



Geothermal Heat Pumps

Functionality, Regulations, and Economic Feasibility

LL97 Energy Goals

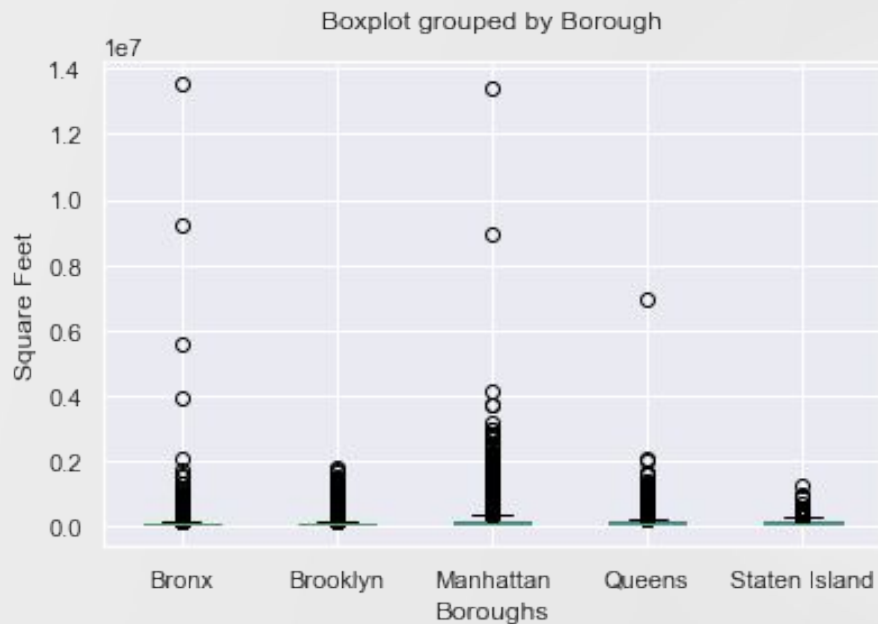
- ❖ NYC is going to try and reduce carbon emissions for covered buildings.
- ❖ There are over 50,000 buildings in NYC that fall into this definition.
- ❖ 40% reduction in city wide carbon emissions by 2030 as compared to 2005 levels and by 2050 there should be a reduction of 80%
- ❖ For covered buildings, this means a 26% reduction in carbon emissions by 2030.
- ❖ Meeting the emission reduction requirements set out by LL97 is going to be challenging for many businesses and property owners. Geothermal energy offers an incredibly efficient and reliable source of energy that most buildings have yet to take advantage of.

C40 Cities

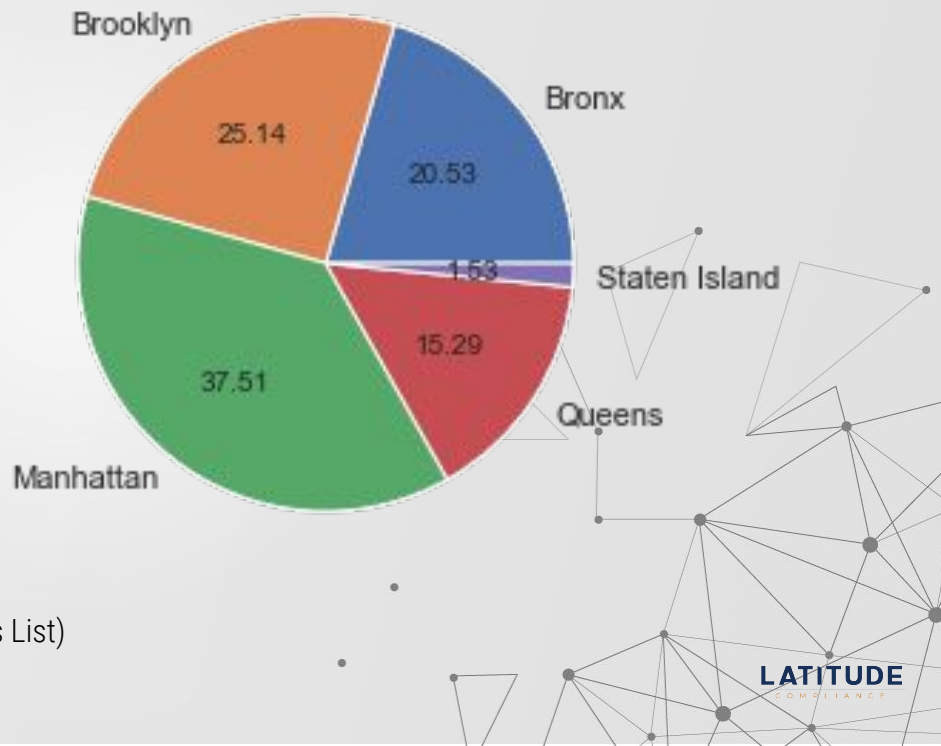
- ❖ C40 cities is a group of 97 cities across the world trying to reduce carbon emissions.
- ❖ These 97 cities account for 25% of the global GDP and 1/12 of people live in one of these cities
- ❖ Many of these cities around the world are already using geothermal energy to try and curtail their carbon emissions



Covered Buildings Breakdown



Covered Buildings in New York

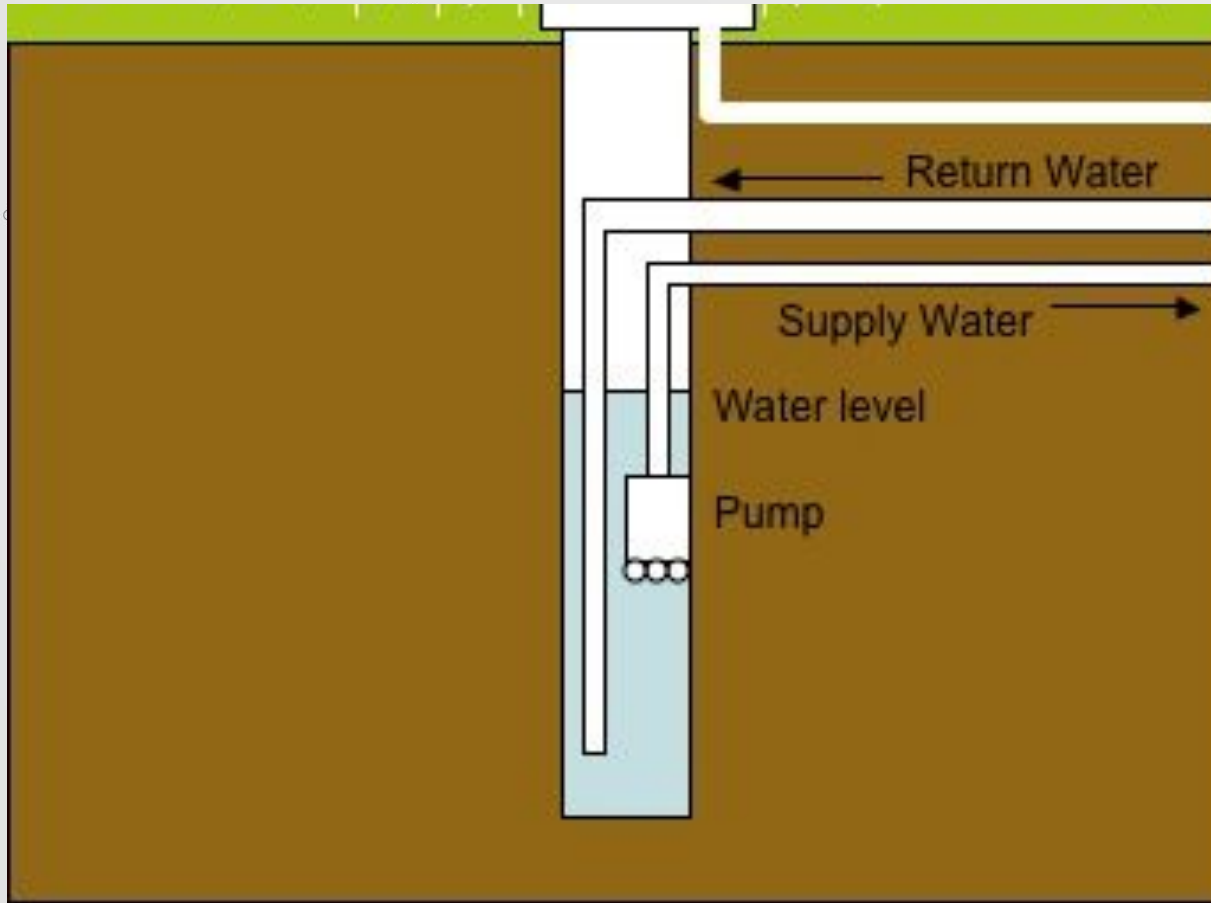


(data provided by the NYC Department of Water's 2015 Covered Buildings List)

GHPs in NYC

- ❖ In a study performed by the United State Environmental Protection Agency (“EPA”), it was found that GHPs are the most energy efficient, environmentally clean, and cost effective space-conditioning systems available, with the lowest carbon dioxide emissions.
- ❖ The standing column well can be implemented in most of Manhattan, the Bronx, northern Queens and western Staten Island where bedrock is reasonably close to the surface





<https://blog.heatspring.com/geothermal-wells/>

Regulatory Agencies

- ❖ EPA Regulation
- ❖ NYS Department of Environmental Conservation (Division of Mineral Resources)
- ❖ NYS Department of Environmental Conservation (Division of Water)
- ❖ NYC Department of Environmental Protection (Water Tunnel Clearance)
- ❖ NYC Department of Environmental Protection (Sewer Discharge Permit)
- ❖ NYC Department of Health
- ❖ NYC Department of Transportation
- ❖ NYC Department of Parks and Rec
- ❖ Public Transit



Environmental Protection Agency (EPA)

- ❖ Standing column wells and open loop diffusion wells are considered beneficial use, Class V, injection wells.
- ❖ Vertical closed loop and open loop system supply wells are not included in the EPA's requirements.
- ❖ Inventory on the well and the site's hydrogeologic condition must be submitted to the EPA before construction.
- ❖ After the well is installed, a groundwater sample must be taken and submitted to the EPA for an analysis to see if there are any containment leaks
- ❖ A Plugging and Abandonment Plan must also be submitted in case the well is abandoned
- ❖ The time the EPA usually takes to process a permit application is around 4-6 weeks.

NYS Department of Environmental Conservation

(Division of Mineral Resources)

- ❖ This is for wells over 500 feet that require a “mining” permit from the NYSDEC.
- ❖ Well locations, depth, use, casing material, cementing procedures, drilling fluid and cuttings disposal methods must be submitted with a permit application.
- ❖ A well owner must also submit a completed Division of Mineral Resources well permitting Environmental Assessment Form, a Supplemental Environmental Impact Statement, and any additional NYSDEC permits.
- ❖ Before a well owner, operator, driller, and/or plugger commences any regulated activity, including preparatory work, a notarized copy of the Oil and Gas Organizational Form must be filed with the Division of Mineral Resources, along with proof of financial security using the Financial Security Worksheet.
- ❖ The well surface casing must extend a minimum of 75 feet beyond the deepest freshwater zone encountered or into competent bedrock, whichever is deeper.
- ❖ The Division of Mineral Resources will consult with the New York State Office of Parks, Recreation and Historic Preservation (“NYS Parks”) on whether the location of a well is within a state-listed historic area in which case permission is required.
- ❖ Within 30 days after the completion of the well, a Well Drilling and Completion Report (Form 85-15-7) must be filed by the owner summarizing the drilling and completion details
- ❖ The Division of Mineral Resources’ review and approval process takes approximately six to eight weeks.

NYS Department of Environmental Conservation (Division of Water)

- ❖ The NYSDEC Division of Water regulates wells that are less than 500 feet deep. Drillers and pump installers are required to be registered and certified for open loop or standing column well systems.
- ❖ A Long Island Well Permit is required from the Division of Water to install and operate an open loop or standing column well system in Brooklyn and Queens with a total pumping capacity greater than 45 gallons per minute ("gpm").
- ❖ The permit application is filed with the Division of Water Region 2 office in Long Island City, and includes a joint application for permitting with the Army Corps of Engineers, a Short EAF, and a Long Island Well Permit form.
- ❖ If well return water is discharged to a surface water body, a State Pollutant Discharge Elimination System ("SPDES") permit is required.
- ❖ This process takes about 6-8 weeks

NYC Department of Environmental Protection (Water Tunnel Clearance)

- ❖ The NYCDEP will issue riders to address geothermal wells located between 200 and 500 feet of any City water supply facility, specifically aqueducts, water tunnels, shafts or appurtenant facilities.
- ❖ Drilling is prohibited within 200 feet of the centerline of a water tunnel or an aqueduct, and proposed drilling locations located within 500 feet from water tunnels are to be identified.
- ❖ For drilling locations over 500 feet from the centerline, NYCDEP approval is required but angular deviation surveys are not required.
- ❖ The NYCDEP will review a site plan with plotted well locations and make a determination of the actual distance of the well(s) to a City water tunnel
- ❖ The NYCDEP will usually respond to a request for determination regarding a proposed wells' proximity to a water supply within a month.

NYC Department of Environmental Protection

(Sewer Discharge Permit)

- ❖ The NYCDEP issues a Dewatering Permit for temporary disposal of drilling fluids and groundwater to the City sewers generated during construction.
- ❖ Approval may be necessary from two separate NYCDEP bureaus depending on the daily discharge amount, one for quality analysis of water from the Bureau of Wastewater Treatment (BWT), and the other from the permitting and compliance section of the Bureau of Water and Sewer Operations (BWSO) for daily discharge volume
- ❖ BWSO's Application for Permit for Temporary Discharge of Groundwater into City Sewer System requires an indemnification agreement, site plan, number and capacity of pumps to be utilized, the quantity, maximum flow rate, average daily flow, and duration of the proposed discharge.
- ❖ In addition, data on the City sewer main and the connection piping to the site must be provided, including pipe locations and diameters, invert elevations at the property line and at the point of connection to sewer main, total capacity of the connection and the percent capacity to be used for dewatering (must be less than 10%), distance from City sewer to the property line, and the slope of connection.
- ❖ Normal turnaround time for approval from the BWT is two to four weeks, although approval from the BWSO may take longer
- ❖ A fee is also required

NYC Department of Health

- ❖ Permit Type 33 is required if well water is used for purposes other than potable supply, such as an open loop supply well.
- ❖ A standing column well that recycles bleed water for other uses, such as irrigation, water fountains or grey water also requires a permit.
- ❖ Bacteriological testing is required, and recommended for volatile organic compounds ("VOC").
- ❖ Form 314C, Application for Permit, and Form PHE 98, Well Water Questionnaire, must be submitted by the well owner.
- ❖ The Bureau of Public Health Engineering will perform an inspection and collect a water sample for its analysis.
- ❖ The initial fee for this permit is \$300 and must be renewed each year.
- ❖ It takes approximately one month from filing to approval to receive a Type 33 permit from the NYCDOH.

NYC Department of Transportation

- ❖ A building owner that plans to install any type of ground coupling system in New York City that requires the owner to construct permanent wells or loops through City sidewalks must enter into a Revocable Consent Agreement (“RCA”) with the New York City Department of Transportation (“NYCDOT”) Bureau of Franchises.
- ❖ Building owners should submit a Petition for a New Revocable Consent (Form RC-1) to initiate this process.
- ❖ Since drilling can occupy large areas needed for a rig and other necessary equipment, projects with limited outdoor space may need to use the adjoining sidewalk and street lane as a work area or for equipment and material storage.
- ❖ There is one permit application form that covers Street Opening, Building Operations/Construction Activity, and Sidewalk Construction Permits for non-governmental work.
- ❖ The filing fee varies depending on the type of permit requested, and the permitting process takes approximately one month.

NYC Department of Parks and Rec

- ❖ Trimming, removal, or replacement of City-owned trees in the sidewalk may at times be necessary, and will require coordination with and approval from NYC Department of Parks and Recreation.
- ❖ Any work within a park requires a Parks work permit and may require consideration of alienation issues.



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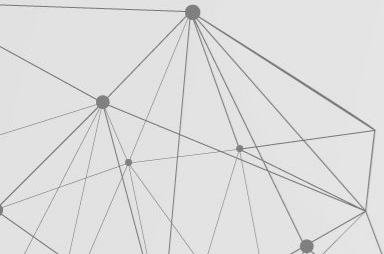
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Economic Overview

Maintenance

- ❖ Usually maintenance of the heat pumps is conducted every 12 months or so.
- ❖ Geothermal pumps require very little maintenance and the main exterior components of the pumps typically last over 50 years while interior components typically last around 25 years.
- ❖ Inspection of the heat pump itself must be conducted.
- ❖ Costs are around 3% of original price every year



Energy Reduction

- ❖ A comprehensive report of geothermal heat pumps applications in NYC was conducted by the Mayor's Office of Sustainability in 2015.
- ❖ Simulations were created for an office building that was slightly over 100,000 square foot.
- ❖ They found that compared to a normal heating and cooling AC system that's found in most NYC buildings, there was a 2% reduction in annual electricity usage when switching to GHPs.
- ❖ Most of where the energy is saved is during the winter because most systems rely on natural gas for heating.
- ❖ Removing this dependency on natural gas allows for a 25% reduction of CO2 emissions by the building and 35% less energy consumed yearly by the building.

Cost Analysis

- ❖ An economic report was also conducted for the simulations of the two buildings in the report from the Mayor's Office of Sustainability.
- ❖ The installation of the geothermal heat pump system in the office building is nearly 3 times the amount of a normal AC system.
- ❖ This geothermal system could work for 5 more years than the normal AC system so an Equivalent Uniform Annual Cost (EUAC) calculation was performed to compare the two systems on their yearly price.
- ❖ They found that the geothermal system will cost 30% more than the normal system every year and this calculation included maintenance costs as well.
- ❖ This calculation did not include the savings on peak electricity that the GHPs system is able to provide nor did it include fluctuating natural gas prices. This calculation also ignores tax credits, renewable incentives and other cost incentives for implementing geothermal technology.

Annual Heating and Cooling Costs by Region

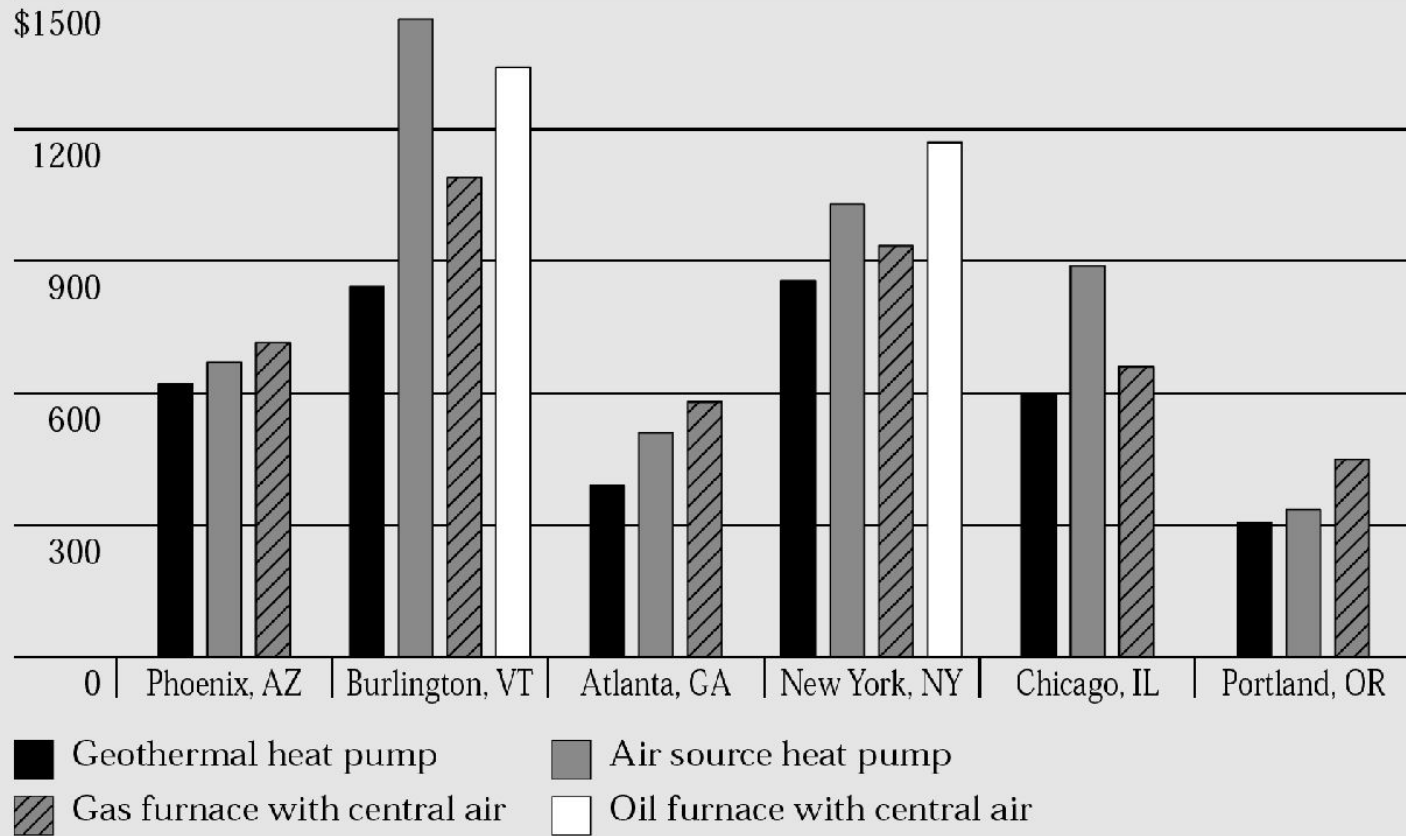


Figure 2 - Annual space conditioning costs for six U.S. cities, EPA 1993 [2].

Federal Tax Incentives

- ❖ The Consolidated Appropriations Act of 2021 allows for federal tax credits for geothermal heat pumps.
- ❖ Systems installed before 2019 have a 30% credit, systems installed before 2023 have a 26% tax credit and 22% for systems installed before 2024
- ❖ Applies to installation costs as well as maintenance



The background is a light gray gradient. On the left side, there is a complex network of thin gray lines connecting various black dots of different sizes, creating a web-like structure. Scattered across the entire background are numerous thin, light gray triangles of various sizes and orientations. Some of these triangles are solid, while others are just outlines. In the upper right corner, there are several small, faint circles or dots.

Questions?

Sources

- ❖ https://www1.nyc.gov/assets/buildings/local_laws/ll97of2019.pdf
- ❖ <https://www.urbangreencouncil.org/content/projects/all-about-local-law-97>
- ❖ <https://www.c40.org/about>
- ❖ <https://www1.nyc.gov/assets/ddc/downloads/Sustainable/GeothermalHeatPumpManual.pdf>
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- ❖ https://www.geothermal-energy.org/pdf/IGAstandard/ISS/2003Germany/II/10_1.gor.pdf
- ❖ <https://www.gsheating.com/blog/geothermal/do-i-have-to-schedule-maintenance-for-a-geothermal-system/>
- ❖ https://www.geothermal-energy.org/pdf/IGAstandard/ISS/2003Germany/II/9_1.gor.pdf
- ❖ https://www.energystar.gov/about/federal_tax_credits/renewable_energy_tax_credits
- ❖ <https://www.nysed.gov/nysed/energy/energy-program-and-incentives/renewable-technology-programs-and-incentives>
- ❖ <http://buffalogeothermalheating.com/nys-rebates/#:~:text=Governor%20Cuomo%20Announced%20Proposals%20for,the%20program%20criteria%20will%20qualify.>

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