

Renewable Energy Science (RES)

Project: Multi-Dwelling - Summary

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Confidential Client

EI Project Multi-Dwelling Energy Independence (EI)

- Project is to implement carbon neutral and zero energy costs to 8 acres, three houses on property
- Client's first priority is to eliminate electric costs for the entire site – Done
- Project strategy summary:
 - Analyzed electric energy need for now and future – grid only as energy backup - Done
 - Provide Energy Independence architecture (zero energy costs, carbon neutral) - Done
 - Provide project ROI; detail design (see subsequent slides); energy storage - Done
 - Oversee implement; help with project management and support - Done
 - 2nd phase to provide heating / cooling analysis and required heat pumps - Done
 - 3rd phase to provide water heating heat pumps - Future
 - 4th phase EVs integration strategy - Future
 - Client wants optional energy monitoring system and Smart Private Grid (SPG™) - TBD
- *Smart Private Grid (SPG™) - AI Energy Supply and Demand Optimization is discussed in another deck*

01 EI Phase 1 – Project Site

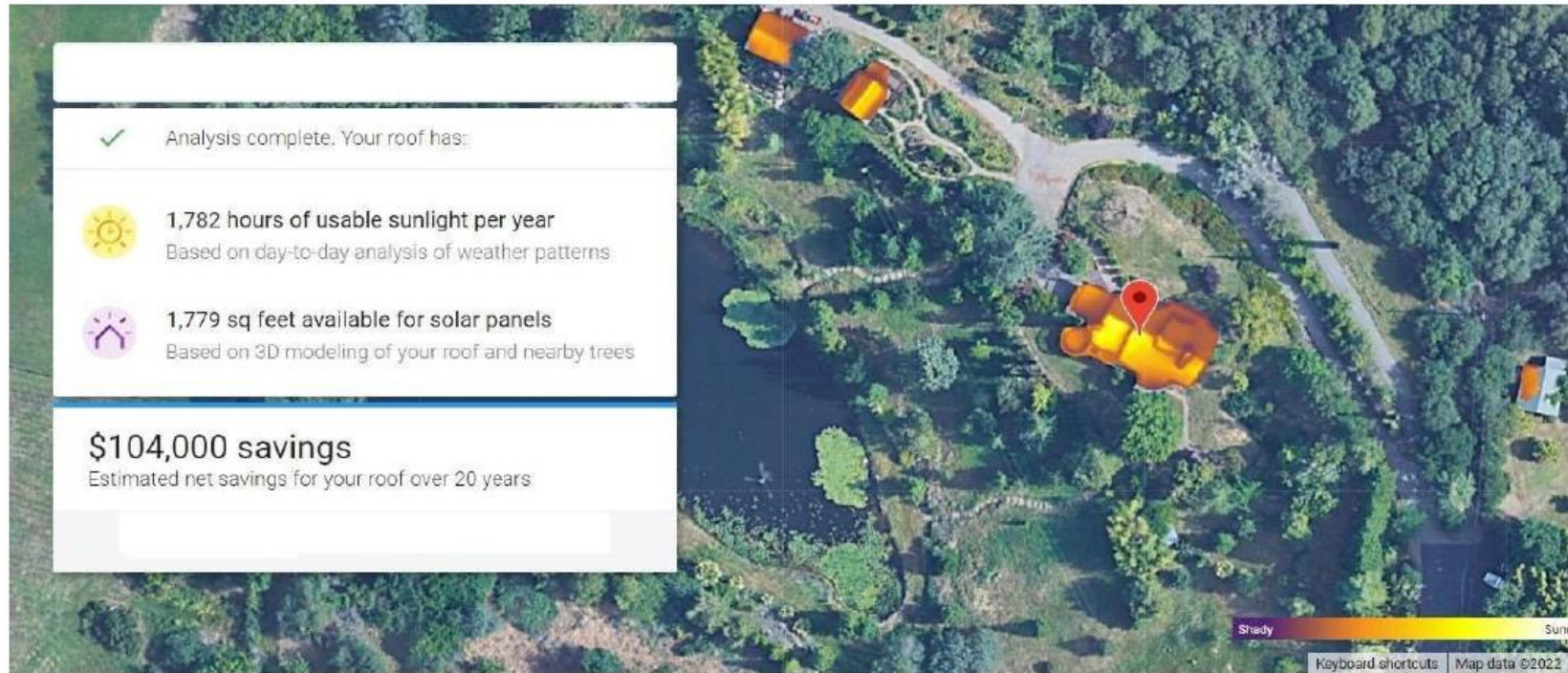


Smart Private Grid Client, CA xxxxx

Version	Changes	Date	Design
1	Original	9/15/2022	BN
1.1	Add 4th inverter	9/29/2022	BN
	Revised PVs topology	9/29/2022	BN
	Update wire size Isolator	9/29/2022	BN
	Update Inverters interconnect	9/29/2022	BN
	Update Solar Power Design Analysis	9/29/2022	BN
	Update electrical drawing	9/29/2022	BN

02

Solar System Analysis and Sizing



YOUR AVERAGE MONTHLY ELECTRIC BILL i

We use your bill to estimate how much electricity you use based on typical utility rates in your area.

\$ 750

YOUR RECOMMENDED SOLAR INSTALLATION SIZE i

This size will cover about 99% of your electricity usage. Solar installations are sized in kilowatts (kW).

14.8 kW
(1,039 ft²)

03



Solar Panel Installed

04

Solar Power Design

Solar Power Design								
Smart Private Grid								
CA								
	Rated Power (W)	Design Total PV Power (W)	Design String Voc	Max String PVs	PV Topology	Number of PVs	PVs Per Series Arrays	# of Parallel Arrays
Inverter # 1	5,000	4,428	292	9	2P6S	12	6	2
Inverter # 2	5,000	4,428	292	9	2P6S	12	6	2
Inverter # 3	5,000	4,428	292	9	2P6S	12	6	2
Inverter # 4	5,000	4,428	292	9	2P6S	12	6	2
					Total # Panels	48		
Total Theoretical PV Power	19,680							
PV Design Power		17,712						
Brand	Panel Wattage	Expected Pwr %	Expected Output Power (W)	Theoretical Power (W)	Voc (V)	Isc (A)	Max Array Voc	MPPT Range
Astronegy	410	0.9	369	4,920	48.6	10.46	450	120 - 430
Astronegy	410	0.9	369	4,920	48.6	10.46	450	120 - 430
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Astronegy	410	0.9	369	4,920	48.6	10.46	450	120 - 430

05

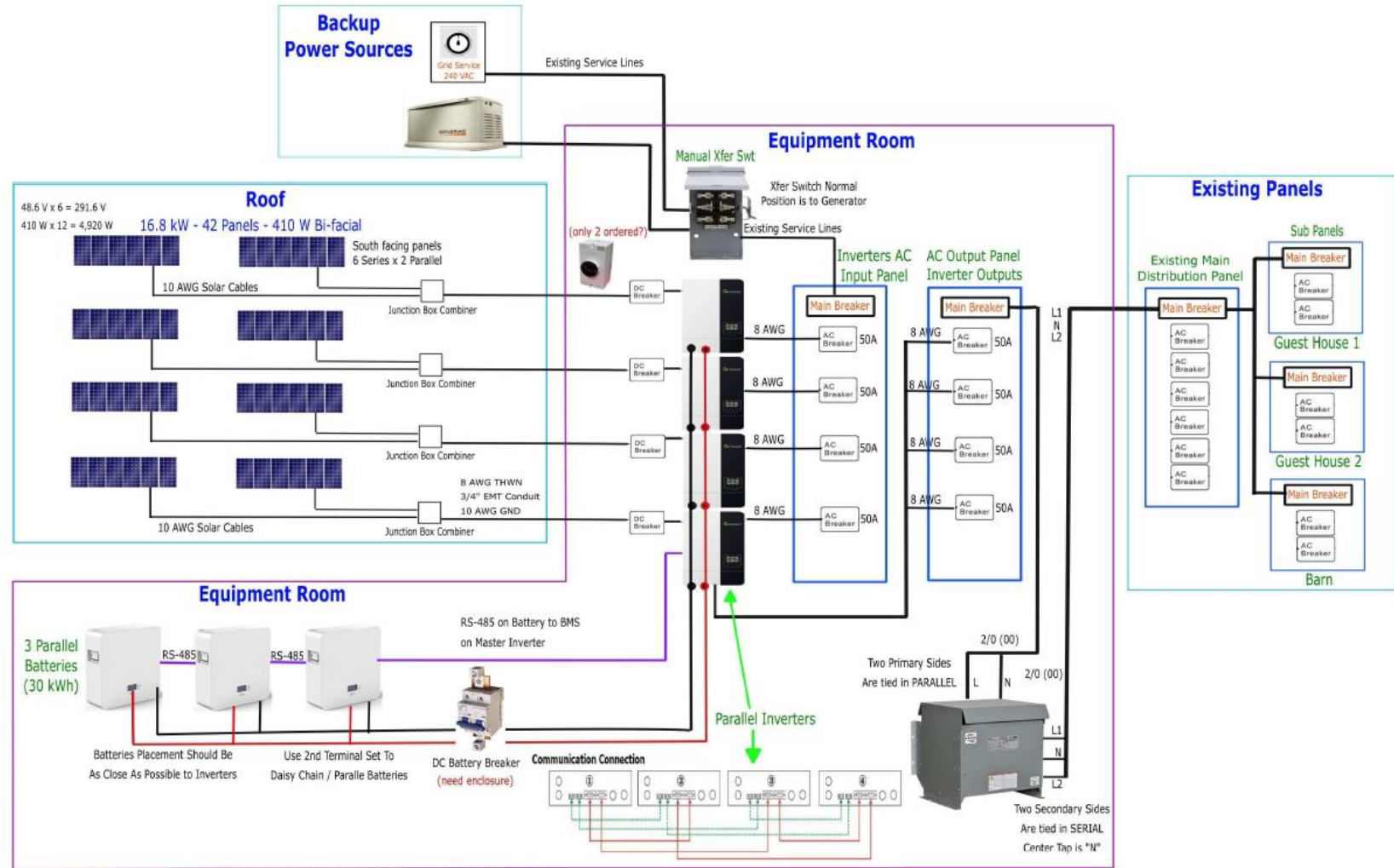
48 - 410 W Panels Analysis: Monthly PV Performance Data

Location	Smart Private Grid, CA
Location	Lat, Lng: 38.89, -121.14
Lat (deg N)	38.89
Lng (deg W)	121.14
Elev (m)	245
DC System Size (kW)	19.68
Module Type	Bi-Facial 410 Watts
Array Type	Fixed (open rack)
Array Tilt (deg)	20
Array Azimuth (deg)	180
System Losses	14.08%
Invert Efficiency	96%
DC to AC Size Ratio	1.2

Month	PV Power Generation by Month					Monthly Actual Usage Analysis 2021 - 22			
	Monthly Expected AC System Output (kWh)	Solar Radiation (kWh/m ² /day)	Plane of Array Irradiance (W/m ²)	Expected DC array Output (kWh)	DC Array Daily Avg	Main House (kWh)	Guest Houses, Garage (kWh)	Daily Ave Usage	Monthly Delta (kWh)
1	1576.05	3.28	101.54	1648.27	55	700	1,750	82	(874)
2	1569.31	3.61	101.05	1642.64	55	600	1,650	75	(681)
3	2509.02	5.38	166.86	2618.28	87	400	1,300	57	809
4	2834.58	6.38	191.43	2958.43	99	600	900	50	1,335
5	3246.79	7.26	224.95	3386.97	113	550	1,000	52	1,697
6	3352.29	7.99	239.70	3494.77	116	1,650	650	77	1,052
7	3476.84	8.15	252.54	3624.64	121	2,800	750	118	(73)
8	3306.27	7.86	243.73	3446.59	115	2,350	750	103	206
9	2862.90	6.91	207.35	2983.08	99	2,200	750	98	(87)
10	2370.34	5.35	165.96	2471.42	82	750	700	48	920
11	1704.82	3.80	114.04	1781.58	59	450	780	41	475
12	1433.71	3.03	93.94	1501.32	50	400	1,300	57	(266)
PV System Annual Total (kWh)	30,243	69	2,103	31,558		Total	13,450	12,280	4,513
Total Existing Annual Usage (kWh)	25,730								
Delta Annual (kWh)	4,513								

06

Smart Private Grid (SPG) High Level Design



All equipment, including solar panels, shall be properly grounded to earth ground stake.
The **only** point of ground and neutral bonding is at the original utility bonded point.

SPG Smart Energy Supply and Demand Optimization software not included in project

07

Equipment Room

September 2022



08



Central Heat Pump Selection



Water Heat Pump Selection



To Date Result

- ✓ No electric cost for entire site via clean and renewable energy
- ✓ Electric grid connected only for emergency back up
- ✓ Heat pumps for solar heating and cooling
- ✓ Main objectives achieved
- ✓ On-going optional phases

10 What's Next?

- Heat pumps – water heater and cloth dryer (ventless)
- Induction and hybrid induction cooktop
- Additional managed LiPO4 battery storage
- Energy Analytics – Monitoring and usage optimization
- EV chargers and EVs integration
- SPGTM Demo - TBD