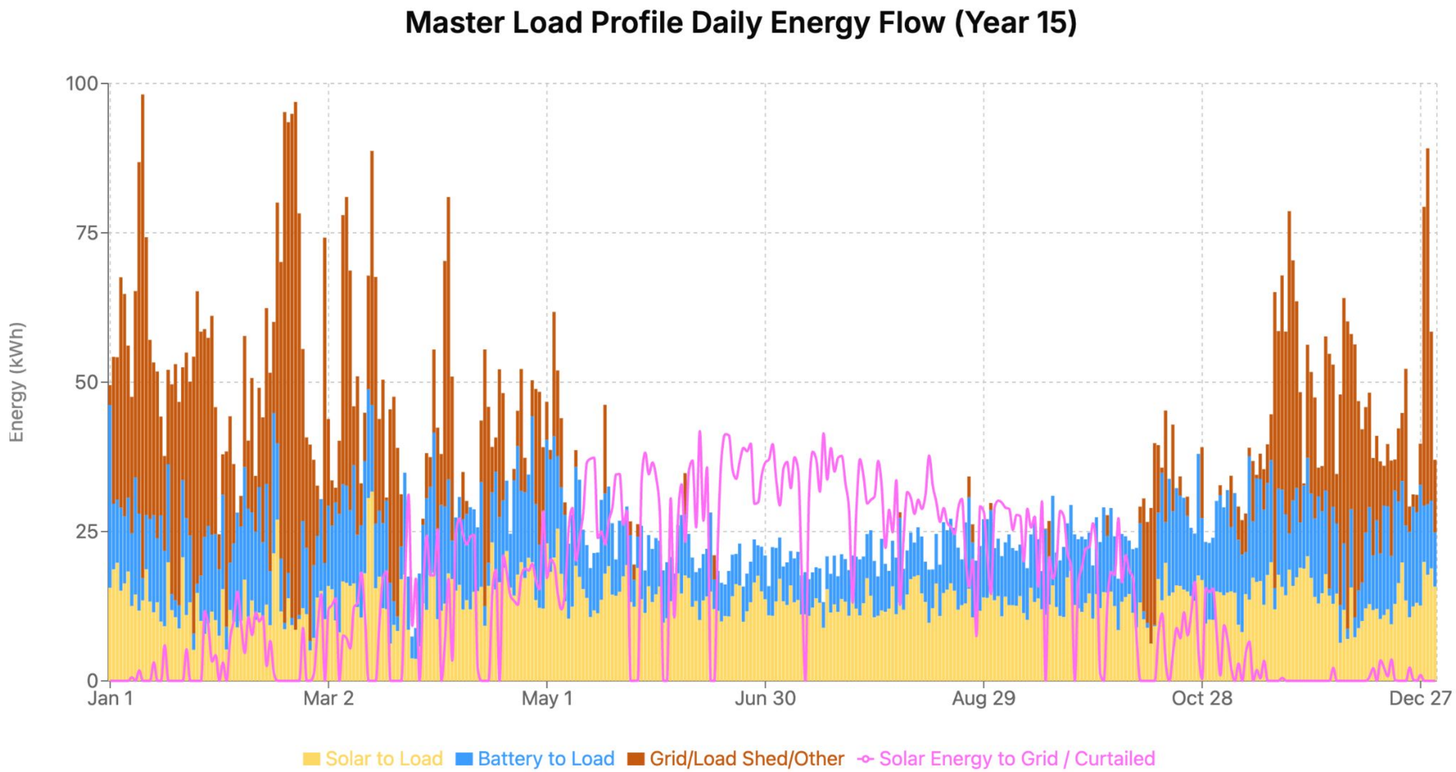

Master Profile Energy Flow Summary (Year 15)

	MLP Total Annual Load (kWh)	Annual Solar Generation (kWh)	Total Solar to Load (kWh)	Total Battery to Load (kWh)	Grid Import/Load Shed/Other (kWh)	Solar Energy to Grid/Curtailed (kWh)
Energy	13,243	15,029	5,005	4,079	4,159	5,393
Percentage of Load	100.0%	113.5%	37.8%	30.8%	31.4%	40.7%
Percentage of Solar	88.1%	100.0%	33.3%	27.1%	27.7%	35.9%

Building Information Modeling (BIM) expert needed