NY GEOTHERMAL ENERGY ORGANIZATION

April 14, 2016

Re: Case 15-E-0302, In the Matter of the Implementation of a Large Scale Renewable Program, Order Expanding Scope of Proceeding and Seeking Comments, issued January 21, 2016.

Staff White Paper on Clean Energy Standard, issued January 25, 2016 –

Comments of NY-GEO, the New York Geothermal Energy Organization

Via e-mail

Ms. Kathleen H. Burgess
Secretary, NYS Public Service Commission
Agency Building #3
Empire State Plaza 12223-1350

Dear Secretary Burgess:

NY-GEO respectfully submits the following comments on the January 25, 2016, DPS STAFF WHITE PAPER ON CLEAN ENERGY STANDARD.

The New York Geothermal Energy Organization (**NY-GEO)** writes as a party to Case 15-E-0302. We are a non-profit organization representing geothermal heat pump (GHP) manufacturers, installers, distributors and industry participants from throughout New York State.

Sincerely,

Bill Nowak

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Re: Case 15-E-0302, In the Matter of the Implementation of a Large Scale Renewable Program, Order Expanding Scope of Proceeding and Seeking Comments, issued January 21, 2016. Staff White Paper on Clean Energy Standard, issued January 25, 2016 - Comments of NY-GEO, the New York Geothermal Energy Organization

The Staff White Paper on Clean Energy Standard includes the following key paragraph: [1]

Certain types of market developments and program initiatives will have the effect of reducing total carbon emissions while increasing electricity demand. These include electric vehicles and geothermal heat pumps. If the adoption of these technologies has the effect of increasing the compliance obligation under the CES, then the CES could potentially have the inadvertent effect of deterring the adoption of beneficial technologies. Parties are encouraged to comment on the treatment of electric vehicles and geothermal heat pump conversions under the CES obligation.

The New York Geothermal Energy Organization welcomes this encouragement and offers this document meant to explore the following areas:

1. The importance of technologies which electrify our energy system and which may add to the electrical load while replacing fossil fuel use, cutting total energy use and reducing greenhouse gas emissions, as well as conventional pollutant emissions. We will refer to these technologies, which can include geothermal heat pumps (GHPs)*, electric vehicles (EVs), and other technologies, as *beneficial electrification technologies* (BET).

2. Mechanisms for neutralizing the inherent contradiction between the proposed CES compliance obligation and the need to increase BET within New York's energy system

3. Estimating electrical load under a scenario of robust adoption of BETs

* There is an acronym glossary on the last pages of this document – Appendix M.

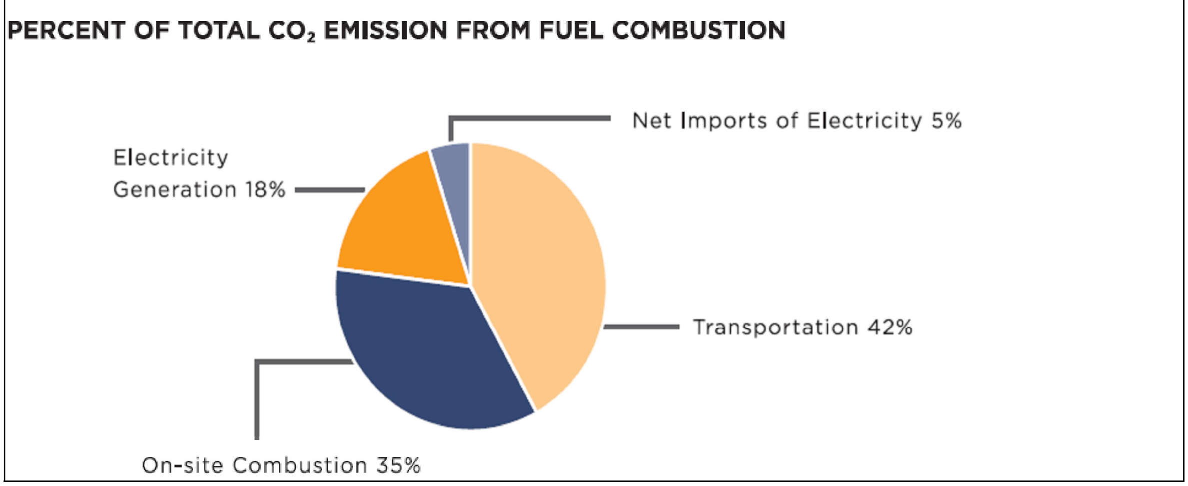
[1] Staff White Paper on Clean Energy Standard in case 15-E-0302, issued January 25, 2016, page 13, https://www.google.com/#q=staff+white+paper+on+clean+energy+standard accessed 2016 03 12

1. Technologies which electrify our energy system and which may add to the electrical load while replacing fossil fuel use, cutting total energy use and reducing GHG emissions

We will refer to these technologies, which can include geothermal heat pumps (GHPs), electric vehicles (EVs), and other technologies, as *beneficial electrification technologies* (BET) [2].

The pie chart below, from the NYS Energy Plan [3], illustrates the potential importance of BETs in reducing greenhouse gas (GHG) emissions in New York State. On-site combustion and transportation together account for 77% of New York's emissions. BETs can replace fossil fuel use in both the heating and transportation sectors [4]. GHG emissions from on-site combustion are shown in the Energy Plan to primarily result from heating homes and buildings in the residential and commercial sectors, with a small portion of those GHGs coming from industrial applications [5].

Figure 1 | 2011 Carbon Dioxide (CO_2) Emissions from Fuel Combustion by End Use Sector



[2] For a further discussion of Beneficial Electrification Technologies, see Environmentally Beneficial Electrification: Electricity as the End-Use Option by Keith Dennis, The Electricity Journal, Volume 28, Issue 9, November 2015, pages 100-112, http://www.sciencedirect.com/science/article/pii/S104061901500202X accessed 2016 03 12. For a more dated but still valuable analysis, see also Beneficial Electrification: An Assessment of Technical Potential by the Electrical Power Research Institute (EPRI), CU 7441, Research Project 2788, Final Report May, 1992, http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=CU-7441 Accessed 2016 03 12

[3] Volume 2 of the 2104 Draft New York State Energy Plan, The Energy to Lead: Impacts & Considerations, page 11 http://energyplan.ny.gov/Plans/2015 accessed 2016 03 12

[4] See appendix A for some of the similarities between GHPs and EVs both in terms of their policy advantages and the degree to which they've received 2nd tier support from official policies.

[5] See appendix B for a chart showing the relative GHG contributions from Volume 2 of the 2104 Draft New York State Energy Plan, The Energy to Lead: Impacts & Considerations, page 11 http://energyplan.ny.gov/Plans/2015 accessed 2016 03 15

New York is expending enormous effort reducing GHG emissions from in-state electricity generation, even though it accounts for only 18% of total fuel combustion emissions. It may be counterintuitive, but this is actually wise for 2 reasons.

1. In-state electricity generation is an area over which the state has a substantial degree of control. Because the bulk of electricity generation comes from large, centralized power plants, improving those plants or replacing them with renewable electricity generation can produce a large impact from a single action.

2. Electrification of the transportation and heating sectors offers the most promising path forward for cutting fuel-combustion emissions. However, increasing the adoption of BETs will likely increase the amount of electricity used, making it more important than ever for that electricity to be generated cleanly.

To illustrate the latter point , transportation and heating are currently far more significant than electricity generation as GHG sources, given the relatively clean generation mix New York has established. However, in the future, as the use of efficient BETs such as EVs and GHPs increases, it will magnify the result of cleaner electricity generation.

For example, a typical GHP might deliver 4 kWhs [6] of heat for each kWh of electricity used to power it. This is often expressed as a coefficient of performance, or COP of 4, and is a fairly typical performance for a well-designed GHP system. If purely as an example, one unit of GHGs is produced during the generation of that one kWh of electricity, we can say that 1 unit of GHGs is produced in delivering 4 kWh of heat. If our electricity generation mix is cleaned up through adoption of renewables and other means, such that only ½ unit of GHG's is produced to generate that same kWh of electricity, we will be getting 8 kWh of heat from that same unit of GHG's.

While the example above points to the importance of continuing to clean our electricity generation mix, it should also make clear the multiplying impact that GHP adoption will have on those mix cleaning efforts.

In considering the effectiveness of simultaneously growing both the renewable electricity and renewable heating markets at the same time, we invite readers to examine appendix C. It is a life cycle analysis done by NY-GEO which concludes that a kWh of solar PV in New York State costs about 10 cents, while a kWh net equivalent of heat yielded from a GHP installation costs about 5 cents.

In this regard it is important that New York not adopt policies and practices that have "*the inadvertent effect of deterring the adoption of beneficial technologies*" [7]. By primarily focusing on

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[6] BTUs and kWh are both convertible units of energy. The conversion factor between BTU's and kWh is that 1 kWh = 3,41214 BTUs https://www.ashrae.org/resources--publications/handbook/the-si-guide Accessed 2016 03 16

[7] Staff White Paper on Clean Energy Standard in case 15-E-0302, issued January 25, 2016, page 13, https://www.google.com/#q=staff+white+paper+on+clean+energy+standard accessed 2016 03 12

the goal of attaining 50% renewable electricity generation by 2030, the Clean Energy Standard (CES) risks the *inadvertent effect* of making it harder to attain the goal of a 40% reduction of GHG emissions by 2030.

To explain further:

Regarding the target of 50% renewable electricity generation by 2030, 50% consists of a numerator (50, representing the relative amount of electricity produced from renewable sources projected as 75,008 gWh in 2030 in the white paper[8]) vis à vis a denominator (100, representing the total amount of electricity demand in 2030, projected as 150,017 gWh).

In this case, every gWh of increased demand means electric utilities, and other load serving entities (LSEs) such as Energy Service Companies (ESCOs) that supply power to utility customers, need to find at least an additional ½ gWh of renewable energy or renewable energy credits (RECs) to maintain compliance with the CES.

Take an example where aggressive adoption of EVs and GHPs might cause the need for 200,000 gWh of electricity generation in 2030. The results would be [9]

- a dramatic reduction in GHGs in the sectors currently producing the most GHGs in New York
- cleaner air
- better public health
- dramatically lower energy costs for New Yorkers through the elimination of natural gas and gasoline bills
- lower electric utility rates through reductions in peak demand [10]
- more flexibility in demand reduction programs, as GHPs and EVs can function as energy storage media [11]
- Reductions in total energy use [12]
- increased electricity sales for utilities - stabilizing their finances [13]
- better grid and distribution system utilization, providing a better return on utility investment
- decreased dependence on natural gas, which is currently dominating both the home heating and electricity generation markets in New York. This would increase fuel diversity and cut vulnerability to volatile prices for New York consumers [14]

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[8] Staff White Paper on Clean Energy Standard in case 15-E-0302, issued January 25, 2016, page 9, https://www.google.com/#q=staff+white+paper+on+clean+energy+standard accessed 2016 03 12

[9] See appendix D for a more visual summary of some of the advantages of GHPs

[10] See appendix E for a discussion of peak demand in New York's various load zones

[11] See appendix F for a description of how GHPs might work as an energy storage medium in a peak demand reduction program

[12] See appendix G for the energy reduction data from a GHP installation at the Lockport Housing Authority

[13] See appendix H for an essay by NY-GEO – *How Utilities Can Thrive in a Solar PV Environment*

[14] See appendix I for data on natural gas fuel dependency in New York

- less hard-earned dollars paying taxes to subsidize the fossil fuel industry through the Home Energy Assistance Program (HEAP) program [15], and
- a reduction in fossil fuel use, resulting in a stronger state economy, since fewer dollars would be flowing out of state for gasoline and natural gas, little of which, in either case, is produced in-state. [16]

However, working against these results would be the fact that LSEs will need to procure RECs representing at least 25,000 more gWh of renewable power. Paying for RECs adds to the expense of providing power, and more REC demand will mean a higher price for those RECs in an open market. DPS Staff is proposing an Alternative Compliance Payment (ACP) that is designed to cap the cost of RECs by allowing LSEs to pay a fixed price ACP unit when utilities fail to procure enough RECs or when RECs rise above the price of the ACP.

The ultimate financial dynamic consists of the following: There will be increased costs for adding RECs or ACPs as result of BETs being installed in a utility's service area. These costs subtract from the financial benefits of increased electricity sales and better system utilization, and will dampen the enthusiasm of the utility to accept or even incentivize BETs, despite their many advantages to both the utility and to society at large.

Many utilities are currently incentivizing BETs for financial and other reasons. These include GHP incentives by utilities such as Commonwealth Edison in Illinois, PSEG Long Island in New York and numerous electric co-operatives such as Western Farmers in Oklahoma and Corn Belt Energy in Illinois. New York's private utilities such as National Grid are investing in EV charging stations and the recently adopted NYS budget includes rebates of up to $2,000 for the purchase of EVs and plug-in hybrid vehicles. [17]

It is important that meeting the Clean Energy Standard does not deter utilities from adopting and/or incentivizing BETs because the expansion of their use is crucial to meeting the goal of a 40% GHG emissions reduction by 2030. BETs will become increasingly more important the closer New York comes to the 40% goal. There are only so many tons of GHGs that can be wrung out of 18% of New York's total emissions.

[15] In NYSERDA's October, 2015 Low Income Forum on Energy (LIFE) program, it was reported that New York spent $366 million on the HEAP program the previous year – more than the annual projected Clean Energy Fund Market Development program, and about what is projected to be spent annually on the total CEF program after 2018. NY-GEO realizes that HEAP includes life-saving measures, and that the funds are from federal taxpayers. But the reality is that after 2018, the CEF will leave New Yorkers spending about as much public money to subsidize fossil fuel companies to keep greenhouse gases spewing out of our chimneys as we do to develop efficiency and clean, renewable energy in our state.

[16] See Appendix J point 5 for a table from NYS Patterns and Trends breaking down expenditures for out of state fossil fuels. The entire appendix makes the point that GHP is at a similar to point of development to where Solar PV was 10 years ago, and that similar support is merited

[17] https://www.nrdc.org/experts/luke-tonachel/new-york-state-enacts-electric-vehicle-consumer-rebate-program Accessed 2016 04 16

According to the Staff White Paper [18] 26% of New York's electricity was generated from renewable sources in 2014. The US Energy Information Agency reports that 45% of New York's mix was from fossil fuels in 2104 [19] (40% Ngas, 3% coal, 2% oil) . The remainder was primarily nuclear. Reaching the goal of 50% renewable electricity might mean cutting the 45% of the supply that comes from fossil fuels by about half, depending on the future of nuclear generation in the state . Fossil fuel emissions from electrical generation amount to 23% of New York's total when including emissions from out of state generation. Cutting 23% in half could yield a 12% reduction in GHG emissions. This would be an important reduction but it leaves New York in need of other very significant measures to meet the 40% reduction in greenhouse gases targeted by the plan. Thus, reduction of emissions in the heating and transportation sectors is crucial to meeting the 40% target.

In many ways it is unfortunate that the history of energy regulation in the US has often maintained silos between various forms of energy. For example, New York regulates electricity separately from natural gas and has little to say about oil, propane, gasoline and diesel fuel.

In many cases, elected officials, the public and the media confuse goals like 50% renewable electricity generation by a certain date with 50% energy from renewables by that date. The increasing number of cities that have set the goal of buying 100% of their electric power from renewable sources are often mistakenly said to have set the goal of 100% renewable energy.

In Europe it is different. The European Union and other authorities set renewable energy goals and it is well understood that the heating sector falls within those goals.

The PSC has taken a giant step forward to break down silos by recently adopting fuel neutrality in its practices, whereby funds can be used to incentivize fuel switching measures regardless of their source.

In addition, in its comments to the EPA on the federal Clean Power Plan[20], the NY Department of Environmental Conservation made clear its understanding that in New York's case, with a relatively clean electric mix, the heating sector often offers more fertile ground than the electric sector for reducing greenhouse gases. One of DEC's sentences puts it quite succinctly: "When compared to New York's electricity sector, the thermal load sector is considerably more GHG-intense".

NY-GEO submits that a total energy perspective is superior to a silo perspective, because it allows a fuller analysis and a more balanced and comprehensive view of potential results. The opening paragraph of the introduction of the Staff White Paper clearly puts the renewable electricity target in the context of the State's overall "longer term goal of decreasing carbon emissions 80% by 2050." [21] However, the white paper quickly reverts to a silo perspective and this proceeding runs a very

[18] Staff White Paper on Clean Energy Standard in case 15-E-0302, issued January 25, 2016, page 7, https://www.google.com/#q=staff+white+paper+on+clean+energy+standard accessed 2016 03 12

[19] Table 5. Electric power industry generation by primary energy source, 1990-2014 from https://www.eia.gov/electricity/state/newyork/ accessed 2016 04 15

[20] see NYSDEC comments on 111D in Appendix A – page

[21] Staff White Paper on Clean Energy Standard in case 15-E-0302, issued January 25, 2016, page 1, https://www.google.com/#q=staff+white+paper+on+clean+energy+standard accessed 2016 03 12

real danger of producing policies that promote the renewable electricity target at the expense of the carbon emissions target.

In our view, given the likely destructive impacts of unabated climate change on the economy and quality life of New Yorkers, the 40% GHG reduction goal should generally have primacy over the 50% renewable electricity goal when the two conflict. It is crucial that the results of this proceeding not distort the market in ways that work against the "longer term goal of decreasing carbon emissions".

The Importance of GHP in Facilitating Other Renewables

There are other significant reasons why BETs such as GHPs need to be well integrated with the Clean Energy Standard.

Peak demand reduction is a key economic consideration in New York's energy policies . GHPs are a particularly effective peak demand reduction measure because they are far and away the most efficient way to cool homes and other buildings and New York's demand peaks come during the summer cooling season. In addition, both EVs and GHPs, as distributed energy resources, can be used as effective demand reduction tools. See appendix F, for an illustrative example of geothermal heat pumps as a distributed energy resource.

In addition, the key growth technologies for new renewable electricity generation in New York are wind and solar – both intermittent sources. The closer New York gets to its 50% target, the greater the impact of that intermittency.

GHPs can be a significant resource by absorbing renewable electricity output that might otherwise be excessive. The Earth Institute at Columbia University has produced a study titled *Potential for increased wind-generated electricity utilization using heat pumps in urban areas* [22]. The study focuses on New York City.

In an excellent summary of the study [23], author Lakis Polycarpou writes:

> As long as the amount of electricity generated from renewable sources remains relatively low, the utilization rate of those sources—the percentage of electricity used as it is generated—remains high. However, because the times when wind-speeds are the highest (or the sun is the strongest) don't necessarily coincide with the times when demand for energy is the greatest, as the percentage of renewable electricity generation grows, the more generation needs to be built to meet peak demand, and the more excess energy produced at non-peak times has to be stored or "shed" — and the more expensive the per-unit cost of that electricity becomes.

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[22] Potential for increased wind-generated electricity utilization using heat pumps in urban areas by Michael Waite and V.J. Modi, Applied Energy Volume 135, 2014 12 05, Pages 634-642 http://www.sciencedirect.com/science/article/pii/S0306261914004127 accessed 2016 03 14

[23] For a Wind Powered City Heat Pumps Are Key by Lakis Polycarpou, 2014 06 27 http://blogs.ei.columbia.edu/2014/06/27/for-a-wind-powered-city-heat-pumps-are-key/ accessed 2016 03 14

“Because of this intermittency issue,” explains Waite, “when you have deep penetration of renewables, you end up having to shed those loads or store the energy, which is very expensive, two to three times the actual cost of the power. So anything you can do to sort of better align [supply and demand] is beneficial to the whole system.”

According to Waite’s analysis, if New York City installed enough wind power to meet 20 percent of total annual electricity demand, about 80 percent of that electricity could be used immediately as it was generated. But if the city decided to install enough wind power to meet 80 percent of the city’s electricity needs, it would have to overbuild to meet summer air-conditioning demand; this overbuilt capacity would then produce excess electricity in the winter, and the utilization rate would fall to between 30 and 40 percent.

If, however, the city changed building heating systems from oil or natural gas boilers to heat pumps, which both cool and heat, they would cool buildings more efficiently in summer and make more use of winter wind energy, while reducing the amount of oil and natural gas burned in buildings for heat.

“Right now we have a scenario where the peak electricity demands are during the day, late afternoon in the summer. What we’re going to end up seeing if we bring on a lot of heat pumps or electric heating of any kind, is that the new demand peak is going to be in the winter at some point—probably early morning,” says Waite. [24]

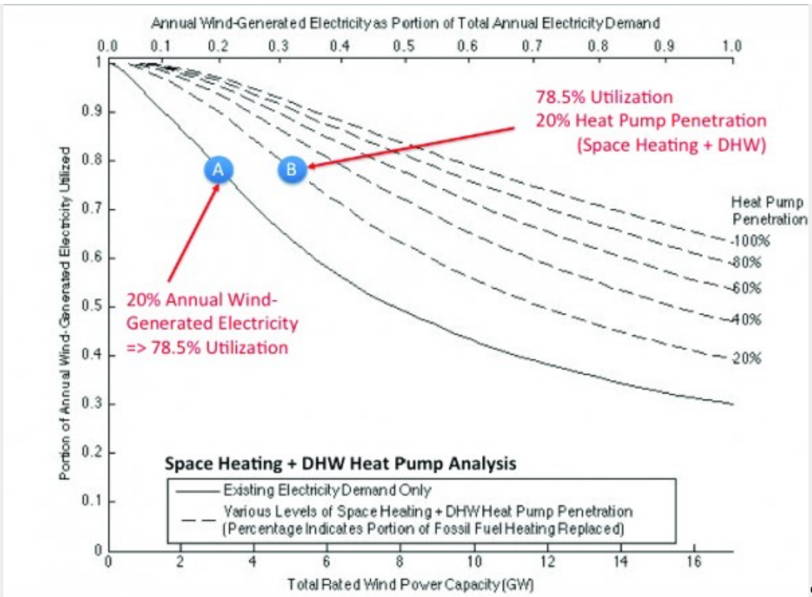
This would increase the utilization rate of installed wind—or, looked at another way, increase the amount of wind generation that could be installed at the same utilization rate.

For example, under current conditions, if 80 percent utilization were required to make installed wind power economical, the city could afford to install enough generation to meet 20 percent of its annual electricity demand. But if 20 percent of buildings switched to heat pumps for heating and hot water, the city could instead meet 30 percent of its total electricity demand at the same 80 percent utilization rate. If the city converted 100 percent of building heating to heat pumps, it could meet over 60 percent of total electrical demand with wind power at the same 80 percent utilization rate—in other words, without increasing the per unit cost of electricity.

According to Waite, this may be the most important finding of the study.

“Let’s say there’s a policy,” explains Waite. “We’re going to install enough wind power to meet 20 percent of the annual electricity demand for New York City. And that’s great. What happens though, is those don’t really align, so you can only use 80 percent of what’s generated, which means you’re only meeting 16 percent of the annual electricity demand. That’s not bad, but the cost of that is 25 percent greater than it would be otherwise. Maybe you accept that, it’s sort of built into the cost of the economics. But if we continue and install more, at about 5.5 gigawatts, we’re already down to 60 percent utilization of the wind-generated electricity. So all of a sudden, you have a cost premium of 67 percent on top of what’s used. But if you have heat pumps installed, that bounces you back up, in line with the target you had before.”

[24] See appendix E for data on current peaks in New York State



Space heating and domestic hot water analysis. Source: Michael Waite.

> "From a pure energy perspective, installing wind power is good," he adds. "From a pure emissions perspective, installing heat-pumps is good, because you have this efficiency, and we already have a fairly clean grid in New York State. But you marry the two together, it makes the heat pumps even more efficient, and it can allow for even more wind power to be installed."

The implications of the Waite/Modi study are not confined to the New York City area, but are broadly applicable across New York State. As New York comes closer to its 50% renewable electric target, BETs will become more and more significant and beneficial.

2. Mechanisms for neutralizing the inherent contradiction between the proposed CES compliance obligation and the need to increase BET within New York's energy system

New Yorkers are consumers of three primary forms of energy – electricity, heating fuel and transportation fuel. A fourth form, the energy embedded in the products we consume, is primarily made up of the first three forms. The purpose of a Clean Energy Standard is to shift energy generation and consumption to energy forms that are clean, meaning forms that are free, or nearly free, of pollution.

Pollution in the current context is of two types – GHGs, which impact climate stability, and more conventional pollutants that impact human health and/or the environment (through phenomena such as acid rain). The 50% renewable electricity target places the obligation for cleaning our energy supply on purveyors of electricity, with the cost ultimately being borne by New Yorkers as electricity consumers.

As explained earlier, reaching the 50% renewable electricity target will bring a cleaning of a limited portion of our energy supply – the electricity sector, which is already relatively clean, and which is the source of only 18% of New York's greenhouse gases (23% when imported generation is included).

Unless a far stronger emphasis is placed on integrating heating and transportation emissions into the CES , it will leave untouched the vast majority of our energy supply and its attendant pollution. New Yorkers, as consumers of heating and transportation fuels, have no obligation and make no progress through a CES that is almost solely focused on a 50% renewable electricity target. Similarly, the companies that supply heating and transportation fuels have no obligation under such a regime.

Beneficial electrification reduces heating and transportation fuel use. Heating and transportation fuels are currently primarily fossil fuels, for which there is no practical method to render them clean, or nearly free from pollution. Minimizing their use through efficiency and conservation reduces their pollutant impact only to the degree that we are using less of them. Electrification offers us a way to eliminate the use of these fossil fuels by shifting their functions to an energy form that can be generated cleanly. In fact, electricity is in the early stages of a transformation to a primarily clean form. This transformation is international in nature and is gaining remarkable momentum.

The CES can only be truly effective and comprehensive in relation to New York's energy pollution if it functions in a way that does not discourage beneficial electrification. This will mean providing a way to reward (or at least hold harmless) purveyors of electricity – LSE's, and by extension New York's electricity consumers - when they take on the obligation of reducing fossil fuel pollution in the heating and transportation sectors.

At this point, New York is not holding the heating and transportation fuel sectors accountable for their pollution or imposing a substantial obligation on them to reduce that pollution. It would be acutely unfair to transfer the obligation to provide clean heating and transportation to the electricity sector – LSE's and ultimately New Yorkers as electricity consumers - without providing revenue neutral or incentivized ways for the electricity sector to meet this increased obligation.

There are essentially two ways, in the context of an electricity focused Clean Energy Standard obligation, to more fairly allow LSEs and electricity consumers to take on obligations for the heating and transportation sectors:

- One is to hold LSE's harmless from increased load stemming from increased installations of BET.
- The second is to provide incentives that outweigh the disincentive that increasing load represents in an electrical compliance obligation environment.

We will attempt to address both these possibilities from the perspective of GHP installations. The approaches we raise may also be applicable for EVs and other BETs. Of course there are likely to be additional approaches specific to those technologies as well.

….Holding LSE's Harmless

One obvious way of holding LSEs harmless is to exempt increased BET load from the CES obligation. In this case, the pledge would be to require 50% of New York's electricity to be from renewables, net of load due to sanctioned BETs.

Measuring the BET contribution to load presents a challenge. However we would expect New York's energy analysts at NYSERDA, NYSDEC, NYISO and NYPA to be tracking these data one way or another. It is valuable information fundamental to identifying the causes of peak load reduction, demand response effectiveness, GHG emissions reductions, fossil fuel replacement, criteria pollutant reduction, green job creation and other phenomena crucial to New York's energy policy progress.

We would expect the preferred method would be to measure these data on a macro level, using current mechanisms that capture energy data in the state. However it would also be possible to create per kWh or MWh "Fossil Fuel Replacement Credits" that would be issued to LSE's for installations of GHP systems, purchases of EVs, etc. within their customer base. These credits need not have a financial value. Their value could solely rest in reducing the LSE's compliance obligation.

The main weakness of the exempting BET caused load is that it would force an asterisk on an important measuring stick that citizens of New York, the nation, and the world will be watching closely. The performance of the Clean Energy Standard, as proposed, will become more and more significant as the worldwide transition to renewable energy progresses.

NY-GEO suggests that the more meaningful measuring stick is the one that measures New York's performance on the 40% GHG reduction goal, as this will have a direct impact on New Yorker's lives and ability to survive climate change.

If the 40% GHG goal were the focus of the CES there would be no contradiction. Things would perhaps get more complicated, but the ultimate measure would more accurately represent true and holistic progress.

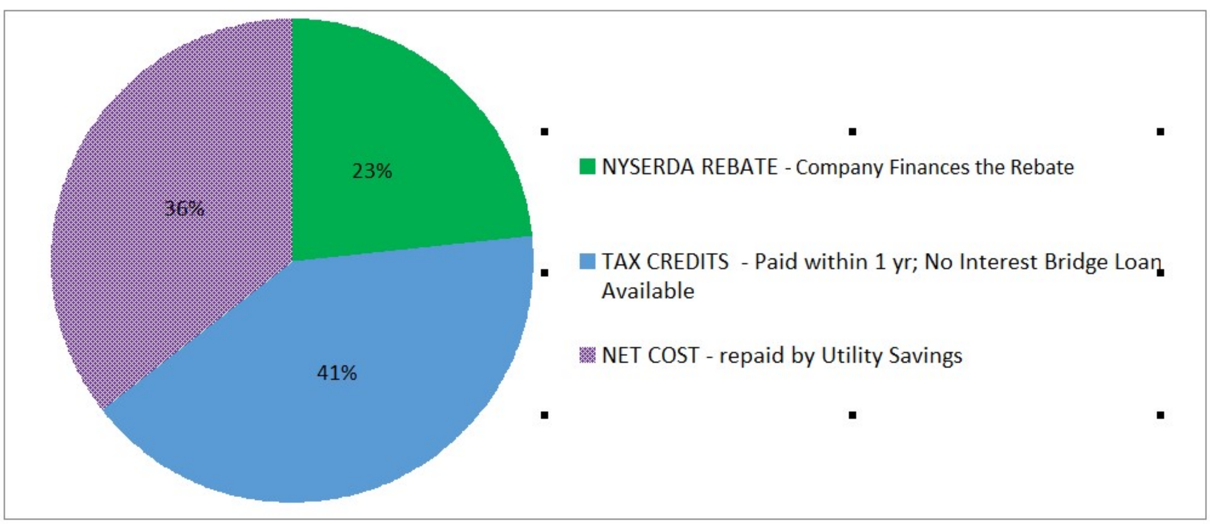
….Develop Incentives to Outweigh the Disincentives

At this point, there are minimal incentives for BETs in New York State. The recent adoption of EV rebates helps, as does State support for EV charging stations, but the transformation fo New York's transportation sector has a long way to go. Fuel switching prohibitions have stymied most heat pump support until recently. NYSERDA's development of its Renewable Heating and Cooling initiative holds tremendous promise, and is being watched closely and hopefully by the GHP industry in New York and throughout the nation and the world. However, that program is still in its infancy and is not yet providing more than demonstration incentives.

Taking an objective look at the contrast between prescriptive support for solar and geothermal installations in New York State can be instructive on the current relative support for these technologies.

A NY-GEO member recently had a 6.67 kW solar PV system installed on his house. His installer supplied him with the following graphic summary of financial considerations:

How your project cost breaks down:



E	F	G
Total System Cost	$27,821	Total value of your solar system and services
NYSERDA Rebate	($6,500)	This as a form of payment directly from NYSERDA
Cash After Rebate	$21,321	You can write a check for this OR charge tax credits to Zero Interest Zero Payment 12 month credit card
Tax Credits	($11,396)	Charged to Zero Interest Zero Payment credit card
Net Cost	$9,924	You can write a check for this OR apply for On Bill Financing and borrow this from the state
On Bill Financing	($9,924)	Repaid on your electric bill monthly, must be less than solar savings
On Bill Financing	-Saving $72 per month -Loan Payments $71 per month -$0 Cash positive per month	- 15 year term - No pre-payment penalty - 3.49% rate

Summary: 64% of system cost covered by local, state and federal incentives. You can pay the remaining 36% ($9924) or borrow this from NYS and repay $71 per month on

A typical geothermal installation within New York would have a similar base cost and, as noted extensively in the first section of this document, would bring at least a similar, if not greater, degree of environmental and economic benefits. However, with the exception of the federal tax credit, which sunsets for GHP systems at the end of 2016, none of the incentives that made this solar installation financially desirable for the homeowner exist for most GHP installations in New York State. This includes the sales tax exemption, NYSERDA rebate, the 25% (up to $5,000) New York State solar PV tax credit and the low interest, on-bill financing. In addition, Solar PV has benefited from more than a decade of consistent state support including education, outreach and inclusion of solar PV in numerous programs.

NY-GEO is working for parity with solar PV on all these fronts and is thankful for a changing and welcoming atmosphere within the PSC, NYSERDA and New York State government. In the meantime though GHP, as a beneficial electrification technology, enjoys none of the above mentioned incentives, and is facing a CES environment in which LSE's will have a good reason to discourage GHP installations because they will increase the obligations the LSE must meet.

….TRECS

New York is considering extending incentives for renewable electricity generation technologies through Renewable Energy Certificates (RECs) as a primary means of meeting the 50% renewable electricity target. In this context, we urge the PSC to consider adopting Thermal Renewable Energy Certificates (TRECs) as a way to begin developing parity for thermal renewable technologies. TRECs may provide a mechanism to allow the electric sector to receive credit for taking on the pollution reduction obligations of the heating sector.

Under a TREC program, every renewable MWh [25] of heat produced in a GHP installation would be awarded a tradable certificate. In a GHP unit functioning at a Coefficient of Performance (COP) of 4, 1 unit of electricity would add to 3 units heat from the ground to contribute 4 units of heat to the building. In this case the 3 units of renewable heat would be measured over time and awarded a TREC for every MWh generated. The TRECs, like RECs would be earned or purchased by LSE's to meet their CES compliance obligation. The number of TRECs , grow proportionally with new renewable heating systems installed.

New Hampshire has led the way for TREC implementation in the United States. Twelve states are at various points of adopting TRECS, according to the Clean Energy States Alliance [26], including Massachusetts and Maryland. In June of 2014, the New Hampshire Public Utility Commission (NHPUC) adopted an order for the TREC system to begin operating for thermal renewable systems installed since January 1st 2013.

The Ground Energy Support web site [27] succinctly explains some of the program elements:

> "Thermal RECs are similar to Solar RECs (SRECs) in that 1 Megawatt hour (MWh) earns 1 REC. Energy production is reported to the New England Power Pool Generation Information System (NEPOOL GIS) that mints the RECs, which are then typically sold by an aggregator to REC purchasers (typically electrical utilities).
>
> According to SB218, NH utilities are now required to produce a percentage of their energy from Class I renewable thermal technologies, including geothermal heat pumps. SB218 requires that electricity producers either produce or acquire, through the purchase of RECs, approximately 40,000 MWh of Class I renewable thermal energy in 2014; 80,000 MWh in 2015; and 160,000 MWh in 2016. By 2017, Class I thermal RECs will account for almost 10% of the total Renewable Portfolio Standard in New Hampshire.
>
> There are two primary factors that contribute to the value of RECs. The first is the Alternative Compliance Payment (ACP). When utilities are unable to produce or acquire Class I thermal RECs, they are required to pay an ACP into the Renewable Energy Fund; part of the Fund is used to support renewable energy projects in the State. The ACP is set by the

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[25] See footnote **6** re the conversion of BTU's to kWh.

[26] Renewable Thermal in State Renewable Energy Portfolio Standards, Samantha Donalds, Clean Energy States Alliance, April 2015, http://www.cesa.org/assets/Uploads/Renewable-Thermal-in-State-RPS-April-2015.pdf accessed 2016 03 17

[27] http://groundenergysupport.com/wp/nh-thermal-recs-need-know/ accessed 2016 04 14

legislature, and for Class I Thermal in New Hampshire, the ACP is $25 per REC. The ACP represents the maximum price for which thermal RECs would be purchased.

The second factor that determines the value of RECs is their availability. RECs will have optimal value when the number of RECs available is less than the minimum number of RECs required to be acquired by the utilities. If there are more RECs available than required to be purchased, the REC value diminishes. As noted above, the obligation for Class I Thermal RECs in New Hampshire will be increasing significantly over the next several years, making market saturation unlikely.

…For systems with a capacity less than 150,000 Btu/hr (12.5 tons), metering can be accomplished by metering heat pump runtime and using certified heat pump performance data to calculate the thermal energy produced. The runtimes and associated computations must then be reported to the NEPOOL GIS by an Independent Monitor, an individual registered with the NH PUC.

Metering equipment costs can vary, ranging from no cost (if already using an Ecobee Smart thermostat), to approximately $400 to meet minimum requirements, to several thousand dollars for systems requiring a heat meter.

Currently, in New Hampshire T-RECS are purchased at approximately $22-23. Even assuming a net yield of $20/REC, the operating cost of a geothermal heat pump system with a COP of 4 can be reduced from $11 per Million BTUs (MMBTUs) to $5 per Million BTUs, compared to $26/MMBTU for oil, $36/MMBTU for propane, and $45/MMBTU for electric heat."

Because TRECs provide a revenue stream, enterprising financiers have already found a way to securitize that revenue stream in New Hampshire, albeit for biomass systems [28]. The New Hampshire TRECs Enterprise Fund offers facility owners, including homeowners , upfront cash for the installation of a qualified wood heating system in exchange for the rights to the TRECs. This method of financing insulates building owners from volatility in the TREC market.

There are numerous questions that would need to be addressed in setting up a TREC program in New York:

- Which technologies are included as truly renewable?
- Should cooling be credited?
- How can volatility be avoided?
- Should a separate thermal obligation be carved out within the RPS?
- How should the Alternative Compliance Payment (ACP) be set?
- How are the ACP funds used?

NY-GEO offers to constructively engage in helping the PSC answer these questions and urges the PSC to include TRECS in the CES as a way to accomplish fairness for LSEs, which are ultimately compensated and supported by New Yorkers as electricity ratepayers.

[28] http://www.t-recsfund.org/uploads/5/1/6/6/51665611/t-recs_enterprise_fund_one_page_summary.pdf
U.S. Endowment for Forestry and Communities , accessed 2016 03 17

In addition to TRECs, NY-GEO would like to briefly suggest a few other ways the PSC can consider to increase GHP installations:

1. **Advocate for incentive parity between GHPs and solar PV** As noted above**,** New York's incentives for solar PV include sales tax exemption, substantial NYSERDA rebates, a 25% (up to $5,000) tax credit and low interest, on-bill financing. In addition, Solar PV has benefited from more than a decade of consistent state support including education, outreach and inclusion of solar PV in numerous programs. New York lost a major clean-energy opportunity when tax credit and sales tax exemptions for GHPs were left out of the 2016-17 State budget. Both these measures had been unanimously passed in both houses of the State Legislature. Strong and well-communicated recognition by the PSC of the desirability of these measures could have resulted in a different outcome.
2. **Educating LSEs** - The PSC has a unique capacity to communicate with New York's electric utilities – investor owned, municipally owned, and member owned. GHPs offer unique benefits for utilities in reducing peak demand and increasing system utilization, as well as sales. These benefits can be crucial to utility survival in an age where on-site electrical generation can threaten the utility business model. The PSC can provide a forum where GHP benefits are explored with utilities. Ultimately, the PSC can pave the way for incentive programs where utilities offer renewable thermal rates or up-front grants proportional to the financial benefits the utility receives.
3. **Renewable Heat Incentive** - The UK's renewable thermal feed-in tariff is a different model than the one New York has been pursuing but it has been very effective. According to the UK Department of Energy and Climate [29], 20,088 residential renewable thermal systems have been accredited under the RHI.
4. **Just Transition Demonstration Projects** – Dunkirk, Tonawanda, Somerset, Ithaca and other communities that host coal generating plants are all facing devastating job and tax revenue losses as these plants close. A program could be developed where workers are retrained and economic development dollars are used to incentivize geothermal systems for interested residents who have been exposed to years and even decades of lung damaging air pollution. This model could also be applied to redevelop hollowed out areas of New York's cities [30] where preinstalled GHP loop fields on currently vacant lots can efficiently set the stage for low utility bills as the lots are in-filled with housing. Low energy costs would stabilize the reinvigorated neighborhood and allow low and moderate income (LMI) residents to be part of the resurgence.
5. **The Merton Rule** – Merton, a town in the UK, developed a groundbreaking planning policy [31], which required new developments to generate at least 10% of their energy needs from on-site renewable energy equipment in order to help reduce annual carbon dioxide (CO2) emissions in the built environment. The rule applied to all types of buildings, not just homes. Merton Council developed the rule and adopted it in 2003. Since then the Mayor of London and many councils have implemented it, and it has become part of national planning

[29] https://www.gov.uk/government/collections/renewable-heat-incentive-statistics Table 2.1 accessed 2016 03 17

[30] See appendix K for a brief proposal for GHP based urban redevelopment in Buffalo NY

[31] http://www.merton.gov.uk/environment/planning/planningpolicy/mertonrule.htm accessed 2016 03 17

guidance. Adopting a renewable energy requirement as part of the state code would be a technology neutral way to rapidly ramp up renewable energy development in New York.

6. **The Denmark Ban** – Denmark simply banned fossil fuel heating in new builds starting in 2013.

Beneficial electrification will happen because climate stability demands that we address the substantial degree that heating and transportation fuel contribute to greenhouse gas emissions, which are causing climate instability. Markets and consumer behavior are currently responding to this demand in a limited way in the absence of effective incentives. It is up to the PSC to weigh the benefits of BETS and to develop appropriate incentives to secure those benefits.

3. Estimating electrical load under a scenario of robust adoption of BETs

Staff's estimate of increased load from EV/HP may prove to be very much an underestimate. The Staff estimate is that 8,615 GWh of EV/HP load would be realized by 2030.

However, as the table below shows, that incremental demand would represent only:

- 5.14% of the energy produced today just by burning fossil fuels in the residential sector.
- 20% of the energy needed to heat all residences using GHP at COP = 3.5

Thus, the Staff is projecting very slow growth of EV/HP use over the next 15 years and very low penetration of GHP.

The EIA Residential Energy Consumption Survey estimates the amount of energy (BTU) sourced from different fuels burned in New York residential buildings in 2009 (the latest data available). From this data, we extrapolate below the amount of electricity that would be needed to heat those homes if they all converted to GHP at COP = 3.5.

Fuel Type	**Quad BTU**	**GWh_fossil**	**Efficiency**	**GWh_ghp @ COP = 3.5**
Natural Gas	0.398	116,642.26	0.90	29,993.72
Propane	0.012	3,516.85	0.90	904.33
Fuel Oil	0.161	47,184.43	0.80	10,785.01
Kerosene	0.0005	146.54	0.80	33.49
Total	0.5715	167,490.08		41,716.56

NY-GEO offers to be part of a working group that helps staff develop aggressive estimates for a beneficial electrification program.

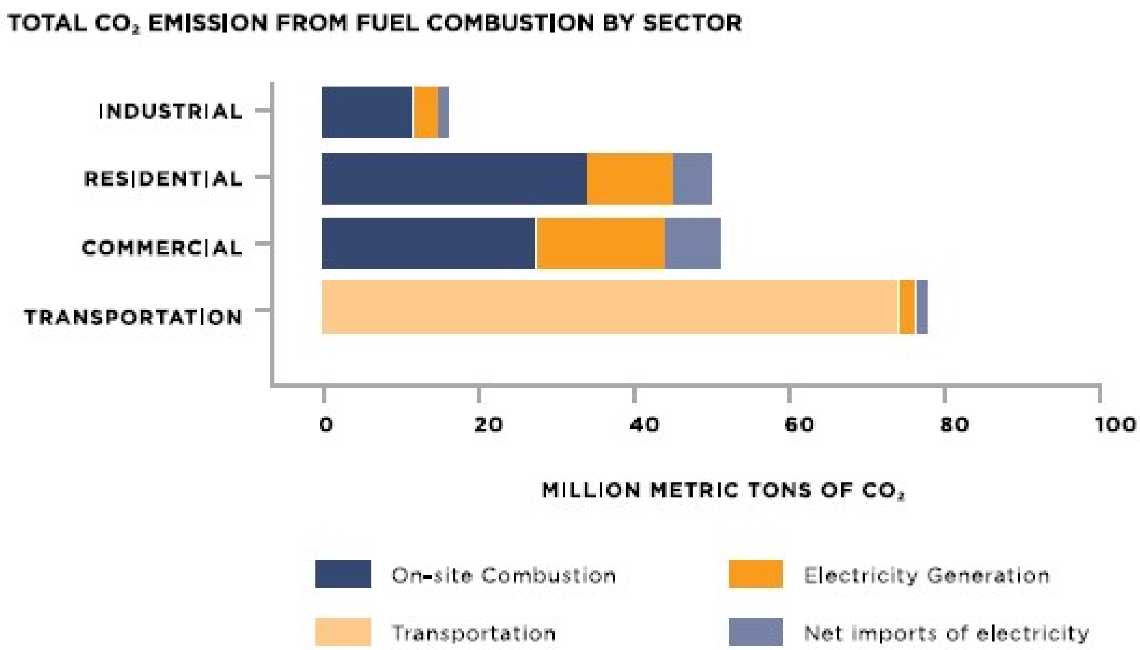
Appendix A - GHP and EV parallels

NY-GEO has consistently pointed to the parallels between GHPs and EVs as positive technologies that need to be better integrated into New York's energy regulatory framework:

- Both address more significant sources of GHG emissions in New York State than electricity generation, given New York's relatively clean generation mix
- In comparison to electricity generation, both have taken a seemingly remote back seat in New York's clean energy efforts
- Both have received inadequate support in the form of rebates and incentives from New York to date to allow significant market penetration
- Both have relatively high up front costs while providing significantly lower operating costs
- Growth of both technologies will allow NY to cut peak demand: EVs by allowing reversible storage when charging in low-demand hours and making power available to the grid in high-demand hours, and GHPs both by functioning as an effective DERm and by cutting peak cooling load as GHP's cooling efficiency is far superior to conventional central AC and ASHP precisely in the hot weather hours of peak demand
- Growth of both technologies will even out electric system utilization in the state
- Both will increase electricity use in New York State while significantly reducing overall energy use – particularly fossil-fuel use
- Both fit poorly in a silo driven regulatory framework that values reduction in electricity use over reduction in energy use
- Both will improve their environmental benefits as New York's electricity mix becomes even cleaner
- Both are key to New York's ability achieve an 80% reduction in GHG emissions by 2050.

Appendix B – On-site Combustion by Sector

This chart from Volume 2 of the NY State Energy Plan [32] shows that the bulk of on-site combustion in New York State is in the residential and commercial sectors, heating homes and buildings



[32] Volume 2 of the 2104 Draft New York State Energy Plan, The Energy to Lead: Impacts & Considerations, page 11 http://energyplan.ny.gov/Plans/2015 accessed 2016 03 12

Appendix C – GHP and Solar Investment Value

February 24, 2016

Re: Comparison of GHP and Solar PV Investment Value

Dear Commissioner Zibelman:

At our January 19th meeting, you asked us to compare the energy return on investment of a typical geothermal heat pump (GHP) installation with that of a typical solar installation before incentives. Below is that comparison developed and reviewed by the NY-GEO board:

A 9 KW solar system in Albany NY would deliver approximately 9,900 KWH of electricity annually, and at $ 3/watt would cost $27,000 to install. Spread out over the assumed lifetime of the system (25 years), the system delivers a renewable KWH for 10.91 cents.

Let's assume a typical new built 2800 square foot single family house in Central New York (Albany, NY), occupied by 3 people, with a design heat loss of 45,000 BTUs/hour for heating, a design heat gain of 26,400 BTUs/hour, and a daily hot water use of 55 gallons.

Modeled with 10 year average weather data, this house would annually use 83.6 Million BTUs for heating (24,501 KWHs), 9.2 million cooling BTUs for A/C (2,696 KWHs), and 16.2 million BTUs for domestic hot water (4,748 KWHs).

A variable speed geothermal heat pump (GHP) will supply the 24,501 KWH using 5,877 KWh of electricity, meaning that 18,624 KWH are coming free from the ground.

In addition, the system will make 54.7% worth of the domestic hot water, and use 588 KWH for that task, whereas 2,010 KWH comes free from the ground.

In A/C, the GHP system runs at an average EER of 31.6, versus a conventional Energy Star A/C unit (SEER 16) which runs at an average EER of 11.5. Thus the geo system provides the cooling load for 290 KWH instead of 801 KWH, saving 511 KWH annually.

In addition, the geo system will use about 1.25 KW during peak summer demand, versus about 3.00 KW for a high efficiency A/C unit, thus shaving about 1.75 KW of the peak demand.

In summary, the geo system delivers a total of 20,634 KWH of free energy from the ground (and saves an additional 511 KWH for A/C), but also consumes 6,755 KWH annually for doing so, which is also delivered as heat to the house or the domestic hot water (for a total of 27,900 KWH annual delivered and saved energy (A/C mode)), including the free energy from the ground.

The free market average price would be $30,000 (including hot water tanks) to install the geothermal system and it would be in lieu of a conventional HVAC/hot water system (gas furnace, air conditioning and gas hot water heater) costing $12,000. The incremental cost would be $18,000. Thus the 21,145 KWH of free and saved energy annually costs $18,000 additional upfront. Spread out over the assumed lifetime of the system (25 years*), the system delivers a renewable KWH for 3.41 cents, about 2.72 times the ROI over solar.

*In reality the geothermal system will have a far longer effective useful life as the ground loop, which accounts for 1/3 to 1/2 the cost of the system, has a materials warranty of 50 years plus in most cases, and is expected to produce for far longer than that.

Including the costs of operating the system over its 25 year lifespan (6,755 KWH/year x 12 cents/KWH (at current net present value) x 25 years = $20,265) to the $18,000 surcharge for the geo system the 697.5 MWH total energy delivered would cost 5.49 cents per KWH delivered, about 2 times the ROI - over solar.

Of note, the electricity the GHP system consumes is mostly in the off peak hours and in winter when electricity demand is low in NY relative to the summer peak which will result in better grid utilization. The average 1.75 KW peak demand shaving per installation can result in a significant impact on peak demand, forestalling or negating the need for investment in expensive new power plants and grid infrastructure.

The current utility business model is at great risk and will be in need of huge capital investment to solve the storage challenge of other renewable energy, creating extreme upward pressure on the cost per KWH delivered by the utility company. A geothermal program would create downward pressure on the fundamental delivered cost through both peak reduction and better asset utilization, with the ability to use onsite stored energy from the ground at the time the load (capacity) is needed.

The practical goal might be to greatly reduce the energy needed for the house by insulating and installing a geothermal system, and then supplying the remaining energy, at no operating cost, with a solar PV system, resulting in a net zero building.

In summary a geothermal delivers about 2 times as much renewable energy for every dollar of installation and operating costs at current installation rates in NYS when compared to solar PV, without considering incentives. In addition it significantly reduces the peak demand and increases the grid load factor during off peak times.

Thank you for this opportunity to supply you with this information. We look forward to your questions and/or comments.

Sincerely,

Bill Nowak

Bill Nowak, Executive Director, NY-GEO
518-3136-GEO
nygeoinfo@gmail.com

Geothermal Heat Pumps (GHPs):

A Great Fit for New York State's Energy Goals

NY GEOTHERMAL ENERGY ORGANIZATION

Reduces Summer Peak

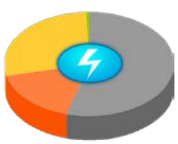
- Best HVAC option for reducing peak air conditioning demand

Improves Winter Grid Utilization

- Increases base load during non-peak winter periods

Least GHG Emissions

- Highest renewable component of practical HVAC systems
- Leverages NYS's clean electric grid capacity

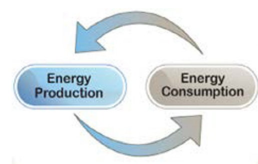


Contributes to Fuel Diversity

- Reducing State's dependence on fossil fuels and related price volatility

Shortest Path to Net Zero Energy

- Lowest non-combustion HVAC powered by renewable solar PV



Local Labor – Creates and Retains Jobs

- Straightforward training for any mechanical contractor
- Relies on local drillers and excavators

Broadly Applicable

- Can be installed in practically any building in NYS

A Solar Technology

- GHPs access the solar energy stored in the ground
- Renewable solar energy accessible 24·7·365

GHPs Offer the Greatest Savings Potential for Many NYS Buildings

- 50% savings on AC for buildings with natural gas access
- Additional 50% savings on heating cost without natural gas service

Appendix E – NYS Peak Demand

Exhibit 2-4 from the DGEIS - 2013 ELECTRICITY DEMAND, BY NEW YORK CONTROL AREA LOAD ZONE is taken from data on page 21 of the 2014 NYISO Gold Book [33].

EXHIBIT 2-4 2013 ELECTRICITY DEMAND, BY NEW YORK CONTROL AREA LOAD ZONE

STATE SUB-AREA	NYCA LOAD ZONE	2013 ANNUAL ENERGY USAGE (GWh)	PEAK DEMAND (MW)	
			SUMMER	WINTER
Upstate	A (West)	15,790	2,549	2,358
	B (Genesee)	9,981	2,030	1,645
	C (Central)	16,368	2,921	2,781
	D (North)	6,448	819	848
	E (Mohawk Valley)	8,312	1,540	1,415
	F (Capital)	12,030	2,392	1,989
	G (Hudson Valley)	9,965	2,358	1,700
Downstate	H (Millwood)	2,986	721	625
	I (Dunwoodie)	6,204	1,517	974
	J (New York City)	53,316	11,456	7,810
	K (Long Island)	22,114	5,653	3,594
	Upstate Subtotal	78,894	14,609	12,736
	Downstate Subtotal	84,620	21,705	14,703
	TOTAL	163,514	33,956	25,738

Source: NYISO, 2014 Load & Capacity Data "Gold Book." Page 21.

It documents that of New York's 13 load zones, 12 experienced summer peaks in 2013. These summer peaks are generally caused by spikes in air conditioning during hot weather periods. GHP performs efficiently on hot days because the cool earth acts as a heat sink for GHP systems. This contrasts with conventional air conditioners, which exhaust their heat inefficiently into hot outside air.

The lone NYISO zone which experienced a winter peak in 2013 was Zone D in the Northeastern corner of Upstate New York. Zone D had a winter peak of 848 MW and a summer peak of 819 MW. In many cases winter peaks can be caused by the use of electric resistance heat, a phenomenon which is encouraged by the very inexpensive NYPA hydropower available to New York's 47 municipal electric systems. Electric resistance heating has a COP of 1. In these cases, GHP systems, with COPs of 3 to 6, could be used to address winter peaks by cutting electricity used for heating down to a 3rd or a 6th of current demand.

33 http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Documents_and_Resources/Planning_Data_and_Reference_Docs/Data_and_Reference_Docs/2014_GoldBook_Final.pdf accessed 12/6/14

Appendix F – NYS Comments on 11D Clean Power Plan

Excerpt from New York State's December 1, 2014 comments to the USEPA on the 111D proposed carbon pollution emission guidelines: [34]

Requiring New York to seek dramatic reductions in the electricity generation sector may also have unintended consequences in broader GHG emission reduction policy and strategy. New York's draft 2014 State Energy Plan identifies a goal of reducing the carbon intensity of its energy economy 50% by 2030. This intensity reduction equates to an approximately 40% reduction by 2030 on a mass basis. New York, like many other cold-weather states, has a large space heating (or "thermal") load, the vast majority of which is met through fossil fuel combustion. Unique to New York is the significantly large portion of this thermal load that is met through petroleum distillate (i.e., "heating oil"); in the residential sector this distillate thermal load approaches 30% of all housing units in the State. When compared to New York's electricity sector, the thermal load sector is considerably more GHG-intense. To meet the State's overall GHG reduction policy, New York will be looking to make more "productive" investment in the thermal load sector, achieving greater levels of GHG reduction per dollar of investment. One potential undesired consequence of EPA's proposal is that, if New York is asked to dedicate a disproportionate amount of its limited investment resources in seeking less productive emissions reduction in the electricity sector, this is likely to sacrifice a level of investment in the more intensive thermal load sector, eroding progress towards overall GHG emission reductions.

[34] Letter from Joseph Martens, John B. Rhodes and Audrey Zibelman to EPA Administrator Gina McCarthy 2014 12 01, page 4 of 22
http://www.dec.ny.gov/docs/administration_pdf/nyscomments.pdf ,accessed 2016 03 12

Appendix G – GHP as a Distributed Energy Resource

Example of Geothermal Heat Pumps as a Distributed Energy Resource

Con Ed forecasts needing to fire up a dirty, expensive peaker plant from 5 to 7 PM on a given hot summer day due to projected demand. Among other measures, the utility turns to its pool of customers with geothermal heating and cooling systems.

These customers have already cut their contribution to peak demand by using 40% to 50 % less electricity to air condition their space. This is so because GHPs use the cool ground as a heat sink, unlike conventional air conditioners and air source heat pumps, which would be using increased electricity to power fans and compressors to reject their heat to the hot summer air.

In addition, the GHP systems would be diverting a portion of their building's rejected heat to their hot water tanks, saving energy in the process and reducing demand for either fossil fuel in the case of gas or oil water heaters, or electricity in the case of electric water heaters.

Under a projected Con Ed DER demand management program, Con Ed either notifies its GHP customers per established protocol, or takes control of their GHP systems per agreement. The systems then cool down the building spaces enough starting at 3:00 PM to allow them to shut down and coast through the 5:00 to 7:00 period, effectively cutting the peak load on Con Ed's system.

In many cases the electricity to power the increased GHP used during the 3:00 to 5:00 PM period will come cleanly and efficiently from solar PV systems within Con Ed's distribution system, which would be generating electricity productively from the late afternoon sun.

The GHP contribution to Con Ed's load reduction could be substantial, and would be proportional to the number of GHP systems installed. A success in this scenario would be defined as allowing Con Ed to avoid firing up the peaker plant due to the GHP demand reduction, coupled with other sources of demand reduction in their program.

Data on GHP and peak demand from a 2010 Oak Ridge National Laboratory Study[35]…

*** Reduced summer peak electrical demand from GHP retrofits for existing US single family homes**

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[35] *Assessment of National Benefits from Retrofitting Existing Single Family Homes with Ground Source Heat Pumps, June 2010, Xiaobing Liu, Oak Ridge National Laboratory (page 27, table 10) http://www.energy.ca.gov/2013_energypolicy/documents/2013-03-21_workshop/background/Liu_GSHP_Report_8-30-2010.pdf accessed 2016 03 12

Census Region	SH-SC-WH System Types	Number of Single-Family Homes that Have Space Cooling	Percentage of Various Equipments Used for Space Cooling	Regional Average of Installed Space Cooling Capacity for the Reference Building	Normalized Peak Electrical Deamd for Space Cooling of Existing SC Systems	Normalized Peak Electrical Deamd for Space Cooling of the GHP System	Reduction in Normalized Peak Electrical Deamd for Space Cooling from the GHP Retrofit	Percentage Reduction of Peak Electrical Deamd for Space Cooling from GHP Retrofit	Estimated Regional Peak Electrical Demand for Space Cooling by Existing Systems	Estimated Regional Potential in Reduction of Peak Electrical Deamd for Space Cooling				
										20% Market Penetration Rate for GHP Retrofit	40% Market Penetration Rate for GHP Retrofit	60% Market Penetration Rate for GHP Retrofit	80% Market Penetration Rate for GHP Retrofit	100% Market Penetration Rate for GHP Retrofit
		(millions)		Ton	kW/ton	kW/ton	kW/ton	%	GW	GW	GW	GW	GW	GW
Northeast	**Space Cooling**	**11.1**	**100%**	**2.0**	**2.7**	**1.0**	**1.8**	**64.9%**	**60.7**	**7.9**	**15.8**	**23.6**	**31.5**	**39.4**
	Central air conditioner	4.95	44.4%		2.3	1.0	1.4	59.0%						
	Room air conditioner	6.10	54.8%		3.0	1.0	2.1	68.5%						
	Both central and room AC	0.10	0.9%		2.7	1.0	1.7	64.4%						

New York’s share of the Northeast peak reduction, if it were proportional to the state’s population within the region, would be 2.8 GW for every 20 % of GHP market penetration. 2.8 GW is over 8% of New York’s peak demand in the years 2010-2012.

Appendix H – Lockport Housing Authority Project

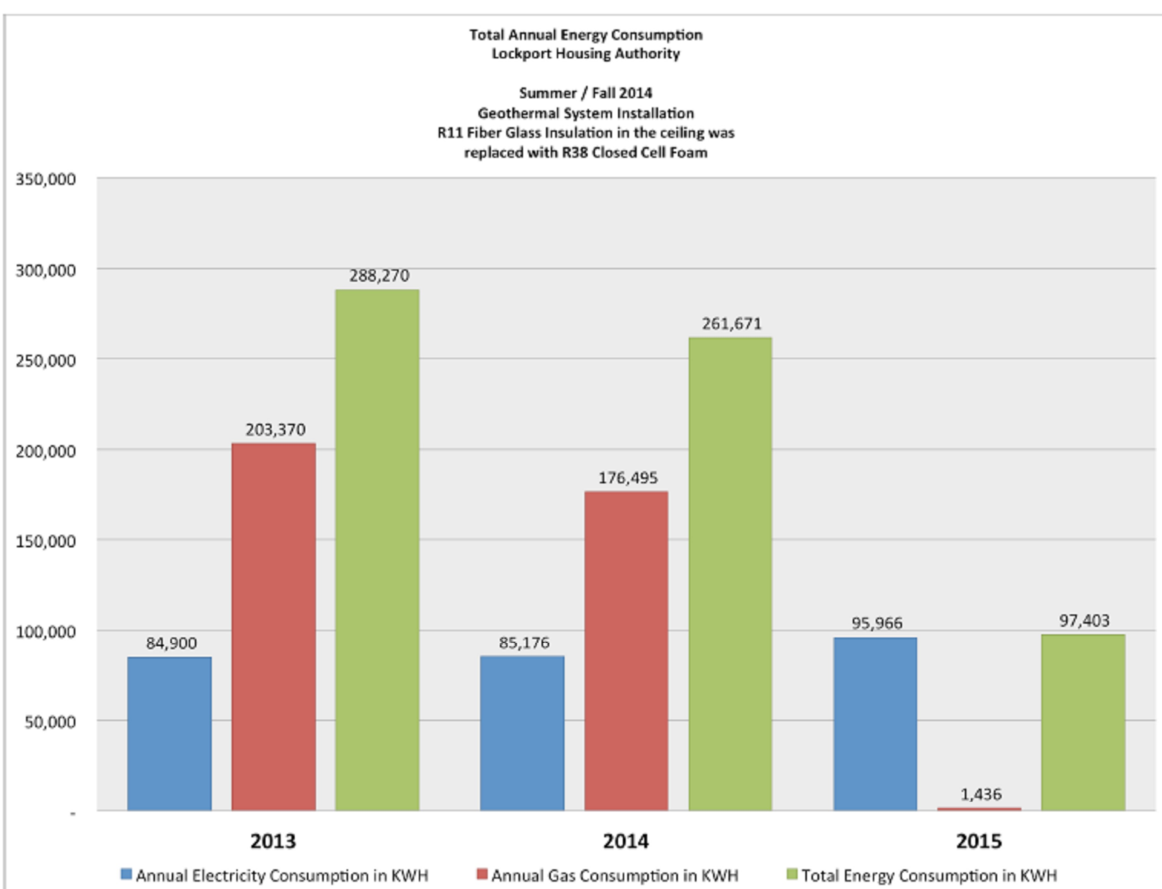
Lockport Housing Authority
Administrative Building Geothermal Conversion
Summer/Fall 2014
Summary

Summary of the roof insulation upgrade and geo conversion

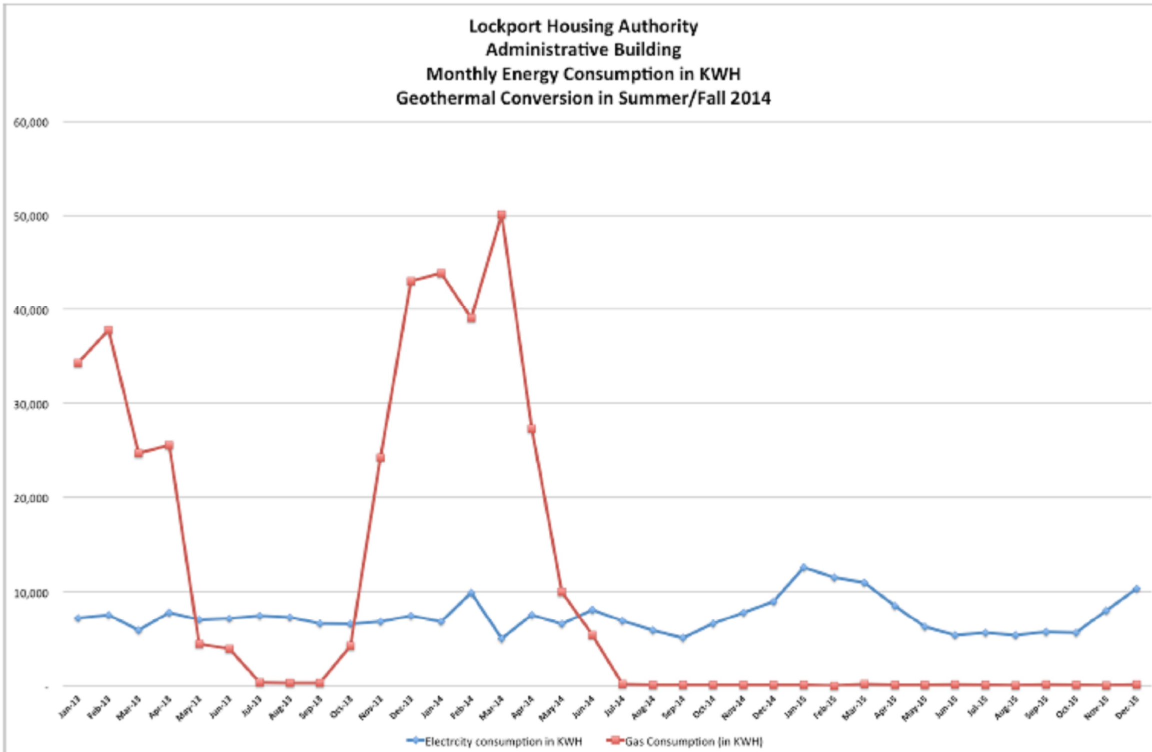
- Location: 301 Michigan Street, Lockport NY 14094.
- 9300 sqf office building.
- The geo system was installed in summer/fall of 2014, which is a transitional year, 2013 and 2015 are full years directly before and after the geothermal installation.
- 28 Ton Horizontal Slinky Loopfield.
- (4) 5-ton and (1) 3-ton Waterfurnace 7 series variable speed heat pumps providing heating, cooling and domestic hot water generation.
- (1) geothermal 20 ton GV-20 flowcenter with (2) ultra efficient DC inverterdriven variable speed circulation pumps for added redundancy.
- Total site energy consumption decreased from 288,270 KWH (BTUs transferred to KWH as units of energy for direct comparison) to 97,403 KWH, a decrease of 67.2%.

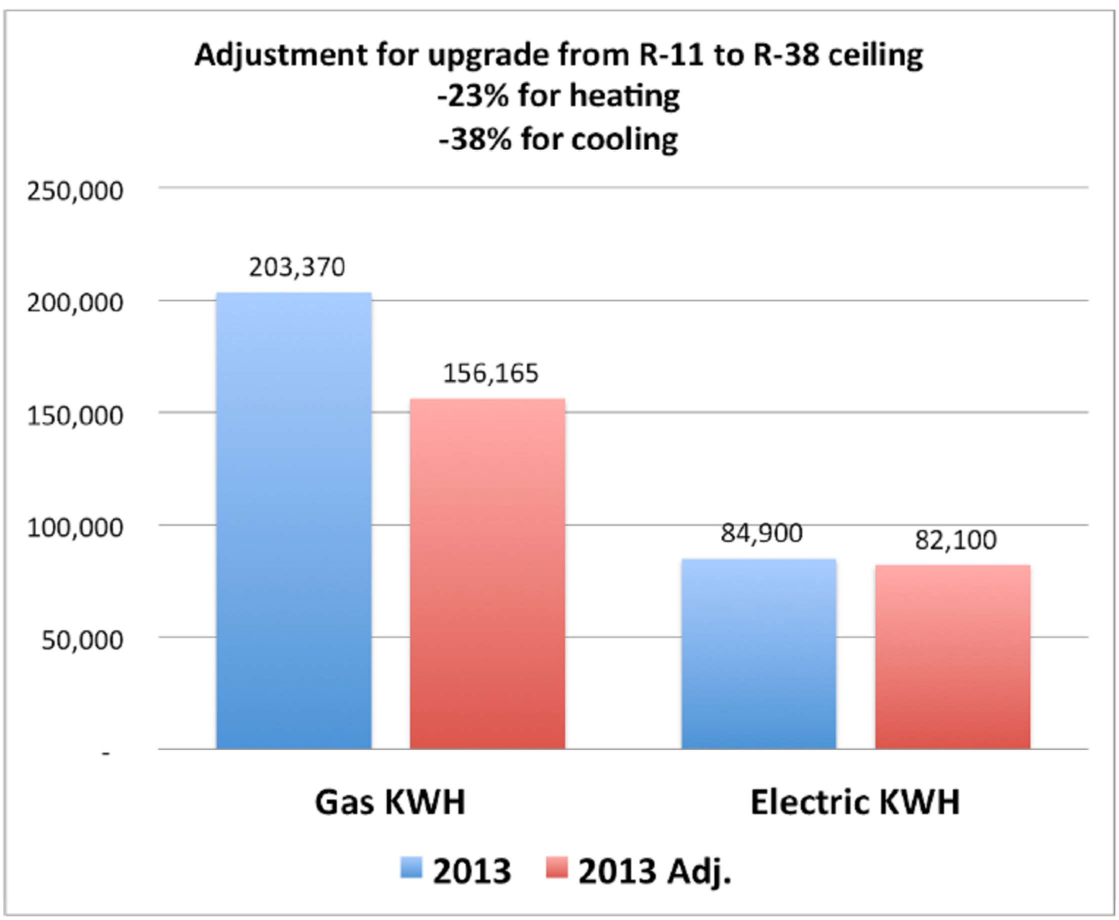
- This is total energy for the whole site, including lighting, computers and other electrical consumers, which obviously did not change.
- Total annual electricity consumption increased by 10,066 KHW between 2013 and 2015.
- R-38 foam insulation in the ceiling was installed, replacing the R-11 fiberglass. Modeling the building with Wrightsoft manual J software suggested that 47,206 KWH in heating and 2,800 KWH in cooling energy reduction can be attributed to the added insulation, and the remaining reduction in heating energy used, from 156,165 KWH to 1,436 KWH (weekly test run of generators remains the only gas consumption), can be attributed to the geo system.
- The total site energy savings attributed to the geo system, after accounting for the impact of the added insulation, the total site energy reduction through the geo system was 59%.
- When adjusted for the difference in weather data between 2013 and 2015 (cooling and heating degree days), the total site energy savings were a total of 60%, since the heating degree-days were increased in 2015 versus 2013 (it was colder in 2015 than in 2013).
- Electricity and Gas meter readings were taken from the monthly utility bills and provided by the housing authority
- No other changes in the use of the building.

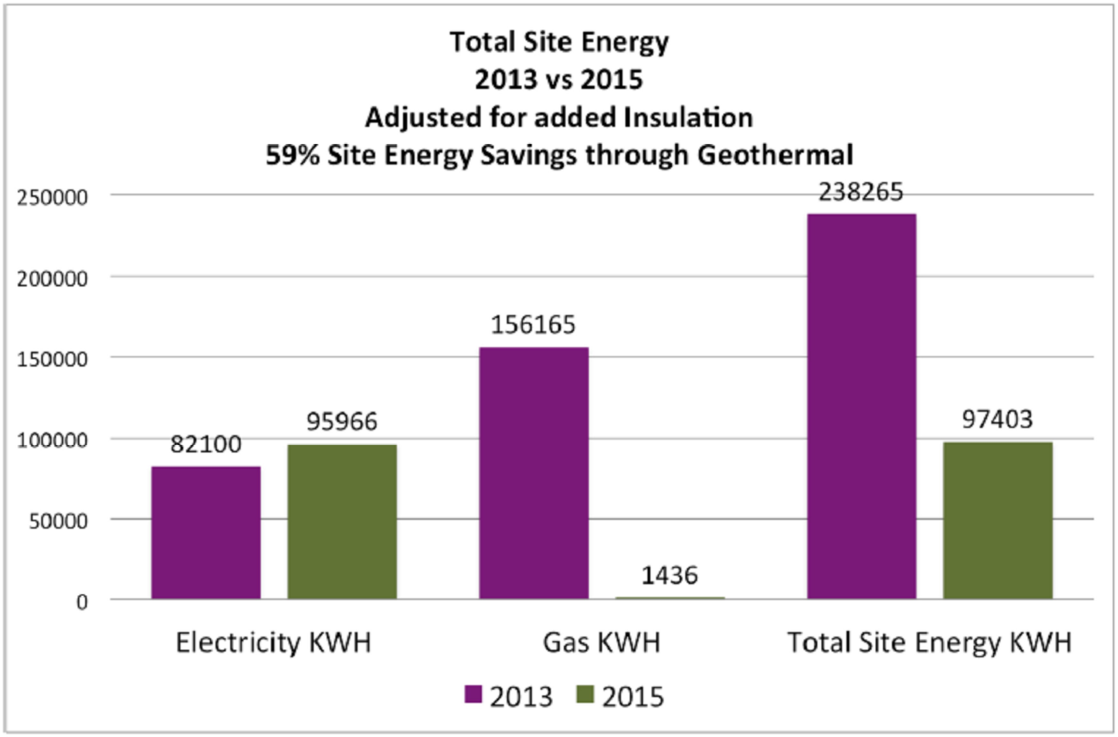
Summary: Converting the building from gas to geothermal, including upgrading the insulation from R-11 to R-38 in the ceiling, reduced the entire site energy consumption by 67.2%. Adjusting the data for the impact of the added insulation, and slightly different heating and cooling degree-days between 2013 and 2015, the geo system alone reduced the total site energy use from 242,837 KWH to 97,403 KWH, which is an annual energy reduction by about 60%.

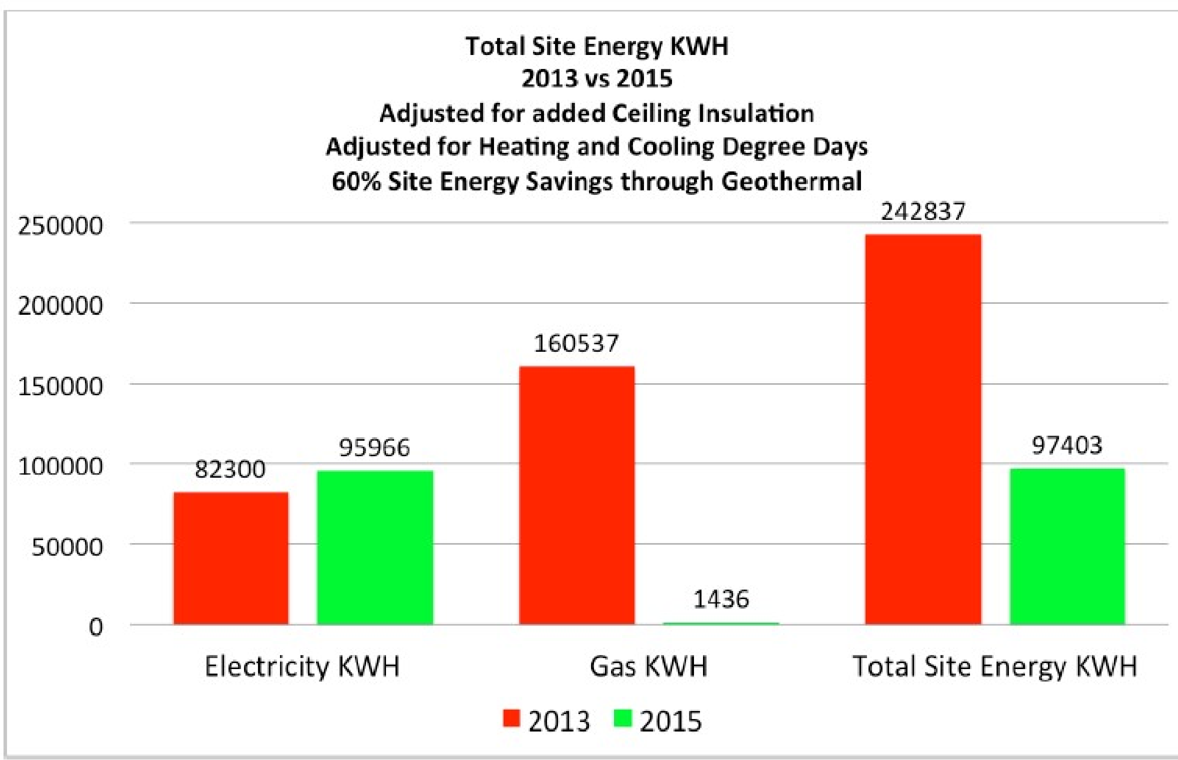


Total Annual Energy Consumption
Lockport Housing Authority
Summer / Fall 2014
Geothermal System Installation
R11 Fiber Glass Insulation in the ceiling was
replaced with R38 Closed Cell Foam
350,000
300,000
250,000
200,000
150,000
100,000
50,000
-
84,900
203,370
288,270
85,176
176,495
261,671
95,966
1,436
97,403
2013
2014
2015
Annual Electricity Consumption in KWH
Annual Gas Consumption in KWH
Total Energy Consumption in KWH


Lockport Housing Authority
Administrative Building
Monthly Energy Consumption in KWH
Geothermal Conversion in Summer/Fall 2014
60,000
50,000
40,000
30,000
20,000
10,000
-
Jan-13 Feb-13 Mar-13 Apr-13 May-13 Jun-13 Jul-13 Aug-13 Sep-13 Oct-13 Nov-13 Dec-13 Jan-14 Feb-14 Mar-14 Apr-14 May-14 Jun-14 Jul-14 Aug-14 Sep-14 Oct-14 Nov-14 Dec-14 Jan-15 Feb-15 Mar-15 Apr-15 May-15 Jun-15 Jul-15 Aug-15 Sep-15 Oct-15 Nov-15 Dec-15
Electrcity consumption in KWH
Gas Consumption (in KWH)


Adjustment for upgrade from R-11 to R-38 ceiling
-23% for heating
-38% for cooling
250,000
200,000
150,000
100,000
50,000
-
203,370
156,165
84,900
82,100
Gas KWH
Electric KWH
2013
2013 Adj.


Total Site Energy
2013 vs 2015
Adjusted for added Insulation
59% Site Energy Savings through Geothermal
250000
200000
150000
100000
50000
0
82100
95966
156165
1436
238265
97403
Electricity KWH
Gas KWH
Total Site Energy KWH
2013
2015


Total Site Energy KWH
2013 vs 2015
Adjusted for added Ceiling Insulation
Adjusted for Heating and Cooling Degree Days
60% Site Energy Savings through Geothermal
250000
200000
150000
100000
50000
0
82300
95966
160537
1436
242837
97403
Electricity KWH
Gas KWH
Total Site Energy KWH
2013
2015

Appendix I – How Electric Utilities Can Thrive in a Solar PV Environment

NY-GEO has developed this standard letter directed to utility officials and to authors and editors when they publish articles on the tribulations of utility companies facing a business model disruption from solar PV

How Electric Utilities Can Thrive in a Solar PV Environment

From NY-GEO – the New York Geothermal Energy Organization

It seems that every day there is a new article on the impact solar PV might have on utility bottom lines. Utility managers frequently lament the loss of revenue and the disruption of their business model that comes when customers install solar PV to generate their own electricity.

Lost in this discussion is the potential for another renewable energy source to neutralize the impact of solar on utility finances.

Electric utilities can replace revenues lost to solar by encouraging ratepayers to convert to heating and cooling with geothermal heat pumps (GHPs).

This will increase off-peak electric consumption with hyper-efficient, electric-powered GHPs to heat indoor spaces. In the process, electric utilities will be capturing the heating market and eliminating society's need to use carbon-dense fossil fuels for heating.

GHPs harvest the solar heat deposited and stored in the earth's crust and very efficiently concentrate and distribute that heat in homes and buildings. They typically produce three (3) to five (5) units of heat for every unit of electricity used. In hot weather, the heat pump cycle is reversed and warm air is removed from the building and efficiently absorbed by the cool ground.

The overall impact of GHP installations on a utility's system will not only increase total revenues; the very efficient cooling capacity of GHPs will also reduce the vexing problem of costly summer peak demand.

When it's hot and humid outside, every cooling system is cranked up to maximum at the same time, forcing 'peaker' plants into operation. These power plants are expensive to maintain and unused most of the year, yet electric generators need to provide the funds to keep them going, and even to build more of them as peak demand continues to rise.

GHPs cut peak demand because they use the cool ground as their "heat sink" and are therefore far more efficient than conventional air conditioners. They also qualify as a Distributed Energy Resource (DER) whereby utilities can work with their customers to use their GHP in a flexible manner that helps the utility avoid the worst peaks. (see attached example)

Forward looking utilities have begun recognizing the advantages of geothermal heat pumps for their bottom lines.

PSEG Long Island combines its geothermal incentives with one of the most robust solar PV installation programs in the state. For commercial properties, PSEG's geothermal rebate, based on the size of the heat pump unit, is $1500 per ton, among the highest in the nation. The rebate for residential properties is based on the GHP's energy efficiency (EER) when cooling. The higher efficiency GHPs are eligible for a flat $1600 rebate, while the lower ones can receive $1200.

John Franceschina, Senior Manager, Energy Efficiency and Demand Management Programs at Lockheed Martin (which administers the PSEG renewables program) wrote, "… We simply concentrate on peak electric load reduction. GHP as compared to traditional DX [split system central air conditioning] saves about 0.3kW of peak electric load for every ton installed." Over two thousand rebated systems have been installed under this program.

Numerous other electric utilities - including large ones like Commonwealth Edison in Chicago, to smaller ones like Western Farmers Electric Cooperative in Oklahoma - have begun embracing incentives for geothermal installations for the reasons cited above.

GHPs create unique opportunities for electric utilities to conserve power and reduce pollution, while promoting the use of renewable energy. By utilizing GHPs, every electric utility can improve its load factor; mitigate power price increases; reduce the strain on transmission grids; forestall the need for new generation capacity; reduce carbon emissions; and foster satisfied ratepayers with improved conditioned space.

Bill Nowak
716-882-9237
Executive Director
NY-GEO

Appendix J – Natural Gas Closing Off Fuel Diversity

As the DGEIS for the REV and CEF notes on page 2-11 [36]

> *"Although much of New York's electric energy has historically been generated by base-load hydroelectric, coal, and nuclear units, currently the units that set the market clearing prices are usually natural gas units… Power plants fueled primarily by natural gas account for more than half of the electric generating capacity in New York State, making the market sensitive to natural gas supply and price volatility. Natural gas prices for utilities are particularly volatile due to the structure of contracts used."*

and on page 2-17

> *" In particular, the portion of New York State's generating capacity from gas and dualfuel (gas and oil) facilities grew from 47 percent in 2000 to 55 percent in 2014, while the segment of generating capability from power plants fueled solely by oil dropped from 11 percent in 2000 to seven percent in 2014. The expansion of dual-fuel generation may be driven in part by the volatility of natural gas prices, as discussed earlier. In addition, dual-fuel plants play a role in meeting reliability requirements. During periods of high electricity usage, reliability rules require many of these plants to switch to burning oil. Outside of peak times, generators can choose to run on whichever fuel is less expensive."*

At the same time New Yorkers are becoming increasingly reliant on natural gas for electricity generation, Ngas also dominates home heating in the state as shown in this table from NYERDA's *Patterns and Trends Report* [37].

Table B-2 Space-Heating[4]

	Households[2] (MM)	Average per Household using the fuel as main heating source	
		Consumption	Expenditure
Electricity	0.5	1,440 kWh	$241
Natural Gas	4.1	59 Mcf	$873
Fuel Oil	2.1	461 gallons	$1,173
LPG[3,5]	0.2	847 gallons	$2,406

[36] Draft Generic Environmental Impact Statement in CASE 14-M-0101 - Reforming the Energy Vision and CASE 14-M-0094 – Clean Energy Fund http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterSeq=44991 - accessed 12/7/14, available on this website as a pdf – listed with the 10/24/14 items

[37] Patterns and Trends - New York State Energy Profiles:1998-2012 – NYSERDA Final Report, November 2014, table B-2, page B-2

4.1 million households represent 56.9% percent of New York's 7.2 million total.

New York's increasingly singular reliance on natural gas leaves us dangerously vulnerable to spikes in volatile gas prices. This passage from page ES-10 from the Executive Summary of the REV/CEF DGEIS is instructive:

> *"Increasing fuel diversity will make customers less vulnerable to price spikes; the estimated total cost to New York customers from the gas-driven price spikes of the winter of 2013-2014 was over $1.0 billion."*

New York's fuel diversity strategies to date have focused on increasing diversity in electric generation by increasing the percentage of renewables in the generation mix It has also focused on maintaining dual fuel generating plants, combining gas generation with oil, and even coal generation capacity, in order to be able to cut Ngas generation during reliability events.

Another strategy which deserves urgent consideration is to turn to thermal renewables such as GHP to reduce the state's reliance on Ngas for space heating. The figure below from NYSERDA's *New York State Energy Fast Facts* [38] shows that residential and commercial buildings - GHP's prime markets - burned 627.9 billion cubic feet of Ngas in 2012 compared with electric generation's 499.1 billion cubic feet.

NATURAL GAS		
Consumption increased 0.5% from 2011		
Consumption (4.8% of U.S. total) (billion cubic feet)		1,223.1
By sector:		
Residential	(29.3%)	357.7
Commercial	(22.1%)	270.2
Industrial	(6.1%)	74.6
Transportation	(1.8%)	21.5
Electric generation	(40.7%)	499.1
In-State production (billion cubic feet)		26.4

[38] 2012 New York State Energy Fast Facts produced by NYSERDA

Appendix K – Solar Then, GHP Now

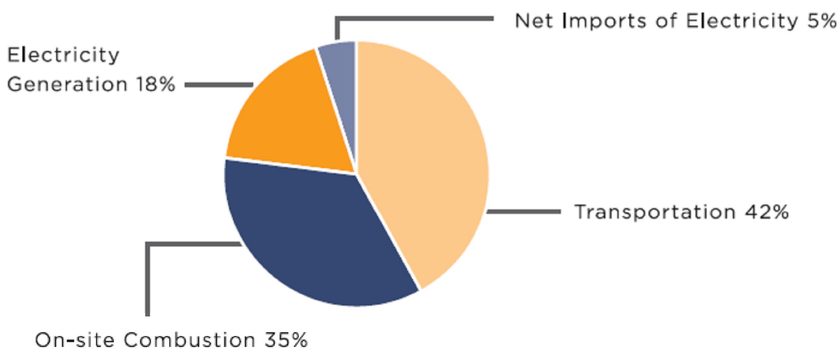
Some of the similarities between "Solar then" and "GHPs now" include:

1. GHPs hold tremendous potential to help New York meet its goals just as solar did a decade ago

- 10 years ago, with the adoption of the Renewable Portfolio Standard, New York recognized the need for its electric generation system to transition away from dirtier, GHG intensive fuels like oil and coal (almost 30% of New York's mix in 2004) to clean renewables. Figure 1 below is from the 2104 Draft New York State Energy Plan [39]. It shows that electricity generation in NY now produces a smaller volume of greenhouse gases than on-site combustion - used primarily to heat our homes and buildings.

Figure 1 | 2011 Carbon Dioxide (CO_2) Emissions from Fuel Combustion by End Use Sector

PERCENT OF TOTAL CO_2 EMISSION FROM FUEL COMBUSTION



If New York is to meet its goal of an 80% reduction in GHGs by 2050, deep cuts in transportation and heating emissions will need to take place. GHPs eliminate the on-site burning of fossil fuels. When coupled with conservation and energy efficiency improvements, they give us the best chance to make the deepest cuts in heating emissions.

New York State's December 1, 2014 comments to the USEPA on the 111D proposed carbon pollution emission guidelines reinforce this point. [40]

[39] Volume 2 of the 2104 Draft New York State Energy Plan, page 11

[40] http://www.dec.ny.gov/docs/administration_pdf/nyscomments.pdf, accessed 12/6/24, page 3

Requiring New York to seek dramatic reductions in the electricity generation sector may also have unintended consequences in broader GHG emission reduction policy and strategy. New York's draft 2014 State Energy Plan identifies a goal of reducing the carbon intensity of its energy economy 50% by 2030. This intensity reduction equates to an approximately 40% reduction by 2030 on a mass basis. New York, like many other cold-weather states, has a large space heating (or "thermal") load, the vast majority of which is met through fossil fuel combustion. Unique to New York is the significantly large portion of this thermal load that is met through petroleum distillate (i.e., "heating oil"); in the residential sector this distillate thermal load approaches 30% of all housing units in the State. When compared to New York's electricity sector, the thermal load sector is considerably more GHG-intense. To meet the State's overall GHG reduction policy, New York will be looking to make more "productive" investment in the thermal load sector, achieving greater levels of GHG reduction per dollar of investment. One potential undesired consequence of EPA's proposal is that, if New York is asked to dedicate a disproportionate amount of its limited investment resources in seeking less productive emissions reduction in the electricity sector, this is likely to sacrifice a level of investment in the more intensive thermal load sector, eroding progress towards overall GHG emission reductions.

- One of the rationales for strongly backing Solar PV is that it can help cut NY's summer cooling peak load. GHPs, an ultra efficient cooling technology, can play the same role in a more consistent fashion, as GHP cooling is available 24/7/365 and doesn't run into solar PV's problem of diminished evening production just as families are coming home and running lights and appliances. In 2010 the Oak Ridge National Laboratory looked at the potential impacts of wide-scale home retrofits to GHPs. They projected a significant beneficial impact on peak demand. The figure below is the Northeast section of a table that estimates a national total potential peak load reduction of 202.1 GW. [41]

Reduced summer peak electrical demand from GHP retrofits for existing US single family homes

Census Region	SH-SC-WH System Types	Number of Single-Family Homes that Have Space Cooling	Percentage of Various Equipments Used for Space Cooling	Regional Average of Installed Space Cooling Capacity for the Reference Building	Normalized Peak Electrical Deamd for Space Cooling of Existing SC Systems	Normalized Peak Electrical Deamd for Space Cooling of the GHP System	Reduction in Normalized Peak Electrical Deamd for Space Cooling from the GHP Retrofit	Percentage Reduction of Peak Electrical Deamd for Space Cooling from GHP Retrofit	Estimated Regional Peak Electrical Demand for Space Cooling by Existing Systems	Estimated Regional Potential in Reduction of Peak Electrical Deamd for Space Cooling				
										20% Market Penetration Rate for GHP Retrofit	40% Market Penetration Rate for GHP Retrofit	60% Market Penetration Rate for GHP Retrofit	80% Market Penetration Rate for GHP Retrofit	100% Market Penetration Rate for GHP Retrofit
		(millions)		Ton	kW/ton	kW/ton	kW/ton	%	GW	GW	GW	GW	GW	GW
Northeast	Space Cooling	11.1	100%	2.0	2.7	1.0	1.8	64.9%	60.7	7.9	15.8	23.6	31.5	39.4
	Central air conditioner	4.95	44.4%		2.3	1.0	1.4	59.0%						
	Room air conditioner	6.10	54.8%		3.0	1.0	2.1	68.5%						
	Both central and room AC	0.10	0.9%		2.7	1.0	1.7	64.4%						

Source: Assessment of National Benefits from Retrofitting Existing Single Family Homes with Ground Source Heat Pumps, June 2010, Xiaobing Liu, Oak Ridge National Laboratory (page 27, table 10)

New York's share of the Northeast peak reduction, if it were proportional to the state's

[41] Assessment of National Benefits from Retrofitting Existing Single Family Homes with Ground Source Heat Pumps, June 2010, Xiaobing Liu, Oak Ridge National Laboratory (page 27, table 10) http://www.energy.ca.gov/2013_energypolicy/documents/2013-03-21_workshop/background/Liu_GSHP_Report_8-30-2010.pdf accessed 12/06/14

population within the region, would be 2.8 GW for every 20 % of GHP market penetration. 2.8 GW is over 8% of New York's peak demand in the years 2010-2012.

2. Ten years ago most New Yorkers had little conception that solar was feasible in our state The same is true of GHPs today, and with a concerted effort, a similar transformation in public awareness and enthusiasm is possible. GHP is a similar technology to solar PV in that it is a largely a customer-cited, behind the meter measure that cuts operating costs dramatically. Even more than solar PV, it has very little in the way of aesthetic impacts. This combination of low impacts, residential scale, and cost savings, promise to make GHPs - like solar PV - a very popular technology, reflecting well on those who have a hand in bringing it to market.

3. Ten years ago most of those who were aware of solar's potential assumed it was too expensive for widespread adoption. Today consumers are clamoring for solar installations as a way to save money. GHP installations are actually in a similar total cost range to solar PV for most home and business owners across the state, yet GHPs lack the tax credits, tax exemptions, up-front rebates, financing options and ratepayer supported momentum that the solar PV industry has enjoyed.

4. One of the key premises in supporting the transition to renewables, and solar PV in particular, has been its potential to create good jobs and retain wealth in our state. This premise has been realized in the development of the solar PV industry. The Solar Energy Industries Association website notes that " There are currently more than 422 solar companies at work throughout the value chain in New York, employing 5,000 people." [42] GHPs have perhaps greater on-shore job creation potential, as most heat pumps installed in the U.S. are manufactured in the U.S. There are about 200 HVAC companies in New York State that have installed GHP systems. For most, this is currently a small part of their business and most GHP jobs are done by 25 of these companies. NY-GEO estimates there are currently 1,000 NY workers employed in GHP marketing, sales, system design and installation. Thousands more employees across a variety of industries provide necessary products and services, including plastic pipe, tools and equipment, installation, engineering, drilling and excavation—jobs that can't be outsourced to other countries. GHP jobs are generally well paying, family sustaining jobs.

5. Another economic consideration is that effective state policies that judiciously cut the impact of GHP's upfront costs would help reduce the 36 billion dollars that leave New York every year in out-of-state fuel costs. Solar PV also reduces out of state fuel costs places with dollars that circulate in local economies, albeit, unlike heat pumps, most solar panels are currently made abroad.

[42] http://www.seia.org/state-solar-policy/new-york, accessed 12/6/14

Table 2 | Energy Expenditures that Leave New York's Economy in 2012

FUEL TYPE	TOTAL ENERGY EXPENDITURES	PERCENTAGE OF ENERGY EXPENDITURES THAT LEAVE NY	AMOUNT OF ENERGY EXPENDITURES THAT LEAVE NY
Electricity	21,825	31%	6,766
Natural Gas	8,084	50%	4,042
Coal	127	85%	108
Gasoline	18,691	80%	14,952
Other Petroleum	12,305	85%	10,459
TOTAL	**61,031**	**60%**	**36,327**

Source: NYSERDA. *Patterns and Trends: New York State Energy Profiles* (1997–2011). June 2013. 2012 values based on EIA preliminary estimates.

Given these similarities to the solar PV industry, NY-GEO believes it is important that enough resources are available over the life the Clean Energy Fund to provide support for GHP similar to that which has allowed solar PV to make such strong inroads in New York State.

While New York is in the process of gradually phasing out rebates for solar PV, it is important to recognize that rebates are an important part of the process that brought solar PV to the point where market self-sufficiency is now within sight. If GHP technology is to grow to a point where it can have significant impacts on peak load reduction, low and moderate income energy affordability and GHG emissions, NY-GEO believes that rebates are an important support for that growth. We urge NYSERDA to look closely at Maine's Home Energy Savings Program [43], which offers incentives up to $5,000 for geothermal systems, at PSEG Long Island's Utility 2.0 program [44] which provides per ton rebates for residential and commercial systems, and the Massachusetts Clean Energy Center/ Department of Energy Resources geothermal rebate program[45] which gives $2,000 a ton up to $10,000 for GHP installations.

NY-GEO looks forward to working with NYSERDA and the Green Bank to develop financing mechanisms that chip away at high up-front price tags. We also remain cognizant that rebates and tax credits have been crucial to the establishment and viability of those financing mechanisms. In order for NY State to maximize GHP's power to help cut peak demand and reduce greenhouse gas emissions, both "old school" rebates and tax credits and "new school" financing mechanisms will be necessary over the 10 year period of the Clean Energy Fund.

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[43] http://www.efficiencymaine.com/at-home/home-energy-savings-program/hesp-incentives/ accessed 12/7/14

[44] www.psegliny.com/files.cfm/2014-07-01_PSEG_LI_Utility_2_0_LongRangePlan.pdf accessed 12/7/14

[45] www.google.com/#q=dsire+massachusetts+geothermal+rebates accessed 12/7/14

Appendix L – Geo Aggregation, Neighborhood Resurrection Project

The East Side of Buffalo is the epicenter of poverty in upstate New York. While Governor Cuomo's Buffalo Billion plan is clearly working its magic in much of Western New York, East Buffalo continues to decline and could stubbornly pull down the momentum of the Governor's initiative if that decline is left unchecked.

The Broadway-Fillmore neighborhood of Buffalo is a prime example of this urban decay. Broadway-Fillmore also houses treasured cultural institutions such as the Broadway Market, the Dyngus Day Parade, the Chopin Singing Society, the Central Terminal, St. Stanislaus Church, the Adam Mickiewicz Library and the more recently developed Wilson Street Farm and the Chua Tu Hieu Temple and Buddhist Cultural Center. It is in desperate need of revitalization and well worth revitalizing.

There is a 3 block area in Broadway-Fillmore, just West of Fillmore Avenue, bounded by Broadway, Wilson Street, Coit Street, and Paderewski Drive, where, of approximately 48 total residential lots, 12, 10 and 8 houses respectively remain on these blocks.

This neighborhood is where Buffalo's Polish population settled in the late 1800's as reflected in street names like Sienkiewicz and Paderewski and the existence of Buffalo's famed Broadway Market, located in the 2nd block East of Fillmore, off Broadway.

Many of the houses exemplify a unique "telescope" style of architecture where shorter and shorter additions were built on the back of the house as more and more family members arrived from Europe. The neighborhood is part of the St. Stanislaus Church parish, a bedrock on the East Side, but one that is in critical need of a resurgence in the surrounding neighborhood.

Spurred on by the Governor's Buffalo Billion, Western New York is clearly turning a corner in its resurgence. The primary area lagging behind and casting doubt on the ultimate success of the strategy is Buffalo's East Side, epitomized by this and many similar nearby neighborhoods. A clear resurrection of these 3 blocks would strike at the heart of these doubts and would spearhead the completion of the Governor's vision.

Reforming the Energy Vision (REV) could be key to this resurrection. We propose setting up a REV demonstration project for this 3 block area. The project will demonstrate 3 strengths of geothermal heat pump technology (GHP) relative to the REV goals.

GHP is an important tool for:

- Reducing peak demand by providing the most efficient air conditioning precisely when it is needed most;
- Reducing New Yorker's energy bills by increasing utilization of New York's electricity system during off peak winter months; and
- Reducing greenhouse gas emissions by eliminating the use of fossil fuels to heat buildings and provide hot water, while also reducing the amount of electricity needed to cool buildings.

Utility costs are a significant driver of poverty in Buffalo's poor neighborhoods, with heating bills being the main culprit. New York State spent $366 million on the Home Energy Assistance Program (HEAP) last year, and current trends indicate that by the 2025 end of the proposed Clean Energy Fund, the state will be spending more to subsidize fossil fuel use through HEAP than it will be spending on clean energy.

The essence of the Resurrection Project will be to efficiently place geoexchange loops on each residential parcel in this 3 block area, providing the base for a respite from crippling and volatile utility bills. By running 48 loops in one project, costs can be reduced dramatically. Running loops on open lots before in-fill housing is built eliminates many logistical and staging expenses. It will provide a ready-to-use source of storage for both heating and cooling energy in the ground beneath the parcels, which stays at a relatively constant temperature through the seasons. As houses are built, either as part of this project, or at a later date, the ground loops can easily be connected with heat pumps in the basements as they are constructed.

We propose that for the houses that are in adequate condition to remain on site, that a financially attractive geothermal system be offered.

The ultra-low operational costs of running GHP for heating and cooling will allow residents to focus their resources on rebuilding the neighborhood, and will leave more income available to support local food resources like the Broadway Market and the Wilson Street Farm one block South of Broadway.

The demonstration project can be paired with any number of similar 3 block areas on the East Side to provide comparable data on reducing peak loads, increasing system utilization and reducing greenhouse gas emissions.

The REV looks to create new financing models that offer an opportunity for scaling up clean energy technology, particularly in the renewable thermal sector. The Resurrection Project might provide the conditions for a power purchase agreement model, where a single owner of the geoexchange loops provides heating and cooling energy and charges an affordable rate to do so. It might even be possible to provide an “owner’s choice” model where the owner of each parcel can decide between purchasing the loop or executing a power purchase agreement.

Appendix M - Glossary

Glossary:

ACP - Alternative Compliance Payment is the amount that Load Serving Entities (LSEs), i.e. electricity suppliers, must pay per MWh of electricity that they are unable to generate themselves or buy rights to through REC purchases in order to meet the state Renewable Portfolio Standard (RPS) requirement

BET - Beneficial Electrification Technologies - the use of electricity as a substitute for on-site fossil fuels like natural gas, propane, gasoline, and fuel oil as a means to reduce greenhouse gases and other emissions and/or to provide other benefits such as reducing operating costsm reducing system wide peak demand, or increasing system utilization

CES - Clean Energy Standard - "The 2015 State Energy Plan (SEP) states that 50 percent of all electricity used in New York State by 2030 should be generated from renewable energy sources (the 50 by 30 goal). The SEP goal for electricity is in the context of some of the nation's most ambitious clean energy targets: 40% reduction in greenhouse gas emissions from 1990 levels by 2030; 50% of electricity generation coming from renewable energy resources; and 600 trillion Btu in energy efficiency gains, which equates to a 23% reduction from 2012 in energy consumption in buildings. These targets put the State on a path to achieve its longer-term goal of decreasing carbon emissions 80% by 2050.

By letter of December 2, 2015, Governor Andrew Cuomo directed the Department of Public Service (DPS) to develop a Clean Energy Standard (CES) that converts the SEP targets to mandated requirements that will ensure their achievement, and present the program to the Commission at its June 2016 session." [46]

COP - Coefficient of Performance "Ratio of realized work or useful output per the amount of supplied effort or energy input. It is used typically as a measure of the energy efficiency. It is the basis for air conditioners, space heaters and other cooling and heating devices. COP equals heat delivered as output, shown in British thermal units (BTUs), per hour divided by the heat equivalent of the electric energy input. The latter is calculated to be one watt = 3.413 Btu/hour, or, alternatively, energy efficiency ratio divided by 3.413. The higher the COP, the higher the efficiency of the equipment." [47]

DPS – New York State Department of Public Service

ESCO - Energy Service Companies– "An ESCO is a company that offers electricity and/or natural gas supply to customers in NYS. An ESCO is not your local distribution utility: it does not own or operate the distribution and transmission systems that deliver energy to homes and businesses.

[46] Staff White Paper on Clean Energy Standard in case 15-E-0302, issued January 25, 2016, page 1, https://www.google.com/#q=staff+white+paper+on+clean+energy+standard accessed 2016 03 12

[47] Black's Law Dictionary http://thelawdictionary.org/coefficient-of-performance-cop/ accessed 2016 04 11

In order for an ESCO to sell energy in NYS, the NYS Department of Public Service requires the company to go through an application process and be deemed eligible to serve NYS customers. A list of eligible ESCOs is available here on our website." [48]

EV - Electric Vehicle

GHP - Geothermal Heat Pump

GWh - Gigawatt Hour - A unit of electrical energy equivalent to:
3.41 billion British thermal units (Btu)
3.6 terajoules
one thousand megawatt hours,
one million kilowatt hours or
one billion (10^9) watt hours.

kWh - Kilowatt Hour - The kilowatt-hour is a unit of energy equivalent to one kilowatt (1 kW) of power expended for one hour (1 h) of time.

LMI - Low and Moderate Income – "LMI is defined as less than or equal to 80 percent of the area (county) median income (AMI). In New York, it is estimated that nearly 3 million households meet this income threshold, with approximately 2.3 million having incomes equal to or less than 60 percent of the state median income (SMI, which is approximately equal to 200 percent of the federal poverty level.)[1] At least 865,000 housing units in multifamily buildings with five dwelling units or more are designated as affordable housing and are managed or owned by various New York State and New York City agencies. Many LMI households also live in privately owned multifamily buildings, or in one-to-four family buildings, which they either own or rent." [49]

LSE - Load Serving Entities – generally a Utility, or an ESCO – "An entity, including a municipal electric system and an electric cooperative, authorized or required by law, regulatory authorization or requirement, agreement, or contractual obligation to supply Energy, Capacity and/or Ancillary Services to retail customers located within the NY Control Area (NYCA), including an entity that takes service directly from the NYISO to supply its own load in the NYCA."[50]

NEPOOL GIS - The New England Power Pool Generation Information System (NEPOOL GIS) issues and tracks certificates for all MWh of generation and load produced in the New England ISO control area, as well as imported MWh from adjacent control areas. In addition to the generation, the

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[48] PSC website
http://www.askpsc.com/askpsc/page/?PageAction=renderPageById&PageId=7f285010bbcba4320235157257b2dc82#ESCO Accessed 2016 04 11

[49] Green Jobs - Green New York - Low to Moderate Income (LMI) Working Group Recommendations
http://www.nyserda.ny.gov/-/media/Files/EDPPP/GJGNY/Advisory-Council-Updates/GJGNY-LMI-Working-Group-Recommendations.pdf. Accesssed 2106 04 11

[50] New York Independent System Operator (NYISO)website
http://www.nyiso.com/public/markets_operations/services/customer_support/glossary/index.jsp Accessed 2016 04 11

NEPOOL GIS provides emissions labeling for the New England load serving entities by tracking the emissions attributes for generators in the region. In recent years the NEPOOL GIS has adapted to the various state RPS laws to track combined heat and power, demand response and conservation and load management certificates.

NHPUC - New Hampshire Public Utilities Commission - NHPUC is vested with general jurisdiction over electric, telecommunications, natural gas, water and sewer utilities as defined in RSA 362:2 for issues such as rates, quality of service, finance, accounting, and safety. It is the NHPUC's mission to ensure that customers of regulated utilities receive safe, adequate and reliable service at just and reasonable rates.

NYSERDA - New York State Energy Research and Development Authority, known as NYSERDA, promotes energy efficiency and the use of renewable energy sources.

NYSDEC - The New York State Department of Environmental Conservation (NYSDEC) - New York State's environmental protection and regulatory agency.

NYISO - The New York Independent System Operator (NYISO) operates competitive wholesale markets to manage the flow of electricity across New York—from the power producers who generate it to the local utilities that deliver it to residents and businesses.

NYPA – New York Power Authority. The country's largest state public power organization.

REC - Renewable Energy Certificates are tradable, non-tangible energy commodities in the United States that represent proof that 1 megawatt-hour (MWh) of energy was generated from an eligible renewable energy resource and was fed into the shared system of power lines which transport energy.

TREC – Thermal Renewable Energy Certificates. Under a TREC program, the renewable MWh [51] of heat produced in a GHP installation would be awarded a tradable certificate. In a GHP unit functioning at a Coefficient of Performance (COP) of 4, 1 unit of electricity would add to 3 units heat from the ground to contribute 4 units of heat to the building. In this case the 3 units of renewable heat would be measured over time and awarded a TREC for every MWh generated. The TRECs, like RECs would be purchased by LSE's to meet their CES compliance obligation, which will be growing proportionally with new renewable heating systems installed.

[51] See footnote 6 re the conversion of BTU's to kWh.