Home Energy Management:

Can You Make The Numbers Work?

Orrin Charm
Charm & Imagination
July 26, 2024

Agenda:

Energy costs and savings are on everyone's mind these days. Solar and home batteries are frequently proposed as a means of easing the pain- but others are predicting the demise of the solar industry and false expectations of customers.

Now in California, the new NEM 3.0 regulations make it even more difficult to recoup the expenses of installing rooftop solar . . .

So out of an abundance of hope and curiosity, I fearlessly took a leap and decided to install solar and batteries myself, and document the results.

Here's What I've Learned:

- My Background
- My Solar Installation!
  - Soaring Electric Costs
    - 2 EV's- 1 Tesla, 1 Hyundai EV
    - Summer HVAC
- Managing Consumption
- Solar and Batteries
- Energy Apps
- EV Chargers
- Schedules?
- "Juggling" Loads
- Conclusions

Orrin Charm

Writer
Integrator
Consultant
Entrepreneur
Product Manager
Product Developer
Featured Speaker
Inventor
Creator

Some Accomplishments:

- 40+ Years in Smart Home Automation Design
- Written recent articles on Energy Management, Water Management, Kitchen/Bath Technology
- Developed Gefen GAVA Home Automation Controller
- Member of TIA Wiring Standards Committees
- Developed Standards for MDU Wiring for Data/TV/Fiber
- Designed First Home High-Speed Internet for MDU's
- Created Systems Integration Council at CEDIA
- Instructor at CEDIA
- Developed First CAD Design System for Lighting Design
- Developed First Whole-House Multi-Touchscreen Automation System
- High-End Home Systems Integrator
- Patented Speaker Hanging System
- Designed Theater Lighting Control Systems

My Latest Article In CEPro Magazine:

TECHNOLOGY | Energy Management

Energy Management Market Matures & Entices

Changing technologies and more manufacturers in the 'Wild West' of electrical power management are enabling integrators to design a range of systems — now it's up to the channel to embrace the opportunity.

By Orrin Charm

THE STATUS of electrical power keeps changing, as new means of generation, new users, and new methods of storage change the game for both electrical utilities and their customers.

First, some background. Most electrical power is generated through electromagnetism: a generator rotates in a magnetic field, converting the rotational power into electrical power that is fed to a distribution grid.

The source of the rotational power is what distinguishes the energy sources. Most generators are powered by steam, which drives the rotor blades. That steam can be produced by burning coal, oil, or gas, nuclear fission, or from solar energy. Other generators are powered directly by water, using hydroelectric turbines, or by wind.

Finally, there are photovoltaic generators, which produce power directly from sunlight.

Electromagnetic generators share some specific properties: they have a very large rotational mass to provide stability, they are capable of constant 24/7 operation, they are difficult to shut down and start up, and they generate a constant amount of power as long as they are spinning.

Photovoltaic power, by contrast, only generates power during daylight hours, and the power output varies with the amount of available sunlight.

One thing they all have in common is that they are extremely expensive to build, update, and maintain.

For the electrical utilities, the highest expense is the creation of additional power capacity, and the difficulty of obtaining locations, acquiring permits, and dealing with the political opposition that invariably accompanies any attempt to build additional power plants.

Since the power generation from most sources is constant, it is most efficient if the utilities can provide a constant supply of electricity to the grid and their customers. There is still no efficient way to store large amounts of electricity and deliver it at another time, or to efficiently transport it over long distances.

Customers, however, have their own schedules, and those don't necessarily provide a constant demand. Most people wake up and go to work in the morning, shifting their power consumption from their homes to their workplaces. Then they all go home in the evening, adjust their home temperature for comfort, turn on lights and appliances, and then go to sleep. Power demand is greater during the day, peaks between 4 and 9 p.m., and then decreases again at night.

That peak power demand is what makes life difficult for the utilities — once they have reached the limit of their generation capacity, they cannot produce more electricity, even if customers would be happy to purchase it.

On the other hand, during the night, they can usually produce more power than customers can use and might even have to shut down some generators since there is no place to store the electricity. For most utilities, solar power does little to compensate, since the solar-generated power is decreasing at the same time as the demand is peaking.

Utility Customers Desire Reliable, Inexpensive Power on Demand

The business model for electrical utilities is to generate and sell electrical power, at a profit, without encountering the huge expenses of upgrading their capacity. At certain times of day, they can provide more power than customers need, while at other times, the demand threatens to be greater than the supply. The critical difference is time!

Utilities have few good options when that happens. They can reduce power output by lowering the voltage, but such "brownouts" create huge problems for customers, since most electronic devices do not tolerate low voltage well and can be damaged. The Utilities might pre-emptively shut off power to some customers, but "rolling blackouts" are equally disliked by the affected customers. Or the third alternative is to raise the cost of power during peak periods to discourage customers from using it during those times.

That last option was not available until recently — traditional electrical meters were located at each property, and needed to be manually read, generally once a month. This meant that the utility knew how much electricity each consumer used since the last reading but had no knowledge of when it was used or how much was used at any time.

> The integration of renewable energy sources and advanced storage systems is changing the game for integrators and homeowners.

"Smart Meters" solved that problem by sending data directly to the utility every few seconds and allowing them to see usage patterns in real time. The new meters are also more accurate and reliable — unfortunately this generally works to the benefit of the utility, so some customers may see slightly higher bills with the new meters.

Some utilities have opted

Skyrocketing Electric Costs!!

Tesla Model 3

2 EV's + HVAC =

$$$

Hyundai Kona Electric

Date bill prepared
08/07/23

Amount du
Due by 08/

MOHAVE DR
SIMI VALLEY, CA 93063-2010

Your account summary

Previous Balance	$474.16
Payment Received 07/26/23	-$474.16
Balance forward	$0.00
Your new charges	$903.80
Total amount you owe by 08/28/23	**$903.80**

mary of your billing detail

Service address	Billing period	Your rate
5328 MOHAVE DR	06/30/23 to 08/01/23	

July Heat!!

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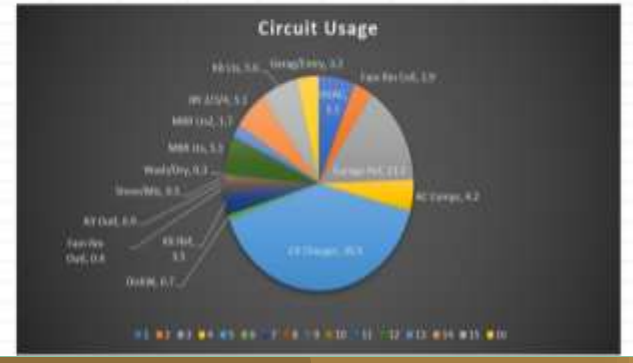
Analyzing Electric Costs!!

Emporia CT Sensors in Main Electrical Panel

Emporia VUE Energy Monitor App

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1		Mohave VUE2-Mair	Mohave VUE2-Mains_B	Mohave VUI	Mohave VUI	Mohave VUI	Mohave VUI	Mohave VUE2-Air (	Mohave VUE2-Ele	Mohave VUI	Mohave VUI	Mohave VUI	Mohave VUI	Mohave VUI	Mohave VUI	Mohave VUI	Mohave VUI	Mohave VUI	Mohave VUE2-	Mohave VUE
2		Main A	Main B	HVAC	Fam Rm Cei	Garage Ref	AC Compr		EV Charger	DishW	Kit Ref	Fam Rm Out	Kit Outl	Stove/Mic	Wash/Dry	MBR Lts	MBR Lts2	BR 2/3/4	Kit Lts	Garag/Entry
3	6/30/2023 0:00	14.2887	22.1795	2.4138	1.7304	4.9955	5.8617	0	0.0003	2.3284	0.3201	0.4644	0.4636	0	2.9874	1.0948	2.9882	3.1987	2.2343
4	7/1/2023 0:00	29.2684	37.805	5.1249	2.1611	13.592	6.0894	0	0.0002	3.6554	0.4445	1.0109	1.1093	0	2.6519	2.0324	2.6533	6.8447	2.5879
5	7/2/2023 0:00	16.4571	18.2994	2.7034	2.1087	5.6889	5.3879	14.7393	1.7388	2.0678	0.3113	0.3657	0.3188	3.1698	2.0843	0.9352	2.0849	3.7776	2.2601
6	7/3/2023 0:00	51.1318	57.5277	3.507	1.9553	8.6238	5.2296	64.567	1.147	2.1436	0.2251	0.4436	0.9859	0	3.4306	1.0846	3.426	4.2342	2.08
7	7/4/2023 0:00	15.6086	21.6519	2.6018	2.1259	5.5842	4.6891	0	0.6317	2.2998	0.3421	0.5145	0.2171	0.2419	3.4185	1.1148	3.4175	3.57	2.1414
8	7/5/2023 0:00	23.3499	24.5347	1.611	1.6527	2.6986	4.7101	16.7894	1.7064	1.9304	0.2369	0.5075	0.3828	0	2.8306	1.6012	2.8293	4.9618	2.1443
9	7/6/2023 0:00	21.659	27.2038	1.5759	1.726	2.6821	4.3258	30.4129	0.0003	2.2965	0.2636	2.0456	0.6134	0	3.4175	1.0982	3.4149	3.8826	2.1558
10	7/7/2023 0:00	11.0996	15.467	1.2958	1.6341	1.8072	4.3564	0.0704	0.0001	3.0547	0.214	0.4588	0.2661	0	3.1507	1.1073	3.1505	2.9827	2.2729
11	7/8/2023 0:00	32.9913	38.3795	1.3977	1.697	2.2104	4.6736	45.9838	0.0001	1.867	0.2554	0.4925	0.4357	0	3.1964	1.0828	3.1942	2.9254	1.9706
12	7/9/2023 0:00	42.8601	47.1473	1.4089	1.8045	2.1335	4.4267	60.6372	1.7022	1.8565	0.2398	0.5164	0.2205	0	4.8074	1.0862	4.8005	4.1527	2.1253
13	7/10/2023 0:00	17.1686	22.9797	2.5823	2.0531	5.3609	5.4712	2.7772	0.0001	2.1772	0.3621	0.5203	0.3485	0	4.14	1.1083	4.1367	4.6141	2.2528
14	7/11/2023 0:00	35.8792	41.939	2.8436	1.6895	5.8716	5.9496	41.8074	0.0001	2.3001	0.3122	0.5839	0.1659	0	3.8108	1.0927	3.8066	3.3222	2.1488
15	7/12/2023 0:00	29.5131	35.8752	4.6434	1.8916	9.4159	6.309	16.022	1.6701	1.957	0.2977	0.6172	1.022	0.1968	4.2373	1.1073	4.2323	4.4057	1.9235
16	7/13/2023 0:00	21.2411	27.6762	4.1672	1.9329	8.8415	6.5702	2.1897	0.0002	2.3447	0.2469	0.4943	0.1387	1.1831	4.2714	1.1075	4.2679	3.7999	2.2691
17	7/14/2023 0:00	37.4103	48.3004	4.7862	1.9629	10.8405	6.5822	38.7673	0.0002	2.6361	0.2788	0.4679	0.1302	0	3.5182	1.1149	3.5144	3.5674	3.0263
18	7/15/2023 0:00	15.2271	25.2397	3.0562	2.0798	6.8217	0.0103	3.5902	0.0001	2.6308	0.3339	0.5507	0.1605	0	4.4201	1.1226	4.4157	2.6984	2.0611
19	7/16/2023 0:00	46.3033	55.5894	5.6167	2.123	14.4695	0.0357	47.8278	0.0001	2.1987	0.2917	0.5356	0.3491	0.0868	2.3745	1.0973	2.3713	5.0066	2.2628
20	7/17/2023 0:00	23.1466	32.7369	5.331	1.9576	14.3617	0.0215	0	1.6533	2.0042	0.2868	0.5469	0.2119	0	3.145	1.107	3.1428	4.0662	2.9688
21	7/18/2023 0:00	35.2863	44.4606	5.1264	1.8901	13.3193	0.0222	28.5826	0.0116	2.131	0.2453	0.5662	0.2963	0	2.8938	1.1025	2.8903	4.7301	1.987
22	7/19/2023 0:00	33.0325	44.0672	5.0805	2.0309	13.3181	0.0234	26.3554	0.0002	2.7837	0.2739	0.9308	0.1221	0	3.4061	1.0996	3.4025	2.4403	2.2825
23	7/20/2023 0:00	26.4583	36.6372	4.3029	1.9021	12.1225	0.0201	18.0159	0.0001	1.914	0.2939	0.4651	0.1286	0	2.2784	1.1125	2.2782	2.4539	2.2182
24	7/21/2023 0:00	44.9056	56.3369	5.137	2.0603	13.4385	0.0219	30.5465	0.0002	1.892	0.382	0.5236	0.0832	0	3.4373	1.1104	3.4325	3.5566	2.2374
25	7/22/2023 0:00	45.9361	58.2004	4.5931	2.2249	12.4635	0.0204	56.3434	0.0001	1.9379	0.185	0.4381	0.092	0	3.935	1.1051	3.9301	2.7509	2.4083
26	7/23/2023 0:00	26.9515	36.796	3.389	2.0074	8.2301	0.013	21.5196	0.0001	2.8387	0.3205	0.5312	0.2157	0.3275	4.9321	1.1249	4.9257	3.8353	2.2433
27	7/24/2023 0:00	43.7164	52.2900	5.5583	1.9626	15.2925	0.0227	39.504	1.7263	2.9978	0.2715	0.4992	0.2241	0	3.0444	1.1034	3.0399	3.2665	2.0012
28	7/25/2023 0:00	24.0834	34.7516	5.9502	2.1098	17.0224	0.0286	0	0.0001	2.2474	0.3477	0.4289	0.1494	0	3.5071	1.1274	3.5031	3.8473	1.0728
29	7/26/2023 0:00	10.2031	14.5006	2.2013	0.8421	5.9197	0.0092	0	0	1.578	0.1442	0.3394	0.0203	0.284	1.698	0.6421	1.6971	1.713	0.9295
30	6/28/2023 0:00																		
31	6/29/2023 0:00																		
32	6/30/2023 0:00																		
33		797.177	996.5734	98.0955	51.3163	237.1261	74.8415	637.049	11.99	62.0704	7.7269	15.9402	8.8817	5.4899	91.0248	30.633	90.9464	100.6028	58.326
34		% of Bill:		5.5	2.9	13.2	4.2	35.5	0.7	3.5	0.4	0.9	0.5	0.3	5.1	1.7	5.1	5.6	3.2
35		Total kWh:	1795.7504				Total EV:	637.049											
36		Compared to Bill:	1.359387131				% of Bill:	0.35475645											
37																			
38																			
39							Av Bill/kWh:	0.358940197											



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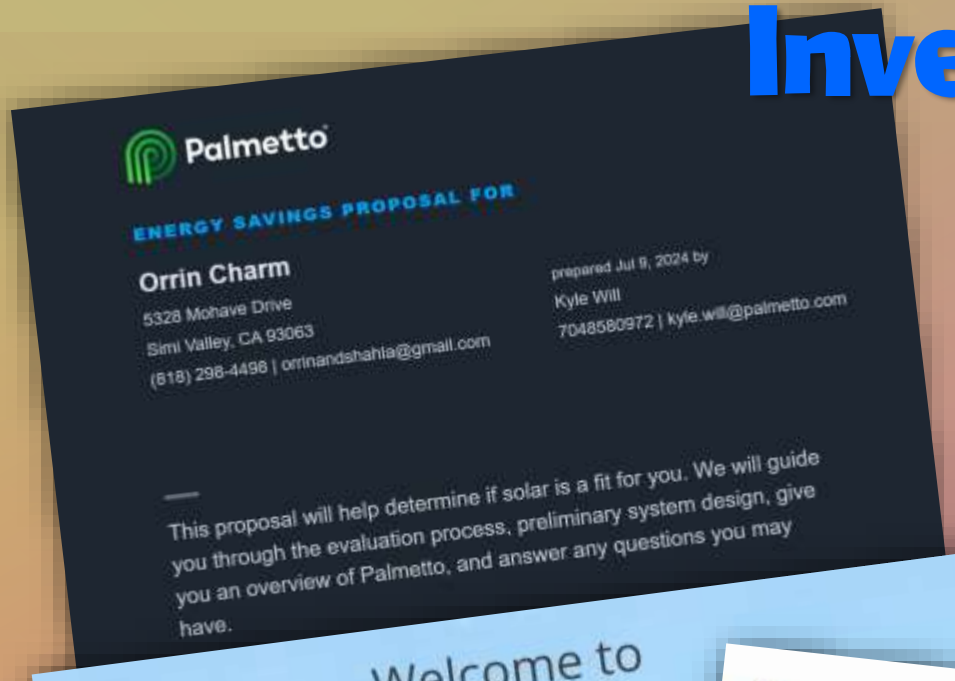
Investigate Solar!

Is It Too Late?



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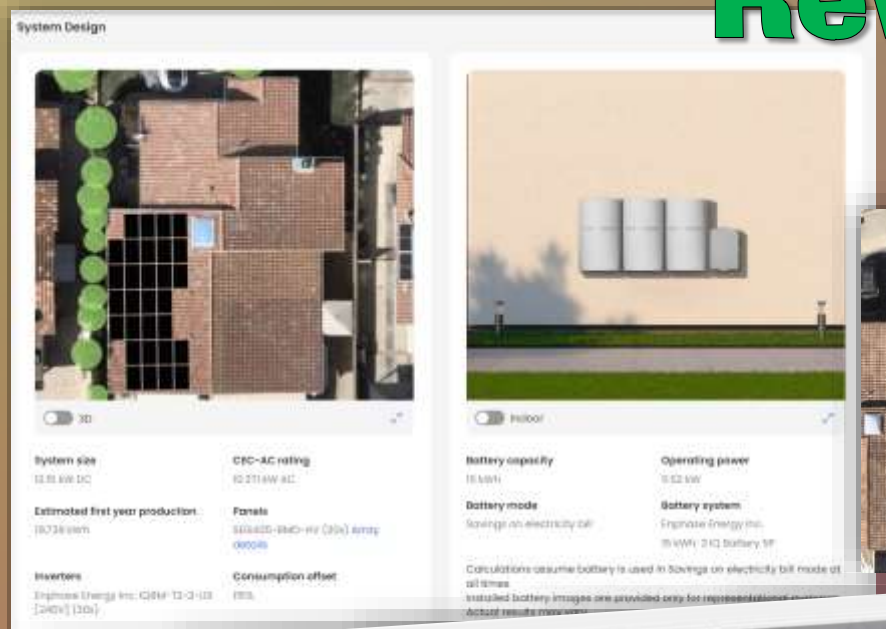
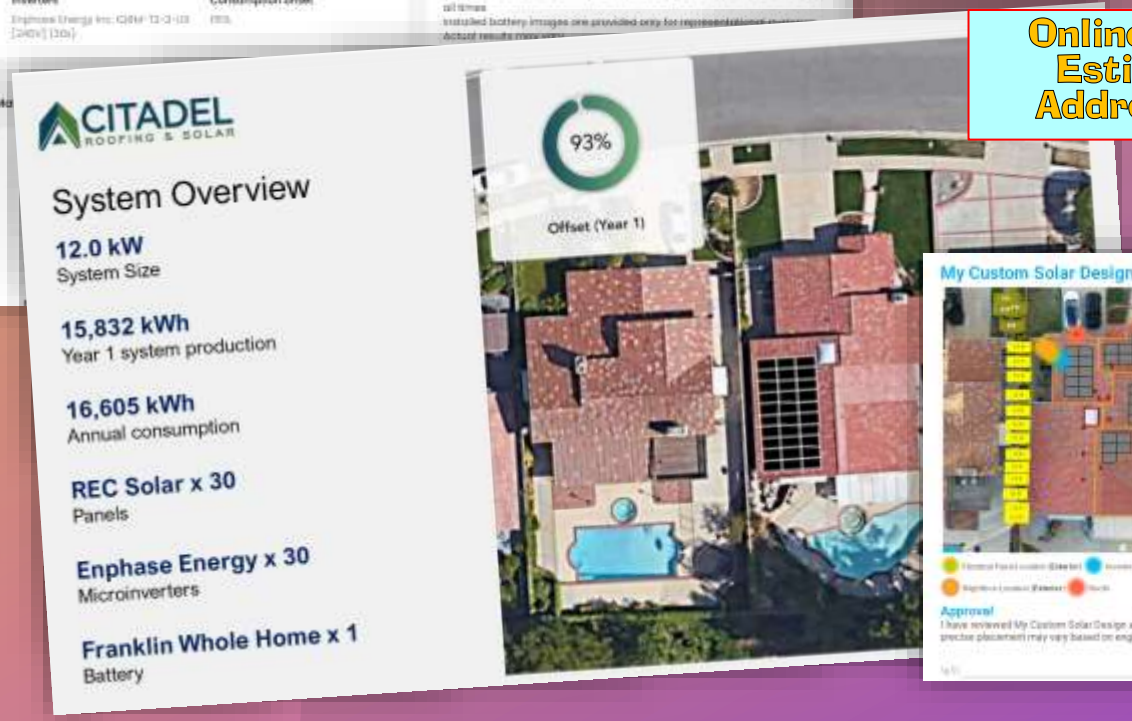
Review Proposals!



Online Heatmaps and Estimates for Any Address/Date/Time!



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Compare Proposals:

	Palmetto (No Backup)		Citadel		Ameco (3 batteries)		Ameco (2 batteries) 2.9%		Ameco (2 batteries) 0%		SunPower		Sunrun		Sunrun (NEW)		Sunrun (LATEST)	
Year	Lease Payment	Annual Cost	Lease Payment	Annual Cost	Lease Payment	Annual Cost	Lease Payment	Annual Cost	Lease Payment	Annual Cost	Lease Payment	Annual Cost	Lease Payment	Annual Cost	Lease Payment	Annual Cost	Lease Payment	Annual Cost
1	$222.10	$2,665.20	$441.05	$4,092.60	$299.00	$3,588.00	$277.31	$3,327.72	$357.92	$4,295.04	$349.29	$4,191.48	$388.00	$4,656.00	$352.39	$4,228.68	$325.81	$3,909.72
2	$223.20	$2,678.40	$350.94	$4,211.29	$307.47	$3,692.05	$285.35	$3,424.22	$357.92	$4,295.04	$349.29	$4,191.48	$401.58	$4,818.96	$352.39	$4,228.68	$325.81	$3,909.72
3	$224.28	$2,691.36	$361.12	$4,333.41	$316.59	$3,799.12	$293.63	$3,523.55	$357.92	$4,295.04	$349.29	$4,191.48	$415.64	$4,987.62	$352.39	$4,228.68	$325.81	$3,909.72
4	$225.35	$2,704.20	$371.59	$4,459.08	$325.77	$3,909.30	$302.14	$3,625.71	$357.92	$4,295.04	$349.29	$4,191.48	$430.18	$5,162.19	$352.39	$4,228.68	$325.81	$3,909.72
5	$226.40	$2,716.80	$382.37	$4,588.40	$335.22	$4,022.67	$310.90	$3,730.85	$357.92	$4,295.04	$349.29	$4,191.48	$445.24	$5,342.87	$352.39	$4,228.68	$325.81	$3,909.72
6	$227.43	$2,729.16	$393.45	$4,721.46	$344.94	$4,139.32	$319.92	$3,839.05	$357.92	$4,295.04	$349.29	$4,191.48	$460.82	$5,529.87	$352.39	$4,228.68	$325.81	$3,909.72
7	$228.58	$2,742.96	$404.87	$4,858.38	$354.95	$4,259.36	$329.20	$3,950.38	$357.92	$4,295.04	$349.29	$4,191.48	$476.95	$5,723.41	$352.39	$4,228.68	$325.81	$3,909.72
8	$229.72	$2,756.64	$416.63	$4,999.27	$365.24	$4,382.88	$338.75	$4,064.94	$357.92	$4,295.04	$349.29	$4,191.48	$493.64	$5,923.73	$352.39	$4,228.68	$325.81	$3,909.72
9	$230.84	$2,770.08	$428.69	$5,144.25	$375.83	$4,509.99	$348.57	$4,182.83	$357.92	$4,295.04	$349.29	$4,191.48	$510.92	$6,131.06	$352.39	$4,228.68	$325.81	$3,909.72
10	$231.94	$2,783.28	$441.12	$5,293.44	$386.73	$4,640.79	$358.68	$4,304.13	$357.92	$4,295.04	$349.29	$4,191.48	$528.80	$6,345.65	$352.39	$4,228.68	$325.81	$3,909.72
11	$233.02	$2,796.24	$453.91	$5,446.95	$397.95	$4,775.36	$369.08	$4,428.95	$357.92	$4,295.04	$349.29	$4,191.48	$547.31	$6,567.75	$352.39	$4,228.68	$325.81	$3,909.72
12	$234.09	$2,809.08	$467.08	$5,604.91	$409.49	$4,913.85	$379.78	$4,557.39	$357.92	$4,295.04	$349.29	$4,191.48	$566.47	$6,797.62	$352.39	$4,228.68	$325.81	$3,909.72
13	$235.27	$2,823.24	$480.62	$5,767.45	$421.36	$5,056.35	$390.80	$4,689.55	$357.92	$4,295.04	$349.29	$4,191.48	$586.29	$7,035.54	$352.39	$4,228.68	$325.81	$3,909.72
14	$236.44	$2,837.28	$494.56	$5,934.73	$433.58	$5,202.98	$402.33	$4,827.55	$357.92	$4,295.04	$349.29	$4,191.48	$606.81	$7,281.78	$352.39	$4,228.68	$325.81	$3,909.72
15	$237.58	$2,850.96	$508.90	$6,106.83	$446.16	$5,353.87	$414.29	$4,971.49	$357.92	$4,295.04	$349.29	$4,191.48	$628.05	$7,536.64	$352.39	$4,228.68	$325.81	$3,909.72
16	$238.71	$2,864.52	$523.66	$6,283.91	$459.09	$5,509.13	$425.79	$5,109.49	$357.92	$4,295.04	$349.29	$4,191.48	$650.04	$7,800.42	$352.39	$4,228.68	$325.81	$3,909.72
17	$239.83	$2,877.96	$538.85	$6,466.14	$472.43	$5,668.90	$438.14	$5,257.68	$357.92	$4,295.04	$349.29	$4,191.48	$672.79	$8,073.44	$352.39	$4,228.68	$325.81	$3,909.72
18	$241.05	$2,892.60	$554.47	$6,653.66	$486.13	$5,833.29	$450.84	$5,410.14	$357.92	$4,295.04	$349.29	$4,191.48	$696.33	$8,356.01	$352.39	$4,228.68	$325.81	$3,909.72
19	$242.25	$2,907.00	$570.55	$6,846.62	$500.20	$6,002.46	$463.92	$5,567.03	$357.92	$4,295.04	$349.29	$4,191.48	$720.71	$8,648.47	$352.39	$4,228.68	$325.81	$3,909.72
20	$243.44	$2,921.28	$587.10	$7,045.17	$514.71	$6,176.53	$477.37	$5,728.47	$357.92	$4,295.04	$349.29	$4,191.48	$745.93	$8,951.17	$352.39	$4,228.68	$325.81	$3,909.72
21	$244.61	$2,935.32	$604.12	$7,249.48	$529.64	$6,355.65	$491.22	$5,894.60	$357.92	$4,295.04	$349.29	$4,191.48	$772.04	$9,264.46	$352.39	$4,228.68	$325.81	$3,909.72
22	$245.76	$2,949.12	$621.64	$7,459.73	$545.00	$6,539.96	$505.46	$6,065.54	$357.92	$4,295.04	$349.29	$4,191.48	$799.06	$9,588.71	$352.39	$4,228.68	$325.81	$3,909.72
23	$246.89	$2,962.68	$639.67	$7,676.05	$560.80	$6,729.62	$520.13	$6,241.44	$357.92	$4,295.04	$349.29	$4,191.48	$827.03	$9,924.32	$352.39	$4,228.68	$325.81	$3,909.72
24	$248.13	$2,977.56	$658.22	$7,898.65	$577.07	$6,924.78	$535.20	$6,422.45	$357.92	$4,295.04	$349.29	$4,191.48	$855.97	$10,271.67	$352.39	$4,228.68	$325.81	$3,909.72
25	$249.35	$2,992.20	$677.31	$8,127.71	$593.80	$7,125.60	$550.72	$6,608.70	$357.92	$4,295.04	$349.29	$4,191.48	$885.93	$10,631.18	$352.39	$4,228.68	$325.81	$3,909.72
Total Payments		**$70,635.12**		**$147,269.50**		**$129,111.80**		**$119,745.80**		**$107,376.00**		**$104,787.00**		**$181,950.53**		**$105,717.00**		**$97,749.00**
Buyout Cost		$2,992.20																
Total Cost		$73,627.32																
Escalation Rate%	**0.99**		**2.90**		**2.90**		**2.90**		**0.00**		**0.00**		**3.50**		**0.00**		**0.00**	
	Kyle		**Mike**		**Logan**		**Logan**		**Logan**		**Wesley**		**Alec**		**Alec**		**Alec**	
Size (kW)	11.3		14.0		12.3		12.3		12.3		13.6		11.0		13.6		13.6	
Panels	28		35		30		30		30		34		29		34		34	
Battery	(9.60)		13.60		10.00		10.00		10.00		26.00		27.00		26.00		26.00	
Production	15,959.00		18,649.00		19,976.00		19,976.00		19,976.00		19,862.00		16,677.00		19,548.00		19,757.00	
Consumption	16,092.00		18,605.00		17,301.00		17,301.00		17,301.00		16,599.00		16,917.00		16,917.00		16,917.00	
Offset- Seller Est	99%		100%		117%		117%		117%		99%		99%		116%		117%	
Offset- Calculated	96.1%		112.3%		120.3%		120.3%		120.3%		116.6%		100.4%		117.7%		118.0%	
2023 Usage kWh	16,605																	
Cost/kW	$0.177		$0.316		$0.259		$0.240		$0.215		$0.216		$0.435		$0.216		$0.198	
Month (2023)	Edison kWh	$5,786.58	$0.348 /kWh		Ameco kWh:				SunPower kWh:									
Jan	1,161	$278.14				956	(208)			839	(342)							
Feb	1,159	$306.99				1,127	(42)			1,084	(85)							
Mar	1,300	$423.46				1,708	408			1,755	455							
Apr	941	$327.96				1,884	943			2,072	1,131							
May	1,248	$443.57				2,123	875			2,294	1,046							
Jun	1,321	$474.16				2,353	1,032			2,267	946							
Jul	2,354	$903.80				2,404	50			2,254	(100)							
Aug	1,748	$664.53				2,220	472			2,171	423							
Sep	1,320	$465.57				1,768	448			1,690	370							
Oct	1,263	$483.25				1,471	210			1,320	57							
Nov	1,367	$523.51				1,009	(244)			887	(480)							
Dec	1,413	$541.44				864	(549)			704	(709)							
						19,976	**5,971**			**19,917**	**2,712**							

Edison TOU-D-PRIME Rates:

June-Sep	
weekday 4-9PM	$0.62
weekend 4-9PM	$0.37
9P-6P	$0.24
Oct-May	
weekday 4-9P	$0.57
weekend 4-9P	$0.22
9P-6P	$0.22
Delivery Charge	$14.06/month

Sunrun Purchase Price:

$120K-140K	w/25yr warranty
$95K	w/o 25yr warranty

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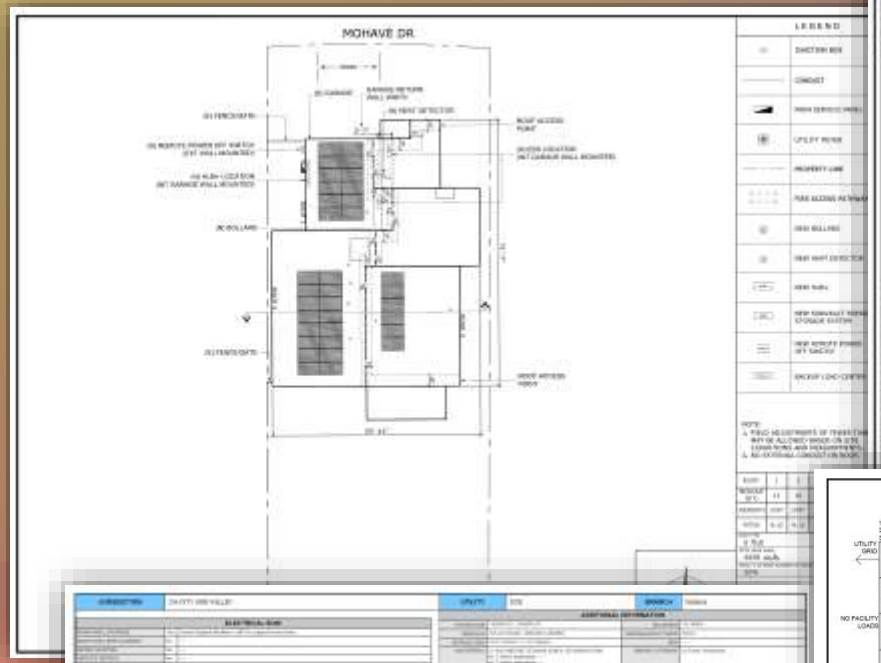
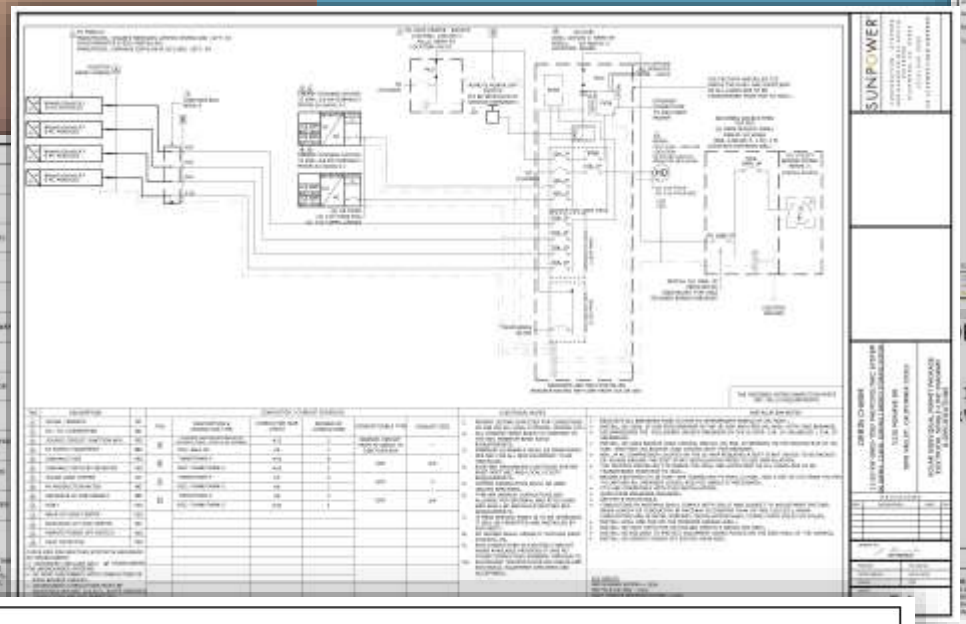
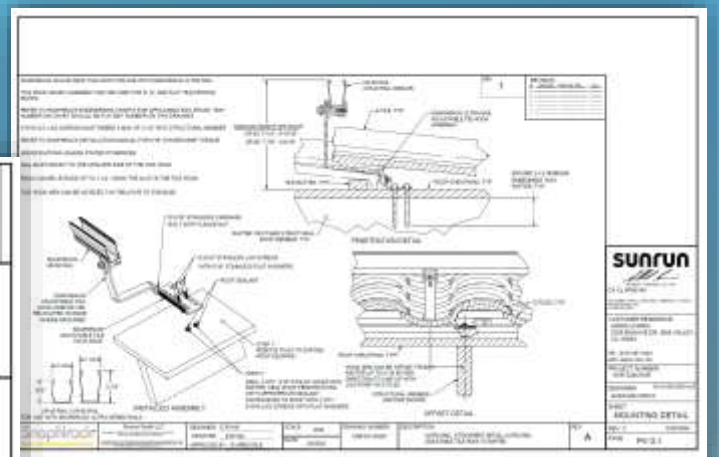
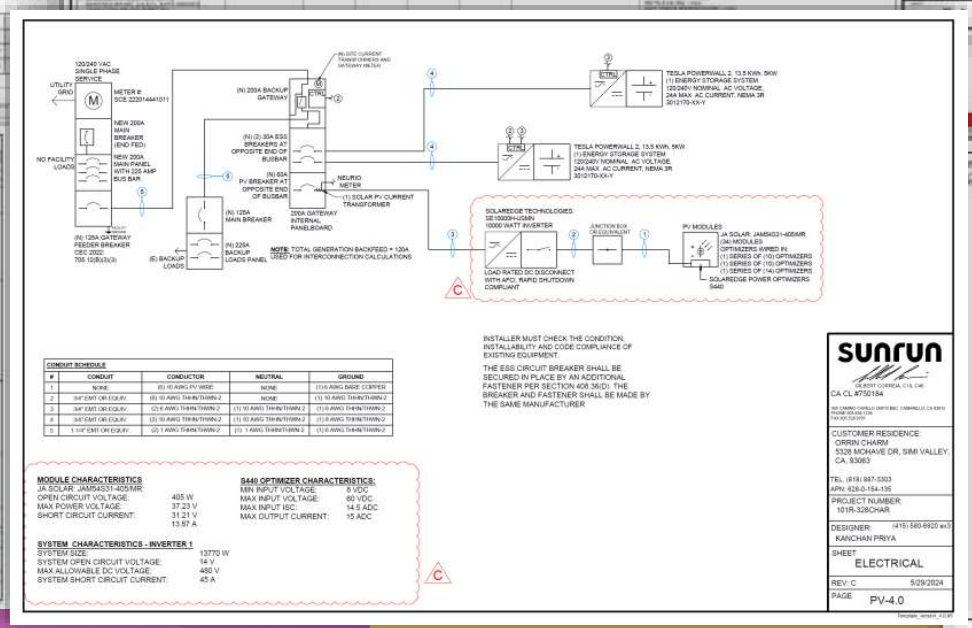
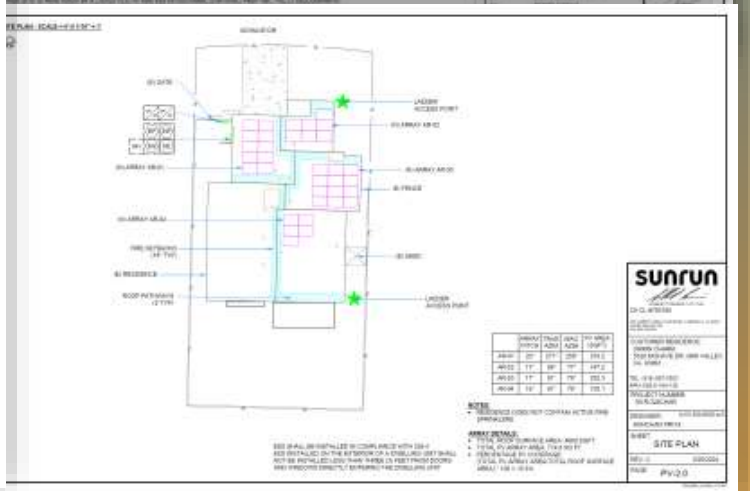
Evaluate Design Plans:











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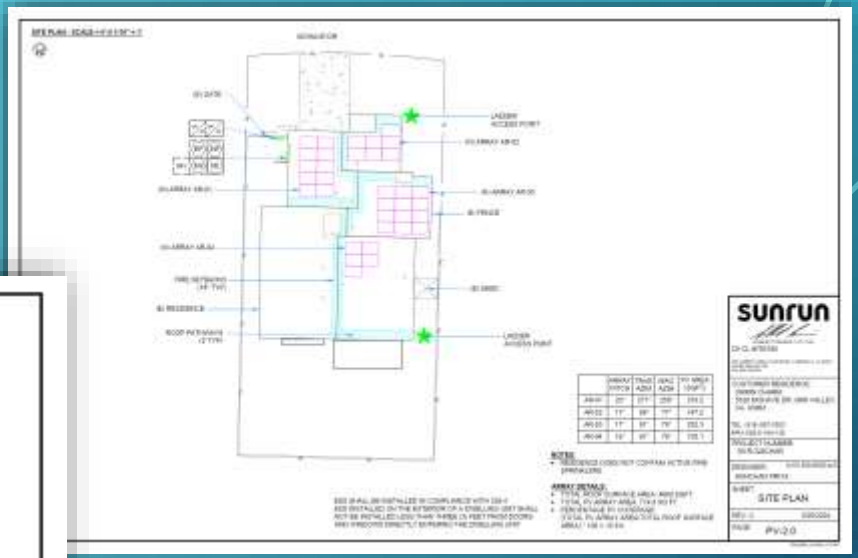
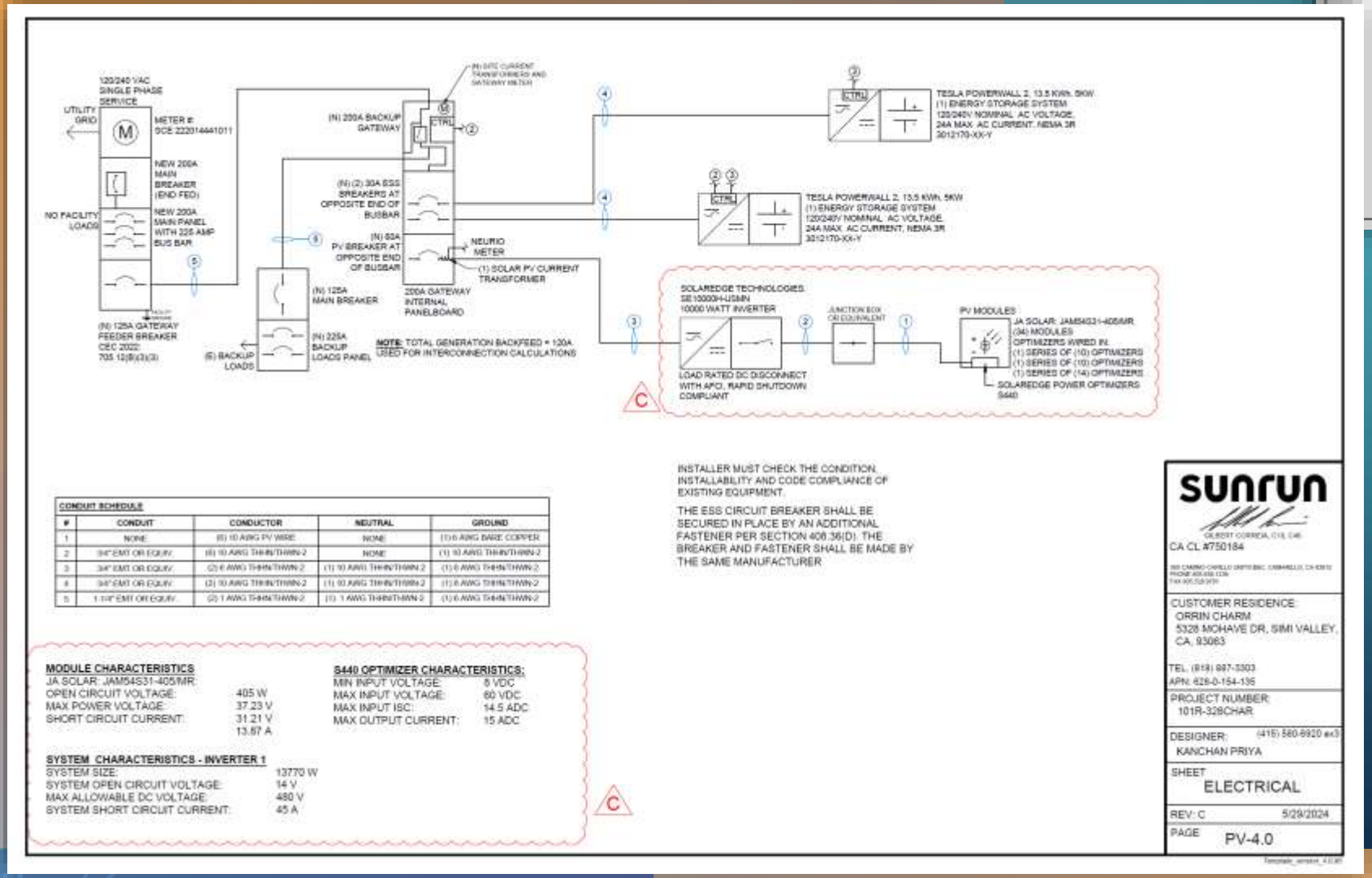
Approve Design





- Sunrun was selected, based on:
  - Lowest Overall Cost/kWh
  - Battery Locations (Outdoors)
  - Best Overall System Design
  - Backup of All Loads
  - Upgrade of Electrical Panel

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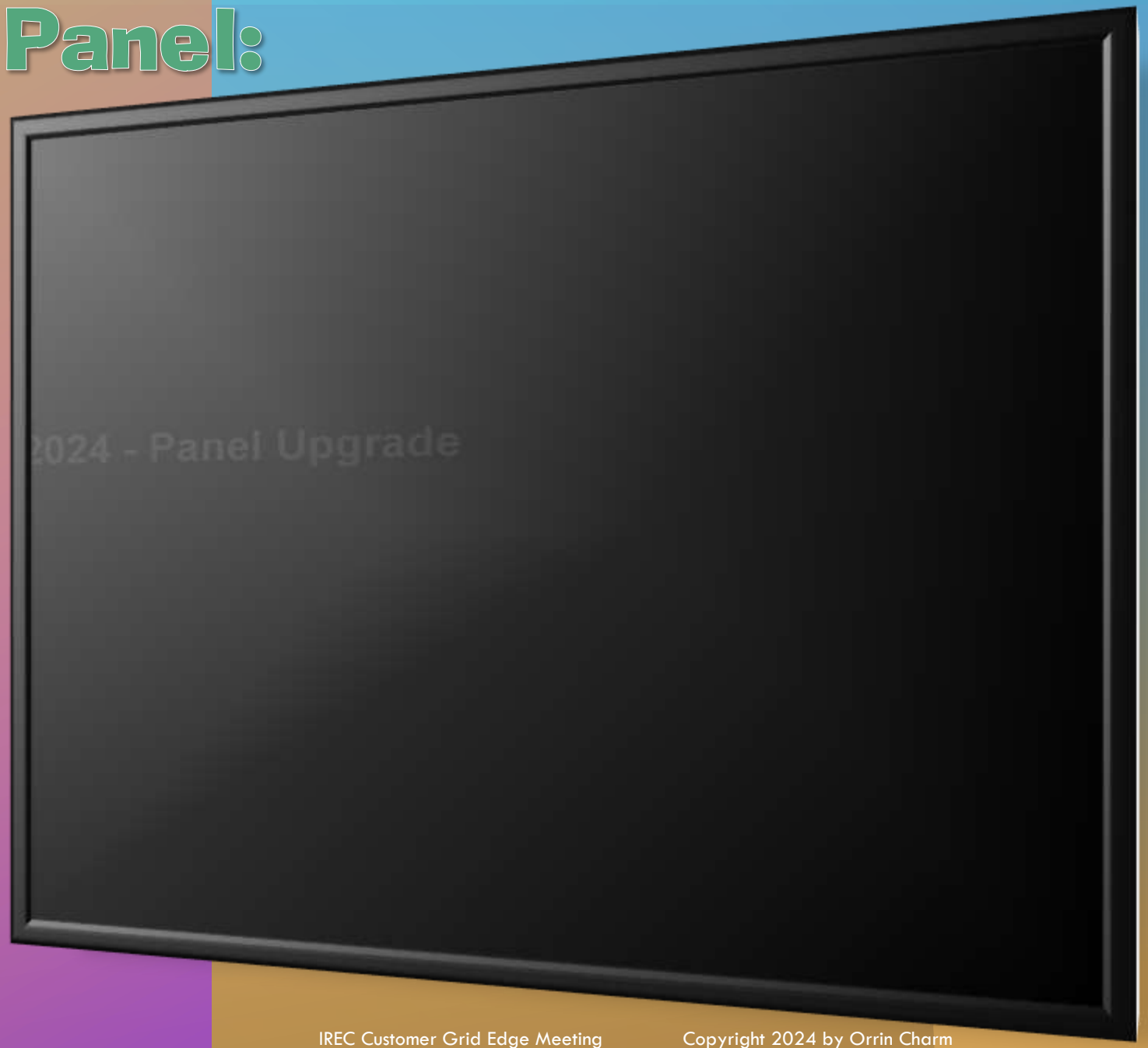
Upgrade Electric Panel:

Process:

- Open Outside Wall
- Turn Off Power
- Remove Meter
- Remove Utility Feeder Cables
- Remove old Zinsco Meter Panel
- Cut Feeder Conduit to lower panel
- Drive New Ground Rods
- Install New Ground Wire
- Install New Square D Panel
- Re-Install Feeders
- Re-Install all Load Cables
- Install New Circuit Breakers
- Terminate Cables to New Breakers
- Label Breakers (?)
- Re- Install Electric Meter
- Turn Power Back On!



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Electrical Panel Upgrade Summary:

(Before)

New Main Panel (After)

Inside Old Panel

Old Zinsco Main Panel

New Square D Subpanel

- Old Zinsco Electrical Panel has been discontinued for many years- has a reputation for arcing and causing fires!
- Panel was not Solar-Rated
- Panel was completely full and overcrowded
- Grounding was questionable
- Service was limited to 100A

- New Square D 225A Panel and new Breakers were Installed
- New 125A Main Breaker Installed
- New Ground Rods Driven and Connected to Panel
- All Existing Circuits were connected to New Main Panel

- Later, when Solar was installed, a new Square D Subpanel was installed
- A new 125A Breaker was added to the Main Panel to feed the Subpanel through the new Tesla Gateway
- All of the Circuits were removed from the Breakers, and Pigtailed over to the Subpanel.
- Emporia VUE was moved first to the new Main Panel, and then to the new Subpanel, with Main CT's left in Main Panel

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Solar Installation:
"Everything Everywhere All at Once!"

Roof Team:
- Deliver Panels to House
- Install Roof Mounts Under Tiles
- Install Racks on Mounts
- Install 34 405W Solar Panels, Optimizers
- Run Wires to Junction Box
- Run Conduit from Roof to Raceway

Electric Team:
- Install Raceway In Garage
- Install New Subpanel
- Install Tesla Gateway
- Install Inverter
- Install Tesla Batteries
- Run Conduits to Raceway
- Turn Off Power
- Jumper Loads from Main Panel to Subpanel
- Install New Breakers in Subpanel
- Label Subpanel (?)
- Turn Power Back On
- Test and Program System

Me (Afterwards):
- Re-Label Panel
- Install Emporia Current Sensors

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Solar Installation Summary:

Inside Garage

Outside Garage

App

Roof

- 34 405W Panels with Solar Optimizers on Four Roof Surfaces
- 10kW SolarEdge Inverter
- 2 Tesla Powerwall 2 Batteries
- 1 Tesla Backup Gateway
- 1 New Electric Subpanel

- 1 Day to install new Main Panel
- 1 Day to install Solar equipment
- 1 Day to replace 120+ Broken Roof Tiles
  - Still waiting for Inspection, Permission-To-Operate and Wall Repair . . .
  - Powerwalls Will Not Operate Until PTO!!

- Craftsmanship was Excellent!
- Customer Service was/is Agonizing!
  - Hard to get Callbacks, Answers, Schedules, Details
  - Installers Really Didn't Want Me Around!!

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Tesla Backup Gateway:

- Tesla Gateway Enables Backup During Outages:
  - Isolates Grid from House to prevent Backfeed
  - Monitors Grid Status During Outages
  - Monitors Grid and Solar Performance
  - Monitors Tesla Batteries
  - Provides Circuit Breakers for Solar, Batteries
  - Communicates with Tesla Vehicles
    - Allows “Charge On Solar” Feature
  - Provides Data to Tesla App
  - Connects Between Main Panel and Subpanel

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Welcome To NEM 3.0 TOU World!

New California Net Energy Metering Rates mean you pay Retail for Electricity; get Paid at Wholesale for what you send back to the Grid!

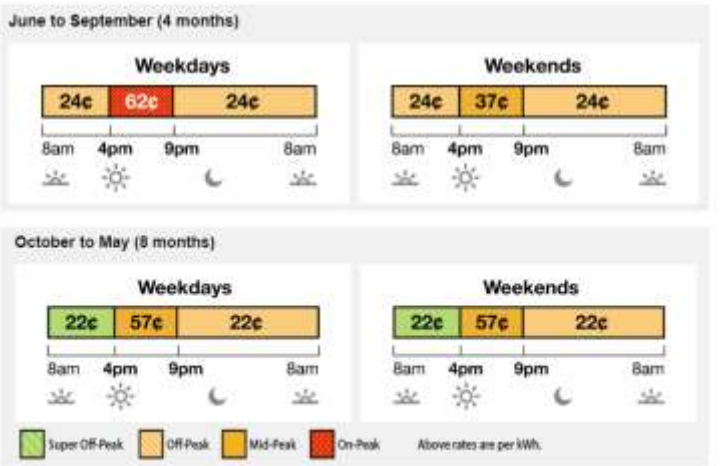
Time-Of-Use (TOU) Rates mean you Pay a lot More Between 4:00PM and 9:00PM!

- **It's a fine line between Winning and Losing the Game!**
- **Battery Storage is a MUST!**
- **Micro-Management is the Key!**
- **Automated Energy Management is More Vital now than it's ever been!**

Southern California Edison - Tariff TOU-D-PRIME

TOU-D-PRIME	Period	Hours	$/kWh
Summer (June-Sept)	On-Peak	4-9pm weekdays	0.62
	Mid-Peak	4-9pm weekends	0.37
	Off-Peak	9pm-4pm everyday	0.24
Winter (Oct-May)	On-Peak	4-9pm everyday	0.57
	Mid-Peak	9pm-8am everyday	0.22
	Off-Peak	8am-4pm everyday	0.22
Monthly Fixed Charge			$14

*Utility Rates adjust slightly over time. Prices effective October 1, 2023



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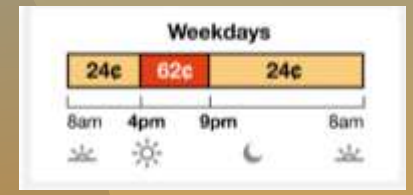
Timing (And The Sun) Is Everything!



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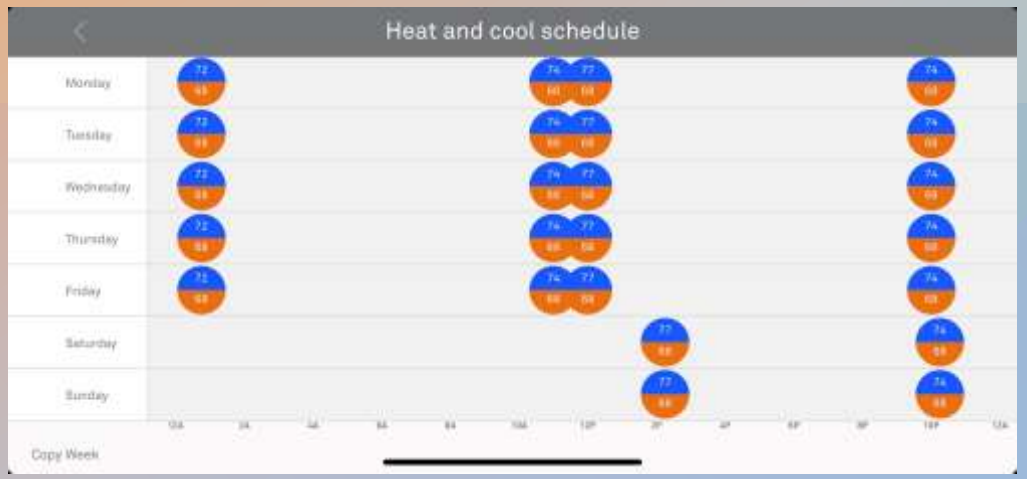
Schedules?

- HVAC?
- EV Charging?
- Appliances?
- Pool Pump?



Solar Production Doesn't Follow Time-Of-Day Schedule

- Seasonal Variables
- Weather
- Shading
- Tree Growth

Heating/Cooling Needs Don't Follow Schedule

- Occupancy Varies
- Family Schedules Differ
- Work-From-Home
- Retired

Appliance Schedules Often Don't Match Power Use

- Long Time Intervals between Power Peaks
- Not Possible to Schedule

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"Juggling" Loads vs. Giving Up Control

- Major Factor is Available Solar Power
  - Schedules Based on Time-Of-Day are often Wrong…
- Secondary Factor is Battery Status
- Tertiary Factor is Utility Rate (TOU)
- Automated Energy Management is the Solution!
  - (Putting ALL of the Pieces Together Is the Problem!)

- Objective is to Consume ALL Generated Solar Power!
  - Do Not Use Any High-Rate Utility Power (Typically 4:00PM - 9:00 PM)!
  - Use Minimum Utility Power If Possible
  - Maintain Battery Reserve for Emergencies!
  - Pre-Condition Air During Off-Peak Periods if Solar/Batteries are Insufficient
  - Try to "Sell" Power to Utility during Peak "Sell" Periods
- Avoid Inconvenience and Discomfort of Typical Utility "Demand-Response" Programs!

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Tesla App- Monitor and Control:

- Tesla App:
  - Same App Monitors Car and Home
  - Allows Tesla car to Charge only on Solar
    - (but not other EV's)
  - Complete Control of Tesla Ecosystem
    - No control of HVAC or other Devices!

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Emporia Monitor and App:

Emporia VUE3 Energy Monitor and App

Emporia Smart Plugs

Emporia VUE Utility Connect

Emporia VUE3 Energy App

- Emporia App:
  - CT's Monitor Mains and Selected Circuits
  - Smart Plugs Monitor and Control Plug-In Loads
  - Smart EV Charger Offers Variable Charging Rate
  - Some Thermostats are also Supported
    - (but not Nest!)
  - Offers "Excess Solar Management" – Control of Devices
  - VUE Utility Connect actually reads Utility Meter
    - (Only supported by some Utilities)

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EV Chargers Comparison- Tesla vs. Emporia:

Tesla Wall Connector

Emporia EV Charger

Tesla Wall Connector:

- Supports Tesla Vehicles Directly
  - Supports Other EV's with J1772 Adapter
- Allows Tesla "Charge With Solar" operation with Tesla Powerwalls and Solar through Tesla App
  (App Controls Tesla EV's, not Charger!)
- No control of HVAC or Other Appliances
- Up to 48 A Level 2 Charging
- Hardwire Only

Emporia EV Charger

- Available in J1772 or NACS Format
- Supports "Excess Solar" Variable Charging through Emporia App
  (with Vue Monitor)
- App Can Control Thermostats and Plug-In Appliances (up to 10A 120V)
- Up to 48 A Level 2 Charging
- Hardwire or Plug-In

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CONCLUSIONS:

Was It Worth It?

- Probably- Too Soon to Tell (I'll Know Next Year . . .)

What Would I Do Differently?

- Try To Manage the Project Better

  (Very Difficult with a Solar Lease!)

What Have I Learned?

- Managing HVAC vs. EV Charging vs. Solar Production is Critical
- It's Impossible to Manually Manage Everything- "Smart" Automation is Needed!
- The User Interface is Very Important . . . And Frustrating!
- I Pity Uneducated Consumers Trying to Deal with This!
- I Worry about the Viability of some Solar Providers . . .

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Thank You!

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