

The Westbrook House <https://enerjazz.com/house> < go here for details and links

The House That Pays for Itself – Efficiency, Plus Passive and Active Solar Energy

In 1996 Paul and Elena Westbrook designed their passive solar house. Passive Solar design was mostly used in colder climates, but we developed strategies that would work for the hot and humid climate of north Texas. We began with the following design goals: energy and resource efficient, low environmental impact, low maintenance, and affordable. A few of the integrative design features of the house are passive solar orientation, structural insulated panel (SIP) construction, solar water heating, ground-source (geothermal) heat pump, energy recovery ventilator (ERV), and a standing seam metal roof (reflective and hail resistant – with insurance savings).

Just weeks after we moved into the house with our young daughter, we participated in the 1996 National Tour of Solar Homes, and had a large turnout. We have participated nearly every year since, and well over 2,500 people have toured the house in person - and many more virtually.

The house exceeded performance expectations with the well-insulated passive solar design. Renewable energy (solar PV electric) was added in 2012. A battery was added in 2022 to provide power during grid outages. We have an electric energy bill of \$0 every month – we just pay the base fee to be connected to the grid.

Payback: One Month

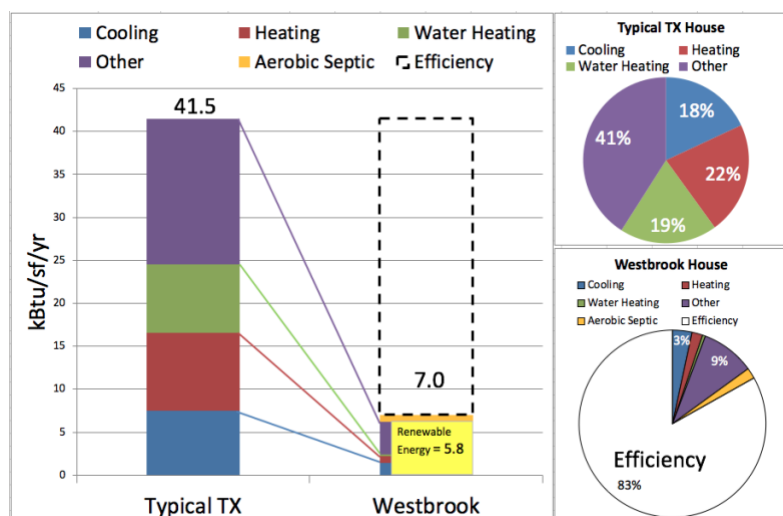
From a cash flow standpoint this is accurate. We spent about \$13K extra on better insulation, solar water heating, ground-source heat pump, metal roof, and durable and sustainable products. That added \$90 to the monthly mortgage payment. However, the utility bill was \$140 less per month (than similar sized homes), so we were ahead financially in the first month. As utility rates have increased, so have the monthly savings. And the total cost was \$85/square foot (\$175/square foot today in inflation adjusted dollars) – very affordable.

Efficiency Savings

The house needs about 75% less energy than a similar north Texas house, so the 29-year savings from energy efficiency have now amounted to over \$44,000. The savings will continue to accumulate for the life of the house.

Solar PV Savings

The solar PV system (installed in 2012) had about a 9-year simple payback, but that investment is providing >7% return on investment and has now resulted in a net zero energy cost electric bill. The panels also charge a plugin Prius with solar energy, which further reduces the family's carbon footprint. The first step was making the house more efficient so that a smaller, less expensive solar system could easily provide the needed electricity. The solar PV system is a modest 3.7kW size (\$6,200 net cost) because the house is so efficient.



Results:

The chart shows a typical Texas house energy use in the mid 1990s (41.5 kBtu/sf/yr = 12.2k Wh/sf/yr). The Westbrook house uses 7.0 kBtu/sf/yr = 2.0 kWh/sf/yr). Code improvements drove new houses down to around 25 kBtu/sf, but our 29-year-old house is still far more efficient than a new home. We produce most of our energy with solar electricity and now enjoy a \$0 energy bill each month.

We use about 500kWh/mo for the house and 100kWh/mo for the plug-in hybrid. We produce about 400kWh/mo from our solar array. The balance of energy use is on free nights/weekends for \$0 cost.

What Can You Do?

Making your existing home more efficient is a great first step. In most existing homes, the attic can be a treasure hunt for energy savings. The three biggest problems are insufficient ventilation, not enough insulation / poorly installed insulation, and poorly installed / leaky ductwork. Visit enerjazz.com/house and click on the tips section.

1. Ventilation – There should be an attic outlet air system (passive preferred, or powered) and air inlets under the eaves. Inlets are usually undersized or blocked with insulation.
2. Insulation – The attic floor should be well insulated.
3. Ductwork – Most attic ductwork is run in flimsy, poorly insulated flex duct. Make sure it's not kinked and double check all connections for leaks.

One solution that solves several issues above is attic encapsulation. Spraying the insulation under the roof deck, then sealing all the ventilation inlets/outlets turns the attic into a semi-conditioned space. Other simple improvements include switching to LED lighting and keeping your air conditioning unit coil and filters clean. When you need a new roof, get one that's reflective (light-colored) and hail-resistant.

Solar Electricity

If you have some clear south roof (east and west are OK, north is bad) consider installing solar electric PV panels. If you have yard space, a ground-mounted system can also be used.

1. Gather your utility bills for the past year. A table of monthly electric use is most helpful. Know your total annual kWh use and your lowest monthly kWh use.
2. Understand your net metering rules. These vary by how your electricity is provided. We are in the Grayson-Collin Coop, who banks our excess kWh for us to use later and offered a free nights/weekends plan. If you are in the Oncor distribution area, you'll need to pick a solar-friendly retail. All solar houses send energy back to the grid, and you need to be fairly compensated for that energy. Solar friendly retail providers: <https://www.texaspowerguide.com/solar-buyback-plans-texas/>
3. Find at least two qualified installers. Go to Google Maps and type "solar installer." Note a few companies in your area that have high ratings (with a large quantity of ratings). Then go to a second site like solarreviews.com, Yelp, or other review sites to cross check. If you're in an Oncor area, research whether they are on the Oncor supplier list: <https://www.oncor.com/takealoadofftexas/pages/residentialsolar>
4. Invite these potential installers to give you a bid on a solar system. Ask each company for two different quotes – one for the system size they would recommend, then a bid for a smaller system to cover about half of your annual use. Ask them if they have the bandwidth to complete it before year end (the 30% federal solar tax credit expires on 12/31/25). If you are in the Oncor grid, ask about the Oncor incentives. Check for other incentives at <https://www.dsireusa.org/>
5. When you get your bids, check the \$/Watt total. Divide the total price (before incentives) by the system size in Watts. Example: 7kW system for \$20,000. $\$20,000/7,000W = \$2.86/\text{Watt}$. Most system should be less than \$3/W, and probably should be under \$2.50/Watt (BEFORE the tax credit or other incentives).
6. Paying for the system is a personal decision, but if you can pay cash, that's best. Getting a home equity loan might be a better choice than any finance deals offered to you. Own your system for maximum savings.

Solar, wind and batteries are the cheapest form of power on the planet - lowering costs, creating new jobs, reducing pollution, and strengthening our communities. Nearly five million U.S. homes already have solar panels, and in just one year (2024) the U.S. installed 50 gigawatts (GW) of utility level solar power, representing more than 80% of all new electric generating capacity added to the grid. **The solution comes up every day!**

All the details of the Westbrook House design and construction can be found in Paul's book *The Joy of Efficiency* (<https://joyofefficiency.com>).

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