Contract Final Report

Verification of Geothermal Energy Savings

Prepared for: APPA Deed Scholarship/Deed Administration

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Wyandotte Municipal Services
3200 Biddle Avenue
Suite 200
Wyandotte, MI 48192-0658
Telephone: (734) 324-7113
Project Title:
Verification of Geothermal Energy Savings

General Overview:
This project has been very useful in realizing the benefits of geothermal energy. The results of this project can be used in all areas of the world with similar climates to see the benefits of geothermal heating and cooling systems. We did not run into many problems during this project. Collecting the data was the most difficult as far as figuring out the best most efficient way to do it. We settled on taking the energy audits done on the homes instead of taking a current reading for x amount of time. This allowed us to obtain a longer range of data to verify the savings these geothermal units can provide. This data seemed to satisfy our goals. We showed that the geothermal energy is the way to go and can save the customer money as well as our utility. No new technology was tested during this project, but newer efficient geothermal units were used in all the homes.

Purpose:
The purpose of this project is to evaluate the performance of the geothermal ground source heat pump systems and compare them to the conventional heating and cooling systems that contain a separate furnace and air conditioning unit. We will then take the performance of these modules to see where efficiency can be increased to reduce the peak value, improve our utility load factor, and possibly gain more geothermal customers. This in turn will lower operation costs for our utility and consumer costs as well.

Utility Name and Address:
Wyandotte Municipal Services
3200 Biddle Avenue
Suite 200
Wyandotte, MI 48192-0658
Telephone: (734) 324-7113

Utility Description:
Wyandotte Municipal Services delivers the city of Wyandotte, MI with Electricity, Steam, Water, and Cable/Internet/Phone services.
**Key Personnel & Phone Numbers:**

Pam Tierney, Energy Services Program Manager

Jim Arnosky, Energy Advisor

Rod Lesko, General Manager

Joe Mazzola and Sean Bafile, L&M Royal Heating & Cooling

**Description:**

For this project, our main goal was to evaluate the savings that geothermal ground source heat pumps can create. To find the savings of these systems, I evaluated them on a few levels. The data I have collected includes gas usage, electrical usage, size of home, occupants, efficiency of equipment, cost of equipment, and location. These numbers will be analyzed and compared between the conventional homes and geo homes. This comparison will tell us where we can save the most for the customer as well as the benefits for our utility.
Annual Cost to Heat and Cool vs. Size of Home

Size of home (Sq FT)

- 700
- 890
- 950
- 1,000
- 1,000
- 1,100
- 1,100
- 1,200
- 1,250
- 1,400
- 1,500
- 1,500
- 1,600
- 1,650
- 1,700
- 1,800
- 1,800
- 2,200
- 2,200
- 2,300

Annual Cost to Heat and Cool

- $0.00
- $1,000.00
- $2,000.00
- $3,000.00
- $4,000.00
- $5,000.00

Diagrams:
<table>
<thead>
<tr>
<th>Type of Energy</th>
<th>BTU/unit</th>
<th>Adj Effic</th>
<th>$/unit</th>
<th>$/MMBtu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Oil, gallon</td>
<td>138,200</td>
<td>80%</td>
<td>$3.62</td>
<td>$32.70</td>
</tr>
<tr>
<td>Kerosene, gallon</td>
<td>136,600</td>
<td>80%</td>
<td>$3.98</td>
<td>$36.43</td>
</tr>
<tr>
<td>Propane, gallon</td>
<td>91,600</td>
<td>80%</td>
<td>$3.39</td>
<td>$46.29</td>
</tr>
<tr>
<td>Natural Gas, therm</td>
<td>100,000</td>
<td>80%</td>
<td>$1.55</td>
<td>$19.40</td>
</tr>
<tr>
<td>Electricity, kwh</td>
<td>3,412</td>
<td>100%</td>
<td>$0.15</td>
<td>$43.46</td>
</tr>
<tr>
<td>Geothermal, kwh</td>
<td>3,412</td>
<td>400%</td>
<td>$0.15</td>
<td>$10.87</td>
</tr>
<tr>
<td>Wood, cord (green)</td>
<td>22,000,000</td>
<td>60%</td>
<td>$180.00</td>
<td>$13.64</td>
</tr>
<tr>
<td>Pellets, ton</td>
<td>16,400,000</td>
<td>80%</td>
<td>$247.00</td>
<td>$18.83</td>
</tr>
</tbody>
</table>

Note: MMBtu equals 1 Million Btus
Dates:

The projects term was from June 2013 until the end of August 2013. The project due date was extended until the end of September 2013 due to events unrelated to the project.

Alternatives:

**Solar** - This uses solar panels to store energy in a battery bank for use at a later time. The costs would include the cost of install and all the parts which include solar panels, wiring, and the battery bank. This would be more costly than a geothermal heat pump system and thus the payoff would be longer. The same testing could be done with solar heating and cooling and could even be used in conjunction with a geo system but would most likely be very costly and not benefit the utility.

**Gas (propane or Natural)** - We compared our geothermal systems to natural gas. We could do the same comparisons for propane and obtain results based on same factors. Results would be even worse than natural gas since propane is more expensive based on the chart provided in the diagram section.

Results to Date:

After collecting all of the data listed in the diagrams and calculating averages and break even points, we have come up with some totals and results of the geothermal systems. Our results were interesting to say the least. The geothermal systems in Wyandotte, Michigan, save the average customer a total of \$580 USD per year! Not only do the geothermal systems save the customer money, it also saves our utility \$580 dollars per year as well! This means it is a win-win situation for both the customer and the utility. The geothermal systems can do other things besides save money. Having geothermal systems on the grid instead of power hungry A/C units in the summer helps to lower the peak value, and provide an improved load factor, which means a more efficient power plant. In the winter when many homes turn to natural gas to heat their homes, they would be using more electricity provided by WMS, to run their geothermal units. There is a high startup cost but after a short 22 years, the WMS installed geothermal systems will be paid off and the savings to the current customer and future owners of the home will begin to build up! Even WMS will start to make more money only 24 years after the install of these geothermal units.

Status:

The status of the project was completed when the DEED scholarship was concluded.
Applicability:

Others can use the results of this project to see if geothermal heating and cooling is the right choice for their utility. Some examples of utilities that could benefit are utilities that:

- Are experiencing a poor load factor
- Have a high peak value
- Don’t supply gas as part of their services
- Are located in a very hot climate

From the results, we can see that in an area that has all four seasons, the geothermal units can provide a cheaper, efficient way to heat and cool homes. Also pay attention to the few outliers we had from the geothermal results. It can be seen that if the users are not trained properly on how to use their geothermal systems, they may obtain poor performance, resulting in a higher utility bill. So the importance of training all new users on how to use this method of heating and cooling is a must. All sizes of public power systems should see benefit from switching to geothermal systems. A couple variables that our project did not consider were:

- Commercial Application
  - Although Wyandotte does have a few commercial buildings with geothermal units, there was not enough data to make any sort of conclusion.
- Our project only covers a Midwest climate (four seasons), somewhere with a drastically different climate may find better or worse results.
- Efficiency of heating/cooling units was considered in our tests which were found to be an average of 80%. Different areas may have a higher or lower average based on age of neighborhoods.
- Age and size of homes was attempted to be accounted for but may differ in different areas due to size and age of homes.

Our results can still be used to estimate savings for other utilities, but when estimating and utilizing our project research for any of the considerations above, the results may be different.

Future Plans:

There will be future research into this topic by our utility. We will continue to monitor the efficiency of these homes and compare them to the costs and usage of the conventional homes. We will determine when the geo homes draw the highest load and the lowest to optimize our electrical production so we can run at the highest efficiency possible. And we will continue to evaluate the geothermal homes by collecting the same data and verify that the savings continue.
**Equipment:**

There was not specific equipment used on this project. We used standard meters on the homes to measure the electrical usage. The gas usage was obtained by audits done on the homes.

**Budget:**

**Funding:** Deed Grant and WMS personnel costs as in kind funding

**Cost:** DEED, $4000; WMS approx. 96 hours averaged rate at $58/hr, $3654

**Bibliography:**


https://www2.dteenergy.com/wps/wcm/connect/14781d50-58e5-4f0f-b361-c7f2d24b1caa/2012RateCards.pdf?MOD=AJPERES&CACHEID=14781d50-58e5-4f0f-b361-c7f2d24b1caa