Solar PV Installation – Westbrook House

10 Year System Performance Update

Installed 2012; expanded in 2014, battery added in 2022 – see additional info below

Latest updates and photos on the web at https://enerjazz.com/house/

Dec 7th, 2022 is the 10th anniversary of the installation of our solar electric PV system. Here are a few highlights from our decade of renewable energy rooftop production.
System size: 3.7kW
System cost (net in 2012): $6,191

Money saved in 10 years: $6,327 (passed the simple payback period this year)
Electricity produced in 10 years: 48,176 kWh

Two favorable policy changes by our electric provider (Grayson Collin Coop) in 2020 have resulted in zero energy bills since July of 2020. We only pay the base fee + taxes each month ($24.40). The first change was a kWh bank where any monthly excess production is credited to a bank with no expiration. The second change was a free nights and weekends plan that works well with our usage pattern and solar production. We've not had a bill for any energy use since these changes and we have over 1,000 kWh in the bank.

The system should last at least another 15 years, so we'll now enjoy all the savings since the simple payback period has passed. Over a 25-year life our $6,191 investment has an after tax rate of return of about 7%. Unlike an investment where your returns are taxed, your savings are not taxed. Other investments carry more risk. This is a safe and predictable investment.

I am obligated to state the energy efficiency should always be the first step. I even wrote a book about it: The Joy of Efficiency (https://joyofefficiency.com). Passive solar design is almost free. Energy efficiency often has very fast payback. An efficient home needs a smaller solar electric system, which saves you more money. We designed and built our house 26 years ago with passive solar design, extreme energy efficiency, and a couple of used solar water heating panels. Our house only requires about 7kBtu/sf/yr of energy, which is 80% less than a typical house in our climate built in the 1990s. It's still about 3x better than new houses built in Texas.

I added a battery system in 2022 – not for savings, but for resilience. The battery works with our solar and we form a microgrid instantly if the grid power goes out. With our efficient house we can operate for days with just a 10kWh battery system. An efficient home needs a smaller battery system.

Many people ask about payback for solar, but they never ask about the payback of a granite countertop, crown molding, or a big SUV – things which have no payback. Efficiency and solar pay back – and generate long term positive returns. The question is not "Can we afford efficiency and solar?" The question should be "Why isn't everyone embracing efficiency and solar?"

Scroll down on my house website to read more about our systems, including the solar PV system: https://enerjazz.com/house/systems.html. Our utility data is posted too: https://enerjazz.com/house/utility.html

original document below

In late 2012 we decided to install a solar photovoltaic (PV) system to produce renewable electricity for our home. I always promote efficiency first, so here's the story of why we decided to add renewable generation.

Efficiency First

In 1996 we built a very energy and resource efficient house that reduced our energy needs to about 1/3 that of a similar sized home in our climate. We used passive solar design, a well-insulated and airtight envelope, solar water heating, and a geothermal heat pump among other strategies. This kept our energy use low. For more details on the design see https://www.enerjazz.com/house. I have documented our efficiency in my book *The Joy of Efficiency* (https://joyofefficiency.com). Below is our annual utility use data prior to solar.

Westbrook House Annual Utility Data							2,713 sf, 3>2 people			
Year	kWh house	kWh util	kWh wind	kWh solar	Elec Cost/Yr	Average Cost/Mo	kBtu/ sf	kWh/ sf/yr	kWh/ DD	Water Use/Yr (gallons)
1997	8,952	8,952	0		$ 739	$ 61.55	11.3	3.3	1.8	34,700
1998	10,195	10,195	0		$ 781	$ 65.09	12.8	3.8	1.9	27,900
1999	9,309	9,309	0		$ 644	$ 53.63	11.7	3.4	2.0	45,500
2000	9,966	9,966	0		$ 684	$ 56.99	12.5	3.7	2.0	38,400
2001	9,875	9,875	0		$ 753	$ 62.79	12.4	3.6	2.1	36,000
2002	10,404	10,404	0		$ 893	$ 74.45	13.1	3.8	2.1	29,000
2003	10,257	10,257	0		$ 934	$ 77.87	12.9	3.8	2.1	37,000
2004	10,624	10,624	0		$ 988	$ 82.37	13.4	3.9	2.4	26,000
2005	11,205	11,205	0		$ 1,177	$ 98.08	14.1	4.1	2.3	38,000
2006	10,633	10,555	78		$ 1,443	$ 120.28	13.4	3.9	2.2	33,000
2007	9,916	9,770	146		$ 1,305	$ 108.79	12.5	3.7	2.0	29,000
2008	9,661	9,419	242		$ 1,364	$ 113.65	12.2	3.6	1.9	37,000
2009	8,403	8,118	285		$ 1,247	$ 103.92	10.6	3.1	1.8	30,000
2010	9,034	8,788	246		$ 1,222	$ 101.84	11.4	3.3	1.7	33,000
2011	8,571	8,238	333		$ 1,137	$ 94.73	10.8	3.2	1.5	43,000
2012	7,573	7,137	228	208	$ 1,033	$ 86.07	9.5	2.8	1.6	28,000
2013	7,791	2,625	216	4,950	$ 590	$ 49.21	9.8	2.9	1.5	31,000
2014	8,742	3,472	7	5,263	$ 698	$ 58.14	11.0	3.2	1.7	29,000
2015	8,670	3,976	0	4,694	$ 735	$ 61.27	10.9	3.2	1.7	31,000
2016	6,817	1,786	0	5,031	$ 462	$ 38.51	8.6	2.5	1.5	23,000
2017	6,326	1,437	0	4,889	$ 465	$ 38.72	8.0	2.3	1.5	18,000
2018	6,932	2,019	0	4,913	$ 518	$ 43.13	8.7	2.6	1.4	21,000
2019	5,603	972	0	4,631	$ 378	$ 31.47	7.0	2.1	1.1	25,000
2020	5,565	1,069	0	4,496	$ 324	$ 26.99	7.0	2.1	1.3	22,000
2021	5,269	809	0	4,460	$ 293	$ 24.40	6.6	1.9	1.6	20,000
2022	5,726	960	0	4,766	$ 293	$ 24.40	7.2	2.1	1.4	20,000
Sums and Averages	kWh sum	kWh util	kWh wind	kWh solar	Cost		kBtu/ sf	kWh/ sf/yr	kWh/ DD	Water Use (gallons)
Total>	222,019	171,937	1781	48,301	$ 21,100					785,500
Annual>	8,539	6,613			$ 812		10.7	3.1	1.8	30,212
Monthly>	712	551			$ 67.63					2,518
https://enerjazz.com/house			2016 major reduction due to aerobic septic air compressor change.							

Table 1. Westbrook House Utility Use

Wind Turbine Beta Test

In 2006 we installed a Skystream wind turbine on the lawn, but it was done as a beta test for Southwest Windpower. We are not a good location for wind and our production numbers verify the importance of having the right location. We have too many trees that obstruct the free flow of the wind. As a beta tester I got a very, very low price, so at worst the turbine is a nice kinetic lawn sculpture. Our renewable wind energy production is minimal and would be about 8x better with a clear, open area and a taller tower. I sold the turbine in March 2014 and added more PV. See the update near the bottom.

Solar Photovoltaic (PV) System

We had been interested in installing solar PV for many years, but our electric provider (Grayson-Collin Coop) didn't offer any incentives like providers in adjacent utility distribution areas. The only incentive available is the 30% federal tax credit. We continued to lower our energy consumption in recent years with improved efficiency – primarily with appliance improvements, timers, and plug load reductions.

By 2012 PV panel prices had fallen so low that it began to look like it would be feasible to install a system. Plus, my money in the bank is earning such a small amount of interest, I figured I could get a much better return investing in renewable energy generation. I analyzed my recent electric use (past 3 years) to size the system just a bit more than our total electric use in our low use month of April. The electric utility will not credit or pay me for production beyond my monthly consumption, so the economical approach is to zero out the low use month. My meter is allowed to turn backwards and credit me for excess production during the month. Using the PV Watts program I figured the optimal size PV system. 3.3kW = (14) 240W panels.
https://pvwatts.nrel.gov/

	Min Use (kWh)	Average Use (kWh)	14 deg 3.33kW DC Solar Estimate	Wind Energy Production Avg (kWh)	Total Renewable (kWh)	% of Avg Use
Jan	717	812	291	27	318	39%
Feb	532	702	307	37	344	49%
Mar	545	601	410	46	456	76%
Apr	453	458	452	41	493	108%
May	553	604	490	21	511	85%
Jun	731	869	491	20	511	59%
Jul	1,009	1,122	504	6	510	45%
Aug	1,046	1,162	473	5	478	41%
Sep	692	742	399	6	405	55%
Oct	385	465	378	15	393	84%
Nov	397	446	388	24	412	92%
Dec	544	685	269	24	293	43%
Average		***722***	***404***	***23***	***427***	***59%***
Total		***8,669***	***4,852***	***272***	***5,124***	***59%***

Table 2. Monthly historical energy use and historical/predicted renewable production.

With no local incentives I had to keep the cost low so I started reviewing various designs and components. I found PV panels via Craigslist. They are Sharp 240W panels that are "B" grade.

That designation means that there might be a cosmetic flaw, but there is no problem with the solar panel energy production, but they do have a short warranty. I got these for $0.85/W delivered – and he even came back to pick up the boxes for reuse after I installed the panels – sweet! The only risk with "B" grade is they have only a 90-day warranty. In general, a panel will fail quickly so the risk is low. For the price I got them I'm basically self-insured. $200 to replace one bad panel would not be an issue since I saved over $2,000 on the panels.

I decided to use micro-inverters because it makes the installation easy and there are no DC issues to worry about. One micro-inverter is installed for each panel and it converts the DC output to 120V AC. I selected the Enphase M215 model because of their long experience in the market and long warranty. I found those online for $149 each delivered. The big advantage of microinverters is that each panel's output is optimized instead of the entire string of panels being fed to a single inverter. With the string approach, the worst performing panel will limit the system output. Microinverters let each panel perform at a maximum level.

The next big material cost item is mounting. I have a standing seam metal roof, which allows me to use one of the non-penetrating seam clamp devices. The original clamp device is the S-5-U. At one point I thought I could use the S-5-U mini with and S-5-PV adapter to simplify the installation at a low cost. However, this would have required a portrait orientation installation and landscape fit better with my available roof area. I settled on the Unirac Solarmount-I system, which has a 1" I-beam that can be attached to the roof with the S-5-U clamps.

Labor

I did all the material ordering and was able to find good deals on many items via the web and Craigslist. I probably saved at least $0.50/Watt by price shopping. I also did good amount of the labor by mounting all the racks and helping with the final mounting. I also pulled the permit and did a few other things to minimize the electrician's time on site. This saved me another $0.50/Watt.

Electrical connection / grounding

When I installed the wind turbine we mounted a sub-panel on the side of the house with extra breaker spaces. The solar will connect to a 240V double pole breaker in that panel. The four #10 wires (L1, L2, Neutral, and Ground) run to a junction box on the roof where the Enphase engage cable is connected to the wire. The inverters simply plug into the engage cable.

The panels are grounded to the rails with Unirac ground clips under the edge of the panel. The inverters are grounded with a #8 wire along with the rails. Everything is taken back to the grounding rod below the sub-panel.

Monitoring – See the system live:

https://enlighten.enphaseenergy.com/public/systems/J6RW139890

Enphase sells a monitoring system that plugs into to a home outlet and reads data on each inverter via power line communication. This device connects to the Internet so data can be viewed and tracked. This system was not inexpensive, but knowing how the panels are performing will help me keep the system optimized and at maximum power production. I also mounted a simple kWh meter next to the breaker box so I can visually see the cumulative production.

Bottom Line
My total out of pocket cost was $8,844. I will get the 30% federal tax credit, which lowers my total cost to $6,191. You can see from my cash flow analysis that my simple payback is about 13 years, but that is a 7% return on my money – after taxes. My savings are currently earning less than 1% now in the bank, and that's before taxes. This is a great investment – financially and environmentally.

In addition to earning a 7% after-tax return on my money, we'll be generating over 55% of our total annual electricity use with renewable energy. We were already very efficient with our energy use. Combined with our family Prius cars we have significantly lowered our household fossil fuel footprint. See my Prius data at https://www.enerjazz.com/prius

So while the evidence mounts for growing negative impacts of fossil fuel use and we blindly keep pursuing the path of drilling, polluting, and ignoring the effects it's nice to know that solutions are available and affordable. Living with less energy and generating electricity with renewable energy allows us to live more comfortably at a lower cost and with a lower burden on the environment and society. What's not to like?

One Month Update (Jan 9, 2013)
The system has been up for a month now and is performing well. One of the 14 panels was a lower wattage panel in the wrong box. I installed it so I could test all the inverters and have been working with the supplier to find a matching replacement. It might just take time until he gets another shipment of that same panel. That replacement will boost my overall system energy output by just over 2%. These cloudy winter days with low sun are the worst the system will see. It's producing right in line with the anticipated production in PVWatts. So far, so good.

End of January Update (Feb 3, 2013)
The system produced 302kWh in Jan vs a predicted 317kWh. Considering I still had the one subpar panel in place it was essentially right on target. On Feb 2nd I replaced the ~180W panel with a 220W panel. This is still less than the other 240W panels, but since I bought these B grade panels I have to pick from whatever inventory is available. Overall I'm very pleased with the system performance so far.

End of February Update (Mar 3, 2013)
The system produced significantly more than expected thanks to a sunny month. We ended up very close to net zero – we only purchased 1kWh of grid power for the month.

Earth Day Update (Apr 22, 2013)
The system continues to perform above expectations and we have been a net energy producer since the end of January. The meter is reading 200kWh less than the last day of January. Jan 31st meter = 54,581; Apr 22nd meter = 54,381. Ironically, our electric company charges me an extra $5 per month for not using enough energy. That's on top of the $18/month they charge for just being connected to the grid.

Since installation on Dec 7th, I have produced 1.64MWh of renewable solar energy. The peak production continues to rise with the increasing sun angle. I recently hit 3.09kW of peak output.

Last Day of Calendar Summer Update (Sep 21, 2013)
The system continues to perform above expectations. We have produced 74% of our energy so far this year with renewable energy.

One Year Update (Dec 07, 2013)
It's been an excellent year. Zero maintenance issues and 4% more energy produced than the PVWATTS estimate. At the end of December I'll post the full 2013 data. As of Dec 07, 2013, the system has produced 4.95 MWh of electricity in a year.

One Calendar Year (full 2013) Update (Jan 01, 2014)
The system performed above expectations. Zero maintenance issues and a 4% better performance than PV Watts estimated. We produced 64% of our annual electric needs with the solar PV system. Here is the full 2014 data.

Month	Meter Net kWh	Total Use (kWh)	Solar kWh	Wind Turbine kWh	Renew Produced (kWh)	% Renew	Net Grid Use (kWh)	Power Cost ($)
Jan	256	579	302	21	-323	56%	256	$23.68
Feb	1	394	357	36	-393	100%	1	$0.10
Mar	-119	394	472	41	-513	130%	-119	$-
Apr	-146	337	455	28	-483	143%	-146	$-
May	-112	396	477	31	-508	128%	-112	$-
Jun	285	846	546	15	-561	66%	285	$27.05
Jul	451	968	512	5	-517	53%	451	$44.20
Aug	697	1226	526	3	-529	43%	697	$71.44
Sep	447	891	442	2	-444	50%	447	$45.82
Oct	136	482	339	7	-346	72%	136	$14.62
Nov	261	556	276	19	-295	53%	261	$28.73
Dec	468	722	246	8	-254	35%	468	$51.48
Total		7791	4950	216	-5166	66%	2625	$307.11

System Expansion Update (April 1, 2014)
From my original Craigslist panel purchase I ended up with a spare 235W panel and a 190W panel. It's been over a year and they guy hasn't come back to get them, so I decided to get another pair of micro-inverters and add these two online. In March of 2014 I sold my Skystream wind turbine. The turbine's production was hampered by poor wind flow on my site. Since I already had power out to the pad, I built a rack and added the two panels there. I built in some tilt adjustment capability to the rack. Adding these two brings my system up to 3.75kW – that's a relatively small system, but our house is very energy efficient.

2017 Update
The system has performed well. I've had zero inverter failures and just one panel failure (remember I bought them as B grade panels very cheaply, so I had to pick up another $200 panel to replace the one bad one). As you can see from the table below, over the past 12 months we've produced 75% of our energy needs (included 100% for 5 of the 12 months). Our average monthly energy bill over the period is $18.88. The system has produced over 23 MWh of renewable energy.

Last 12 month period

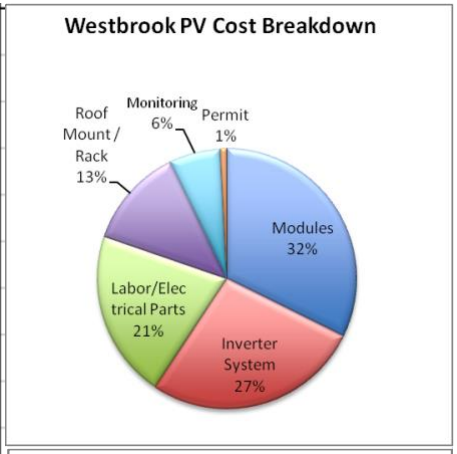
Year	Month	Meter Net kWh	Total Use (kWh)	Solar kWh	% Renew	Net Grid Use (kWh)	Power Cost ($)	Fees / Taxes
2016	Sep	293	753	460	61%	293	$ 31.35	$ 20.39
2016	Oct	-42	405	447	110%	-42		$ 19.91
2016	Nov	72	374	302	81%	72	$ 7.71	$ 19.47
2016	Dec	363	569	206	36%	363	$ 38.85	$ 20.24
2017	Jan	204	517	313	61%	204	$ 21.83	$ 21.09
2017	Feb	5	340	335	99%	5	$ 0.54	$ 19.63
2017	Mar	-80	337	417	124%	-80	$ -	$ 24.40
2017	Apr	-80	339	419	124%	-80	$ -	$ 24.40
2017	May	-86	416	502	121%	-86	$ -	$ 24.40
2017	Jun	225	700	475	68%	225	$ 24.06	$ 19.60
2017	Jul	434	953	519	54%	434	$ 46.42	$ 21.14
2017	Aug	345	762	417	55%	345	$ 36.92	$ 22.33

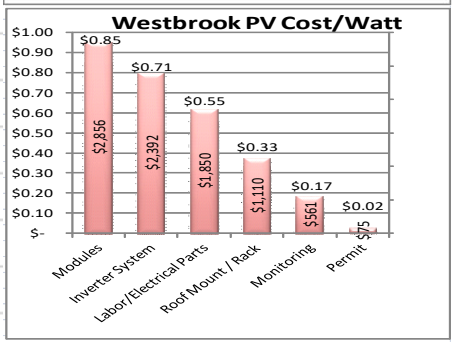
2020 Jan Update

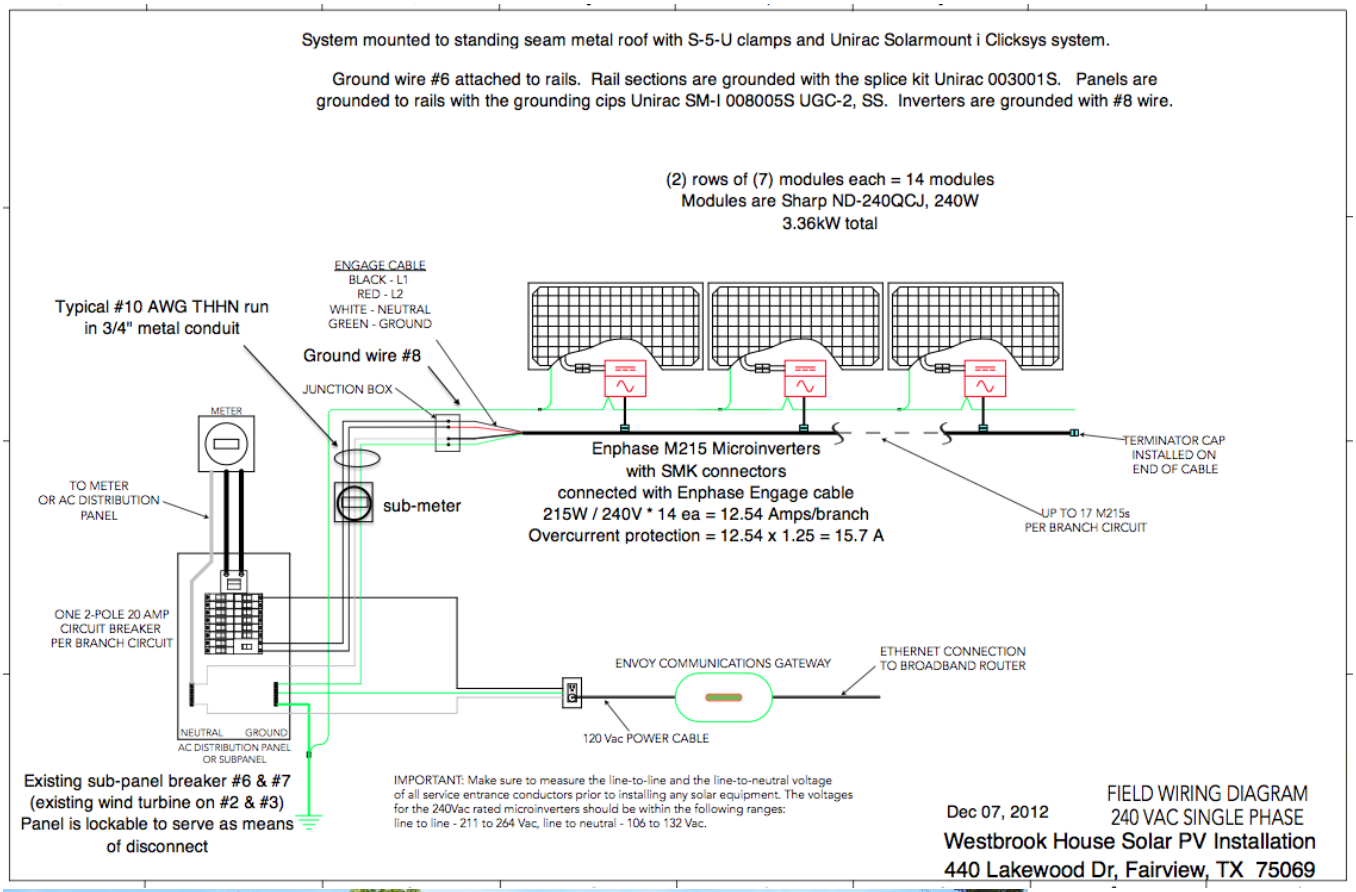
All is well after 7 years of operation:
Solar energy produced: 34,371 kWh
Cost savings: $3,884

Total system cost information

# Modules:	16	Ea
Module Power (avg):	230	W DC
Total Power:	3680	W DC
Total External Cost:	$9,326	
Cost/Watt:	$2.53	
Tax Credit/ Rebate:	$4,079	
Net Cost:	$5,247	
Net Cost/Watt:	$1.43	
Panel Mount Angle:	14	deg
Annual Output:	4,852	kWh
Elec Rate:	$0.113	/kWh
Annual Savings:	$548	
Annual Rate Incr:	1.0%	
Panel Degredation:	0.75%	/year
Simple Payback:	9.6	years
Rate of Return:	8.5%	
Effective electric rate:	$0.058	/kWh







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2021 Update – New Net Metering plus Free Nights and Weekends Plan

Two significant changes occurred in 2020 at our utility provider – Grayson Collin Electric Coop (GCEC). First, they implemented a net metering bank. In any month that we produce excess energy we can bank those kWh for future months – and there is no expiration on the hours.

The second major change occurred mid-year of 2020. They introduced a few different rate plans. The free nights and weekends plan looked like a good match with my solar production. Fortunately, I had detailed hourly utility data for our use pattern and it indicated that the plan would be beneficial to us.

Here are the new plans they offer:

GCEC Rate Plans	Fixed Rate	Prepaid	Block Rate	Free Nights & Weekends	Time of Use	Unbundles	All Energy
Details	--	No Deposit Required	--	10pm-6am Daily All Day Sat & Sun	Peak - 2pm-7pm Off-Peak - All Other Hours	Itemized Pricing	One Price *minimum 1500kWh required
Base Charge	$18	$0.75/Day	$0.13	$23	$23	$34.85	--
Energy Charge per kWh	$0.10	$0.10	** charged for usage above the block limit	Weekday Rate - $0.154 Nights/Weekends - $0	On-Peak Rate - $0.152 Off-Peak Rate - $0.071	Distribution System - $0.017 Purchased Power - $0.071	$0.12
Current Month PCRF	$0.01	$0.01	--	Weekday - $0.01 Nights/Weekends - $0	$0.01	$0.01	--
Minimum Billing	$23	--	$50	$23	$23	$23	--
Budget Billing Available?	Yes	No	No	Yes	Yes	Yes	Yes
Total Energy Charge (325kWh)	$52.78	$57.28	$50.00	$49.06	$54.81	$66.70	$40.06
Total Energy Charge (800kWh)	$103.60	$108.10	$110.33	$87.14	$101.30	$113.25	$98.60

I ran the analysis on all plans and the best for my use pattern was Free Nights & Weekends

Net Energy Use = Use - Solar Feedback - 12 months of GCEC Net Data

NET (kWh)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
0	18.8	18.6	15.7	18.1	27.8	30.1	58.2	40.1	40.3	28.3	10.5	13.2	320
1	14.1	11.9	10.8	22.6	40.3	39.8	55.0	52.9	52.2	27.9	8.3	10.2	346
2	9.8	7.4	8.5	24.5	36.6	44.6	53.3	58.3	60.3	27.6	7.4	7.1	345
3	7.4	7.9	8.1	21.8	31.3	45.4	49.2	48.8	47.4	21.6	7.0	7.2	303
4	6.8	8.2	8.0	17.1	26.9	30.8	42.0	40.4	39.5	19.0	7.7	6.8	253
5	8.5	11.4	8.4	17.0	18.9	27.9	31.2	33.1	40.8	14.1	8.9	8.9	229
6	35.6	37.0	10.3	6.9	7.6	17.4	18.4	19.3	34.8	19.8	25.6	31.2	264
7	36.8	32.4	13.0	-7.7	-4.6	3.9	2.5	0.4	7.9	13.6	28.2	31.8	158
8	25.4	14.9	10.5	-19.8	-21.3	-12.1	-17.0	-14.9	-8.4	3.2	12.4	15.8	-11
9	7.0	-10.4	-0.9	-28.0	-27.9	-23.6	-28.1	-22.1	-12.9	-18.7	-9.9	-10.2	-186
10	-7.1	-23.6	-13.4	-38.1	-36.0	-29.9	-34.4	-25.9	-25.5	-33.1	-26.5	-25.4	-319
11	-12.5	-28.6	-20.5	-37.3	-36.2	-38.5	-36.9	-34.6	-29.4	-34.9	-26.8	-30.5	-367
12	-20.0	-34.0	-26.4	-32.6	-30.5	-34.9	-34.5	-29.6	-27.9	-35.7	-33.1	-35.2	-374
13	-20.1	-23.8	-27.8	-32.8	-24.3	-29.6	-30.6	-22.2	-22.9	-33.0	-25.7	-30.1	-323
14	-10.0	-16.5	-23.1	-21.8	-12.9	-20.2	-20.1	-9.9	-7.2	-20.2	-11.5	-20.2	-194
15	1.9	-3.6	-13.4	-4.9	0.2	0.5	1.6	6.9	8.8	-12.3	5.5	-1.9	-11
16	20.0	8.6	1.1	4.5	8.9	6.5	8.5	11.6	10.1	1.8	19.5	18.7	120
17	27.9	23.1	14.9	14.1	13.0	12.3	14.6	15.5	17.2	15.6	26.4	32.7	227
18	29.4	30.1	22.0	15.5	9.2	13.3	17.5	15.0	16.0	13.1	22.8	30.5	234
19	28.4	30.9	23.1	16.6	8.1	9.8	17.9	12.8	14.6	16.6	30.7	32.7	242
20	27.9	31.8	23.3	13.4	9.1	8.2	12.6	13.6	14.1	20.1	36.6	32.0	243
21	31.1	43.5	30.2	11.8	11.3	8.6	15.7	17.1	13.7	23.3	33.9	32.8	273
22	29.1	39.2	27.0	11.6	17.9	12.1	16.0	13.2	23.4	25.1	31.3	27.8	274
23	28.4	34.0	22.5	11.7	21.0	16.2	18.0	15.4	34.3	26.3	25.3	21.9	275
Grand Total	325	250	132	4	94	138	231	255	341	129	214	208	2,322
Bin 6-10	202	112	23	-140	-126	-108	-92	-47	3	-61	108	105	-22
Bin 10-6	123	138	109	144	220	247	323	302	338	190	106	103	2,345

Free Nights & Weekends Plan

FNW	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$0.164	$ 4.31	$ 3.79	$ 1.52	$ (0.90)	$ (0.54)	$ 0.45	$ 0.30	$ 0.05	$ 0.93	$ 1.59	$ 3.31	$ 3.72
$0.164	$ 2.97	$ 1.74	$ 1.23	$ (2.32)	$ (2.49)	$ (1.42)	$ (1.99)	$ (1.74)	$ (0.98)	$ 0.38	$ 1.46	$ 1.85
$0.164	$ 0.82	$ (1.22)	$ (0.10)	$ (3.28)	$ (3.27)	$ (2.77)	$ (3.29)	$ (2.58)	$ (1.51)	$ (2.19)	$ (1.16)	$ (1.19)
$0.164	$ (0.84)	$ (2.76)	$ (1.57)	$ (4.46)	$ (4.22)	$ (3.50)	$ (4.03)	$ (3.03)	$ (2.98)	$ (3.88)	$ (3.10)	$ (2.97)
$0.164	$ (1.47)	$ (3.34)	$ (2.40)	$ (4.37)	$ (4.24)	$ (4.51)	$ (4.32)	$ (4.06)	$ (3.44)	$ (4.08)	$ (3.14)	$ (3.57)
$0.164	$ (2.34)	$ (3.99)	$ (3.09)	$ (3.81)	$ (3.57)	$ (4.09)	$ (4.04)	$ (3.47)	$ (3.27)	$ (4.18)	$ (3.88)	$ (4.12)
$0.164	$ (2.36)	$ (2.79)	$ (3.26)	$ (3.84)	$ (2.84)	$ (3.47)	$ (3.58)	$ (2.60)	$ (2.68)	$ (3.86)	$ (3.01)	$ (3.52)
$0.164	$ (1.17)	$ (1.93)	$ (2.71)	$ (2.56)	$ (1.51)	$ (2.37)	$ (2.36)	$ (1.16)	$ (0.85)	$ (2.37)	$ (1.34)	$ (2.36)
$0.164	$ 0.22	$ (0.42)	$ (1.57)	$ (0.57)	$ 0.02	$ 0.06	$ 0.18	$ 0.81	$ 1.03	$ (1.44)	$ 0.65	$ (0.22)
$0.164	$ 2.35	$ 1.01	$ 0.13	$ 0.52	$ 1.04	$ 0.76	$ 1.00	$ 1.36	$ 1.18	$ 0.21	$ 2.28	$ 2.19
$0.164	$ 3.26	$ 2.71	$ 1.75	$ 1.65	$ 1.53	$ 1.44	$ 1.71	$ 1.81	$ 2.01	$ 1.83	$ 3.09	$ 3.83
$0.164	$ 3.44	$ 3.53	$ 2.58	$ 1.81	$ 1.08	$ 1.56	$ 2.05	$ 1.76	$ 1.87	$ 1.53	$ 2.67	$ 3.57
$0.164	$ 3.32	$ 3.62	$ 2.70	$ 1.94	$ 0.95	$ 1.15	$ 2.10	$ 1.50	$ 1.70	$ 1.95	$ 3.60	$ 3.83
$0.164	$ 3.27	$ 3.72	$ 2.73	$ 1.57	$ 1.07	$ 0.96	$ 1.48	$ 1.59	$ 1.65	$ 2.36	$ 4.29	$ 3.75
$0.164	$ 3.64	$ 5.09	$ 3.54	$ 1.38	$ 1.33	$ 1.01	$ 1.84	$ 2.01	$ 1.61	$ 2.73	$ 3.97	$ 3.84
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Energy	$ 19.45	$ 8.76	$ 1.49	$ (17.23)	$ (15.67)	$ (14.74)	$ (12.96)	$ (7.76)	$ (3.72)	$ (9.44)	$ 9.67	$ 8.62
Base Incr	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00
											TOTAL >	$ 26.46
											savings:	$ 222.03

Below are my bills at 11 months through the program. It appears we will not have any more energy charges going forward – just the base fee each month. We'll bank hours in the fall and spring, then use some during the winter and possible part of the summer. This change is accelerating my solar payback and I'm track for breakeven right at the 9 year mark. That means the next ~16 years of operation are all generating savings for us – a great return on the initial investment.

Note below by weekday use (M-F 6AM-10PM) has been net positive. I have some net usage during nights/weekends when the rate is $0 because demand is lower and energy is cheap.

Date	Total Net kWh	Day Net kWh	N/WE Net kWh	Elec Cost ($)	Bank Add	Bank Used	Bank After kWh
8/14/20	197	(63)	260	$ -	63	-	63
9/14/20	243	(41)	284	$ -	41	-	104
10/22/20	86	(110)	196	$ -	110	-	214
11/14/20	57	(18)	75	$ -	18	-	232
12/14/20	194	(2)	196	$ -	2	-	234
1/14/21	224	63	224	$ -	-	63	171
2/14/21	284	59	284	$ -	-	59	112
3/14/21	208	13	208	$ -	-	13	99
4/14/21	(97)	(153)	56	$ -	153	-	252
5/14/21	(10)	(74)	64	$ -	74	-	326
6/14/21	97	(36)	133	$ -	36	-	362
7/14/21							
Year TD		(362)	1,980				
Avg/Mo		(33)	180				

Solar Advice

We get a lot of questions about solar. I've distilled my typical response down to this:
Before adding solar you should always look to improve your efficiency first. Reducing the amount of energy you need will save you money and reduce the size of your solar system. I gave a presentation on solar last fall which is posted here: https://enerjazz.com/house/files/Solar_PV_Basics.pdf. You'll learn some basic info there.

For a system size estimate, gather your monthly kWh data for the past 12 months. Divide the lowest monthly use by 115 for a base size. (Example - lowest month is 500kWh. 500/115 = 4.3kW system. That's the smallest system you would probably want. Add up your total kWh for the year and divide by 1400 for the max size (Example 11,000kWh / 1,400 = 7.8kW).

Most people are connected to the grid and just use the solar to reduce their power use. You'll want to look for a power plan that allows net metering (you feed excess back to the grid and your meter turns backwards). If you produce more than you need during the month they bank it for use in a future month, or credit you the cost. I found this power plan guide that's updated monthly: https://www.texaspowerguide.com/solar-buyback-plans-texas/

Most people don't have any battery storage. If you don't have storage and the power goes out the solar can't produce because it needs to see the grid signal to synch to.

Battery systems have been dropping in price and some people now install a battery system that can cover all their load for a short period or a smaller load for a longer period. These systems can disconnect from the grid and set up the house as an "island." The battery inverters will produce a sine wave that allows the solar inverters to operate and provide energy/charge the batteries if the grid is down. Not all battery inverters and solar inverters are compatible, so verify that your choice will function.

The Federal Solar Tax Credit of 26% was recently extended through 2022, so that will help with the cost. I advise getting a few competitive bids. Those proposals should fall within your upper and lower range estimates calculated above. The Federal Tax Credit is back up to 30% for many years.