



The Westbrook House

Efficiency = Resilience

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March 2021

NTREG Meeting

www.enerjazz.com/house



Outline

- Quick House Overview
- Weather and Power Data
- Passive House Performance
- Renewable Energy Performance
- Recommendations

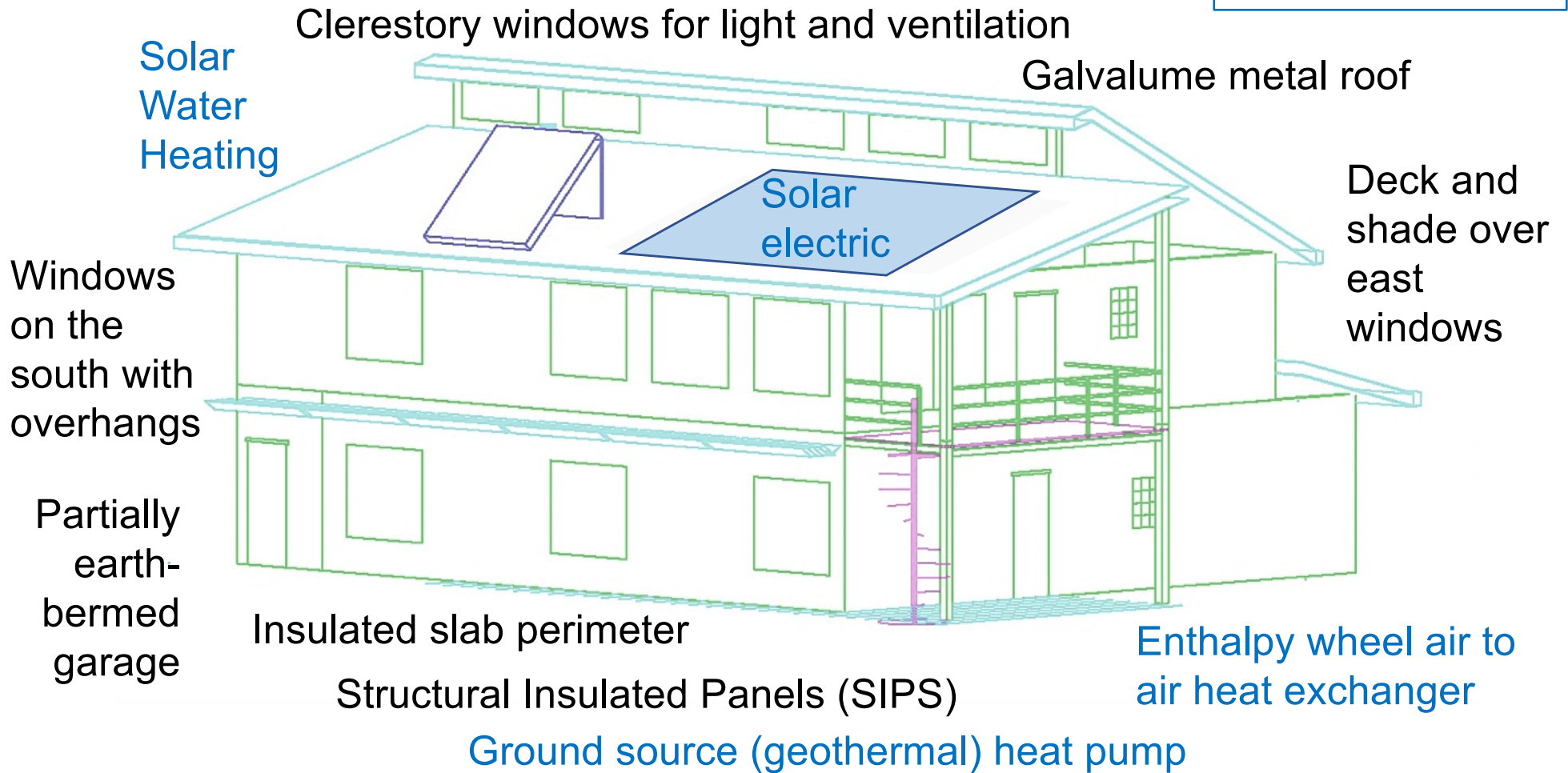


Westbrook House - Southeast View

- Well insulated and air-tight construction
- 3.7kW solar array, **no battery storage, grid connected**

Compact, two story stacked

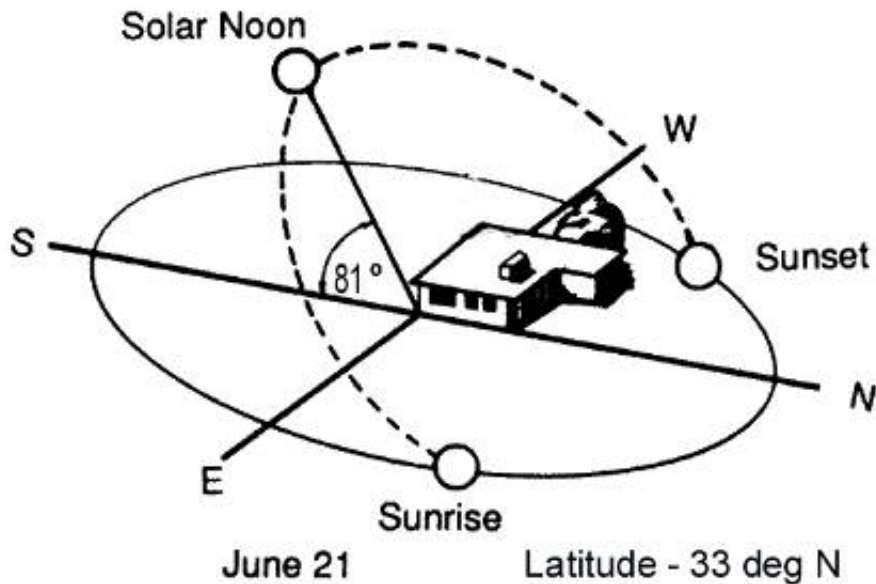
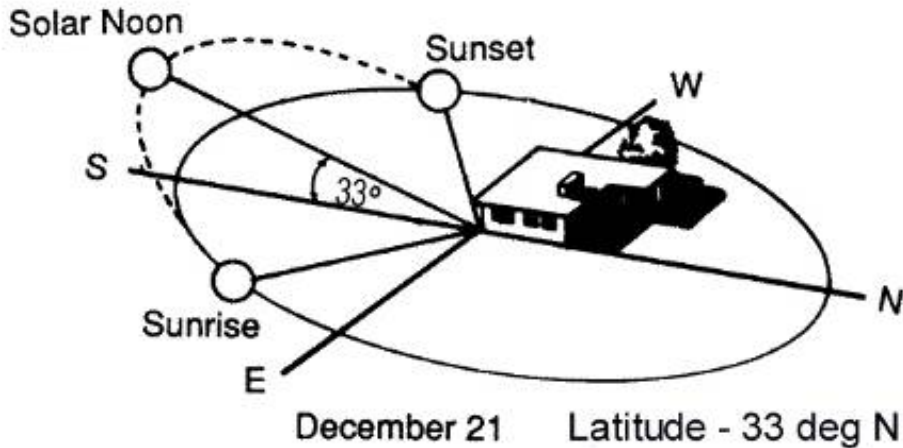
Passive Features
Active Features



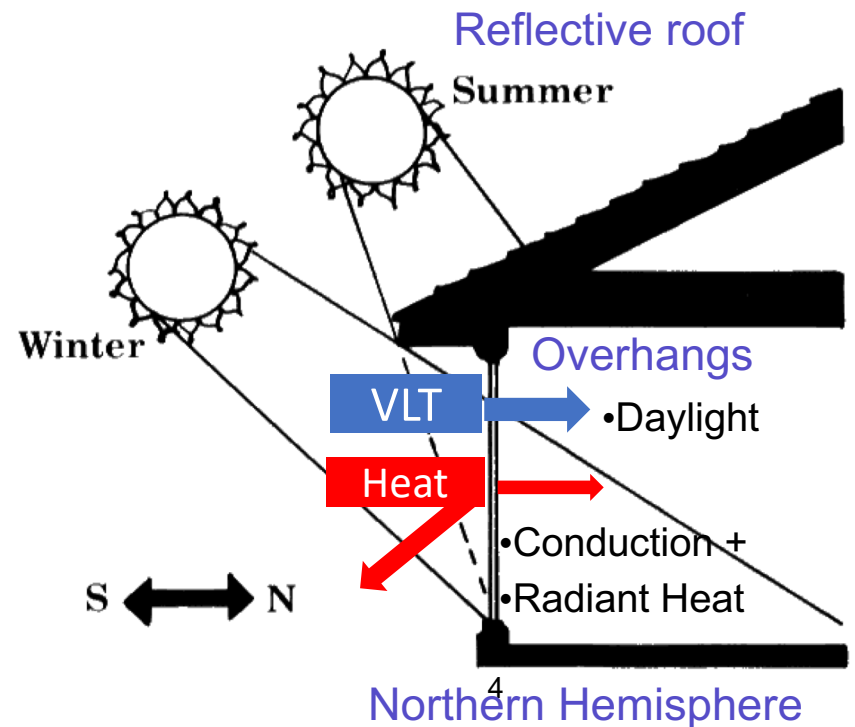


Passive Solar

- Orientation
- Solar Control
- Mass and Insulation



Minimize E & W windows



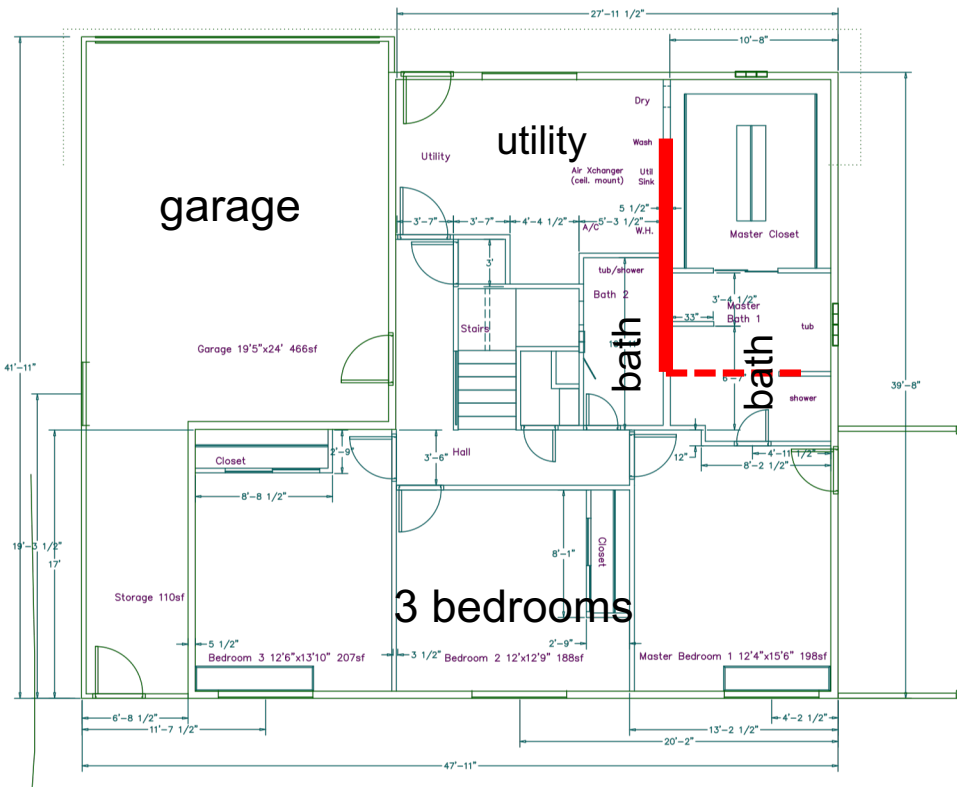


Floor Plan - Stacked

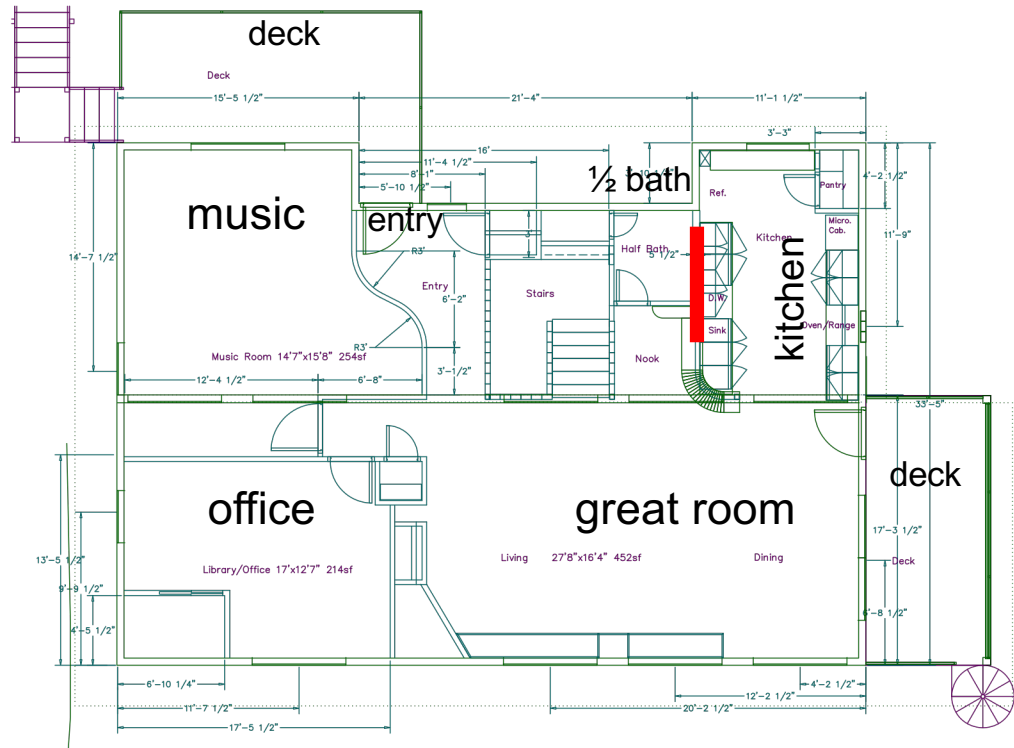
All plumbing was placed in interior walls

Common plumbing wall

Living areas upstairs



•1st Floor



•2nd Floor

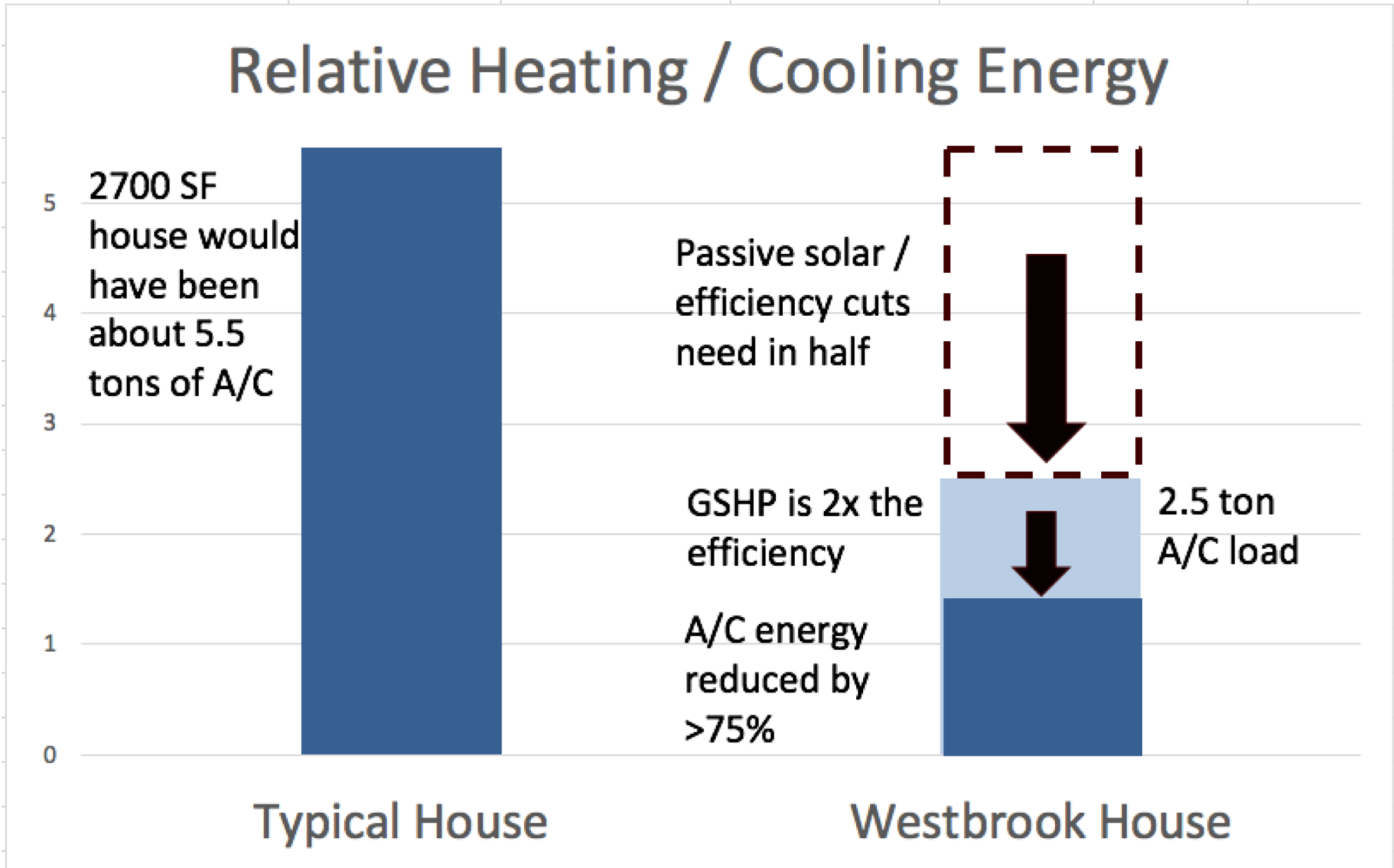


Other Helpful Items

- Earth bermed the west wall of the attached garage and insulated it – temperature stays between 51°F – 86°F (fell to 46°F during the extreme cold)
- Small wood stove with outside air intake for combustion
- SIP construction is very air-tight

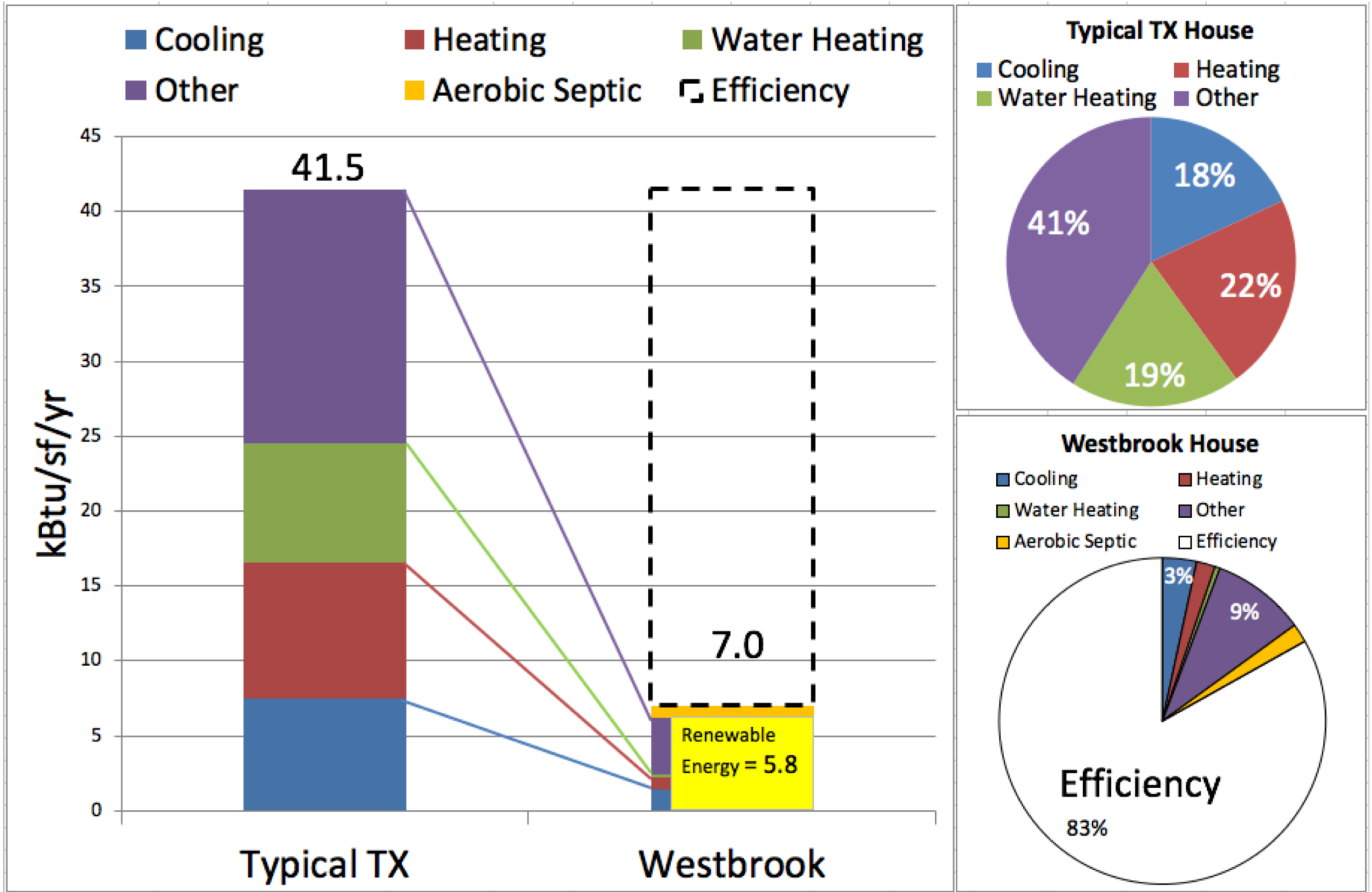


Utility Usage Comparison





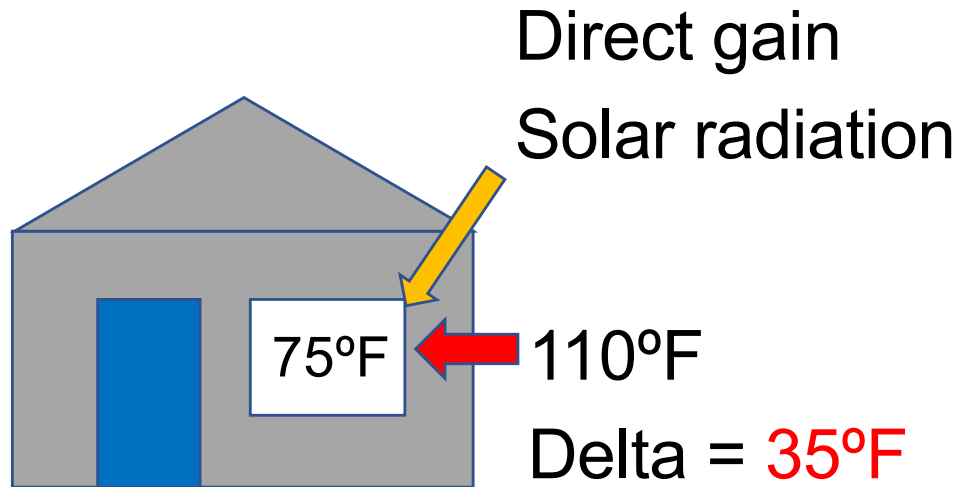
Results: Energy Efficiency



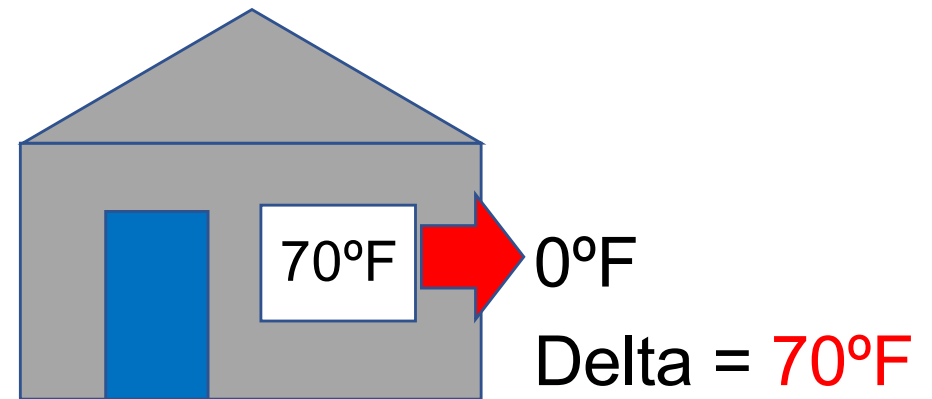


How Weather Affects Comfort

- Summer



- Winter



Delta T is twice as big during intense cold periods

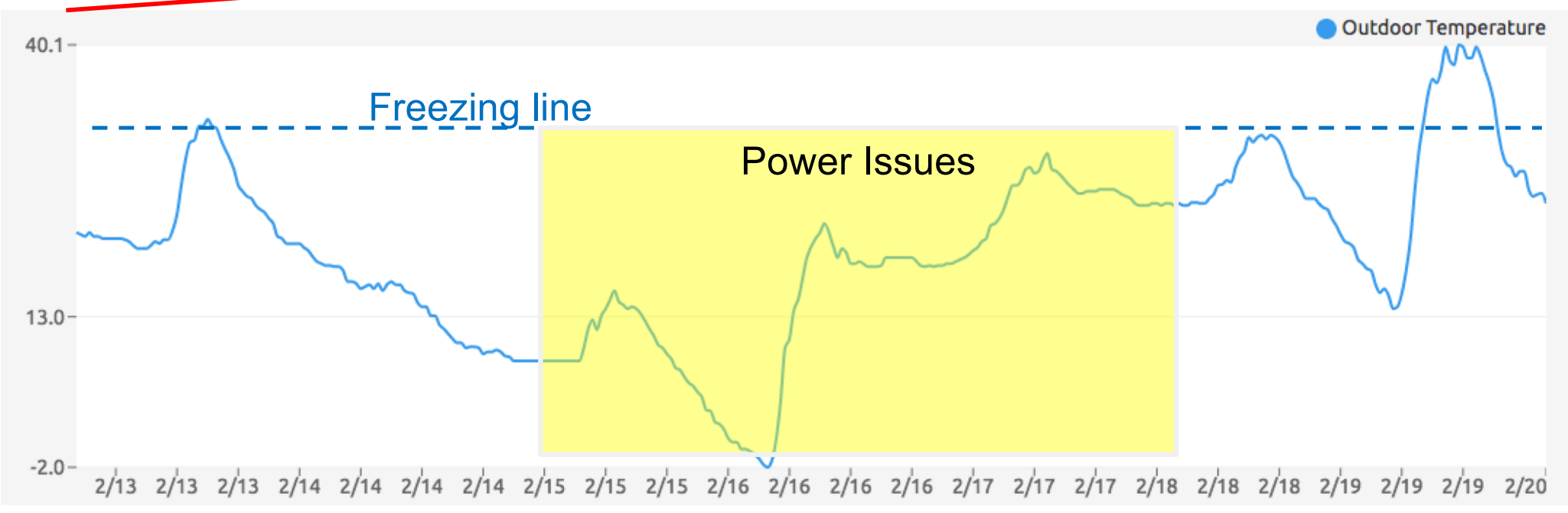
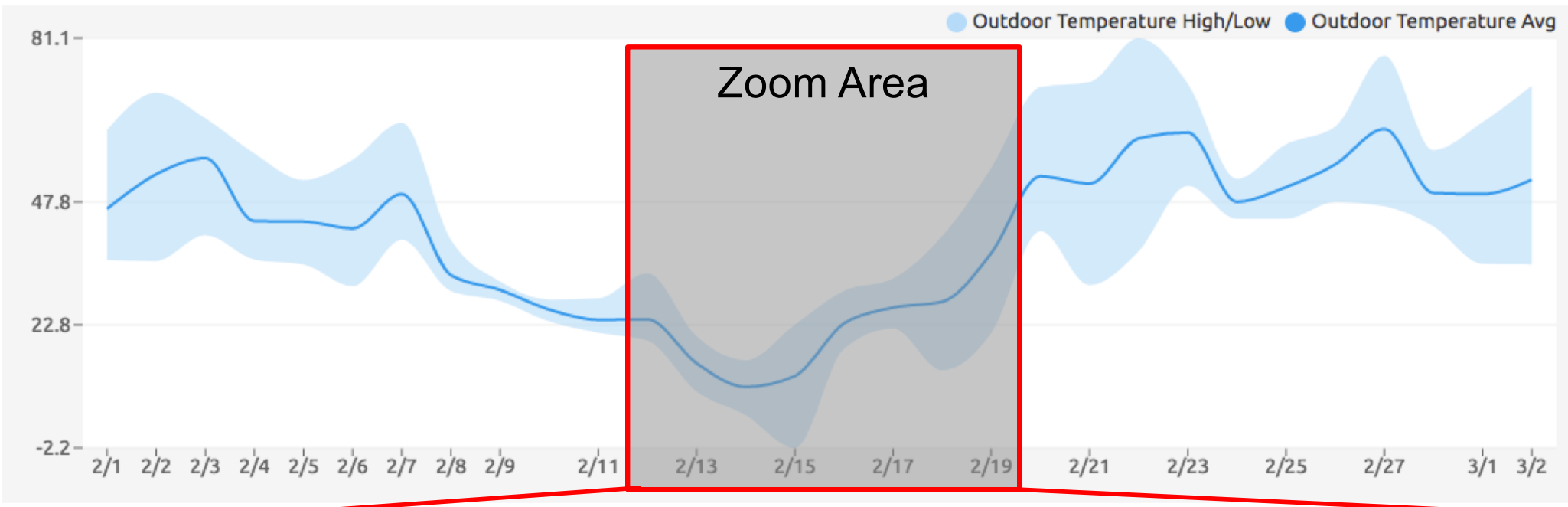
$$Q \text{ (heat loss/gain)} = U \text{ (U-factor)} \times A \text{ (area)} \times \Delta T$$



Weather & Power Data



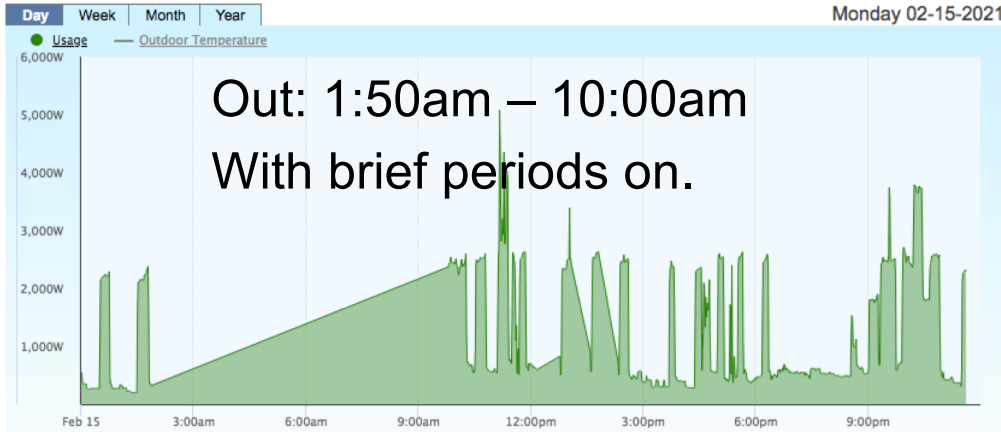
Weather – The Dip



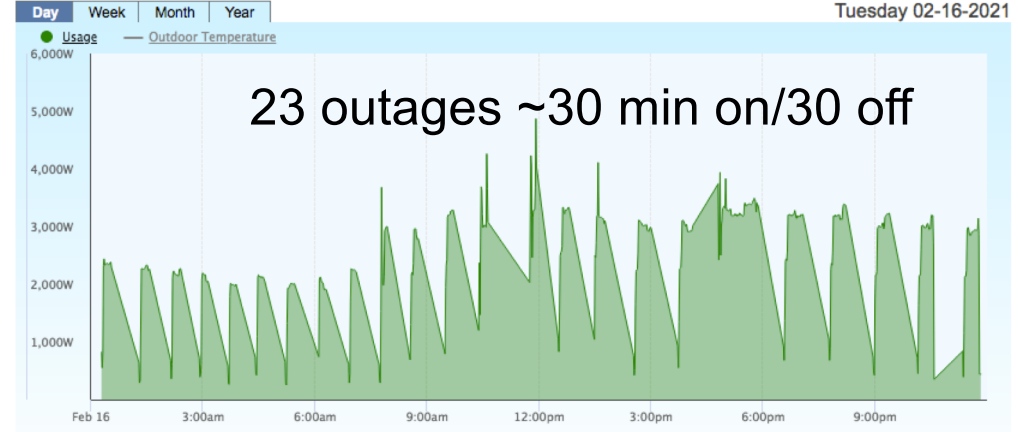


Power Problems

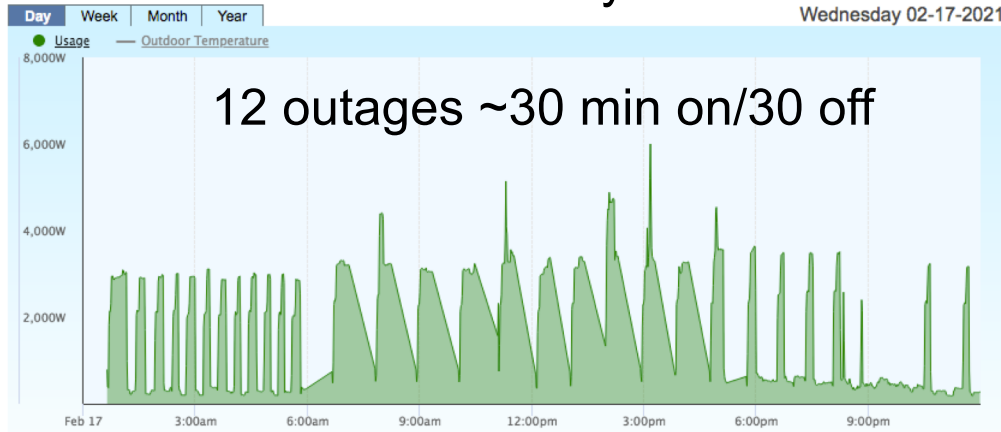
Monday 2/15



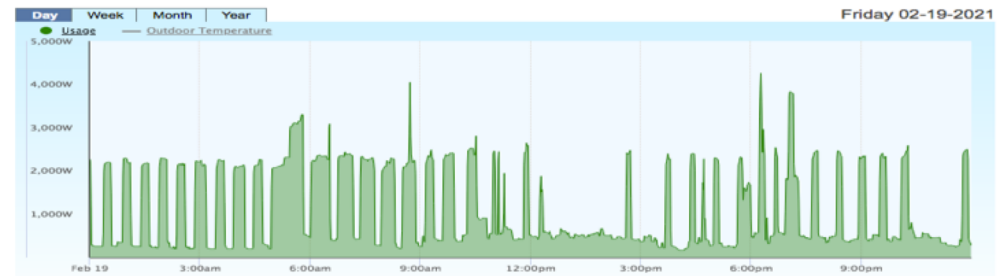
Tuesday 2/16



Wednesday 2/17



Normal cold day – Friday 2/19



~8 hours off + 11.5 off + 6 off = 25.5 hours without power

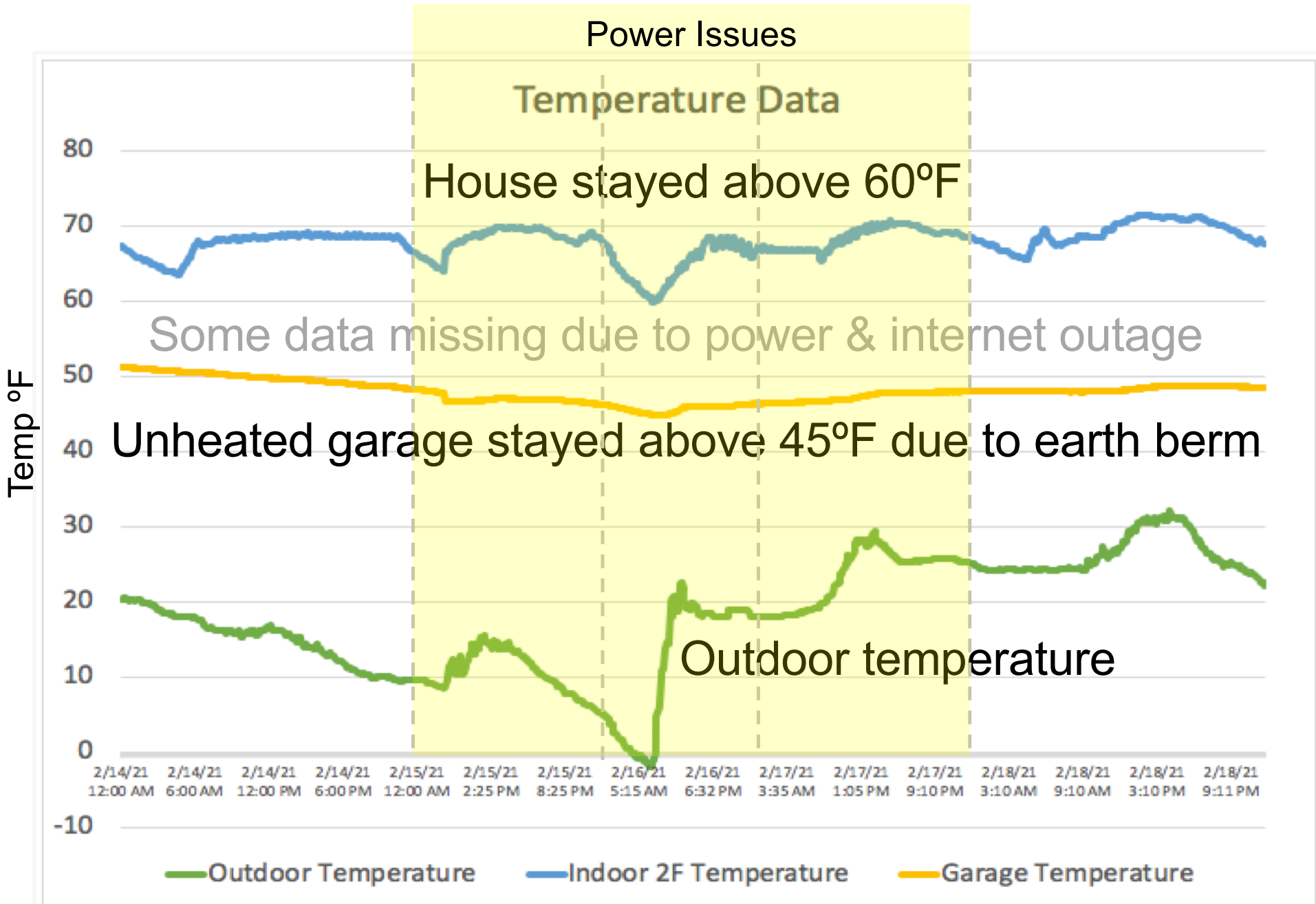
Mon 2/15 – Wed 2/17



Passive House Performance



Temperature Data



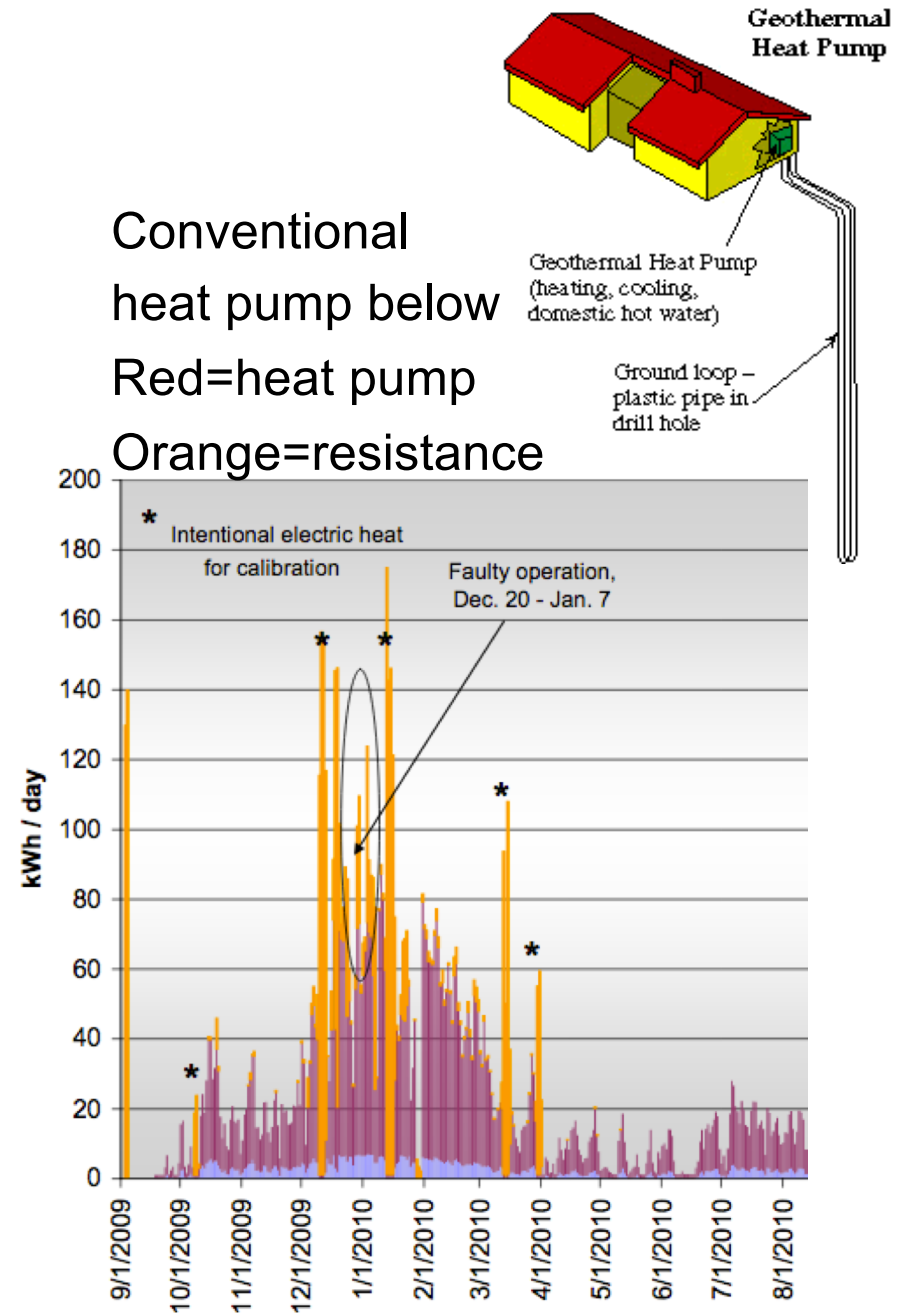


Active & Renewable System Performance



Ground Source Heat Pump (GSHP)

- The GSHP uses the relatively constant temperature of the earth as a heat sink or source.
- The minimum efficiency unit has a SEER of 14 (as of 2020). The Westbrook House GSHP has an EER of 28.
- During cold weather it doesn't have to use electric resistance heat (very inefficient – about a 3X penalty)

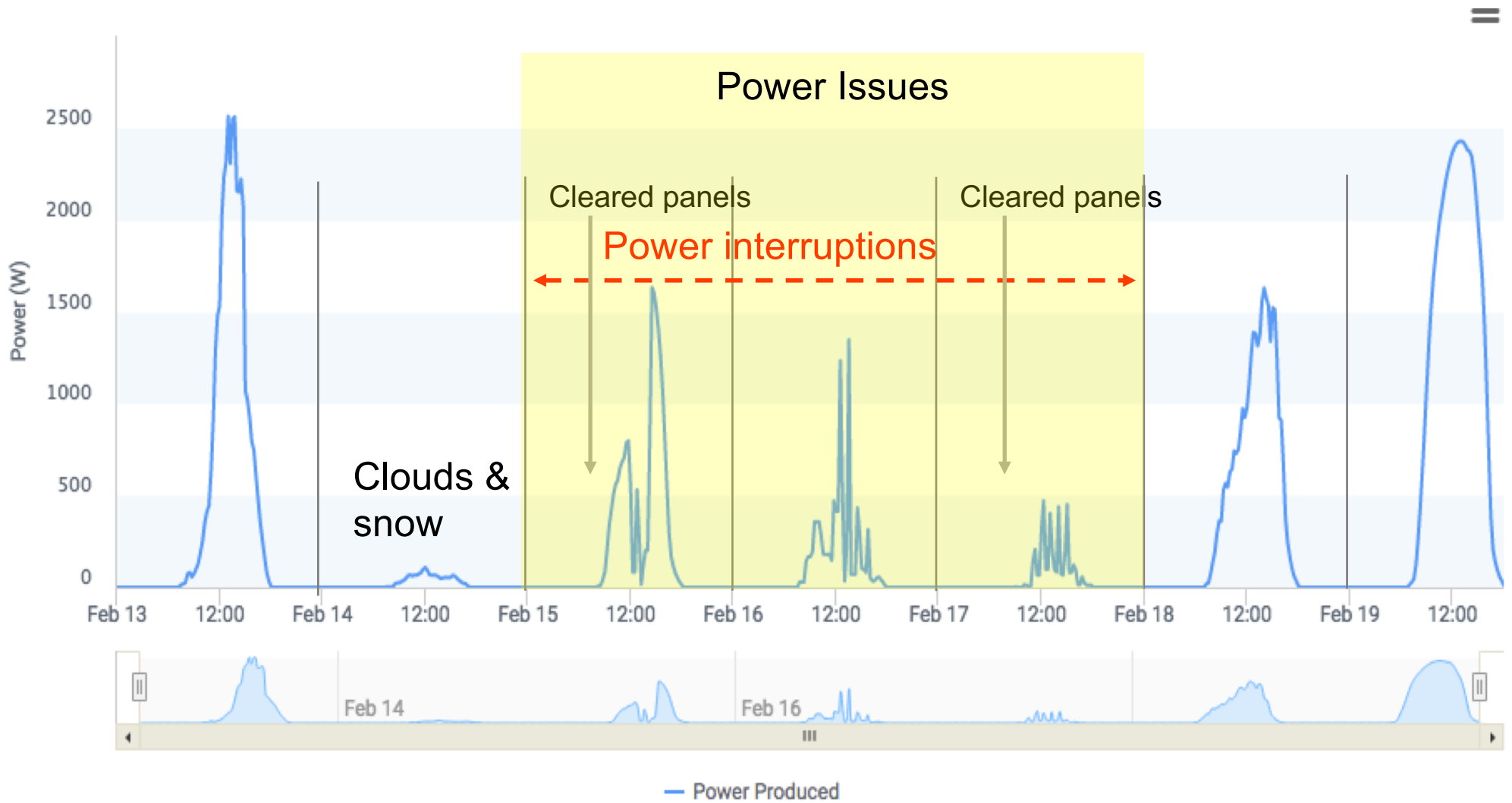








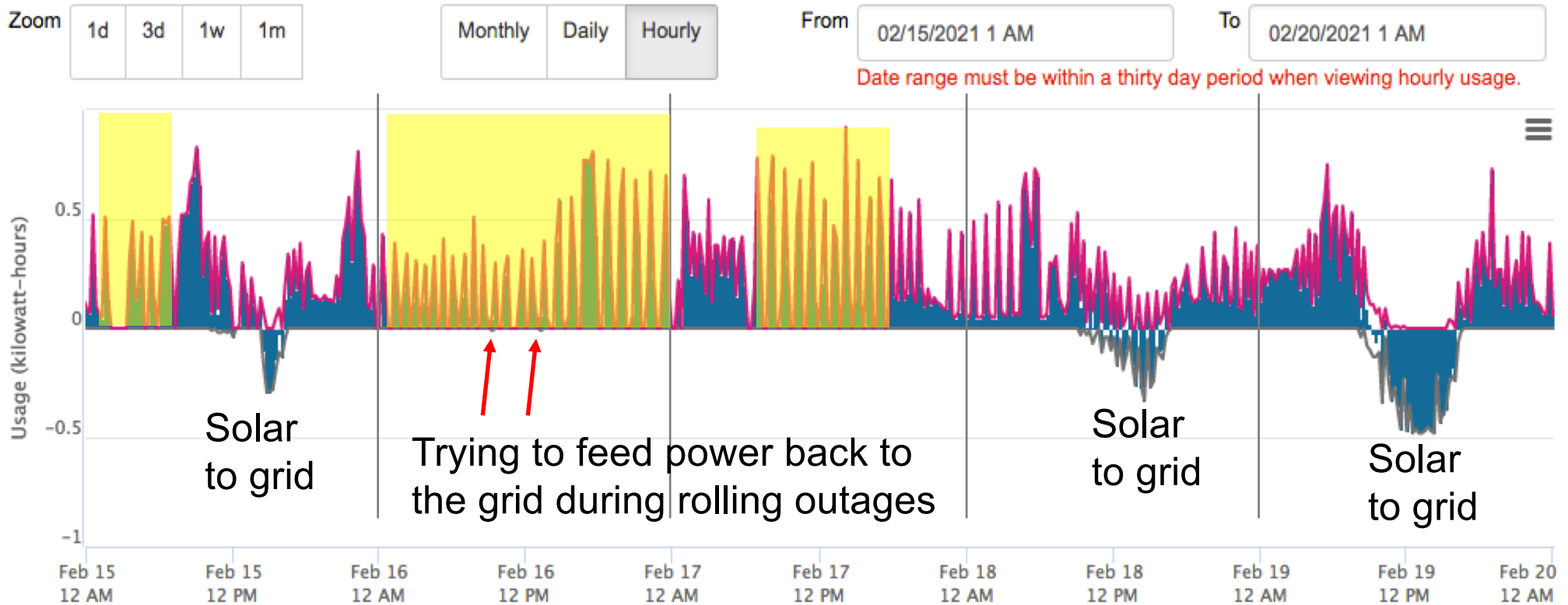
Solar PV Output





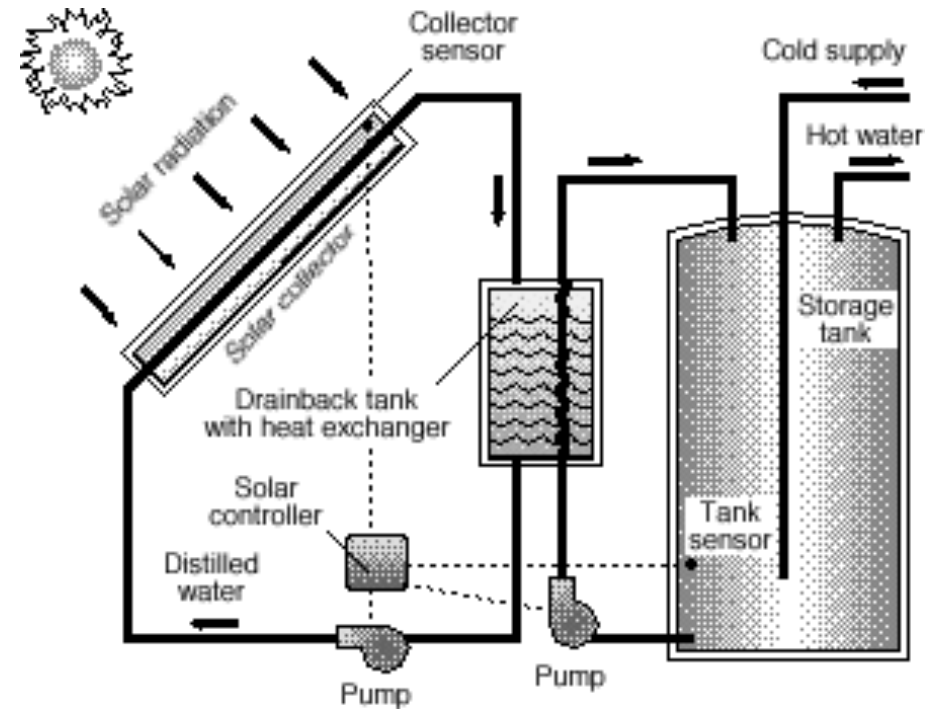
Trying to Send Power to Grid

Outages every 30 minutes cut off my ability to send power back to the grid



Solar Water Heating

- Water heating can account for up to 30% of the electric use in a home.
- Solar Flat Plate water heating is very cost effective in the Dallas area.
- R-25 polybutylene water heater / storage tank provides for long storage.
- We had water coming back from the roof at 175°F during the outages



I did have to hook up a small battery / inverter to the circulation pumps during the outages, but we had plenty of hot water





Recommendations



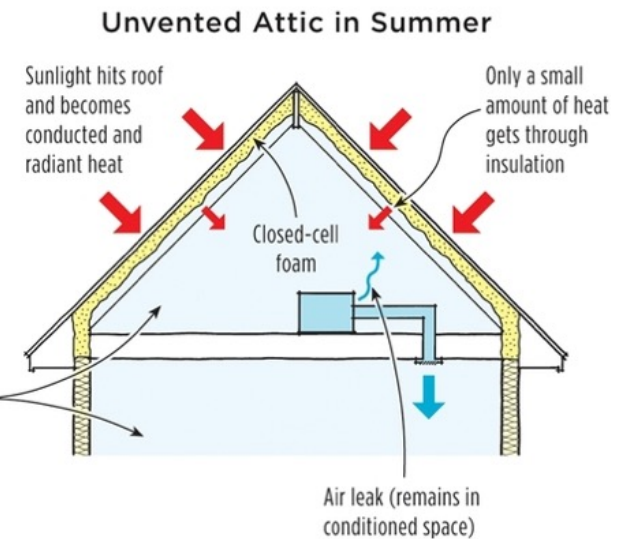
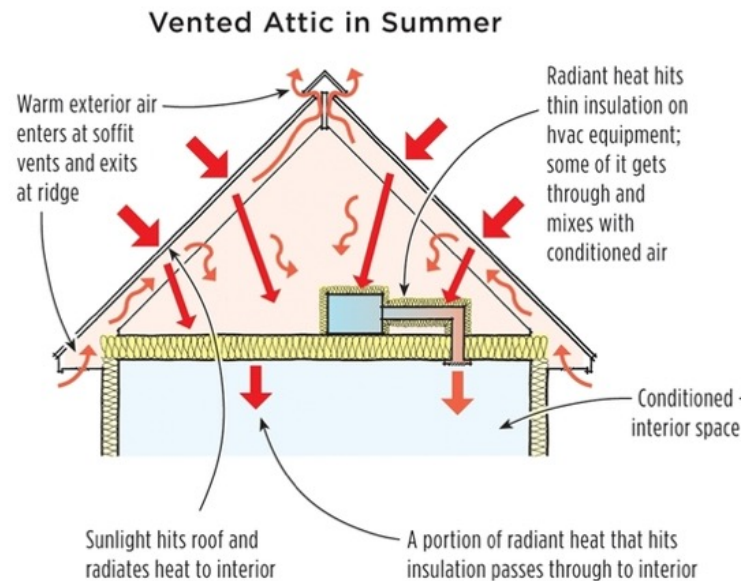
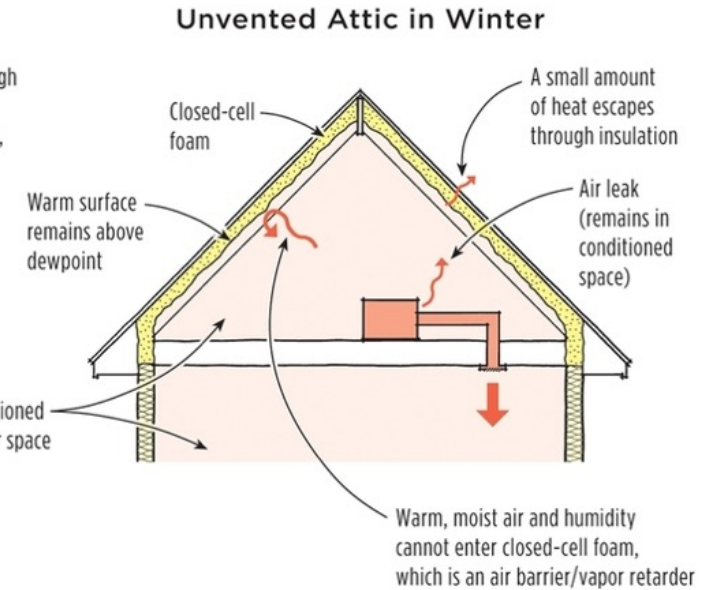
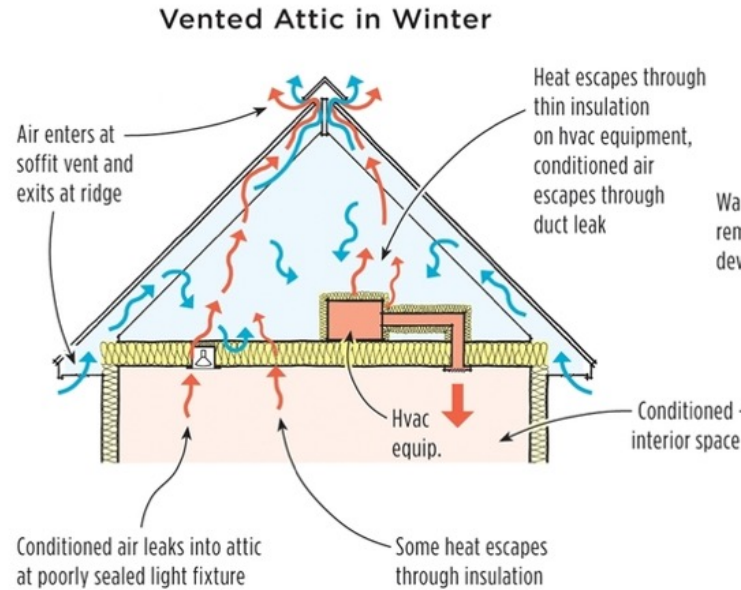
Tips for Existing Homes

- Consider an energy audit to help prioritize your efforts
- The attic is usually a good place to start
 - Adequate insulation
 - Check ductwork for leaking connections and proper insulation
 - Insulate any water pipes in the attic
 - Provide good ventilation – exit AND intakeOR
 - Consider attic encapsulation

Attic Encapsulation

- Spray foam underneath the roofing
- Seal up all vents
- Attic becomes semi-conditioned space

Vented vs. Unvented Attics





Tips for Existing Homes


- Plug leaks in walls – caulk and weatherstrip
- Tune up your systems
 - Change the air conditioner filter
 - Clean the exterior coils
 - Insulate your water heater
- I have some tips here:
<https://enerjazz.com/house/tips.html>
- NTREG has a self audit section here:
https://www.ntreg.org/dnld/DIY_EnergyAudit.pdf

Testimonial

- A couple of years ago my neighbor (certified energy auditor) and I did an audit of a house on our street (40 year old house).



February 16 at 10:40 AM · 

A shoutout to  and owners Roger and [Denise C. Taylor](#). They performed an energy audit of our home (with an assist by [Paul Westbrook](#)) a couple years back. We executed a number of their recommendations, and our house is holding its heat very well through these rolling blackouts. Thanks, guys! 🙏

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11 Comments



What I Could Do Differently

- Add battery storage to ride through short outages & power solar hot water
- If the battery inverter worked with solar inverters, then I could have kept producing energy during the day
 - Several battery inverters do work with solar inverters and even solar microinverters
- Working with Coop to leave houses with PV on during power constraints, since we are often sending power to the grid



What is the Payback on Resilience?

- What is the payback on a granite countertop?
- The two least “sexy” components of our house provided the most value – insulation and air tightness
- Our house efficiency features had a payback of one month (on a cash flow basis) – we paid a little more for our mortgage payment, but even less for our electric bill



Become Resilient

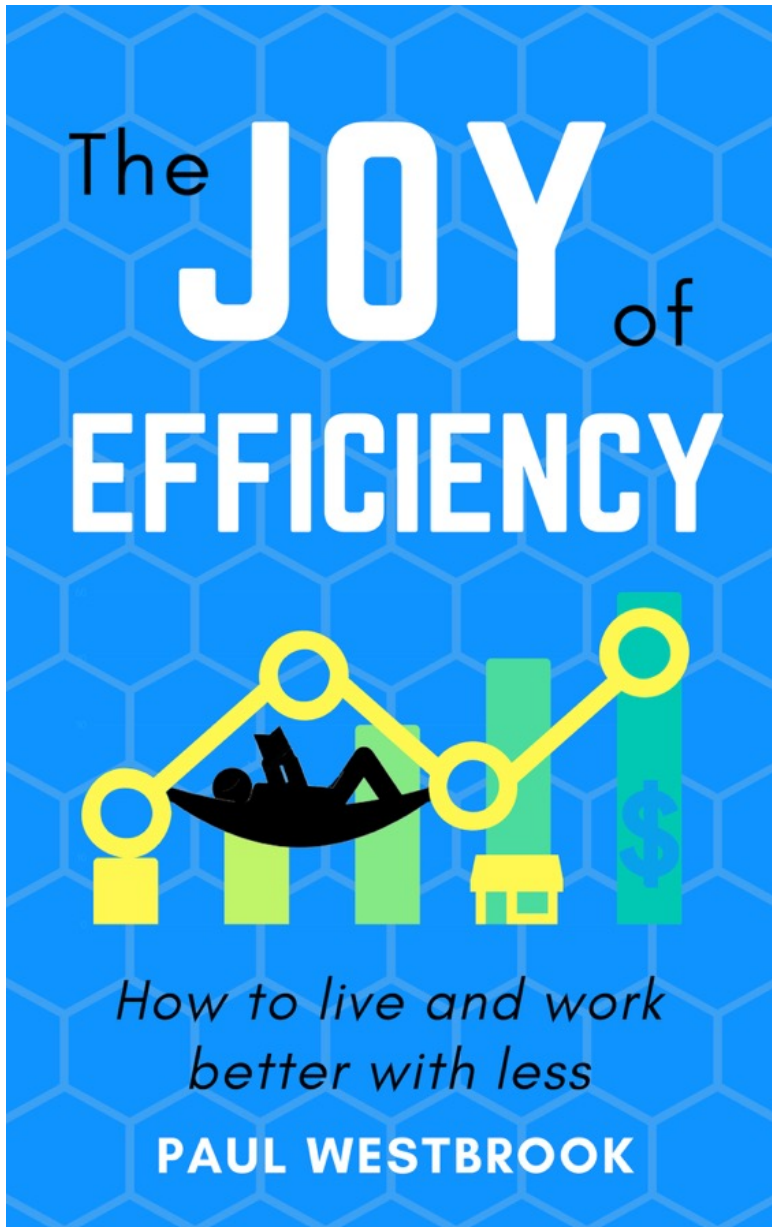
- Whole system, integrative design can provide efficiency, sustainability, and resilience for very little extra cost
- A few key upgrades to your homes can improve your resilience, and save you money year round

Visit my web site for tips and links:

www.enerjazz.com/house

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More Information



- I published a book with general efficiency tips, details on my house, and details on industrial efficiency

joyofefficiency.com

Paul Westbrook

