

Westbrook House Utility Use 2016

We completed our 20th year in our passive/active solar house. Below are some of the utility trends. For more information about our house visit: <https://enerjazz.com/house>

We built the house in 1996 and moved in late September of that year. It's a passive solar design with structural insulated panel (SIP) walls and roof, solar water heating, a geothermal (ground-source) heat pump, and an energy recovery ventilator (ERV). We added a wind turbine in 2006, but sold it in 2014 because we have too many tall trees (turbulence). We added solar electric (PV) in late 2012.

The table below is for the data junkies. Subsequent trend charts will make more visual sense.

Westbrook House Annual Utility Data											2,713 sf, 3 people	
Year	kWh sum	kWh util	kWh wind	kWh solar	Cost/Yr	Average Cost/Mo	Effective Elec Rate (\$/kWh)	kBtu/sf	kWh/sf/yr	kWh/DD	Water Use/Yr (gallons)	
1997	8,952	8,952	0		\$ 739	\$ 61.55	\$ 0.083	11.3	3.3	1.8	34,700	
1998	10,195	10,195	0		\$ 781	\$ 65.09	\$ 0.077	12.8	3.8	1.9	27,900	
1999	9,309	9,309	0		\$ 644	\$ 53.63	\$ 0.069	11.7	3.4	2.0	45,500	
2000	9,966	9,966	0		\$ 684	\$ 56.99	\$ 0.069	12.5	3.7	2.0	38,400	
2001	9,875	9,875	0		\$ 753	\$ 62.79	\$ 0.076	12.4	3.6	2.1	36,000	
2002	10,404	10,404	0		\$ 893	\$ 74.45	\$ 0.086	13.1	3.8	2.1	28,000	
2003	10,257	10,257	0		\$ 934	\$ 77.87	\$ 0.091	12.9	3.8	2.1	38,000	
2004	10,624	10,624	0		\$ 988	\$ 82.37	\$ 0.093	13.4	3.9	2.4	25,000	
2005	11,205	11,205	0		\$ 1,177	\$ 98.08	\$ 0.105	14.1	4.1	2.3	37,000	
2006	10,633	10,555	78		\$ 1,443	\$ 120.28	\$ 0.137	13.4	3.9	2.2	35,000	
2007	9,916	9,770	146		\$ 1,305	\$ 108.79	\$ 0.134	12.5	3.7	2.0	28,000	
2008	9,661	9,419	242		\$ 1,364	\$ 113.65	\$ 0.145	12.2	3.6	1.9	38,000	
2009	8,403	8,118	285		\$ 1,247	\$ 103.92	\$ 0.154	10.6	3.1	1.8	29,000	
2010	9,034	8,788	246		\$ 1,222	\$ 101.84	\$ 0.139	11.4	3.3	1.7	34,000	
2011	8,571	8,238	333		\$ 1,137	\$ 94.73	\$ 0.138	10.8	3.2	1.5	42,000	
2012	7,573	7,137	228	208	\$ 1,000	\$ 83.32	\$ 0.140	9.5	2.8	1.6	29,000	
2013	7,791	2,625	216	4950	\$ 575	\$ 47.89	\$ 0.219	9.8	2.9	1.5	33,000	
2014	8,742	3,472	7	5263	\$ 673	\$ 56.10	\$ 0.194	11.0	3.2	1.7	28,000	
2015	8,670	3,976	0	4694	\$ 708	\$ 59.02	\$ 0.178	10.9	3.2	1.7	27,000	
2016	6,817	1,786	0	5031	\$ 447	\$ 37.21	\$ 0.250	8.6	2.5	1.5	22,000	
Sums and Averages	kWh sum	kWh util	kWh wind		Cost		Elec Rate (\$/kWh)	kBtu/sf	kWh/sf/yr	kWh/DD	Water Use (gallons)	
Total>	186,598	164,671	1781	20146	\$ 18,715						655,500	
Annual>	9,330	8,234			\$ 936		\$ 0.129	11.7	3.4	1.9	32,775	
Monthly>	777	686			\$ 77.98						2,731	

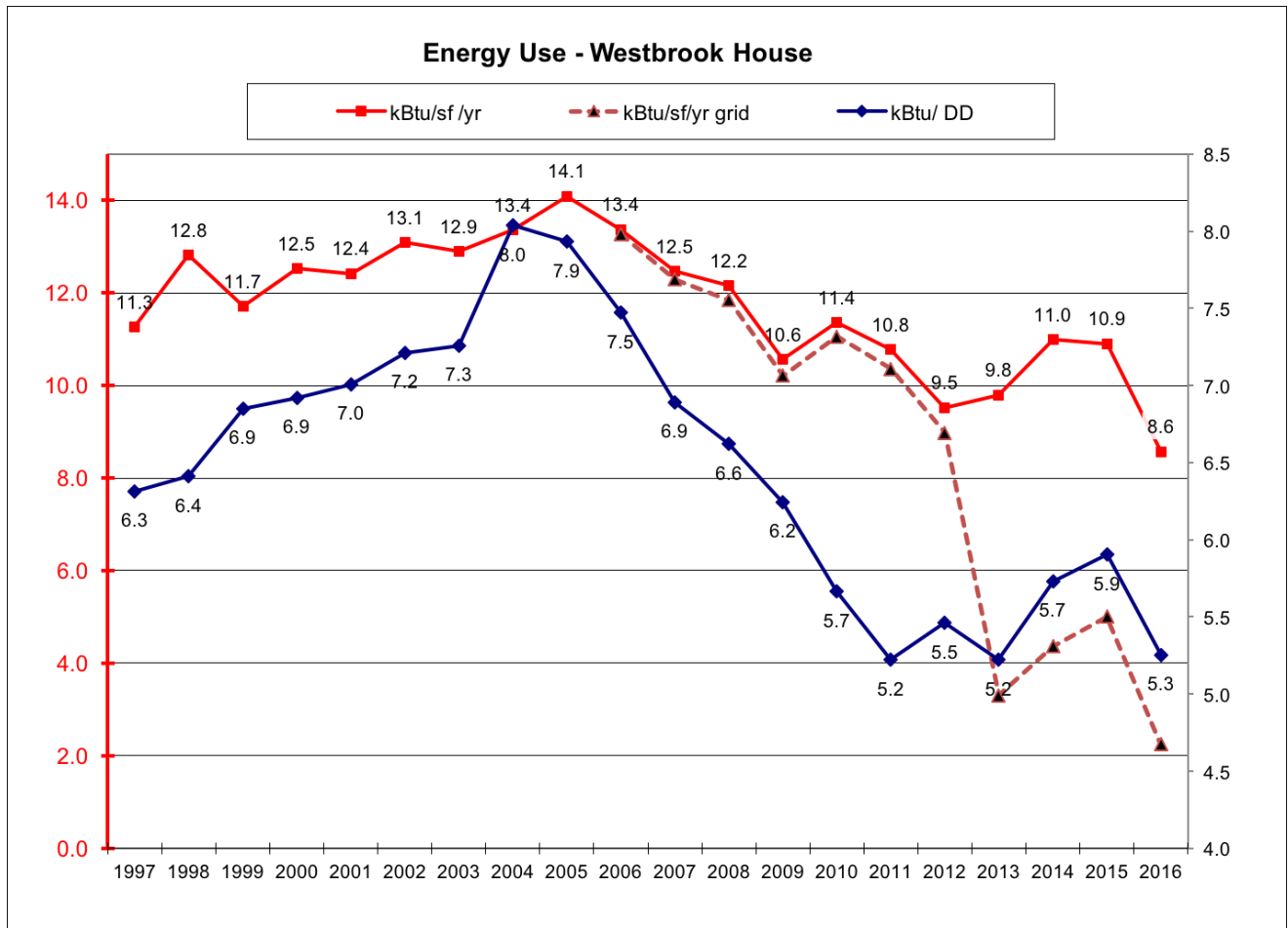
<https://enerjazz.com/house>

2016 major reduction due to aerobic septic air compressor change.

Note our electric utility (Grayson-Collin Coop) has a fairly high base cost minimum of \$19/month and a high electric rate (\$0.107/kWh). The Electric Rate shown in the effective net. As we use less and generate more the effective rate becomes quite high due to the base fee. We pay the base if we use zero net electricity from the grid. The \$37/month average for 2016 was just \$18 in energy use (for the average 169 kWh/month from the utility) and \$19 base fee.

Energy Trend

The chart below shows a few key energy use indices. The red line is our site energy use (converted to kBtu) per year divided by our house size in square feet (sf). The average for a home in Texas is about 42kBtu/sf/yr (we were 8.6 in 2016). The big drop in 2016 was due to an efficiency improvement – we changed the air compressor on our aerobic septic system to a much more efficient model in July. Our use is better than the qualification level of the rigorous Passive House standard. The dashed line is our site energy use from the grid. After we installed energy generation in 2006 this number began to drop. The blue line shows our site energy use divided by the number of relevant cooling/heating degree days in a year. This helps account for yearly weather variations.

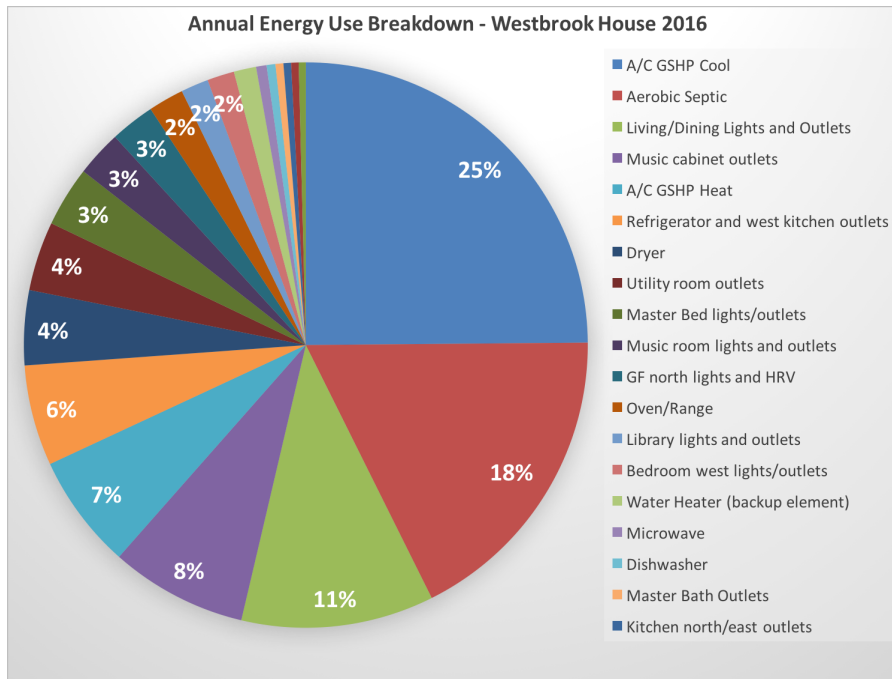


A few observations on the energy chart above. The peak year of 2006 revealed that our heat pump was low on Freon and was operating poorly. Also our daughter went from age 3 in 1997 to 12 in 2006, which accounted for some of the increased use in other areas. About the time we repaired the heat pump we also began to lower our internal loads with more efficient TV's and computers.

2011, 12, and 13 were low use years as our daughter was away at college for most of that time. She lived with us again from mid-2014 until late 2015 and she now has a place of her own. In 2016 she did still do most of her laundry at our house, which added dryer energy use to our total.

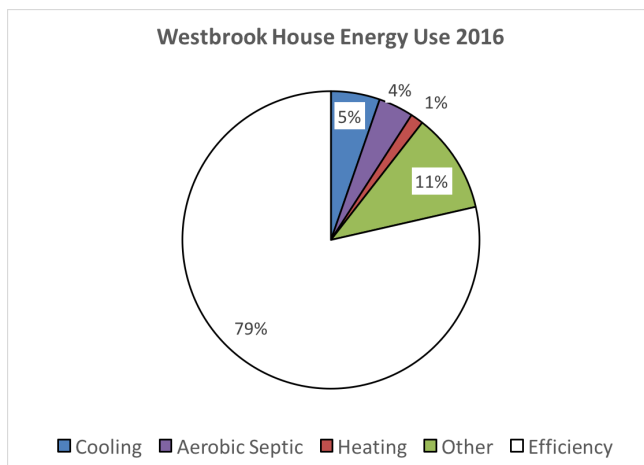
Energy Use

Where do we use the energy? We have circuit level monitoring, so I generated a pie chart of our 2016 energy use.



The majority of our energy went to cooling (25%). Heating was fairly small (7%). Our aerobic septic aerator is a very large energy consumer (18%), but that is lower than prior years because I replaced the aerator with a more efficient model in July. Our next largest load (11%) is the main living/dining area where we spend most of our time with lights and the TV. The next highest load (8%) is for the outlet where the internet, routers, and other 7x24 electronics reside. Note that solar water heating covers almost all of our water heating energy. The backup electric element was less than 2% of our use.

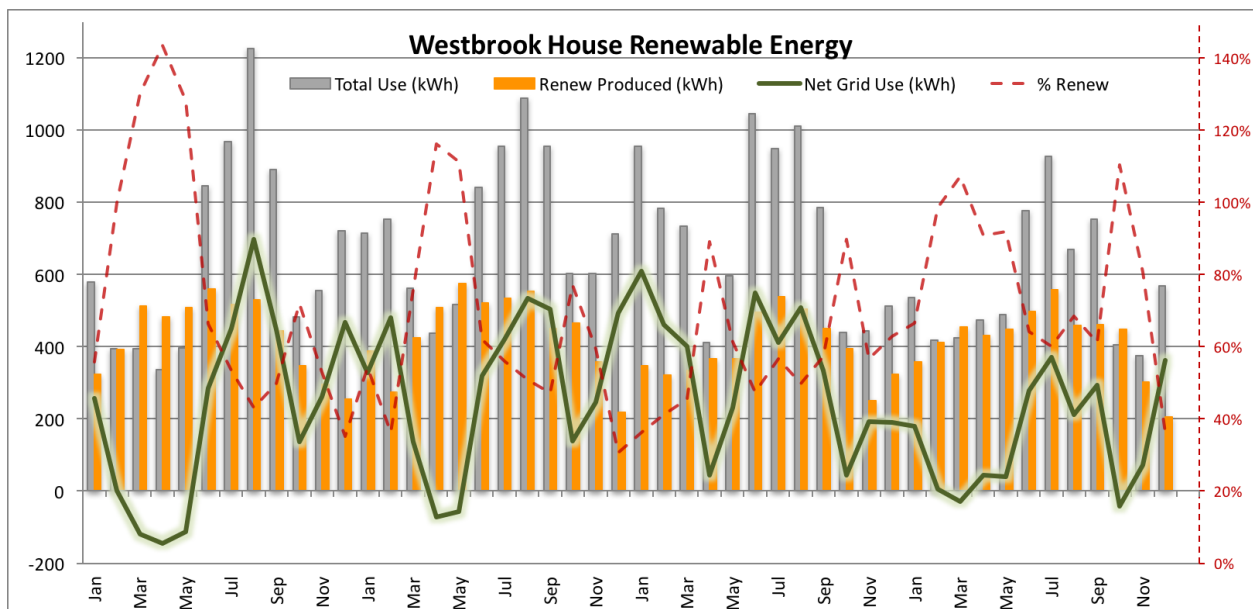
Of course, with my use being less than a 1/4th of a typical house even my large % loads are still relatively small energy users. The next chart shows my use if I were a typical Texas home – I eliminated most of the usage with efficiency.



Energy production

We added a Skystream Wind Turbine in 2006. I was a beta tester for them and my site did not meet the required criteria (300 foot clear radius around the tower), but I got it for a very low cost. The production was about 1/10th of what it would have been on a clear, open site. I sold the turbine in 2014 to someone with a better site. The turbine never could cover even 4% of my energy needs, instead of the 30% or 40% it would have covered on a better site.

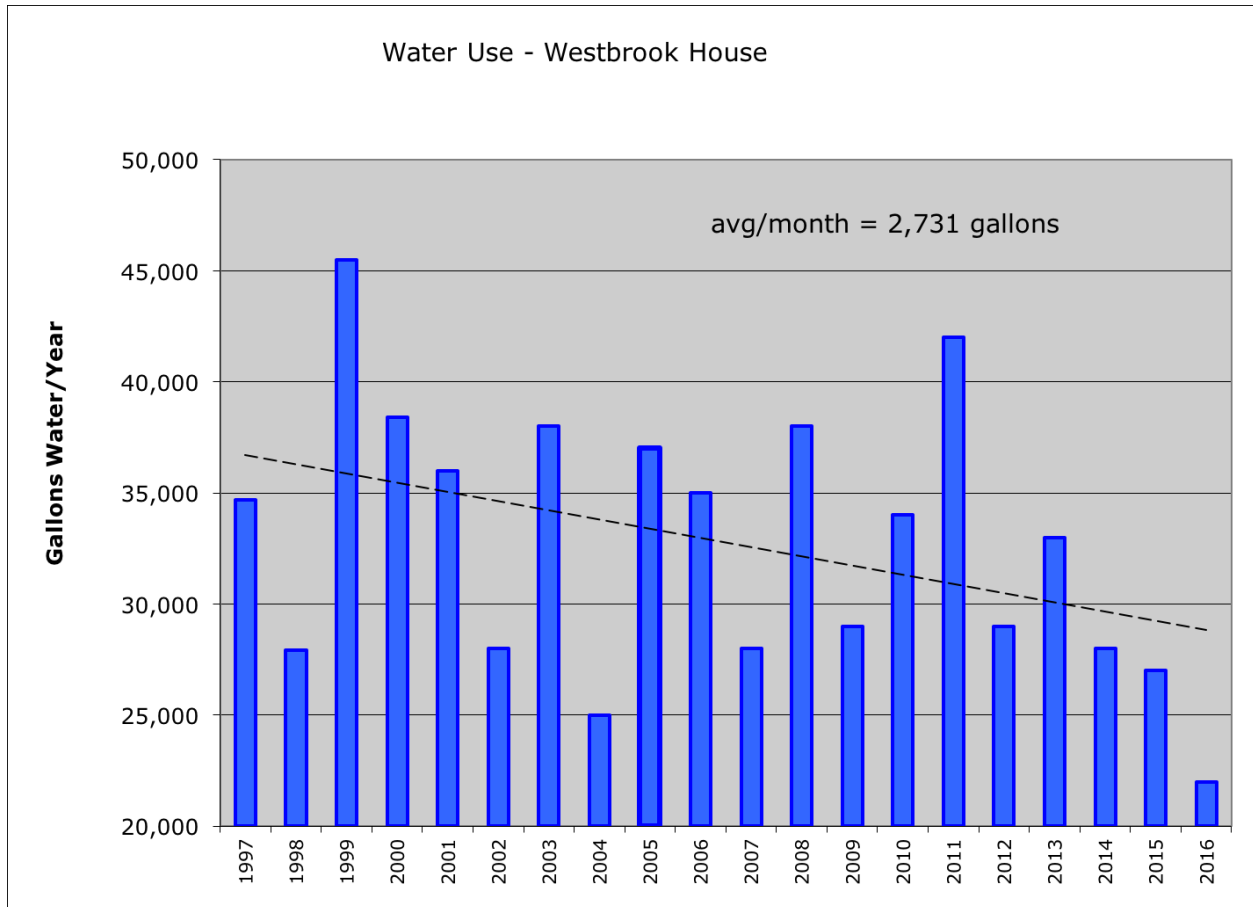
In late 2012 I installed a 3.5kW solar photovoltaic (PV) array – later expanded to 3.75kW. This system is producing about 75% of my energy needs. I could have boosted the size of the system a bit and been a net-zero house, but our electric utility provider does not give any credit for excess energy produced. My system is optimally sized for the best financial return. This policy has also shifted our behavior. If we see we're going to give some energy back to the utility in a low use month we might run some laundry or other loads late in the billing period and shift the usage a bit.



In 2016 we produced 74% of our annual energy needs with the solar electric system. That percentage should rise in 2017 as we will have our more efficient aerobic aerator for the entire year. See all the details of my solar installation at <https://enerjazz.com/house/systems.html>

Water Trend

We have 3,200 gallons of rainwater collection which handles most of the outdoor uses. We have 2.2 acres, but almost all of it is native with no irrigation. We irrigate a garden and refill an outdoor pond with the collected rainwater. Our average municipal water use is about 1/6th of a typical home in our area. Most months our bill is the minimum \$18.62 (2,000 gallons or less), with an annual average of <\$19/month for water.



Summary

Living light on the planet does not mean we make a sacrifice. In fact, it's the reverse. Our home is so well insulated and air-tight that we enjoy even indoor air temperatures and a pleasant humidity level year round. We have much less dust and pests due to the tight shell construction.

Our native plants are healthier and greener than some of our neighbor's non-natives despite their constant irrigation. And our diverse plants create a habitat for roadrunners, coyotes, bobcats, owls, hawks, butterflies (including the Monarch), bees, armadillos, possums, skunks, and many more animals. And that creates a wonderful habitat for us.