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June 12, 2024

Sherri L. Golden
Board Secretary
New Jersey Board of Public Utilities
44 South Clinton Avenue, 1st Floor
P. O. Box 350
Trenton, NJ 08625-0350

Re: GeoExchange Comments *In the Matter of New Jersey's Energy Master Plan (Docket No. QO24020126)*

Dear Secretary Golden:

Thank you for the opportunity to provide comments on The New Jersey Board of Public Utilities (BPU) proposal for the New Jersey Clean Energy Master Plan (NJEMP), pursuant to the BPU notice issued March 11, 2024. The Geothermal Exchange Organization (GeoExchange) supports the EMP effort as an important step to unify clean energy policy across the state, and encourages the BPU to continue to take steps to further support the inclusion of geothermal heat pumps in the EMP.

GeoExchange is a nonprofit trade association promoting the manufacture, design and installation of geothermal heating and cooling technology, also known as ground source heat pumps. Our members include manufacturers, installers, technology providers, utilities, and others in New Jersey and across the country. Geothermal heat pumps (GHPs) are one of the most efficient heating and cooling systems available and can significantly reduce greenhouse gas emissions and energy bills for businesses, non-profits, and residents across the state.

Background on Geothermal Heat Pump Systems

GHP systems represent one of the most efficient heating and cooling systems available to businesses, schools, multifamily buildings, and homeowners. GHPs use the constant temperature of the earth to transfer heat from the ground and into buildings, even during the coldest winter weather. In the summer, they run in reverse, transferring heat from buildings into the ground, where it is stored until the winter, further improving the heating efficiency during the heating season.

Geothermal system designs

Geothermal heat pumps use a loop of pipe buried in the earth – typically drilled up to 500 feet or deeper – to circulate fluid which transfers heat with the heat pump equipment inside of the building. GHPs frequently use a vertically-drilled, closed-loop system to continuously circulate the fluid (e.g. water and

biodegradable antifreeze such as propylene glycol), so there is no need to extract or inject water into the ground.[1] Key benefits of GHPs include:

- Due to the stable ground temperature, GHPs use approximately 50% less electricity than air source heat pumps over the course of a year,[2] and generate two to four times lower peak demand compared to air source heat pumps on the hottest days and coldest nights. This also yields performance efficiency more than four times higher than equivalent fossil fuel systems.[3]
    - Stable ground temperature also allows GHPs to efficiently meet 100% of a building's heating needs, without requiring any fossil fuel backup or "dual-fuel" systems on the coldest days while also keeping peak electric loads low.
- GHPs also have the longest service life of any HVAC equipment; the U.S. DOE estimates that the interior heat pump equipment will last 25 years or more, and the ground loop is expected to last more than 50 years.[4] GHPs also have lower maintenance and upkeep costs than other systems, as there is no exterior equipment exposed to harsh weather.

Energy Master Plan

Based on these myriad benefits, geothermal heat pumps can, and should, form a key pillar of New Jersey's EMP strategies. GHPs directly support Strategies 3 and 4 of the Energy Master Plan, and should be incorporated into any successor goals and strategies in the 2024 EMP:

Strategy 3: Maximize Energy Efficiency and Conservation and Reduce Peak Demand

GSHP provide the dual benefit of high efficiency heating and cooling, while also further reducing peak electric demand as compared to other high-efficiency heat pumps. This provides both energy savings and grid benefits directly support many of the sub-goals under goals 3.1 and 3.2, including:

Goal 3.1: Increase New Jersey's Overall Energy Efficiency

[1] Additional systems designs can include horizontal systems (buried in shallow trenches rather than vertically drilled); open-loop systems which withdraw water, extract/add heat, then replace it underground; or direct exchange systems which circulate different heat transfer fluids.

[2] Reeg, Lauren, et. al, "Clean Energy 101: Geothermal Heat Pumps," RMI, March 29, 2023, https://rmi.org/clean-energy-101-geothermal-heat-pumps/

[3] While a high efficiency gas furnace may yield 98% efficiency, geothermal system efficiency is often 300%-400% or more, yielding three to four units (Btu) of energy for every one unit consumed.

[4] U.S. DOE, "5 Things You Should Know about Geothermal Heat Pumps," August 1, 2017, https://www.energy.gov/eere/articles/5-things-you-should-know-about-geothermal-heat-pumps

- *3.1.1 – Implement the Clean Energy Act requirement that electric and gas utilities reduce consumption by at least 2% and 0.75%, respectively, including the establishment of clear performance indicators and evaluation, measurement, and verification methods*
    - GHPs use 70% to 80% less electricity than conventional heating or cooling systems according to the U.S. Department of Energy,[5] and can reduce emissions by 85-90% compared to conventional fossil fuel HVAC systems.[6]

- *3.1.2 – Increase awareness of and access to New Jersey's Clean Energy Program and its suite of statewide programs*
    - In 2017, the New Jersey Department of Energy (DEP) conducted a survey with HVACR contractors, well drillers, architects, planners, and general contractors. Survey participants largely cited limited customer awareness as a major obstacle to GHP adoption, with 53% responding that their company or customers are not aware of incentive programs for GHPs in New Jersey.[7] Participants then responded that methods to increase consumer awareness could include customer testimonials, demonstration events, online case studies, trade shows and conventions, project open houses, and more.[8]

- *3.1.3 – Establish strategic and targeted energy efficiency programs to increase energy reductions and customer engagement*
    - Strategic and targeted energy efficiency programs are exactly what is needed to further support GHP adoption. The New Jersey DEP concluded that while GHP adoption continues to grow at a rate of more than 1,500 tons of capacity annually, "enhanced policies and an increase in financial incentives and customer awareness will be needed to spur growth of this technology to achieve our statewide emissions reduction goals."[9]

- *3.1.4 – Establish a clearinghouse for home energy and health and safety programs targeted to low-income households*
    - Low-income households and affordable housing buildings particularly benefit from the long-term operational savings of GHPs, significantly reducing energy costs for residents and housing providers. By leveraging a combination of federal and state-level incentives,

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[5] U.S. Department of Energy, "Choosing and Installing a Geothermal Heat Pump System," accessed March 25, 2024, https://www.energy.gov/energysaver/choosing-and-installing-geothermal-heat-pump-system
[6] Reeg, Lauren, et. al, "Clean Energy 101: Geothermal Heat Pumps," RMI, March 29, 2023, https://rmi.org/clean-energy-101-geothermal-heat-pumps/
[7] Gergely, Rya, Anthony Bevacqua, and R. Christopher Barry, New Jersey Ground Source Heat Pump Baseline Report, New Jersey Department of Environmental Protection Bureau of Climate Change & Clean Energy, December 2023, p. 32, https://dep.nj.gov/wp-content/uploads/cleanenergy/new-jersey-ground-source-heat-pump-baseline-report_final.pdf
[8] Ibid, p. 34.
[9] Ibid, p. 23.

affordable housing developments have been completed or are underway in locations such as Colorado,[10] New York,[11] Massachusetts,[12] Michigan,[13] and Wisconsin,[14] providing long-term energy savings to households that need it most.

- *3.1.5 – Adopt equitable clean energy financing mechanisms that enable greater penetration of energy efficiency opportunities for all customers*
    - Despite the long-term operational savings, up-front costs of GHP systems can nevertheless remain a barrier for some potential customers. Clean energy financing mechanisms, including those available through the Greenhouse Gas reduction Fund of the Inflation Reduction Act, will be critically important in expanding the deployment of heat pumps in the state.

Goal 3.2: Manage and Reduce Peak Demand

- *3.2.1 – Support and incentivize new pilots and programs to manage and reduce peak demand*
    - The high efficiency of GHPs results in significantly lower electric demand than other heating and cooling systems – particularly during the hottest and coldest hours of the year, precisely when the electric grid is most stressed.
    - A November 2023 study by the Oak Ridge National Laboratory estimated that widespread deployment of geothermal heat pumps could save a cumulative total of more than $1 trillion dollars in energy system costs nationwide through 2050.[15] This included a decrease of 185 GW of nationwide winter peak capacity by 2050.[16]

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[10] "Willoughby Corner, a New 400-Unit Affordable Housing Development in Lafayette ," Colorado Construction and Design, accessed May 15, 2024, https://ccdmag.com/project-updates/willoughby-corner-lafayette/

[11] Hoffman, Connor, "Housing Authority recognized for geothermal work | Local News," Lockport Journal, July 22, 2017, https://www.lockportjournal.com/news/local_news/housing-authority-recognized-for-geothermal-work/article_17ea7655-8d2c-5556-b1b8-b56574069e89.html and Galindo, nadia, "Affordable housing project to use geothermal energy," News 12 Westchester, November 1, 2023, https://westchester.news12.com/affordable-housing-project-to-use-geothermal-energy

[12] "Healey-Driscoll Administration Awards $27 Million to Decarbonize Affordable Housing Across Massachusetts," Office of the Governor of Massachusetts, November 21, 2023, https://www.mass.gov/news/healey-driscoll-administration-awards-27-million-to-decarbonize-affordable-housing-across-massachusetts

[13] Venclovaite-Pirani, Amanda, "What to know about affordable housing at 121 Catherine St." The Michigan Daily, February 19, 2024, https://www.michigandaily.com/news/ann-arbor/everything-you-need-to-know-about-affordable-housing-at-121-catherine-st/

[14] Phillipps, Samantha, "Prairie Heights: Breaking New Ground in Affordable Housing," West CAP, May 2, 2023, https://westcap.org/2023/05/prairie-heights-breaking-new-ground-in-affordable-housing/

[15] Liu, Xiaobing, et. al., "Grid Cost and Total Emissions Reductions Through Mass Deployment of Geothermal Heat Pumps for Building Heating and Cooling Electrification in the United States," Oak Ridge National Laboratory, November 2023, p. xii, https://info.ornl.gov/sites/publications/Files/Pub196793.pdf

[16] Ibid, p. xix. The "EFS + GHP" scenario models 68% electrification of residences and 49% electrification of businesses, representing approximately 100 million GHP systems installed; this yields a peak reduction of 1.85 kW per system (primary residential systems). See https://www.census.gov/quickfacts/fact/table/US/HCN010217 for source of 144 million residences and https://www.eia.gov/pressroom/releases/press485.php for source of 5.9 million commercial buildings.

        - The study estimated that the widespread adoption of GHPs would have positive impacts on electric and gas ratepayers alike. Gas infrastructure development will slow, resulting in consumer savings of $19B per year by 2050.[17] Furthermore, because GHPs reduce electricity demand, electric rates will decrease as well, saving ratepayers money across the board.
    - A study published in 1998 by the Oak Ridge National Laboratory found that following the widespread introduction of GHPs in on-base housing at Fort Polk, Louisiana, the community was able to reduce their peak electricity demand by 43.5%.[18] While air conditioning and heat pump technologies have improved in the subsequent decades, this significant performance advantage demonstrates how GHPs have a long history of positive impacts for the electric grid.
    - A 2022 study of building electrification scenarios and winter peak demand found that under inefficient electrification scenarios such as electric resistance heating (coefficient of performance [COP] of 1), meeting peak demand with renewables would require up to a 28x increase in January wind generation, or a 303x increase in January solar generation. Moving to high efficiency electrification with a COP of 6 (such as a network geothermal system) can substantially shrink this winter peak—requiring only 4.5x more generation from wind or 36x more from solar.[19]

Strategy 4: Reduce Energy Consumption and Emissions from the Building Sector

GHPs allow full building electrification due to their ability to function year-round without a backup fuel. This also eliminates on-site building emissions, supporting the subgoals of sections 4.1 and 4.2, including:

Goal 4.1: Start the Transition for New Construction to be Net Zero Carbon

- *4.1.1 – Electrify state facilities*
    - In the summer of 2013, Colorado City Hall became the first state capitol in the country to use a geothermal system to heat and cool the building. The completed 23-ton GHP system

[17] Ibid, p. xii.
[18] Hughes, P. J. and Shonder, J. A. "The Evaluation of a 4000-Home Geothermal Heat Pump Retrofit at Fort Polk, Louisiana: Final Report," Oak Ridge National Laboratory, April 1998, p. 30, https://digital.library.unt.edu/ark:/67531/metadc694790/m2/1/high_res_d/638196.pdf
[19] Buonocore, J.J., Salimifard, P., Magavi, Z. *et al.* Inefficient Building Electrification Will Require Massive Buildout of Renewable Energy and Seasonal Energy Storage. *Sci Rep* **12**, 11931 (2022). https://doi.org/10.1038/s41598-022-15628-2

saved $95,000 in utility bills in its first year.[20] Savings are anticipated to increase 3% annually, reaching $165,000 in annual savings by 2029. The Colorado Department of Energy cited both pollution reduction and long-term taxpayer savings as incentives for the retrofit.[21] New Jersey should retrofit it's government buildings with GHPs in order to save taxpayers money and to serve as local examples for the benefits of geothermal energy deployment.

- *4.1.2 - Partner with private industry to establish electrified building demonstration projects*
    - The New Jersey DEP is currently collaborating with the New Jersey Corporation for Advanced Technology (NJCAT) to promote the development of environmental technologies and business. This collaboration aims to promote environmental technology policies and regulatory measures, identify and recommend which technologies should be standardized, establish relationships to help market new technologies to New Jersey government, and to assist in identified markets for commercialized technologies. The DEP and NJCAT scope of work also includes the implementation of demonstration projects to obtain information on the requirements of geothermal deployment across the state. GeoExchange supports this effort and encourages the New Jersey DEP to continue this collaboration with the NJCAT to leverage support and awareness for GHP technology and development.

- *4.1.3 – Expand and accelerate the current statewide net zero carbon homes incentive programs for both new construction and existing homes*
    - The extremely high efficiency performance of GHPs also results in significant emissions reductions to help New Jersey meet its climate goals. A recent report by the New Jersey DEP found that the 3,000 existing GHP installations in the state avoid approximately 66,000 metric tons of greenhouse gas emissions every year.[22] Importantly, larger commercial, public, and academic buildings represent over 75% of the energy and emissions savings, demonstrating the significant savings potential of large-scale geothermal deployments. The DEP report recognized that up-front costs could pose a barrier for some and recommends studying new financial incentive programs "targeting specific segments of the building sector to overcome cost barriers, reduce fossil fuel use,

[20] "State Capitol Building Retrofitted With Geothermal Heat-Pump System," *HPAC Engineering*, March 31, 2015, https://www.hpac.com/heating/article/20927969/state-capitol-building-retrofitted-with-geothermal-heat-pump-system

[21] "Geothermal," *Colorado State Capitol*, https://capitol.colorado.gov/projects/geothermal

[22] Gergely, Rya, Anthony Bevacqua, and R. Christopher Barry, New Jersey Ground Source Heat Pump Baseline Report, New Jersey Department of Environmental Protection Bureau of Climate Change & Clean Energy, December 2023, p. ES1, https://dep.nj.gov/wp-content/uploads/cleanenergy/new-jersey-ground-source-heat-pump-baseline-report_final.pdf

and improve energy equity in New Jersey."[23] These tailored GHP incentives are precisely the types of incentives the EMP goal 4.1.3. should seek to support to achieve net zero building construction and retrofits.

- *4.1.4 – Study and develop mechanisms and regulations to support net zero carbon new construction*
    - New construction is the optimal time to install a GHP system, and building familiarity with GHP design and installation principles across the new construction industry will significantly accelerate the deployment of GHP systems in New Jersey. Conducting drilling on a cleared construction area is easier than drilling later around an existing structure. The installation of a GHP during new construction can also optimize placement of the borehole. The internal HVAC systems will also be custom built to optimize GHP performance. These lead to lower costs and higher system performance, making GHPs the ideal solution for new construction HVAC in the state. For residential production homes, up-front costs can be even lower through drilling efficiency and re-use of system design across similar home models.

Goal 4.2: Start the Transition to Electrify Existing Oil- and Propane-Fueled Buildings

- *4.2.1 – Incentivize transition to electrified heat pumps, hot water heaters, and other appliances*
    - While the long-term operational cost savings from GHPs can be significant, up-front costs often remain a barrier to adoption, particularly for residential households and small businesses. Up-front incentives, such as those supported by BPU and the utilities in the Triennium 2 proceedings, therefore represent a critical element in advancing the widespread deployment of GHP systems. These energy efficiency and decarbonization incentives, particularly when combined with federal tax credits and rebate programs, can help to significantly reduce the up-front cost of GHPs systems, unlocking the long-term cost savings for residents and businesses. In addition to the incentives offered in utility programs, New Jersey should also offer tax credits and financing programs for GHPs to promote the transition to electrification.

- *4.2.2 – Develop a transition plan to a fully electrified building sector*
    - Geothermal heat pumps should play a key role in New Jersey's transition to an electrified building sector, and the state should plan to grow GHP market share to 20-25% of all heating and cooling systems by 2030 to optimize grid benefits and reduce long-term costs for New Jersey residents and businesses.

[23] Ibid, p. 25.

- Modeling for the New York Climate Action Council Scoping Plan modeled GHP representing 22-23% of all residential and commercial heating and cooling by 2030 to efficiently meet the Scoping Plan goals.[24]
- A study by the Brattle Group modeled 33% GHP adoption as part of their optimized "mixed scenario" for building decarbonization in Rhode Island.[25]

Conclusion

Geothermal systems offer nearly unlimited potential to New Jersey in meeting its energy goals in an efficient, low-carbon, cost-effective manner. GeoExchange is excited about the potential for geothermal heating and cooling in the state, and we look forward to working with the BPU to support the broad deployment of GHPs in new construction projects.

Sincerely,

Ryan Dougherty
President
Geothermal Exchange Organization

[24] See Draft Scoping Plan Appendix G: Annex 2: Key Drivers and Outputs, scenarios S2 and S3, residential and commercial space heating projections; December 2021, https://climate.ny.gov/resources/draft-scoping-plan/
[25] The Brattle Group, "Heating Sector Transformation in Rhode Island," p. 39, https://energy.ri.gov/sites/g/files/xkgbur741/files/documents/HST/RI-HST-Final-Pathways-Report-5-27-20.pdf