GEOTHERMAL ALLIANCE OF ILLINOIS

Net-Zero Ready Home or Business
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“If you’re a carpenter, every problem looks like a nail and every solution is a hammer.”
Getting to Net-Zero

Most of our “civilian” friends think this simply means installing enough wind machines and solar cells to operate a normal home or business.
...and thinking in those terms, most consider this too extreme and dismiss the concept.
Even some of us experts wonder how NZ can be achieved on a windless starry night in February...
For winter heating, a typical Illinois home with a typical 100MBTU/h furnace could substitute:

5 Tesla Power Walls (6.4 kWh model) PER HOUR at $3,000 each.  
https://www.teslamotors.com/powerwall

16 pounds of firewood wood PER HOUR.  
https://chimneysweeponline.com/howood.html

Probably unrealistic alternatives for most of us…
The Land of Lincoln may be the *Home of the Windy City*, but…
Wind Generators may not fill the solar gaps at 29 kW of energy per house per hour.

Maybe the solution isn’t more electricity
According to the folks who collect this information at the EIA...
It’s cold outside!

- Air Conditioning
- Water Heating
- Appliances, electronics, lights
- Space Heating
It takes a lot of heat to survive a Midwestern winter…

In a really big house…

And a lot of electricity to deliver that heat..
## Energy Use Summary

<table>
<thead>
<tr>
<th>STATE</th>
<th>Total MBTUs</th>
<th>Total KWH</th>
<th>Average Square Footage</th>
<th>% of Energy for Heating &amp; Cooling &amp; Hot Water</th>
<th>Total energy for Heating &amp; Cooling &amp; Hot Water</th>
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<tbody>
<tr>
<td>IL</td>
<td><strong>130</strong></td>
<td><strong>10,200</strong></td>
<td><strong>2,186</strong></td>
<td>69%</td>
<td><strong>90</strong></td>
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<td>110</td>
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<td>2,076</td>
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<tr>
<td>WI</td>
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<td>8,700</td>
<td>2,605</td>
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<tr>
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<td>CA</td>
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<tr>
<td>FL</td>
<td>55</td>
<td>14,500</td>
<td>1,668</td>
<td>50%</td>
<td>28</td>
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</table>
ILLINOIS CHALLENGE IS NOT SIMPLY “ENERGY” IT’S **THERMAL ENERGY**

Electricity provides 1/3 of all power needs—and it’s absolutely necessary.
ILLINOIS CHALLENGE IS NOT SIMPLY “ENERGY” IT’S THERMAL ENERGY

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And Illinois has a priceless electrical grid.
ILLINOIS CHALLENGE IS NOT SIMPLY “ENERGY” IT’S **THERMAL ENERGY**

Electricity provides 1/3 of all power needs—and it’s absolutely necessary.

And Illinois has a priceless electrical grid.

2/3 of Illinois home power is thermal energy—*and nearly all of it is heat*...
<table>
<thead>
<tr>
<th></th>
<th>Renewable</th>
<th>Global Warming Potential</th>
<th>Collateral Environmental Impact</th>
<th>Lifecycle Cost</th>
<th>Initial Cost</th>
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<tbody>
<tr>
<td>Burn fossil fuels</td>
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<td>☀ ☀</td>
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<tr>
<td>Natural Gas, Propane, Oil, and Coal</td>
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<tr>
<td>Burn Renewables</td>
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<td>☀ ☀</td>
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<tr>
<td>Wood, Pellets, or biomass Methane</td>
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<tr>
<td>Geothermal Heat Pumps</td>
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<td>☀ ☀ ☀ ☀ ☀</td>
<td>☀ ☀ ☀ ☀ ☀</td>
<td>☠ ☠ ☠ ☠ ☠</td>
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<tr>
<td>Use the stored heat in the ground</td>
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</table>

The table compares the environmental impact and cost efficiency of using renewable and fossil fuels for thermal demands. Geothermal heat pumps are shown to have the lowest environmental impact and highest lifecycle cost and initial cost, while burning fossil fuels have the highest environmental impact but the lowest lifecycle cost and initial cost.
Ummm... it's right here.
Using a series of underground pipes, it exchanges heat with the earth instead of outdoor air. While air temperatures can vary greatly from day to night or winter to summer, the temperature just a few feet below the earth’s surface stays an average 55-70° F year-round.
But, gee whiz Mr. Wizard, Geothermal Heat Pumps don’t make electricity, they use electricity
That’s right Timmy. They use a small amount of electricity to pump a large amount of heat.
GEOTHERMAL IS RENEWABLE

1 unit of electricity
4 units of “free” energy from the earth
5 units of heating or cooling delivered into home
GEOTHERMAL IS RENEWABLE

The “Best House in America”

Connecticut
3,442 sq ft
Well built
17.7 KW of Solar
Way beyond Net-Zero

Award-winning net-zero energy home heats and cools with geothermal system
GEOTHERMAL IS RENEWABLE

The “Best House in America”

Connecticut
3,442 sq ft
Well built
17.7 KW of Solar
Way beyond Net-Zero

Final HERS rating for this home

Award-winning net-zero energy home heats and cools with geothermal system
Illinois Home Thermal Energy Demand

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<tr>
<th>BTU/Yr</th>
<th>KWH/BTU</th>
<th>KWH/Yr</th>
<th>MWH/Yr</th>
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<tr>
<td>90,200,000</td>
<td>0.000293</td>
<td>26,435</td>
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</table>

Ground Source Heat Pump Coefficient of Performance (COP)

<table>
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<tr>
<th>COP</th>
<th>Renewable Energy Credits Generated (COP-1) X MWH</th>
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<tbody>
<tr>
<td>5</td>
<td>21</td>
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</table>
QUICK TECHNOLOGY TANGENT...

VS

Geothermal Heating in Winter
A geothermal heat pump transfers heat from the ground into the house.

Source: The Smart Guide to Geothermal
Illustration by Will Suckow
### NOT ALL HEAT PUMPS ARE CREATED EQUAL

<table>
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<th>ASHP</th>
<th>GSHP</th>
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<tr>
<td>• 10 – 14 EER</td>
<td>• 14 – 53 EER</td>
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<tr>
<td>• Heating COP declines with as ambient falls</td>
<td>• Constant COP at all ambient temperatures</td>
</tr>
<tr>
<td>• Cooling EER declines as ambient rises</td>
<td>• Constant EER at all ambient temperatures</td>
</tr>
<tr>
<td>• Capacity declines as ambient falls or rises</td>
<td>• Capacity unaffected by ambient temperature</td>
</tr>
<tr>
<td>• 10 – 12 Year Lifecycle</td>
<td>• 20 – 40 Year Lifecycle</td>
</tr>
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</table>
NOT ALL HEAT PUMPS ARE CREATED EQUAL

**ASHP**
- There’s less of it when you need it most

**GSHP**
- Unaffected by the weather
“In God we trust. All others must bring data.”

Net-Zero stakeholders need verification. Without data, it’s just an opinion.
WHAT IF YOUR HEATING SYSTEM...

Measured and recorded all of its energy usage by component?

Reported all indoor and outdoor conditions to your phone?

Could be completely monitored and diagnosed from anywhere in the world?
WHAT IF YOUR HEATING SYSTEM…

Two years ago this went from “What if” to Reality
SYMPHONY WEB-ENABLED HOME COMFORT PLATFORM
SYMPHONY

Aurora WebLink
The Aurora WebLink router communicates directly with your Aurora control board, rather than simply connecting to the thermostat. This provides you and your dealer with access to unit sensors, energy use and system information rather than the limited information a typical thermostat sees.

Symphony Thermostats
An internet-enabled thermostat allows homeowners to change temperatures, set a schedule, monitor vacation mode, and more via smartphone or tablet. Connect to the personalized dashboard for remote functionality—all from the comfort of your sofa.

Invisible Thermostat Capability
The concept of a dedicated thermostat is becoming outdated. If you'd rather not have a thermostat cluttering your walls, install an invisible flushmount temperature sensor (plugged above) and use a Symphony-based smartphone or tablet to control your home comfort levels instead.

Water/Sump Alarm
Symphony can also be expanded to prevent water damage from household equipment failure. External water sensors provide you email/alert notification in the event of a sump pump malfunction or washer hose failure.

Optional Feature

Advanced Zoning System
Remotely control temperatures and programs in up to six areas of your home with our Intellicore2 zoning system. WaterFurnace is the only geothermal manufacturer to offer this zoning solution, and now we're the only ones with online control.

Optional Feature

Symphony Dashboard
The personalized dashboard provides quick access to your system's settings, operational status and history, alert history, energy usage, and zone temperatures as well as local weather. Accessible from anywhere.

WaterFurnace
Smarter from the Ground Up™
Heat Pump Troubleshooting

**Status**
Mode: Heat Stage 1
Fault:

**Thermostat and Outputs**
- Y1: On - Fan Spd: 5
- Y2: Off - Comp Spd: 2
- O: Off - Pump: On
- G: On - Pump PWM: 78%
- W: Off - AUX: Off

**Electrical**
- Fan A: 0.3 A - Fan W: 40 W
- Comp1 A: 0.0 A - Comp W: 518 W
- Comp2 A: 0.0 A - Aux W: 0 W
- Aux A: 0.0 A - Pump W: 472 W

**Temperature and Pressure**
- Disch T: 123.3 °F
- Disch P: 256.0 psig
- Sat T: 85.5 °F
- Suct T: 47.5 °F
- Suct P: 110.1
- SH: 11.7 °F
- SC: -1.6 °F
- Comp T: 75.0 °F
## SYMPHONY – DATA HISTORY

### Water and Air
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<th>Fault Code</th>
<th>Mode</th>
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<th>LWT</th>
<th>Flow</th>
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<th>LAT</th>
<th>HEMR</th>
<th>Suct Prass</th>
<th>Sat Evap</th>
<th>SH</th>
<th>Disch Prass</th>
<th>Hg</th>
<th>Clg</th>
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### Control Inputs

- DH: Room Temp
- Y1, Y2: Active Setpoint
- Y3: Dehumid Temp
- Y4: Humid Temp
- Y5: Dehumid Setpoint
- Y6: Humid Setpoint
- Y7: Dehumid %
- Y8: Humid %
- Y9: Heating Temp
- Y10: Heating Setpoint

### Control Outputs

- HW: Temp
- HW: Setpoint
- FP: Temp
- FP: Setpoint
- CC: Temp
- CC: Setpoint
- CE: Temp
- CE: Setpoint

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*Water Furnace*

Smarter from the Ground Up™
If you have any questions about what I’ve covered today or to discuss anything

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