JULY 2015 North Carolina's Geothermal Industry

Uncovering Impact and Opportunities



NORTH CAROLINA'S GEOTHERMAL INDUSTRY

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The NC Sustainable Energy Association (NCSEA) is a 501(c)(3) nonprofit membership organization of individuals, businesses, government, utility providers and nonprofits interested in North Carolina's sustainable energy future. NCSEA drives public policy and market development to create energy jobs, economic opportunities and affordable energy to benefit North Carolina.



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INTRODUCTION

While North Carolina is not well-suited to generate electricity from geothermal power, it is still able to use it as energy efficiency. **Ground source heat pumps (GSHPs)** are energy efficient clean energy technologies which transfer heat to or from the ground for heating and cooling purposes.² This paper examines the advantages, hurdles and measurable impacts associated with North Carolina's emerging GSHP market.

"Energy efficiency is the low cost, least risk resource and [geothermal heat pumps] GHPs are the most energy efficient technology for satisfying the thermal loads of homes and buildings."

- Robert "Tate" Rust Waterfurnace International, Inc.

How GSHPs Work

Many of us have experienced feeling the cool air after stepping into a basement on a hot summer day or, alternately, the warm air during the cold winter. A few feet below the earth's surface, the ground remains at a relatively constant temperature ranging from 45°F (7°C) to 75°F (21°C) and areas, such as the basement, are not subject to the highs and lows of the seasons.² GSHPs utilize this constant ground temperature to transfer heat into the indoor air delivery system during the winter and, in the summer, to remove heat from indoors back to the ground. The heat removed from the indoor air during the summer can also be used to heat water, providing a free source of hot water.



Figure 1. Ground Source Heat Pump Technology



OVERVIEW OF GSHPS IN NORTH CAROLINA

A Compatible Landscape

North Carolina's soil is well suited for GSHPs. Its hydraulic conductivity, one of the hydraulic properties of soil, allows for the soil to retain fluid (usually water) and move it through the soil matrix with ease.³ These properties make the soil more efficient and effective for the conductivity properties – such as pore size, particle size, distributions, and soil texture – needed for geothermal, such as on the coast where saturated sand has conductivity for heat transfer wells.

An Efficient Alternative

This cyclic method of exchanging heat to and from the earth's surface allows GSHPs to be over 45% more energy efficient than conventional heating and cooling options.⁴ While GSHPs do not generate power, they save electricity through highly efficient operations. Traditionally, energy efficiency is least cost, low risk, and provides consumers with instant savings and return on investment.

North Carolina's growing renewable energy and energy efficiency sectors are driven by many factors, including rising electricity prices. Many customers are responding to their utility bills by adopting new technologies that more efficiently and, over time, more affordably meet their energy needs. This observation is noted in a 2013 report, *Motivations and Behaviors of Solar PV and Geothermal System Owners in North Carolina*, in which survey participants cited the cost of utility bills as overwhelmingly significant in their decision to install a GSHP.⁵

Across the state, customers are taking steps to optimize the performance of their heating and cooling systems by installing GSHPs that enhance the comfort of their home or building and save energy and money on utility bills. According to the same report, GSHPs are often one option in a suite of alternative resources customers adopt to improve the comfort in their homes and businesses. Many customers adopted other technologies to achieve energy efficiency at the same time they decided to install GSHPs. This could be because GSHPs, Energy Star appliances, duct and air sealing, attic and slab-edge insulation, programmable thermostats, high efficiency lighting, and low emissivity window treatments all relate to reducing utility bills, the number one motivator of GSHP adopters.⁵

What We Can Know: The Data Gap

The type of GSHP system a customer will choose depends on the climate, soil conditions, available land, and installation costs. Each of these unique systems require permits at the state and local level, and there is no overlap in permitting that captures installations for all GSHP types. As a result, there is not a "one-stop shop" for obtaining data about GSHP installations in North Carolina. Without data, there's a gap in what we know about installations in the state and we're left with an

incomplete understanding of the industry's true impact in North Carolina.



The Permitting Process

The permitting process plays an important role in understanding the number of GSHPs that have been installed. Since permits capture when and where a system was installed, this information can be used to provide a glimpse into certain system installations.

North Carolina has a state permitting process through the North Carolina Department of Environment and Natural Resources (NC DENR) for the following kinds of GSHP systems: Open Loop Heat Pump, Vertical Closed Loop Heat Pump, and Heat Pump "Pump and Dump" systems. NC DENR requires these types of GSHP installations to acquire state level permits and construction notices.⁶

In addition to state permits, the county or municipality may require GSHP systems to have additional permitting or construction notices before installation.⁷ As seen in Figure 2, at least 2,015 systems have obtained state level permitting from NC DENR since 1978.⁸ The locations of these systems are spread across North Carolina's geographic and economic regions. Today, the top 5 Counties who have obtained the majority of permits issued by NC DENR are Buncombe, Orange, Durham, Wake and Onslow (see highlighted below, west to east).

Figure 2. GSHPs that Obtained Permitting from NC DENR from 1978-2015



Independent Industry Research

The NC DENR data, while not inclusive of all GSHP installations statewide, provides a telling glimpse into the true impact of an industry that is creating jobs and energy efficient infrastructure for North Carolinians today. In addition to this data, further information is available that may help with closing the information gap about GSHPs in North Carolina.

Since 2008, NCSEA has surveyed companies, institutions, and organizations in the clean energy industry to quantify their growing impact on the state's economy. Employment in the clean energy industry has increased 25% since 2012, far outpacing the growth of other industries. Based on NCSEA's *2014 North*

Carolina Clean Energy Census, the geothermal sector in North Carolina represents 12% of all clean energy business units. These businesses generated \$143 million in revenue, accounting for 3% of the state's clean energy income.⁹

Figure 3. NC Geothermal [GSHP] Industry Impacts



The Air-Conditioning, Heating, and Refrigeration Institute (AHRI), an organization with over 300 member companies that produce more than 90% of the residential and commercial air conditioning, heating, water heating, and commercial refrigeration equipment made in North America, is also able to get a picture of the market activity by tracking units across the U.S.¹⁰

According to AHRI, since the NC Renewable Energy Investment Tax Credit was extended to include GSHPs in 2009, over 10,500 units have been shipped to North Carolina. While this too is not a full representation of what is installed, it does indicate that more GSHP systems are entering our state.

NCSEA'S GEOTHERMAL BUSINESS SURVEY

As the preceding findings support, customers see the value in using these efficient alternatives to meet heating and cooling demands. But before the GSHP market can be fully deployed for widespread adoption in our state, key opportunities and barriers to the industry need to be identified and addressed.

To better understand the geothermal industry and the market, policy, and technology trends that affect adoption in North Carolina, the NC Sustainable Energy Association (NCSEA) reviewed the current state of the industry in North Carolina by inviting stakeholders and experts in the industry to participate in its first *Geothermal Business Survey*.



This resulting report describes GSHPs' important role in the clean energy market, what we know of the state of the technology in North Carolina, and how policies and regulations can impact whether the market will continue to drive forward.

Survey Methodology

The *Geothermal Business Survey* was distributed to 108 individuals who were identified as stakeholders in the geothermal and GSHP industry through the aforementioned *2014 Clean Energy Industry Census*. The survey was not distributed to all *2014 Clean Energy Industry Census* participants because they either did not fit within the intended audience of the survey or individuals did not have updated contact information needed for distribution.

The survey was developed and distributed through SurveyMonkey, an online survey software tool, and had a 48% response rate with 52 total participants.¹¹ Of the 52 participants, 43 submitted complete surveys. Among the completed surveys, 39 of the participants were located in North Carolina and 4 identified their contact locations as out-of-state, but confirmed that they conduct business in North Carolina.¹² See Appendix B for the full results of the *Geothermal Business Survey*.

Key Findings

As we have learned, there is a data gap about the geothermal industry in North Carolina – in particular, its installed GSHP presence. The *Geothermal Business Survey* (see full results, Appendix B) offered a new window of insight into this dynamic business sector, which generated at least \$143 million in revenues in 2014. Below are noteworthy themes observed in the survey results:

Diverse Business Activities

The geothermal industry encompasses many business activities, including: manufacturers, designers, and installers of GSHPs; sub-contractors and/or loop installers; and well-drillers. Specifically, the top three business activities were: installer and developer, sub-contractor and/or loop installer, and designer of GSHPs (33%, 21%, and 17% respectively).

Residential, Commercial Customers Driving Market

Residential and commercial were the primary customer bases of survey participants (44% and 35% respectively). Military and Other were the smallest customer bases of survey participants (6% and 5% respectively).

Limited Local Personnel, Workforce Communication

The top two local hurdles for businesses were identified as: (1) knowledge base of personnel and (2) communication between contractors, sub-contractors, local inspectors, and/or regulators.

Looming Expiration of State, Federal Tax Credits a Concern

The top two state and federal hurdles for businesses were identified as: (1) [expiration of] the North Carolina Renewable Energy Investment Tax Credit (REITC) and (2) the [expiration of] the Federal Business Energy Investment Tax Credit.

INSIGHTS

Impacts of Clean Energy Policies and Regulations

In 2014, uncertainty about the Federal Production Tax Credit (PTC) and Investment Tax Credit (ITC) created an unbalanced market for developers installing geothermal power projects in the western U.S. As a result, the U.S. market for geothermal electricity did not expand or grow in 2014.¹³ The industry was left with a large enough unknown that many companies chose to restructure in order to better position themselves in the industry. Similar to the PTC and ITC debate, understanding North Carolina's suite of clean energy policies and regulations is the first step in identifying their impact – and preventing policies and regulations from hindering North Carolina's geothermal industry. In North Carolina, there is still a need for a level playing field that enables cost competitiveness with the electric utilities to meet energy efficiency demands. When given the opportunity to describe hurdles, Geothermal Business Survey participants indicated they do not anticipate the costs of systems to decrease. Participants also stated that if the North Carolina Renewable Energy Investment Tax Credit (NC REITC) expires, they foresee a drop in business and employment. In North Carolina's highlyregulated electric market, a select few traditional utilities hold monopoly control over the majority of the state, making it difficult for clean energy technologies like GSHPs to enter and compete on price and value. Even though the installation price of GSHPs can be several times that of conventional heating and cooling systems, customers see costs returned in energy savings in less than 5 to 10 years.² By lowering the high upfront cost of GSHP systems, the NC REITC helps to open the market for GSHPs and allow customers to see rolling cost savings on their utility bill through energy efficiency sooner.¹⁴ If accessible and appropriately put into place, clean energy policies can allow a clean energy market to flourish and compete on price and quality of traditional energy resources in North Carolina. Continuing the NC REITC will signal to the clean energy industry that North Carolina remains in a strong position to attract jobs, investments, and lasting energy infrastructure to communities in all regions of our State.

Cost Considerations

Without debate, the tax credit has been a key component to the geothermal industry and the majority of GSHP system owners agree it's an important source of financing. In fact, the *Motivations and Behaviors of Solar PV and Geothermal System Owners in North Carolina* report found that state tax credits were regarded as either "very "or "somewhat" important by 92.7% of geothermal system owners. As noted previously, once customers could take advantage of the NC REITC in 2009 the rate of deployment for certain GSHP systems increased.¹⁵

The cost of GSHPs can only start to decrease if more systems are installed annually in North Carolina. As we know, North Carolina has a highly-regulated, monopoly electricity market, where alternative technologies like GSHPs have a limited opportunity to compete and become economically viable. Independent of incentives, one way to open the market for GSHPs is to identify and reduce soft costs such as permitting, inspection and labor. Soft costs can be reduced by understanding what percentage of permitting and training personnel is cost and, if determined to be a significant portion, implement strategies to reduce them. Stakeholders in the geothermal industry, as well as local and state governments, will need to play a significant role in identifying costs and the role they play in the

permitting and installation process. With the engagement of stakeholders, NCSEA may be able to identify soft costs and how best to address and reduce them.

Closing the Gap

As mentioned previously, at least 2,015 vertical closed loop GSHP systems have been installed as of June 2015. According to the survey, only 28% of participants utilized this particular type of system in their business, leaving a gap in tracking how many GSHPs have actually been installed in North Carolina. With the assistance of identified key players, NCSEA may be able to uncover the true scale of the industry and provide industry stakeholders, decision makers, and organizations with a better understanding and appreciation for the geothermal industry's real impact on our state.

CONCLUSION

It's apparent that geothermal is among the growing clean energy industries that are laying the groundwork for an affordable, long-term energy future in our state by providing customers with a stable and highly efficient option that can reduce utility bills over time. Geothermal technology is commonly used in the industrial, commercial, military, and residential markets as the most efficient way to satisfy the heating and cooling needs and overall comfort demands for facilities, buildings, and homes.

As shown in Figure 2, certain types of GSHPs have already been adopted in nearly every county of North Carolina. With continued support and increased engagement among stakeholders in business, regulatory and policy realms, the geothermal industry can continue to grow and diversify the clean energy market in North Carolina. Stakeholder engagement can address the questions and fill in the data gaps to create business certainty and encourage an increasing number of homes and businesses to install this high efficiency heating and cooling technology.

Working together, stakeholders can produce the solutions needed to continue advancing this hidden gem of an industry – benefiting all North Carolinians in the form of jobs and energy savings in the process.



GLOSSARY OF TERMS

Closed-Loop System	GSHP system circulates an antifreeze solution through a plastic tubing closed loop usually buried underground. The closed-loop system can be designed in horizontal, vertical or lake/pond. ²
Horizontal Configuration	Applied widely for residential with sufficient land. The most common design includes two pipes buried at least four feet deep. ²
Vertical Configuration	Suitable for building with limited land space, two pipes are buried underground 100 to 400 feet deep. ²
Lake/Pond Configuration	The most cost-effective option if the system is near lake/pond. The coiled supply pipe is connected between building and water. ²
Open-Loop System	This GSHP system uses water as heat exchanger fluid, and the circulated water returns to the ground. This option is only applicable for systems near sufficient clean water and permits must be applied before construction. ²



REFERENCES

¹ Geothermal energy is a unique resource that offers value on both sides of the clean energy spectrum, in the form of renewable energy and energy efficiency technologies. As a renewable energy resource, geothermal power systems tap into thermal energy stored in the earth's surface to generate electricity. The majority of these systems are located in the western United States (U.S.) where reservoirs of thermal energy are stored under the earth's surface. *Energy Technical Potential, Geothermal, Maps*, National Renewable Energy Laboratory (NREL), accessed at http://www.nrel.gov/gis/geothermal.html (last updated 6 June 2015). ²*Geothermal Heat Pumps*, U.S. Department of Energy, accessed at

http://energy.gov/energysaver/articles/geothermal-heat-pumps (last updated 24 June 2012). ³ Soil Scientist Evaluation (2011), pp. 10-11, Soil, Water, & Environment Group, accessed at

http://www.unc.edu/community/b/0911/UNC%20Bingham_Soil%20Scientist%20Report_FINAL_3%205KGPD.pdf

⁴ Heat Pumps, Geothermal for Consumers, ENERGY STAR, accessed at

http://www.energystar.gov/products/certified-products/detail/heat-pumps-geothermal.

⁵ Motivations and Behaviors of Solar PV and Geothermal System Owners in North Carolina (2013), UNC Kenan-Flagler Business School and NCSEA, accessed at

http://c.ymcdn.com/sites/www.energync.org/resource/resmgr/Resources_Page/NCSEA_solarpvgeo.pdf. ⁶ Open Loop Heat Pump Systems are considered return well systems and require state level permitting. Vertical Closed Loop Heat Pump Systems do not utilize well water, but have a close relationship with groundwater and are required to submit a well construction notification prior to construction. Heat Pump "Pump and Dump" Systems are regulated only as water supply wells and as long as the total design flow rate is less than 100,000 gallons, then no state level permit is required.

⁷ Geothermal Heating and Cooling Injection Wells, Division of Water Resources, accessed at http://portal.ncdenr.org/web/wq/aps/gwpro/geothermal.

⁸ The number of GSHP system installations was obtained from the N.C. Department of Environment and Natural Resources (DENR) permit holder records. This data is not inclusive of all geothermal systems installed. This data only includes systems that must obtain one of the following permit types: (1) Injection Water Only GSHP Well System, (2) Injection Deemed Geothermal Aqueous Closed-loop Well, (3) Injection Deemed Geothermal Direct Expansion Closed-loop Well, (4) Injection Mixed Fluid GSHP Well System, and (5) Injection Heating/Cooling Water Return Well.

⁹ North Carolina Clean Energy Industry Census 2014, NC Sustainable Energy Association (February 2015). ¹⁰ Reports are available to AHRI members. To learn more about Air-Conditioning, Heating, and Refrigeration Institute (AHRI), visit http://www.ahrinet.org/site/1/Home.

¹¹SurveyMonkey, accessed at https://www.surveymonkey.com/.

¹² The total number of responses reported by Survey Monkey was 53. However, only 43 were considered completed and 9 were considered incomplete survey responses. Incomplete survey responses means the participant opened the survey, but did not answer a question. One participant submitted the survey twice and the first response was removed and the second attempt was considered final for the purpose of the analysis.

¹³ 2015 Annual U.S. & Global Geothermal Power Production Report (2015), pp. 12-13, GeothermalEnergyAssociation, accessed at http://geo-

energy.org/reports/2015/2015%20Annual%20US%20%20Global%20Geothermal%20Power%20Production%2 0Report%20Draft%20final.pdf.

¹⁴ Honari, H, Makhyoun, M., Sridhar, V., Hoover, K, *Economic Analysis of Ground Source Heat Pumps in North Carolina*, ASHRAE (2014).

¹⁵ The maximum amount of awarded tax credit is \$2.5 million for nonresidential property and \$8,400 for residential property installing GSHP system. N.C. Gen. Stat. § 105-129.15 et seq, accessed at www.ncleg.net/EnactedLegislation/Statutes/HTML/ByArticle/Chapter_105/Article_3B.html 3.

APPENDIX

Appendix A: NCSEA's Survey Procurement Letter

Dear _____,

The North Carolina Sustainable Energy Association (NCSEA) would like to invite you to participate in our **Geothermal Business Survey**!

The purpose of the survey: NCSEA is conducting a study to determine the factors that impact the development and deployment of geothermal/ground source heat pumps systems in North Carolina. Industry specific efforts help NCSEA, business leaders, and decision-makers better understand the geothermal industry and the market, policy, and technology trends that affect adoption in North Carolina.

Your participation matters: As a geothermal system manufacturer, distributor, designer, or developer conducting business in North Carolina, your feedback and expertise is critical. Not only does NCSEA find this information important, but so do your peers. Please see attached for a letter from Robert "Tate" Rust, a professional and expert in the geothermal industry as well as a valuable member of NCSEA, encouraging you to please take a few minutes to complete this survey.

Geothermal Business Survey- click here!

If this link above does not work, please manually enter the following web link into your browser, https://www.surveymonkey.com/s/8L6YDQ3

The survey will close Monday, May 18th.

After you complete the survey: Our team will alert participants and NCSEA members when the Geothermal Business Report is available! If you have any questions in the meantime, please feel free to contact me, Kacey Hoover at kacey@energync.org. We may also contact you for additional feedback or testimonials about your experience. If you do not wish to be contacted after the survey, please respond to this email and I will remove you from further communication.

Again, thank you your participation and our team looks forward to hearing from you!

NC Sustainable Energy Association



Appendix B: Survey Questions and Results

Question 1. Please complete or verify your professional contact information.

ALL CONTACT INFORMATION IS KEPT STRICKTLY CONFIDENTIAL. The results are published in aggregate as a freely available online report following the completion of the study. Individual organization information is never released publically or privately and is not sold, remarketed or used in any way that would compromise an organization's anonymity.

Name	
Company	
Address	_
City	
State	
Zip Code	
Email	
Phone	

Question 2. Please indicate the business activities your organization conducts (select all that apply).

- Manufacturer and distributor of ground source heat pump systems
- Designer of ground source heat pump systems
- Installer and developer of ground source heat pump systems
- Sub-contractor and/or loop installer
- Well-driller
- Other _____





Question 2 Results: Geothermal Business Survey Participant's Business Activities¹

Question 3. Who is your customer base (please select all that apply)?

- Residential single family
- Residential multi-family
- Commercial < 4,000 ft2
- Commercial > 4,000 ft2
- Military
- Other _____

Question 3 Results: Geothermal Business Survey Participant's Customer Base²



¹ For participants who choose other business activities, they indicated: architect, builder, GSHP manufacturer's representative, tax and financial services, and utility professional.

² For participants who choose other as their customer base, they indicated: installers, utilities, agribusiness and HVAC contractors.



Question 4. What type(s) of geothermal systems does your business utilize (please select all that apply)?

- Open loop heat pump systems and/or "pump and dump" heat pump systems
- Vertical closed loop heat pump systems
- Horizontal closed loop heat pump systems
- Lake loops and/or pond loops
- Commercial water source heat pump
- Other ____



Question 4 Results: Geothermal Business Survey Participant's Geothermal System Type

Question 5. What are the regulatory and/or policy barriers that your business may face?

Question 5 Results: Since this question was an open ended question, the frequency of responses was used to identify main response themes: N/A, state and/or local regulations, costs, and tax credits.

- 31% considered state and/or local regulations, such as DENR regulations and permitting, to be hurdles.
- 24% selected N/A
- 21% considered incentives, such as the expiration of the state tax credit, critical to their business and industry.
- 7% considered costs, such as upfront costs and access to PACE financing, to be hurdles.

Question 6. Rank the following LOCAL hurdles your business may face, 1 being the biggest hurdle to your business (selecting N/A indicates this is not considered a hurdle to your business).

- Well Construction Standards Criteria and Standards Applicable to Water Supply Wells and Certain Other Wells
- County or municipality requirements



- General and/or sub-contractors
- Building Permitting
- HVAC permitting
- Well permitting and/or loop permitting
- Property lines, septic fills, and/or existing infrastructure
- Knowledge base of personnel
- Communication between contractors, sub-contractors, local inspectors, and/or regulators
- Other _____

Question 6 Results: The Local Hurdles Faced by Geothermal Business Survey Participants³

Local hurdles	Rank
Knowledge base of personnel	1
Communication between contractors, sub-contractors, local inspectors, and/or regulators	2
Property lines, septic fills, and/or existing infrastructure	3
County or municipality requirements	4
Well permitting and/or loop permitting	5
Well Construction Standards – Criteria and Standards Applicable to Water Supply Wells and Certain Other Wells	6
General and/or sub-contractors	7
HVAC permitting	8
Other	9
Building permitting	10

Question 7. Rank the following STATE and FEDERAL hurdles your business may face, 1 being the biggest hurdle to your business. (Selecting N/A indicates this is not considered a hurdle to your business.)

- State groundwater quality standards
- [Expiration of] Renewable Energy Investment Tax Credit (State)
- Permitting and/or licensing
- [Expiration of] Federal Business Energy Investment Tax Credit
- Other

³ The ranks are calculated based on the methodology below: The most selected biggest hurdle is assigned a score of 10, the second most selected biggest as a score of 9 and the smallest hurdle get a score of 1. The final score used for ranking is the sum of all weighted scores in each hurdle. Even though some participants were given the option to select "other" as a hurdle to the industry, participants identified similar hurdles in their response including knowledge base of personnel and restrictive regulations at the local level.



Question 7 Results: The State and Federal Hurdles Faced by Geothermal Business Survey Participants.⁴

State and federal hurdles	Rank
[Expiration of] Renewable Energy Investment Tax Credit (State)	1
[Expiration of] Federal Business Energy Investment Tax Credit	2
State groundwater quality standards	3
Permitting and/or licensing	4
Other	5

Question 8. If you chose "contracting", "permitting", "licensing" or "other" to questions #6 or #7, please explain and/or list the requirements that are considered a hurdle. If not, type N/A.

Question 8 Results: Of the 26 participants that responded to this question the primary hurdles listed included the expiration of tax credits, lack of knowledgeable personnel, and restrictive regulations (both state and local).

Question 9. What is the average cost per ton of heating and cooling for the following:

- Residential single family ______
- Residential multi-family ______
- Commercial < 4,000 ft2 _____
- Commercial > 4,000 ft2 _____
- Military _____
- Other _____

Question 9 Results: The median average cost per ton of heating and cooling for the customer bases were \$8,000 for residential single family, \$7,000 for residential multi-family, \$8,800 for Commercial < 4,000 ft2, \$8,000 for Commercial > 4,000 ft2, and \$9.250 for military.⁵

Question 10. To get an understanding of costs, what have the cost trends been over the past 5 years and what are they expected to be in the next 5 years?

Question 10 Results: The majority of participants has seen an increase and expects to see an increase in system cost. Over the past 5 years, at least 70% stated a between a slight and significant cost increase. In the next 5 years, at least 62% expect costs to increase slightly to significantly.

⁵ StataCorp. 2011. Stata Statistical Software: Release 12. College Station, TX: StataCorp LP.



⁴ The ranks are calculated based on the methodology below: The most selected biggest hurdle is assigned a score of 10, the second most selected biggest as a score of 9 and the smallest hurdle get a score of 1. The final score used for ranking is the sum of all weighted scores in each hurdle. Even though some participants were given the option to select "other" as a hurdle to the industry, participants identified similar hurdles in their response including tax credit and restrictive regulations at the state level.

Appendix C: Letter from Robert "Tate" Rust

Request from a member of the North Carolina Geothermal Heat Pump Industry and NCSEA:

Geothermal Industry Professionals

As a participant in this exciting and expanding industry, I would like to encourage you to take a few minutes to fill out this crucial survey.

Over the last few years I have been privileged to become more involved with NCSEA and its efforts to develop and promote a viable clean energy market in North Carolina. This includes Geothermal. Tomy surprise there was a noticeable deficiency of knowledge of our industry and its impact on North Carolina. When I started to exam the issue I found that there has been a number of attempts togather information but they have met a lack of interest from the industry itself. So NCSEA has not been able to get a complete picture of what is actually happening and how it is effecting NC businesses, consumers, and economics.

This is problematic, not only could we miss opportunities with businesses leaders, potential customers, and policymakers, but lose in addressing some of our unique challenges and ineffective in influencing regulatory policy's. Remember we are different, we save energy through efficiency. We claim our efficiency from our renewable technology of utilizing the relative constant temperature of the earth to heat and cool homes and buildings, not generation of electricity. Energy efficiency is the low cost, least risk energy resource and GHP's are the most energy efficient technology for satisfying the thermalloads of homes and buildings. We need to make sure our story is told.

Please take time to respond to this survey it order to assist NCSEA. It is vital to geothermal in North Carolina.

Thank you.

Robert "Tate" Rust Sr., Territory Manager Waterfurnace International, Inc. The Great State of North Carolina

