Net-Zero Carbon Home Project in Maryland: First Year Progress Report

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“And now for something completely different!”

-- Monty Python
Outline

• Rationale & description of the project
• Equipment selections
• First year results
• Electricity flows & carbon
• Rough-cut economics
• Thoughts/Conclusions
Rationale: ‘By-the-way’ carbon neutrality

• New 5,140 s.f. bay-front home in St Michaels, MD is optimized for beauty, comfort, ease of operation, style, resort living – not carbon.

• Carbon/energy program focused on:
  • Better-than-code energy-efficient structure.
  • Best energy equipment available (2018)
  • Automated, familiar controls.

• Lighting is mostly LED, but kitchen & other appliances not energy efficiency leaders.
8-ton HVAC System

• Eight 220’ depth 1” bore geothermal wells drilled in front yard, day and a half.

• Two 4-ton ClimateMaster 48.8 SEER ground-source heat pumps; industry-leading, developed at ORNL, 2x efficiency of most others.

• System provides all heat, AC & hot water.

• House siding of 2’ x 6’ with 2” blown-in insulation and 4” batting.
18 kwh Solar PV System

- Fifty 360-watt SunPower PV panels (Model X22-360).
- Industry-leading, but maybe not for long.
- Roof-mounted flush in trade-off to hide from ground view (suboptimal).
- Local contractor, Sunrise Solar, Chestertown, MD.
40.5 kwh Battery Storage

- Three Tesla 13.5 kwh PowerWall battery packs.
- 40.5 kwh storage, minus various inefficiencies.
- So far, used mostly to back-up electricity supplies (6 brief outages in first year).
- More aggressive deployment planned in 2nd year.
Climate in St. Michaels not representative: harsher than Los Angeles, milder than U.S. averages.
Net negative energy (carbon) in 1st year: -2,033 kwh.

### Billed Usage
- Aug-18*: 446 kwh
- Sep-18: 364 kwh
- Oct-18: 230 kwh
- Nov-18: 756 kwh
- Dec-18: 1,697 kwh
- Jan-19: 1,816 kwh
- Feb-19: 2,011 kwh
- Mar-19: 1,359 kwh
- Apr-19: 1,135 kwh
- May-19: 1,064 kwh
- Jun-19: 700 kwh
- Jul-19: 840 kwh

### Billed Generation
- Aug-18*: (2,131) kwh
- Sep-18: (2,027) kwh
- Oct-18: (1,171) kwh
- Nov-18: (912) kwh
- Dec-18: (389) kwh
- Jan-19: (331) kwh
- Feb-19: (419) kwh
- Mar-19: (755) kwh
- Apr-19: (1,608) kwh
- May-19: (1,405) kwh
- Jun-19: (1,727) kwh
- Jul-19: (1,576) kwh

### Net
- Aug-18*: (1,685) kwh
- Sep-18: (1,663) kwh
- Oct-18: (941) kwh
- Nov-18: (156) kwh
- Dec-18: 1,308 kwh
- Jan-19: 1,485 kwh
- Feb-19: 1,592 kwh
- Mar-19: 604 kwh
- Apr-19: (473) kwh
- May-19: (341) kwh
- Jun-19: (1,027) kwh
- Jul-19: (736) kwh
Payback expected in about 10 years.
Caveats!

• Subsidies received: 30% ITC on geothermal and solar PV investments, plus $4,000 in Maryland grants.

• Economics based on comparison with owner’s previous Bethesda, MD home, similar climate, patterns, size (a gas showcase!)

• First year included final four months of construction.

• Batteries not included: Expected subsidies in 2019 include 30% ITC and $5,000 Maryland tax credit for battery storage – brings battery costs down to slightly more than the cost of an emergency gas-powered generator.

• No performance degradation assumed, etc., etc.!
Going forward, battery strategy can focus on carbon-avoidance, countering duck curve.
Technical choices not (yet) made:

- With vs. without EV charging – 1st year was mostly without, thus more carbon.
- Possible lawnmower: Ryobi 42 in. li-ion battery-powered unit would be charged using the existing NEMA 14-50 outlet installed in the garage.
- Possible boat: biodiesel used in 200 hp Yanmar Turbodiesel outboard motor.
Conclusions, end-notes

• **Zero-net energy (ZNE) is not a dream – even possible on an incidental basis like this project.**

• But still need the grid every night if battery limited to emergency back-up – also on many winter and soggy days; Tesla hasn’t yet written the kind of carbon-avoidance program we need.

• Owner’s livelihood in gas industry spans 40 years (ouch) – here’s what this teaches:
  1. Gas is not a fossil fuel, but it **is** a carbon fuel, and renewable costs are falling fast.
  2. The gas industry must soon face its existential challenge: decarbonization.
  3. Meanwhile, steer demand toward replacing fossil fuels.
References

• Economic data: EIA, PJM, Energy Star, other public websites
• Cost & performance data: equipment manufacturers
• Billing: Choptank Electric Cooperative invoices
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• More on the project at www.BSAenergy.com/wordpress1