A Geothermal Story

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CECC, Genesee/Finger Lakes Region
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Introduction

- BA in Politics & Government, Cum Laude ‘05
- MPA in Public Management & Public Policy ‘17
- Former Assistant City Manager in Canandaigua, NY
- Guided City to both CEC & CSC Certifications
- Love for that work guided me to G/FLRPC
- In my “spare time,” I coach Soccer
  - HAC Boys Varsity
  - Canandaigua Attack Boys

January 31, 2021

There was just one problem… or three

Furnace

Hot Water Tank

Air Conditioner

Exploring Our Options…

- Looked at both Gas & Electric Options
  - Quoted anywhere from $13k-$18k to replace all three units
    - Only interested in High Efficiency Equipment, which impacted cost
  - Had the option for monthly payments
  - Variable Costs to cool home during summer & heat home during winter
    - Running AC = Additional Electric Cost
    - Still Paying NYSEG in Perpetuity

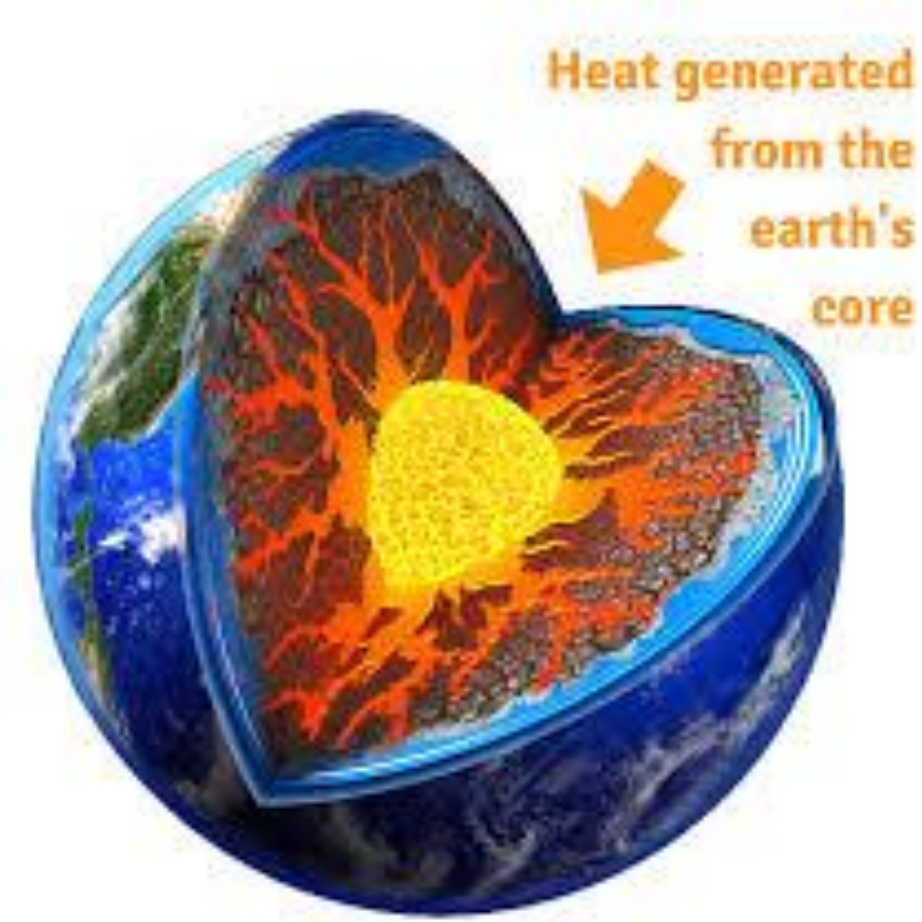
- There must be a better way…

Community Campaigns!

- Spoke w/ Brendan Ryan from CH&C of Monroe County
  - Had a Geothermal System Installed on his home & LOVED it
    - Utilized rebates & incentives to reduce cost of project substantially
    - Had AC in his home for the first time- without the extra costs
    - Even Climate throughout his home
    - Eliminated his gas bill completely- no longer paying NYSEG in perpetuity
      - Monthly payment for his system was comparable to his monthly gas bill
- A decision was made… THE RICHARDSON'S ARE GOING GEOTHERMAL!!!

So, what is Geothermal?

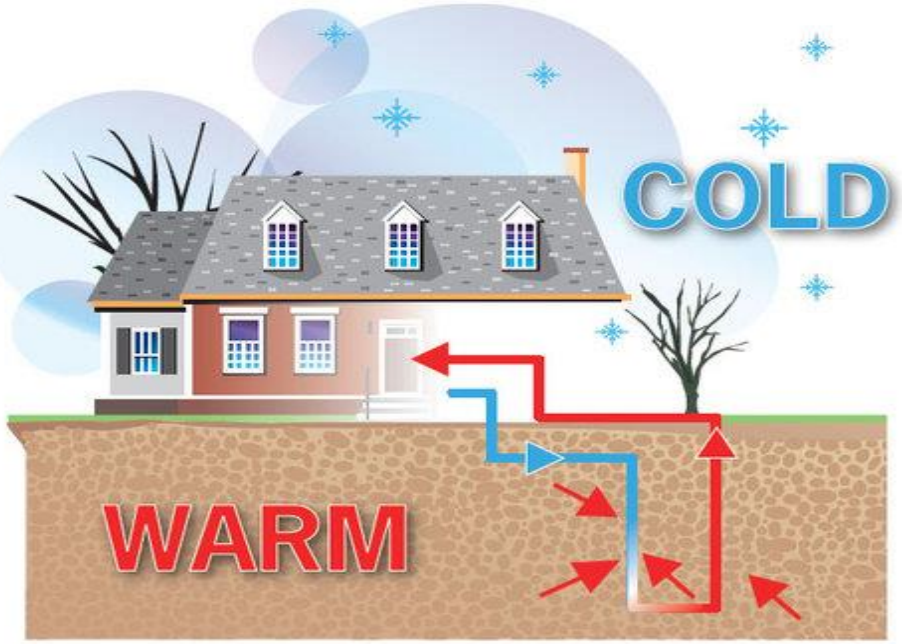
- "Earth Heat" contained in the rock & fluid filling the fractures & pores of the earth's crust
- Deep wells are drilled to access underground reservoirs of steam & hot water
- These are brought to the surface and used for a variety of applications:
  - Electricity Generation
  - Direct Use
  - Heating & Cooling



So, what is Geothermal?

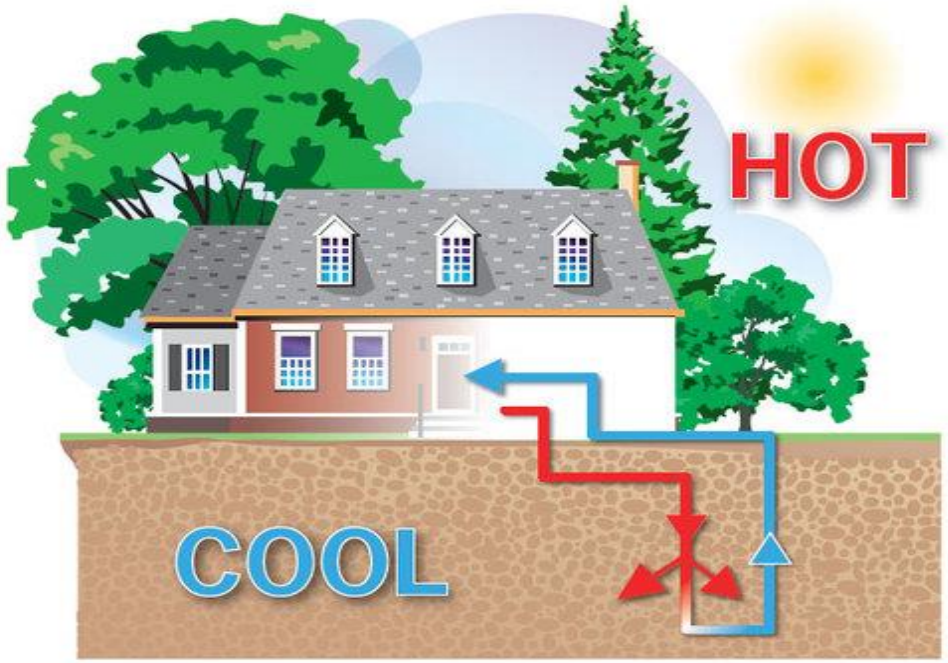
- Harnessing Geothermal Energy for Heating & Cooling requires three system components:
  - Earth Connection Subsystem- connected pipes or "loops" buried in the ground that circulate fluid that absorbs heat from, or relinquishes heat to, the surrounding soil
  - Heat Pump Subsystem- removes the heat from the fluid in the earth connection, concentrates it, and transfers it to the building
  - Heat Distribution System- conventional duct work used to distribute heated or cooled air from the heat pump to the building

How does it work?



Heating

In the winter, water circulating inside a sealed loop system absorbs heat from the earth and carries it to the heat exchanger. Here, the water is compressed to a higher temperature and is sent as warm air to your indoor system for distribution throughout your home.



Cooling

In the summer, the system reverses and expels heat from your home to the cooler earth via the same closed loop system. This heat exchange system is not only a natural process but is a highly efficient way to create a comfortable climate in your home.

Benefits of Going Geothermal

- Dual heating and cooling, steady heating and cooling
- GSHP systems typically sized to provide 100% of the heating and cooling loads for a residential or commercial building
- Relative to air-source heat pumps, they are quieter (no fan units), last longer, need little maintenance, and do not depend on the temperature of the outside air
- No on-site combustion
- No exposed equipment outdoors
- Low operating cost – cost savings through elimination of oil or gas (and associated pricing fluctuations), efficiency of heat transfer, minimal maintenance and long life of equipment)
- Long life expectancy (e.g., central AC 10-15 yrs, conventional furnace 15-20 years, geothermal heat pump 20-25 years, geothermal ground loop 50+ years[1])
- Low-cost integrated water heating
- Filters and puts out air at optimal humidity

Resources:

- www.nyserda.ny.gov/Researchers-and-Policymakers/Geothermal-Heat-Pumps
- DOE Consumer Guide to Geothermal Heat Pumps
- ConEd description of benefits and testimonial video from Hastings on Hudson.
- Video: Geothermal Install Tarrytown, NY
- Energy.gov – Geothermal Heat Pumps
- FAQ from International Ground Source Heat Pump Association
- Example heating and cooling savings from a Cortlandt, NY home, and NY utility incentive information: dandelionenergy.com/geothermal-operating-costs
- EPA Geothermal Heating and Cooling Technologies
- www.energysage.com/clean-heating-cooling/geothermal-heat-pumps/costs-benefits-geothermal-heat-pumps/

1. Dandelion Energy, Geothermal Operation Costs; https://dandelionenergy.com/geothermal-operating-costs
2. energy.gov Consumer Guide to Geothermal Heat Pumps Fact Sheet

April 19, 2021

- Closed on the House
- Called Alternative Carbon Energy Systems (A.C.E.S) a week later
- Initial Walk Through Scheduled for May 6th

A.C.E.S.
GEOTHERMAL & SOLAR

May 6, 2021

- Zack from A.C.E.S. does systems assessment
  - Checked Electric Panel
    - Capacity for subpanel to power system
  - Checked Existing Duct Work
  - Checked Dampers & Wiring
  - Checked Hot Water Tank
  - Checked Size of Existing Furnace
  - Checked Air Conditioning Unit

Worse than we thought

Furnace
Installed 1989

Hot Water Tank
Installed 1989

Air Conditioner
Last Manufactured 1993

Furnace Completely Shot

- Cracks/Chips on the Coils
- Casing Corroding
- “Shiny Tape Solutions”

We had a “Custom Job!”

May 6, 2021

- Assessed Space for Well Drilling
  - Vertical or Horizontal
  - One well or multiple
  - Where to drill & what rig to use
- Explained process moving forward & Timelines
  - Drilling (3-4 Days)
  - Trenching (1 Day)
  - Installation (2-3 Days)
- Determined Vertical Well was best option
- Scheduled Driller Assessment for June 1st
  - Drillers Agreed with Recommendation for Vertical Well

June 1st to August 15th

- Received proposal from A.C.E.S.
- Signed Agreement to Authorize work
- Researched various financing mechanisms
- Scheduled Drillers for August 16th
- Satisfied municipal requirements
  - Building Permit from City of Canandaigua
    - A.C.E.S. took care of everything

August 16, 2021

August 16, 2021

Positioning the Drill

Breaking Ground

August 16 & 17, 2021

- Vertical Well drilled 500 ft. below my driveway
- Piping is lowered down the bore hole to bedrock preventing dirt from collapsing and creating seal
- Grout poured down to solidify space around the casing, prevent ground water contamination & assist with heat transfer
- Inserted High-Density Poly-Ethylene (HDPE) Pipe Loop filled w/ Anti-Freeze & Water

August 18 & 19, 2021

Sediment & Ground Water sucked out into giant bags for burial/disposal. Once complete, the well is capped & secured until trenching process begins.

August 19, 2021

August 23, 2021

August 23, 2021

August 23, 2021

August 23, 2021

August 23, 2021

August 23, 2021

August 23, 2021

August 23, 2021

August 23, 2021

August 23, 2021

August 25, 2021

- Geothermal Unit backordered, but install begins
  - Installed Hybrid Hot Water Heater & Tank
  - Set up all the piping & wiring
  - Prepped subpanel for Geothermal Unit
  - Removed unnecessary gas hookups, piping & wiring
  - Connected my doorbell

- Remainder of Install scheduled for the 9/1

August 25, 2021

August 25, 2021

September 1, 2021

September 1, 2021

September 1, 2021

September 1, 2021

September 1, 2021

Furnace Coils

Geothermal Coils

September 1, 2021

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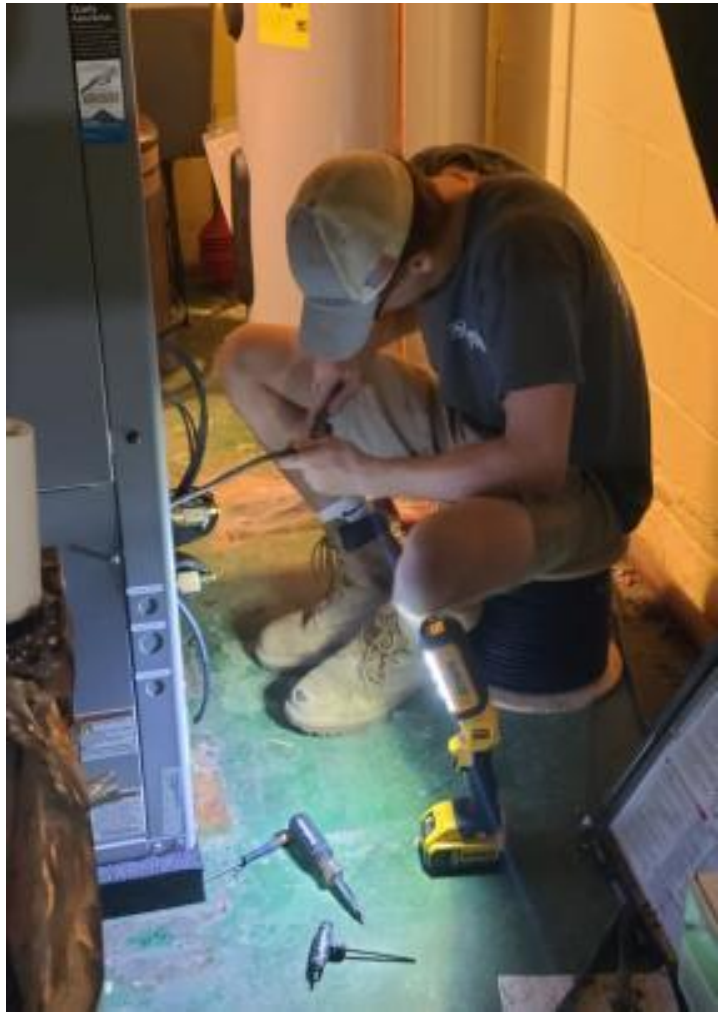


September 1, 2021

September 2, 2021

- Finished Clean up
- Removed exterior AC Unit & sealed holes in foundation
- Explanation of how everything works
- Only there for 2 hours

September 9, 2021

- City of Canandaigua Code Enforcement inspects final project
  - Requirement of building permit
- Officer is there for less than 10 minutes
  - Leaves saying, “That’s f*cking cool!”

She’s a beauty

Disruption

- In my case, minimal, but it's a sliding scale
- Project spanned almost 4 months
  - Biggest delay was the drillers
    - Waited three weeks to have them look at property
    - Waited another 10 weeks before they could start work
- Once started, the project took 18 calendar days
  - August 16th to September 2nd
- Actual work time (actively working on property) was less than 8 days
  - They were done each day by 3:30 p.m.
- Drill rig & equipment stayed on my property for 4 days.
  - Once trenching was completed all work was done internally

Disruption

- Noisy during the drilling & trenching process (to a lesser degree)
  - Took proactive steps to prevent complaints and backlash
    - Alerted my neighbors, so they weren't concerned or complaining
  - Highly recommend this
    - Projects where there is neighbor backlash are problematic on multiple fronts
    - Stories of other projects where social media & harassment from neighbors created issues
    - In one case, caused the property owner to change the scope of the project to finish it sooner
- Only long-term disruption is driveway/front lawn-
  - Minor inconvenience for the overall benefits
  - Potential to add costs for landscaping & driveway repair

Disruption will vary based on project & mitigating factors

Potential Mitigating Factors

- Installer Involvement
  - Select an installer who will make your life simpler
    - Handle Equipment Rebates
    - Deal with Municipal Requirements
- Municipal Requirements
  - Permitting Process varies by community
- Size/needs of project
- Property Space/Size & Layout
  - Impacts equipment & approach they can use (horizontal vs. vertical)
  - Different equipment, space limitations lengthen drilling process & increase costs.

Potential Mitigating Factors

- Geology
  - Can find complicating factors after breaking ground
  - Need More Wells? More Expensive & Time-Consuming Process
- Well Drilling can create a massive bottleneck in the process
  - 3 Companies in the Area = Tough to Schedule
  - Different drillers have varying equipment/capabilities
- Limitations on available equipment
  - Lead time for geothermal units has increased from 3 days to 3-4 weeks in the last few months.
- Neighborhood Reception

So, what did you buy?

- ***Water Furnace 5-Ton, 7 Series 700A11***
  - "The Cadillac"
  - Most efficient heat pump on the market
  - Only unit to surpass both 41.0 EER & 5.3 COP efficiency barriers
    - 30% Higher than current two-stage Geothermal Heat Pumps
  - Industry's first fully launched Variable capacity residential unit
  - Variable Capacity Technology Provide Exceptional Comfort
    - Variable Capacity Compressor
    - Variable Speed Loop Pump
    - Variable Speed Blower Motor
  - Provides Savings up to 70% on heating, cooling & hot water

- ***NP Series Non-Pressurized Flow Center***
  - Provides truly closed loop system w/ Controlled Pressure, Vacuum Relief, System Flushing
  - Flushing valves built into flow center eliminate external flush ports
    - Considerably reduces installation time & additional costs

So, what did you buy?

- ***80 Gallon Voltex Hybrid Electric Heat Pump Water Heater***
  - Most Cost Effective/Energy Efficient Available
  - Self-Contained Heat Pump on top of Tank
  - 4 Settings (Efficiency, Hybrid, Electric, Vacation)
  - Reduce Water Heating Costs 73%
  - 2-3 Year Payback

- ***Symphony Platform & Programmable Thermostat***
  - Connects unit's internal computer to Wi-Fi Router
  - System access & control through cloud-based platform
    - Provides control for entire system- not just temperature
  - Thermostat acts as monitoring system
    - Stores/Tracks Energy Usage & Cost
    - Holds up to 13 months of data

How Much Did it Cost?

Geothermal Pricing Breakdown	
Total Project Cost Before Rebates & Credit	$40,300
NY-Clean Rebate (Installed Equipment)	- $8,455
Cost After Rebates	$31,845
26% Federal Tax Credit	- $8,279
Total Project Cost After Rebates & Credit ***Includes 10 Year Warranty on Equipment** **Represents a 42% cost reduction**	$23,566*

How are you paying for it?

- Variety of options other than paying cash, including multiple financing options
  - NYSERDA's Program offering 3.5% interest rates below a certain income threshold
    - I didn't qualify
  - Loan Programs through Department of Energy (energy.gov)
  - Lenders/ Credit Unions specifically for Clean Energy Projects
    - I financed my project through the Clean Energy Credit Union
    - Piloted the option for ACES & CH&C Program
    - My rate was ok, but higher than it should have been based on my credit score
    - Issues closing on the final paperwork – credit union learning curve

CLEAN ENERGY CREDIT UNION

- $154 a month w/ a 20-year payoff
  - No penalty for early payoff
  - Paying $185 & saving $3,500 in interest

Increase	Monthly payment	Total interest	Interest saving	Payoff date
10%	$169.47	$11,071.44	$2,062.85	Nov 2038
20%	$184.87	$9,584.96	$3,549.33	Sep 2036
30%	$200.28	$8,459.10	$4,675.18	Feb 2035

Estimated Payback- Simple Calculation

- Identify savings
  - Subtract estimated annual cost of system operation from cost of annual gas usage
    - $2,000 (avg. for home my size) - $600 (geothermal heat, cooling, water)
    - Estimated Annual Savings = $1400

System Payback- Simple Calculation

Total System Cost	$23,566
Estimated Annual Savings	/ $1,400
	16.83
Expected Payback	16 Years, 10 Months

Estimated Payback- Sunk/Prospective Costs

- Factors in the cost of replacements w/ natural gas equipment
  - ***NEEDED*** to be replaced regardless of Geothermal Project

System Payback w/ Sunk/Perspective Costs	
Total Project Cost	$23,566
Sunk/Prospective Cost of Standard (NG) Replacements	-$13,000
	$10,566
Estimated Annual Savings	/ $1,400
	7.55
Expected Payback	7 years, 6 Months

The Benefits Provide Context

- Safer. No fossil fuel combustion or carbon monoxide emissions
- Since we have all electric appliances, the system eliminates our gas bill completely
  - Based on the prior usage history, gas bills from September to April were $100-$175
  - Despite not having any gas appliances, we still managed to have a $30 gas bill in August
- My electric in August, because we ran the old AC unit, was $175.
  - Average Electric Bill for us is between $50-70
- Cost of Gas & Increased Electric for AC comparable to Monthly Payment for System
- I’m no longer paying NYSEG in perpetuity

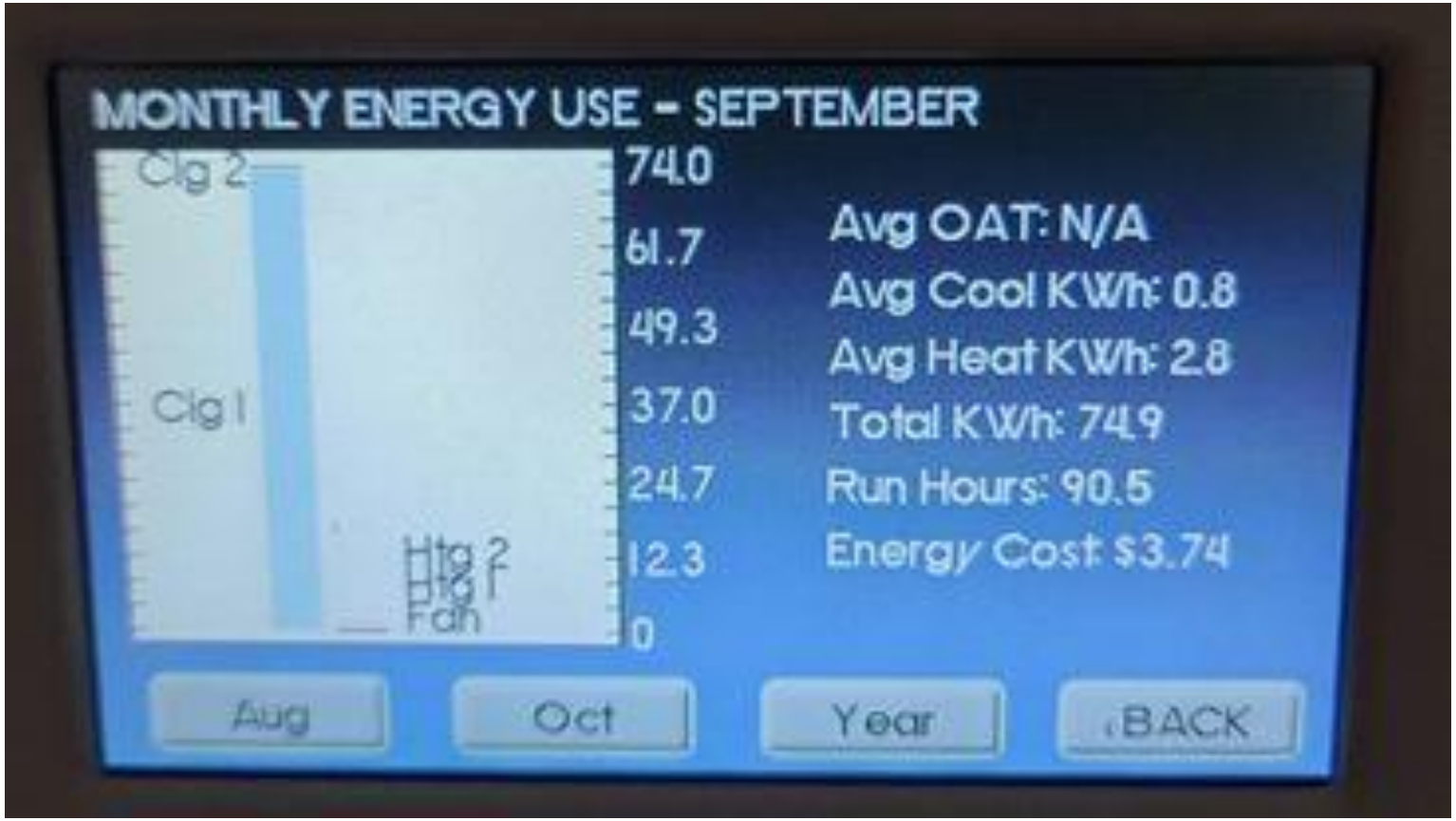
The Benefits Provide Context

- Eliminated the uncertainty & variability of natural gas prices
  - Anticipated to rise substantially this winter
  - Electric is also a variable commodity and can fluctuate, but its price is far more stable and it's not a finite, fossil resource
- Based on heat load calculations I'll be able to heat & cool a 2,000 sq ft home for $600 a year including hot water tank operation.
- With City of Canandaigua running on CCA, moving to geothermal has allowed us to eliminate the carbon footprint of our home completely with the potential to have a negative carbon footprint.

Additional Things to Consider…

- Timing was right for us, but might not be for everyone
  - All 3 components (furnace, AC & Hot Water Tank) beyond useful life & NEEDED replacing
  - Without Credits & Incentives, we wouldn't have done this project
    - Existing ductwork also reduced cost
- Not a project you can do at the drop of a hat, requires some foresight and planning
- Drilling & Trenching are the most expensive part w/the greatest impact on overall cost…
  - Process only needs to be done once
- Changing out the equipment is no different than switching out a standard furnace
  - Equipment costs are comparable & Geothermal Systems tend to have a longer useful life

The Proof



In the 3 weeks since the system went live, it's cost me less than $4 dollars to keep my house at a cool & comfortable 69°.

Thank You For Your Time!

Rob Richardson
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Please feel free to contact me if you have any questions.