

# Westbrook House Utility Use 2015

We completed our 19<sup>th</sup> year in our passive/active solar house. Below are some of the utility trends and detailed analysis. For more details on our house visit: <http://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.

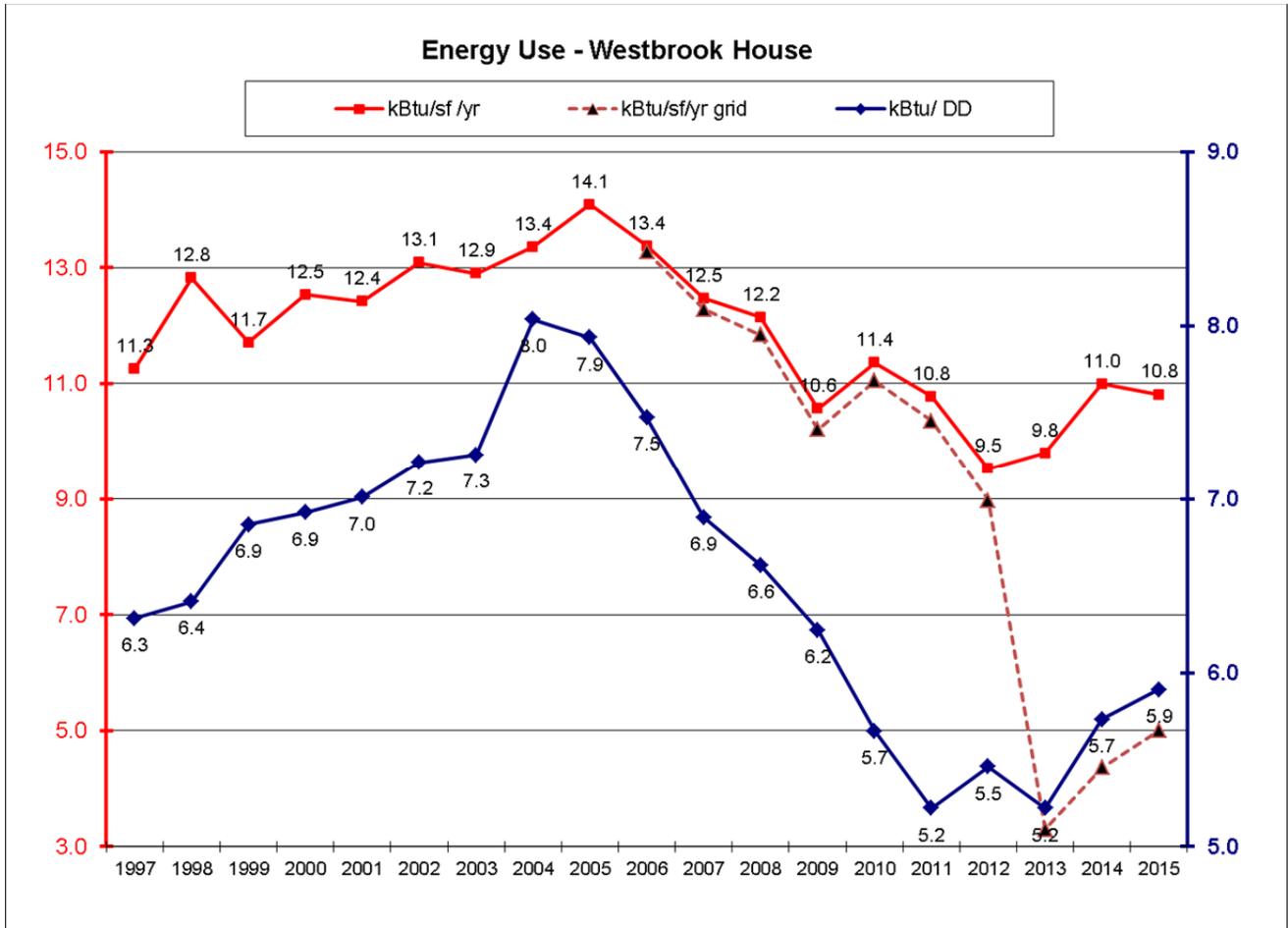
| Westbrook House Annual Utility Data |         |          |          |           |          |                 |                     |          |            |          | 2,713 sf, 3 people     |  |
|-------------------------------------|---------|----------|----------|-----------|----------|-----------------|---------------------|----------|------------|----------|------------------------|--|
| Year                                | kWh sum | kWh util | kWh wind | kWh solar | Cost/Yr  | Average Cost/Mo | Effective Elec Rate | 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                                | 8,598   | 3,976    | 0        | 4622      | \$ 708   | \$ 59.02        | \$ 0.178            | 10.8     | 3.2        | 1.7      | 27,000                 |  |
| Sums and Averages                   | kWh sum | kWh util | kWh wind |           | Cost     |                 | Elec Rate (\$/kWh)  | kBtu/ sf | kWh/ sf/yr | kWh / DD | Water Use (gallons)    |  |
| Total>                              | 179,709 | 162,885  | 1781     | 15043     | \$18,268 |                 |                     |          |            |          | 633,500                |  |
| Annual>                             | 9,458   | 8,573    |          |           | \$ 961   |                 | \$ 0.122            | 11.9     | 3.5        | 1.9      | 33,342                 |  |
| Monthly>                            | 788     | 714      |          |           | \$ 80.12 |                 |                     |          |            |          | 2,779                  |  |

<http://www.enerjazz.com/house>

Note our electric utility (Grayson-Collin Coop) has a fairly high base cost minimum of \$23/month and a high electric rate. We pay the base if we use zero net electricity from the grid. So the \$59/month average for 2015 was just \$36 in energy use (for the average 331 kWh/month from the utility) and \$23 of 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 55kBtu/sf/yr (we were 10.8 in 2015). Our use is down near 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.

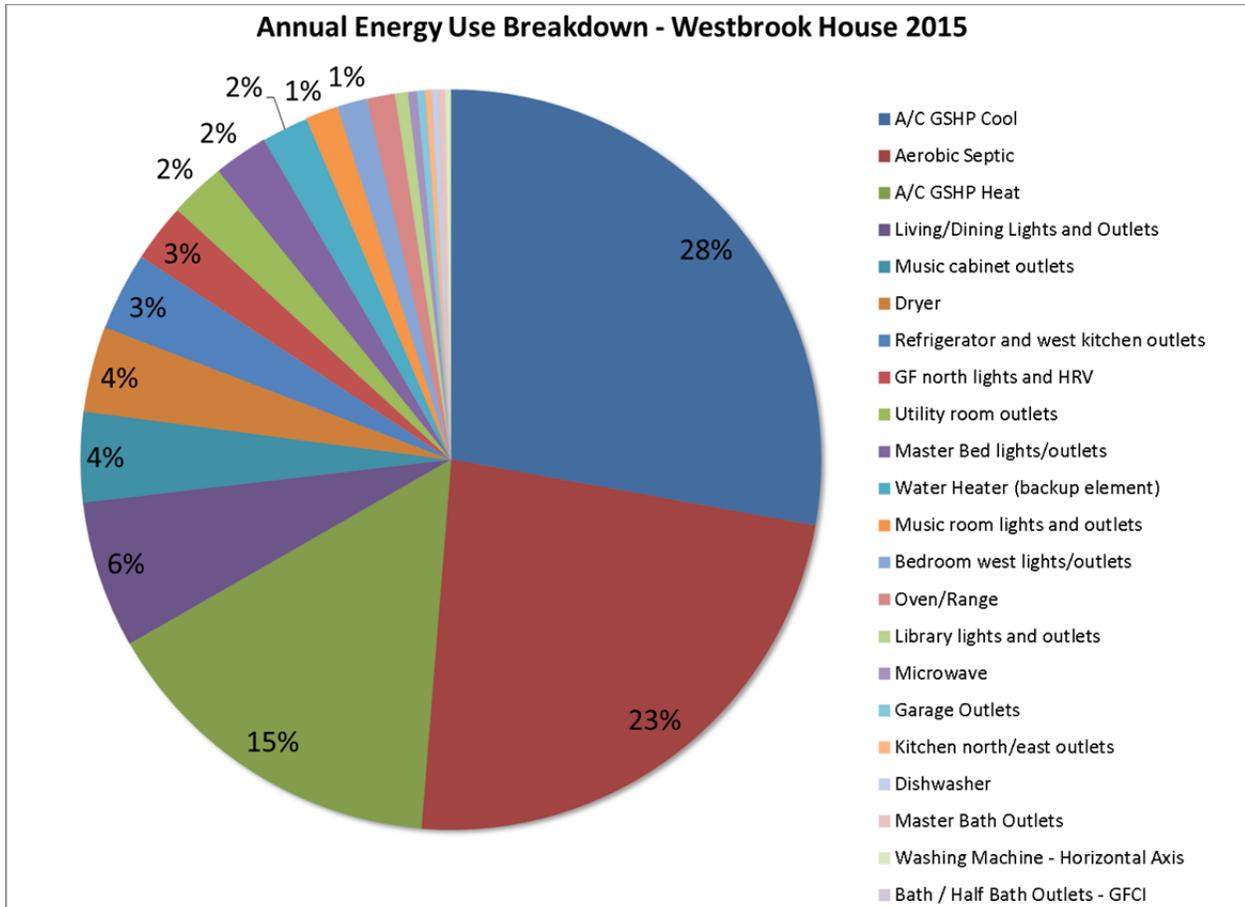


A few observations on the energy chart above. The peak year of 2006 revealed that our heat pump was low on Freon and was operating poorly. Also our daughter went from age 3 in 1997 to 12 in 2006, which accounted for some of the increased use in other areas. About the time we repaired the heat pump we 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, so I expect 2016 to trend back down.

## Energy Use

Where do we use the energy? We have circuit level monitoring, so I generated a pie chart of our 2015 energy use.



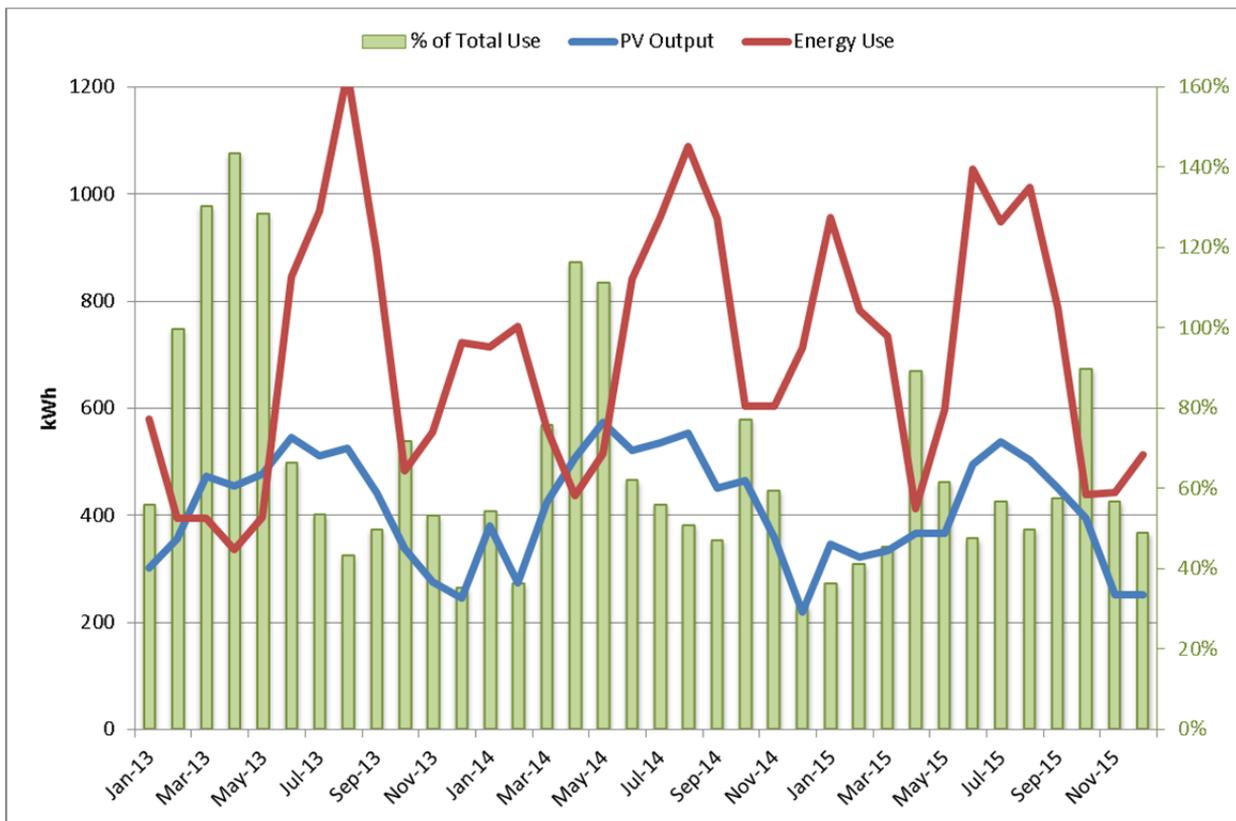
As you see above the majority of our energy went to cooling (28%) and heating (15%). However, our aerobic septic aerator is a very large energy consumer (23%). I recently identified a significantly more efficient aerator and will try that unit in the near future. Our 4<sup>th</sup> largest load is the main living/dining area where we spend most of our time with lights and the TV. The 5<sup>th</sup> highest load is for the outlet where the internet, routers, and other 7x24 electronics reside. The next two loads are the dryer and the refrigerator. Note that solar water heating covers almost all of our water heating energy. The backup electric element was just 2% of our use.

Of course, with my use being less than a 1/3<sup>rd</sup> of a typical house even my large % loads are still relatively small energy users.

## 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 1/10<sup>th</sup> 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 in a clear open site.

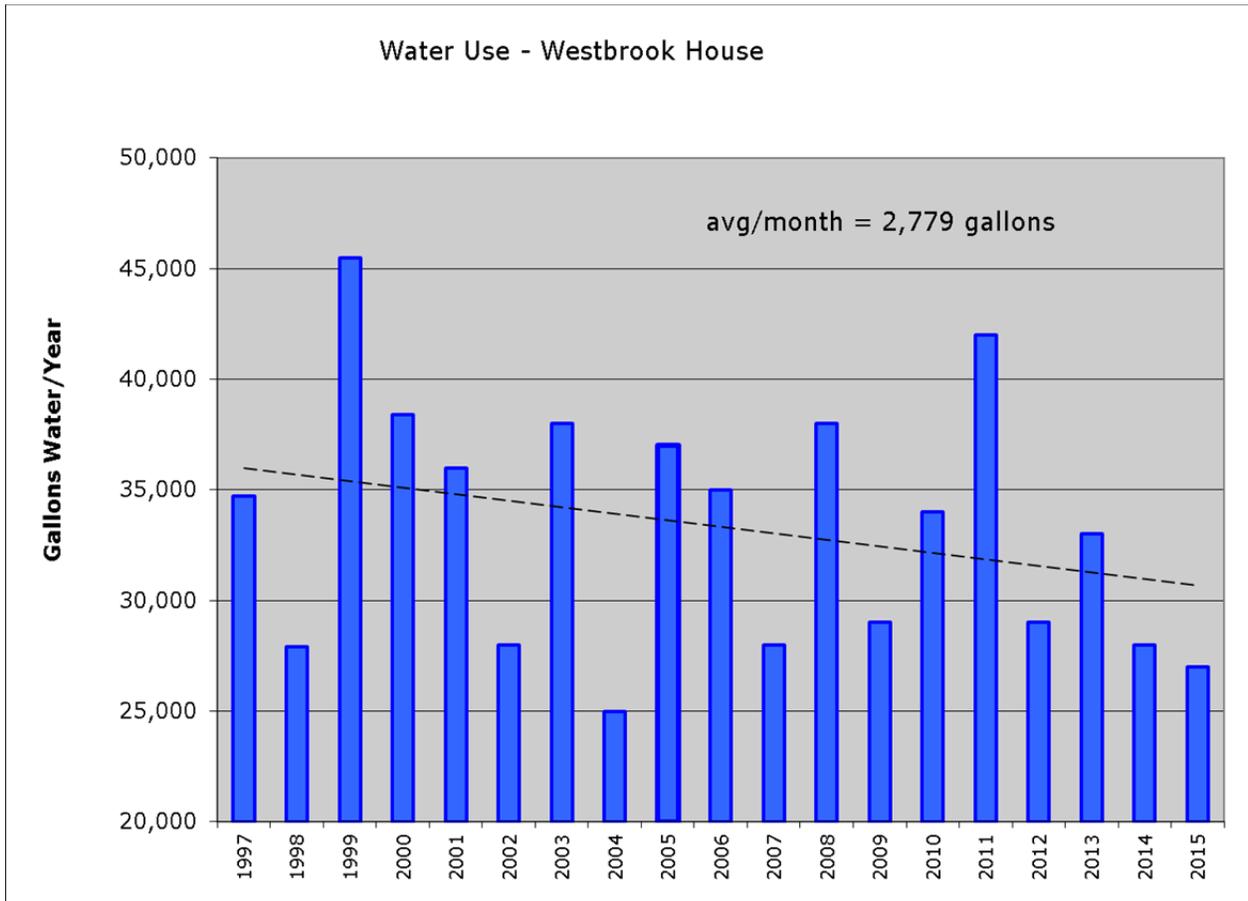
In late 2012 I installed a 3.5kW solar photovoltaic (PV) array – later expanded to 3.75kW. This system is producing well over ½ my energy needs. I could have boosted the size of the system a bit and been a net-zero house, but our electric utility provider does not give any credit for excess energy produced. 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.



As you see above we are producing around 50% of our own energy most months. PV output was down slightly in 2015 due to weather plus one of my 16 panels suddenly dropped to ½ output. Solar panels normally have a long warranty, but I purchased my panels as “B” grade for significantly less money, but they have a shorter warranty. See all the details of my solar installation at <http://enerjazz.com/house/solarpv.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 1/6<sup>th</sup> of a typical home in our area. Most months our bill is the minimum \$16.19 (2,000 gallons or less), with an annual average of \$18.84/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, and many more animals. And that creates a wonderful habitat for us.