



Meeting Energy Needs of the Empire State Plaza Without Fossil Fuels

**Sheridan Hollow Alliance for Renewable Energy
Science Committee**

July 11, 2019

I. INTRODUCTION

The Sheridan Hollow Alliance for Renewable Energy (SHARE) is a coalition of individuals, experts, organizations, and environmental justice advocates with a common purpose of ensuring that energy needs of the Empire State Plaza in Albany, New York are met with renewables rather than fossil fuels burned in Sheridan Hollow.

This report discusses feasible renewable energy alternatives to a fossil fuel microgrid project proposed by the New York Power Authority (NYPA) and Office of General Services (OGS). It refutes inaccurate or misleading information, and it challenges agencies to think outside the box of a system architecture that relies predominately on fracked gas for heat and power. Drawing upon knowledge from allies with expertise in the design and retrofit of large scale systems, the document re-envision the concept of a microgrid within a larger network of renewable resources, describing how energy needs can be met during normal operation while also ensuring that provisions exist for resiliency during emergencies. As explained in the report, this involves converting the Plaza's antiquated steam-based system of heating and cooling to far more efficient geothermal and thermal load-sharing technology, as well as the deployment of renewables for electricity—both locally and outside of the downtown area.

Significantly, this year the Governor and legislature amended language within the state budget to require the use of renewable energy to heat, cool, and power the Empire State Plaza to the extent *possible*. This document is intended to explore exactly what that means—indeed all that is, in fact, possible. Moreover, this year state climate legislation was enacted to require that New York transition rapidly to renewables, achieve carbon-free electricity within twenty years, and dramatically slash greenhouse gas emissions while protecting environmental justice communities from harm. Making good on that promise requires a very different approach to energy.

For over a century, Sheridan Hollow has been disproportionately targeted with combustion emissions to satisfy the energy needs of government. By rejecting plans that would burn more fossil fuels in Sheridan Hollow and instead pursuing the innovative solutions described herein, those impacts can be avoided and the capital of New York firmly established as an example of climate leadership for the world. It is our hope that this report will help realize that opportunity.

Empire State Plaza



Acknowledgement:

SHARE would like to thank Jay Egg, and his wife Kristie, for their invaluable support and assistance.

II. BACKGROUND

A History of Environmental Injustice

Sheridan Hollow is a low-income community of color located in a geographic hollow of downtown Albany, approximately one-half mile from the Empire State Plaza. Since 1911, the community has been exposed to combustion emissions from a steam plant located on Sheridan Avenue, originally built to heat the state Capitol with high-pressure steam delivered through a tunnel underground. Burning coal, oil, and now natural gas, the combustion system has been expanded over time not only to supply heat for the entire Plaza complex, but also to create cold air with steam-driven chillers. Today, those chillers are 50 years old. Because the facility relies on super-heated steam for space heating and for cooling, the plant burns gas throughout the year.



Sheridan Avenue Steam Plant

In 1981, a garbage incineration plant known as ANSWERS¹ was built next door to supplement steam production for the Plaza. Despite numerous reports of health problems within the surrounding community, ANSWERS continued to operate until 1994 when black soot from the facility fell on the snow covered lawn of the Governor's mansion. Today, several current and former residents of Sheridan Hollow attribute high rates of cancer to the exposure of family members to pollution from the facility. While ANSWERS has been shuttered for 25 years, the community still suffers from the burning of fossil fuels to create steam for the Plaza. Ending environmental injustice requires eliminating this source of pollution.



ANSWERS Refuse Derived Fuel (RDF) Building

**New York Accused of Racism on Incinerator Site:
Blacks were told the plant posed no hazard. Blackened snow
at governor's mansion brought action.**

March 06, 1994 | NEKESA MUMBI MOODY | ASSOCIATED PRESS

ALBANY, N.Y. — For the last 12 years, officials have assured residents of a predominantly black neighborhood in Albany's inner city that a trash-burning incinerator was no health threat.

But less than three weeks after the incinerator's emissions blackened the snow at the nearby governor's mansion, the incinerator was shut down.

For Emily Grison and others, the garbage-burning incinerator had been a longstanding irritant and an example of environmental racism.

Grison has lived on the same block as the state-owned incinerator since it began burning trash in 1981. In the summer, she has had to close her windows because of the stench of burning garbage. And, on certain days at certain times, she said she and her neighbors suffered from stuffed-up noses.

Grison said she knows at least 10 neighborhood children who suffer from asthma, and she links their problems to the incinerator.

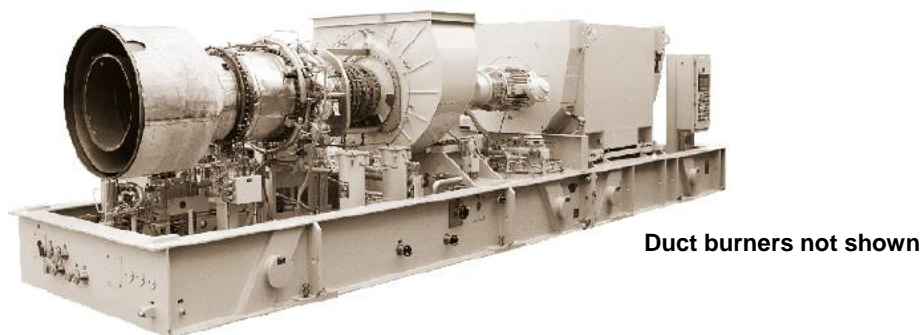
"... (But) no one's looking at that," she said. "They have not bothered, because this area is 99% black. They have never bothered. If it was in a white community, five or 10 kids, they would say, 'That's outrageous.' "

¹ ANSWERS is an acronym for Albany New York Solid Waste Energy Recovery System.

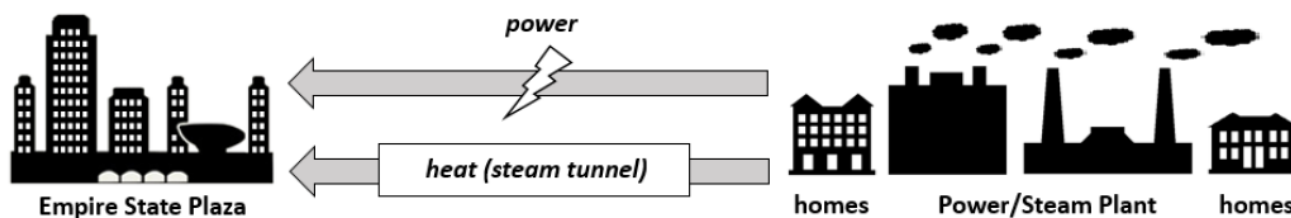
NYPA's Fossil Fuel Microgrid

In 2015, the New York State Energy Research and Development Authority (NYSERDA) announced creation of the New York Prize Community Grid Competition, a program intended to promote and fund the development of microgrids. With support of NYPA and OGS, Cogen Power Technologies submitted a proposal and feasibility study for converting the shuttered ANSWERS building into a 16 megawatt (MW) cogeneration (combined heat and power) plant. The proposal entailed installation of two 8 Megawatt *TAURUS 70* gas-fired turbines to generate electricity for the Empire State Plaza, along with heat recovery units and gas-fired duct burners for the production of hot steam to partially offset boilers in the adjacent steam plant. The proposal also included replacement of two outdated 3.25 Megawatt emergency diesel generators with a pair of new 3 Megawatt diesel generators, as well as an additional 1 Megawatt "black start" diesel generator (used during turbine restart).

Taurus 70 Turbine
(1 of 2)



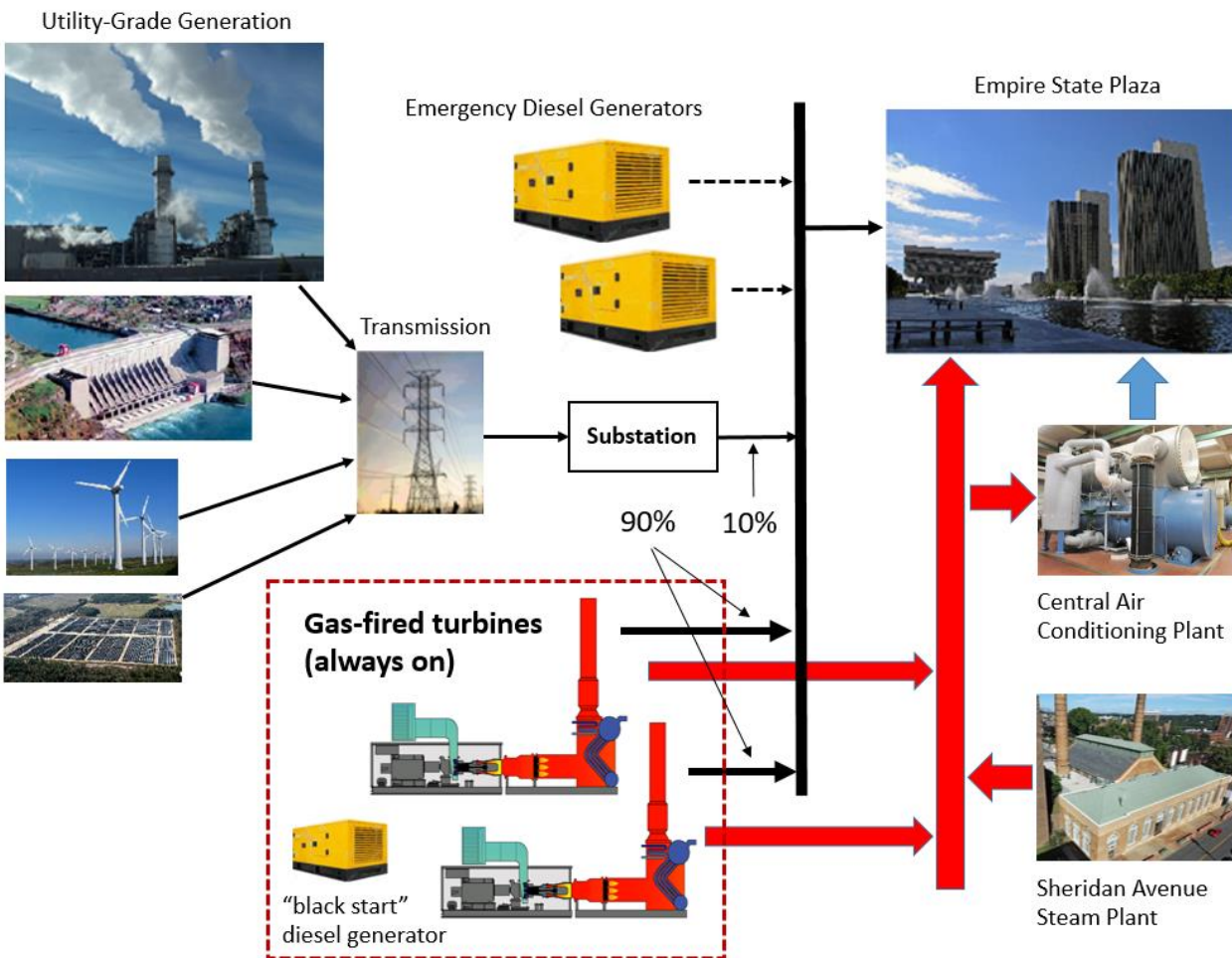
NYPA has touted its microgrid proposal as a resiliency improvement that would allow the Plaza to function in an emergency when electricity is lost on the external grid. However, the two gas turbines which are core to the project would operate not only during emergencies, but *continuously*—24 hours a day, 7 days a week. As such, over 90 percent of the Plaza's electricity, and all of its energy for heating and cooling, would come from fossil fuels burned in Sheridan Hollow and delivered to Albany by pipeline from the fracking fields of Pennsylvania. Moreover, nearly 50 percent more gas would be burned in the community than today.



Since 1911, the steam tunnel between Sheridan Hollow and government buildings in Albany has been an instrument of energy segregation, separating people who reap the benefits of energy from those exposed to the pollution it creates. By inextricably tying electricity, heating, and cooling to combustion, NYPA's proposal would perpetuate that environmental injustice long into the future.

The following illustration provides an overview of NYPA's proposed fossil fuel project.

NYPA's Proposed Fossil Fuel Microgrid with CHP



Everything outside of the dotted red box above represents existing equipment and facilities. Today 100% of electricity serving the Plaza is supplied from the external grid, which includes both fossil fuel and renewable sources. Heat for the Plaza comes from hot steam generated by boilers in the Sheridan Avenue Steam Plant (SASP) and delivered by underground steam tunnel. This steam is also used to mechanically drive five 4,500-ton chillers located in the Plaza's Central Air Conditioning Plant (CACP). During a rare loss of power, electricity for essential services is provided by two 3.25 MW diesel generators that comprise the Plaza's Emergency Power Supply System (EPSS).

NYPA's proposal would involve the installation of equipment in the ANSWERS building (dotted red box), including two 8MW Taurus 70 gas turbines with heat recovery and duct burners, along with a 1MW black start diesel generator used during startup. During normal operations, the gas turbines would operate continuously to generate 90% of the Plaza's electricity, with the remaining 10% of electricity coming from the outside grid. (This essentially shrinks the amount of renewables serving the Plaza to 10% of electricity from renewables serving the Plaza today.) Gas turbines and duct burners would partially offset steam production at the SASP as shown. NYPA also proposes to replace the two EPSS diesel generators with new 3MW diesel generators.

A Fossil Fuel RFP

In March 2017, NYPA issued a Request for Proposals (RFP) to bidders on the proposed project and SHARE subsequently requested that the document be made public. However, it was only after the New York Committee on Open Government upheld SHARE's right to the information that it was released. Unlike a typical RFP that provides a certain amount of design flexibility, the bid package from NYPA described a very specific project in which individual component parts had already been selected. Additional research revealed that the RFP appears to have been copied largely from plans for a cogeneration project designed by AECOM for Rikers Island prison. AECOM is also one of only four bidders on the Empire State Plaza microgrid.



SPECIFICATION
FOR
EMPIRE STATE PLAZA MICROGRID PROJECT
"SHERIDAN AVENUE CHP PROJECT"
ENGINEERING, PROCUREMENT AND CONSTRUCTION
REQUEST FOR PROPOSALS
BID PACKAGE

VOLUME 1

TECHNICAL REQUIREMENTS

Prepared by:
Guth DeConzo Consulting Engineers, P.C.
Troy, NY
March 2017
for
New York Power Authority



Rikers Island Correctional Facility

Technical Involvement by SHARE and Project Status

NYPA has made a number of inaccurate or misleading statements about its proposed gas-fired microgrid, both in public meetings and in material posted online. This included a "frequently asked questions" document appearing on the agency's website that made dubious claims of efficiency and greenhouse gas reduction and dismissed renewables as either infeasible or impractical.² In response, SHARE prepared a detailed critique of that document, along with a letter to the Governor's office and state agencies in February 2018.³ As a result, NYPA announced that it would put its proposed fossil fuel project on hold and conduct "listening sessions" for the purpose of considering renewable options.

Since then, SHARE and a team of professionals with expertise in the design and retrofit of large-scale projects met with NYPA, OGS, and NYSERDA staff to discuss solutions including geothermal technology, thermal load sharing, and electricity generation from renewables within and outside of the proposed microgrid. As reported in a subsequent letter to the Governor, that meeting proved with startling clarity that the electricity, heating, and cooling system of the Empire State Plaza can in fact be redesigned as a renewable energy project *without* CHP.⁴ Those solutions are described in Section VI of this report in the context of a microgrid architecture that provides resiliency while supporting a full transition to renewable energy for normal operation. SHARE has also met with legislators, agency heads, organizations, and community groups as part of its ongoing outreach work.

The New York legislature and Governor have weighed in as well. During the 2018 legislative session, members of the Assembly and Senate cosigned letters in support of a renewable solution for the Empire State Plaza. Then in 2019, the legislature and Governor amended the state budget to remove the explicit authorization of a CHP cogeneration plant in Sheridan Hollow, instead allocating funds for a project that "to the extent possible" can meet heating, cooling, and electricity needs of the Plaza with renewable energy. SHARE sees these as steps in the right direction. The ball is now in NYPA's court to embrace this mandate by earnestly pursuing a project that is very different from its original proposal.



SHARE appreciates that plans for a fossil fuel project have been put on hold and that the legislature is now calling for the maximum use of renewables. However, we believe that a full evaluation of what is feasible requires more comprehensive engagement (and appropriate access to relevant information) by professionals with experience in the conversion of large-scale systems. Accordingly, SHARE suggested in its February 2018 letter to the Governor that NYPA issue a new **renewable** Request for Proposals (RFP) that would allow the best and most experienced experts from industry to submit detailed concepts for meeting the full spectrum of energy needs for the Plaza with renewable technology. We still maintain that a Request for Proposals (or Request for Information) should be issued.

² See *Empire State Plaza Combined Heat and Power and Microgrid Project—Repurposing Existing Facilities with Cleaner, More Efficient Technology* <https://www.nypa.gov/innovation/initiatives/rev/empire-state-plaza-microgrid>. Citations to the document in this report refer to latest version, dated 12/6/2017.

³ Letter to Governor Cuomo dated February 6, 2018 and critique titled *Response to NYPA's Answers to Frequently Asked Questions on Albany's Proposed Microgrid* with attachments: http://sharealbany.org/wp-content/uploads/2019/07/SHARE-letter-to-Cuomo-with-critique-and-attachments_2-6-18.pdf

⁴ Letter to Governor Cuomo dated May 31, 2018, *Renewable Plan for the Empire State Plaza*: <http://sharealbany.org/wp-content/uploads/2019/07/SHARE-letter-to-Cuomo-after-NYPA-meeting-5-31-18.pdf>

III. A FLAWED PROPOSAL

The following discusses various flaws with the gas-fired microgrid that had been proposed by NYPA, elaborating upon SHARE's 2018 response to information contained in the agency's "frequently asked questions" document.

Misplaced Affinity for Natural Gas

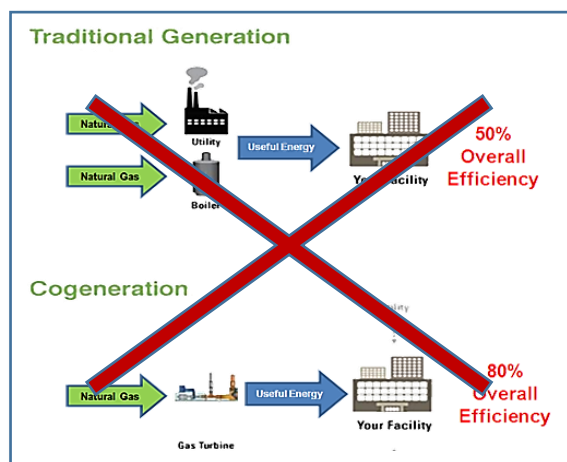
NYPA has stated that its proposed project would be powered by "*clean-burning*" natural gas, a misleading characterization frequently repeated by the fossil fuel industry. Gas produces less combustion emissions per unit of energy than other fossil fuels, but this is only half the story. The main ingredient of natural gas, methane, is 86 times more potent as a driver of climate change than carbon dioxide over twenty years—the timeframe in which scientists warn that dramatic cuts in fossil fuel consumption are needed. Moreover, methane leakage occurs throughout the course of extraction, processing, and transport. When total lifecycle emissions of methane from well to point of combustion are taken into account, gas has a carbon footprint that is just as big as, or bigger than, coal. Natural gas is not a bridge fuel. It is a gangplank to climate disaster.

As with all fossil fuels, natural gas also creates pollutants hazardous to human health, like carbon monoxide, nitrogen oxides, formaldehyde, and particulate matter. Moreover, the primary process by which natural gas is extracted from the earth today—high volume hydraulic fracturing—has significant, adverse environmental and public health impacts. This is why fracking was prohibited in New York. It does not reflect well on the state that banned fracking if the vision of energy for the future of its own capital is fracked gas.

Inaccurate Claims of Efficiency and Greenhouse Gas Reduction

NYPA's claims of greenhouse gas reduction have hinged upon two assertions: (1) that its proposed project would meet energy needs of the Plaza much more efficiently than the present case; and (2) that the project would displace gas consumed elsewhere, thus resulting in less net emissions. Both assertions are flawed.

In its FAQ document and material online, NYPA stated that its proposal would improve efficiency by 30 percent, using an illustration (at right) which makes a generalized comparison between CHP and a scenario in which a power plant and boiler generate electricity and heat separately. However, no information has been provided to demonstrate that a 30 percent efficiency gain would be achieved for the particular proposal in Albany. On its face, the illustration is an invalid comparison because boilers in the existing steam plant would not be entirely eliminated.⁵ The continued use of boilers at the steam plant (in addition to the firing of supplemental duct burners within CHP heat recovery units) represents "heat without power".



Unsupported claim of 30% efficiency gain

⁵ According to NYPA's project overview presentation (Nov 7, 2017 and Jan 3, 2018), boilers in the steam plant would still be needed to produce 30 percent of steam required by the Plaza, which is significant. The project feasibility study also suggests that unused boilers will be maintained in a hot standby mode, which requires combustion. In addition, the proposed gas turbines would be equipped with duct burners to ensure temperatures sufficient for steam production.

Furthermore, according to NYPA, future project phases could involve extending electricity generated from the burning of gas in Sheridan Hollow to additional buildings that are not connected to the steam distribution network. These additional electrical loads, including the Times Union Center, 112 State Street, Courthouse, City Hall, and several other large buildings outside of the Plaza complex, would represent approximately 30,000 Megawatt-hours of "power without heat."

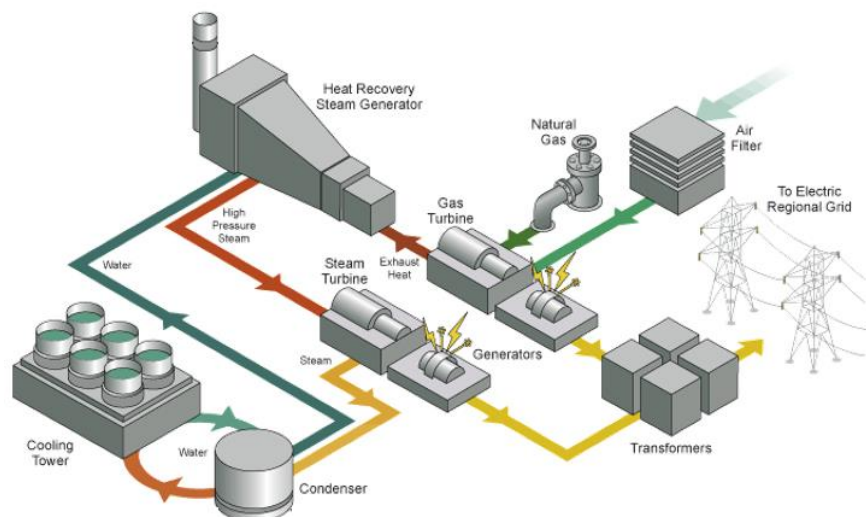
Steam corridor and proposed microgrid network



Beyond these basic mischaracterizations of the proposal, NYPA failed to properly consider how electricity is actually generated on the grid today. According to the agency, "removing the Plaza load from the statewide electrical system will result in a reduction in the electricity generated by inefficient gas and oil fired power plants that currently operate to serve the marginal loads in the state."⁶ However, this confuses the functional difference between baseload generators and less efficient "peaker" plants. The fact that the proposed project would produce only 16MW of power does not mean that customers receiving that power are "marginal loads." As proposed, the turbines in NYPA's microgrid would operate continuously—not intermittently, only in times of peak demand, or just during emergencies. Thus any comparison of technology must be for **baseload** generation.

Significantly, almost all grid-based fossil fuel generators that provide baseload power in New York (including the nearby Bethlehem power plant and other grid-based generators within electricity Zone F) are combined-cycle facilities that employ a secondary steam-turbine generator to augment electricity production. This means that exhaust heat is *not* wasted today—it is used to produce *additional* electricity, creating more kilowatt-hours of energy and less greenhouse gas emissions per unit of gas.

Combined-cycle power plant with heat recovery



⁶ NYPA FAQ 12-6-17, page 2.

On the other hand, electricity generated internal to the proposed Albany microgrid would *not* be combined cycle. By using turbine exhaust to instead heat the Plaza, the proposed project would forego more efficient electricity generation. When this trade-off between the use of exhaust heat for electricity or space heating is considered, NYPA's prior claims of efficiency and greenhouse gas reduction diminish significantly.



**750 MW Bethlehem Energy Center
combined-cycle power plant**

The consequence of this mistake is seen in information obtained from the project's original RFP.⁷ NYPA used a "non-baseload" rate of 1228.56 pounds of CO₂ per MWh to represent current conditions for grid-delivered electricity. However, this rate is characteristic of an inefficient, simple-cycle peaker plant that wastes exhaust heat. The Empire State Plaza and other buildings in Albany do not receive most of their electricity from peaker plants. (They obtain electricity from peakers only during peak load conditions.) As with other loads in Zone F, almost all of the fossil fuel electricity received by the Empire State Plaza is sourced by combined-cycle generators, like the nearby Bethlehem Energy Center.

Applying an exaggerated rate, NYPA improperly concludes that the proposed microgrid would result in statewide greenhouse gas emissions attributable to the project falling by 18 percent, the equivalent of 5000 cars removed from the road. If this is corrected using a combined-cycle baseload rate for grid-delivered electricity of 828 pounds of CO₂ per MWh (which corresponds to Bethlehem Energy Center), net greenhouse gas emissions drop by only about **4.5 percent**. See the figure on the next page depicting corrections to NYPA's calculations appearing in Appendix 4A of the proposed microgrid RFP. This scenario is made even worse if buildings not connected to the steam distribution system are added to the microgrid, because those additional loads would receive simple-cycle electricity generated inefficiently without cogen heat. Significantly, the data in Appendix 4A of the RFP also indicate that the amount of gas burned within Sheridan Hollow itself would actually increase by about **46 percent**. NYPA's emission calculations contain other discrepancies as well. For example, the RFP's summary of greenhouse gas reduction provides an estimate of CO₂ emissions from natural gas burned on site that is less than its inventory of expected emissions from the turbines, duct burners, and boilers, or even the turbines and duct burners alone.⁸

These figures further expose NYPA's dubious reference to a 30 percent efficiency gain. Claims of efficiency are meaningless unless they translate to a meaningful reduction in fuel consumption and greenhouse gas emissions. Decades ago when electricity was generated on the grid primarily by coal or gas-fired boiler systems, NYPA's project might have represented a notable efficiency improvement. Today it does not.

⁷ *Specification for Sheridan Avenue CHP Project: Engineering, Procurement and Construction Request for Proposals Bid Package—Volume 1 Technical Requirements*, March 2017"; see Appendix 4A "CHP Emissions Reduction Calculation Summary."

⁸ Appendix 4A states that 114,210 US Tons of CO₂ would be produced annually from the burning of natural gas in the proposed case. However, Appendix 4B "Emissions Inventory" states that the expected actual emissions from proposed new equipment (turbines and duct burners) would be 128,401 US Tons of CO₂ (page 692). Appendix 4B predicts that existing equipment would produce 18,829 US Tons of CO₂ per year, based on boilers operating 500 hours annually and emergency generators operating 100 hours annually (page 690). NYPA does not provide analysis to show that existing burners would operate 500 hours annually and how this correlates to fuel use in Appendix 4B.

Corrections to NYPA Estimate of CHP Carbon Savings⁹

Specification for Sheridan Avenue CHP Project: Engineering, Procurement and Construction Request for Proposals Bid Package—Volume 1 Technical Requirements, Appendix 4A

Sheridan Avenue CHP Carbon Savings and Offsets

Emissions Factors			
Energy Source	Factor	Unit	Source
Grid Delivered Electricity	828	lb/MWh	eGrid 2012 NYUP Subregion Non-Baseload Rates
Natural Gas	117	lb/MMBtu	www.eia.gov/tools/faqs/faq.cfm?id=73&it=11
NYS Capital CO2	6,711	Tons/Yr	OGS Calculated 2014 Footprint - Actual PSC Fuel Mix
Average Car CO2	5.17	Tons/Yr	www3.epa.gov/otaq/climate/documents/420f14040a.pdf

Existing Case				
Energy Source	Usage	Units	Annual CO2	Units
Grid Delivered Electricity	110,975,255	MWh	45,944	US Ton
Natural Gas	1,335,722	MMBtu	78,140	US Ton
Total			124,084	US Ton

Proposed Case				
Energy Source	Usage	Units	Annual CO2	Units
Grid Delivered Electricity	10,511,435	kWh	4,352	US Ton
Natural Gas	1,952,311	MMBtu	114,210	US Ton
Total			118,562	US Ton

Total CO2 Savings (Tons)	5,522	US Ton
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Combined-cycle **baseload** rate should be used for grid delivered electricity. Bethlehem Energy Center produces 0.414 US Tons CO₂/MWh = 828 lb/MWh. (2016 EPA and EIA data)

110,975.255 MWh x 0.414 US Tons/MWh = 45,944 US Tons

10,511.435 MWh x 0.414 US Tons/MWh = 4,352 US Tons

124,084 – 118,562 = 5,522 US Tons

5,522 US Tons / 124,084 US Tons = **4.45%**, not 18%

Does not include electricity for the microgrid loads outside of the Empire State Plaza. In the proposed case, those loads would also produce more CO₂ per MWh than today since the turbines are not combined cycle (1169 lb/MWh based on a Taurus 70 heat rate of 9955 BTU/kWh). **This further shrinks the relative CO2 saving to about zero.**

⁹ In 2016, Bethlehem Energy Center produced 1,953,191 metric tons of CO₂ and 5,202,357 MWh of electricity, according to EIA and EPA respectively.

<https://www.eia.gov/electricity/data/browser/#/plant/2539?freq=A&ctype=linechart<ype=pin&pin=&map>

<https://ghgdata.epa.gov/ghgp/service/facilityDetail/2016?id=1000777&ds=E&et=&popup=true>

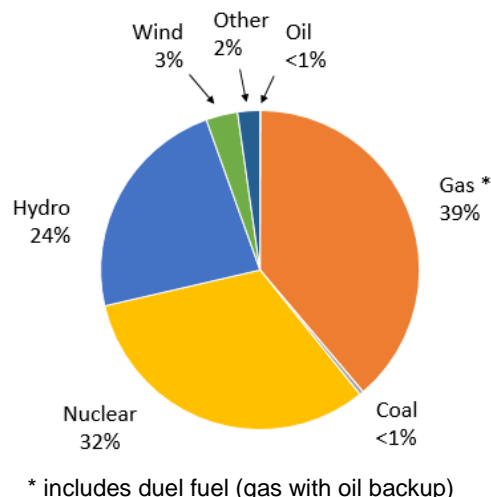
This corresponds to 0.381 metric tons of CO₂/MWh, which is equivalent to 0.414 US Tons of CO₂/MWh or 828 pounds of CO₂/MWh. Substituting this for NYPA's invalid "non-baseload" value of 1228.56 pounds/MWh shown in Appendix 4A of the project's RFP causes the amount of CO₂ produced from grid-delivered electricity to be significantly lower than calculated by NYPA in the existing case. This causes total CO₂ emissions to be 124,084 US Tons annually in the existing case and 118,562 US Tons annually in the proposed case—a difference of only 5522 US Tons, which is much lower than NYPA's calculated value of 25,642 US Tons. This corresponds to a relative reduction of only 4.5 percent, rather than 18 percent claimed by NYPA. In addition, the total amount of natural gas burned in Sheridan Hollow itself would increase by 114,210 - 78,140 = 36,070 MMBtu, or about 46 percent.

Dubious Displacement

As previously discussed, NYPA's incorrect analysis of efficiency and fuel consumption translates to an incorrect prediction of net greenhouse gas reduction. However, the agency's underlying assumption that installing gas-fired turbines in Sheridan Hollow would replace other gas-fired generation must be questioned as well.

In its calculations, NYPA compared its proposed project to a scenario in which all grid-delivered electricity is from gas. Yet natural gas is responsible for only about 40 percent of electricity in New York. Almost all of the rest is from sources of energy which do not produce combustion emissions such as hydropower, nuclear power, and wind. As proposed, the microgrid in Albany would burn gas continuously in Sheridan Hollow to provide the Empire State Plaza with 90 percent of its electricity. This means that the amount of electricity from renewables serving the Plaza today would actually drop.

2017 NYS Electricity Generation
(NYISO Power Trends 2018)



While it may be reasonable to assume that the installation of gas-fired turbines in Albany will not lead to curtailment of *existing* renewables deployed on the grid, it is not safe to assume that doing so will lead to the curtailment of existing gas-fired generators. For example, if New York's remaining nuclear power plants retire in about ten years, this will result in a loss of annual electricity from combustion-free sources that exceeds the amount of additional electricity presently expected from renewables within that same timeframe.¹⁰ Furthermore, the beneficial electrification of transportation and other systems statewide should create a greater demand for electricity. So unless the state obtains significantly more energy from renewables than currently anticipated, gas-fired generators will make up for this shortfall.

It is not difficult to find evidence of this tacit plan for satisfying future demand with fossil fuels. In fact, the original feasibility study for the Empire State Plaza microgrid prepared by Cogen Power Technology boasted that by removing the Plaza as a load from the external grid, existing generators could provide more electricity to others, stating: "with an electric reduction of this magnitude on the distribution system, the utility will have more capacity for other customers on the National Grid utility system."¹¹ This does not indicate an intention to curtail electricity supplied by existing gas-fired power plants as suggested by NYPA, but instead a desire to burn even *more* gas than before. To this point, NYPA's comparison of its proposed microgrid project to thousands of vehicles being *removed* from the road can only be described as creative fiction. The project would likely be an *adder*, not a replacement, of fossil fuel capacity—and regardless of *relative* efficiency, incremental statewide greenhouse gas emissions would likely increase if it is built.

¹⁰ Pursuant to the NY Clean Energy Standard adopted by the Public Service Commission in 2016, approximately 29,200 GWh of additional annual electricity generation from renewable sources should be available by 2030 (Power Trends 2018, NYISO). This is significantly less than the amount of electricity currently produced by New York's nuclear facilities, which generated 42,175 GWh in 2018.

¹¹ *NY Prize Stage 1 Feasibility Assessment Final Report*, Cogen Power Technologies, April 22, 2015; Executive Summary, page 1.

Missed Opportunity for Real Efficiency

The most significant issue affecting efficiency at the Empire State Plaza is the antiquated mechanism by which heating and cooling takes place today. As previously discussed, the Plaza currently relies on fossil fuel combustion in Sheridan Hollow to produce superheated steam, using water from the Hudson River as a supply source and for thermal discharge—fundamentally the same process that has existed for over a century. This steam is transported through a half-mile underground tunnel to the Plaza where it provides heat and is used to mechanically drive five 4,500 ton chillers that produce chilled water within the Plaza's Central Air Conditioning Plant (CACP). Heat and chilled water for cooling are then circulated via separate systems throughout the complex. Complaints of poor temperature regulation are common.



Steam tunnel between Sheridan Avenue and Empire State Plaza

Not surprisingly, this outdated method of heating and cooling is also the largest part of the Plaza's carbon footprint, representing about 80% of greenhouse gas emissions (compared with EPA data for electricity in the sub-region of upstate New York, including Albany).¹² Even using NYPA's calculations that incorrectly equate all grid-delivered electricity to peak power generation, heating and cooling would be responsible for over half of greenhouse gas emissions attributable to the Plaza. This means that any effort to significantly reduce emissions *must* tackle this inherently inefficient aspect of the Plaza's total energy picture.



Empire State Plaza Central Air Conditioning Plant

Although chillers inside of the CACP were refurbished and repainted a few years ago, they are over 50 years old and unlikely to last much longer.¹³ Therefore, how the Plaza meets its energy needs is at a crossroads—and with it an example of the future the state seeks to forge for itself. If New York decides to spend \$88 Million on a CHP power plant in Sheridan Hollow, then it will have made a long-term commitment to steam-

¹² See <https://www.epa.gov/energy/power-profiler>. According to the EPA, the average emission rate for electricity generation in upstate New York (including Albany) is 294.7lb/MWh. Using NYPA's value of 110,975,255 kWh (RFP, Volume 1 Technical Requirements, Appendix 4A), this corresponds to 16,352 tons of CO₂ annually. NYPA's RFP also attributes 78,140 tons of CO₂ emissions annually to the SASP. Therefore, this amounts to about 80% of total emissions associated with energy for the Plaza. (Applying statewide data where gas-fired electricity constitutes 40% of total generation yields a similar result.) As discussed in Section III, NYPA erroneously equates grid-delivered electricity for the Plaza to peaker plant generation at 68,170 tons of CO₂ emissions annually. However, even using this number, heating and cooling would constitute 53% of the Plaza's carbon footprint.

¹³ The fact that chillers in the CACP are nearing the end of their useful life was confirmed by NYPA staff in its meeting with SHARE and experts in geothermal technology in April 2018.

based heating and cooling that requires the perpetual combustion of fossil fuels. However, in doing so, it will have *additionally* committed itself to *spending many millions of dollars more* in the foreseeable future to replace outdated steam-driven chillers at the Plaza that are near the end of their life.

Notwithstanding environmental injustice associated with the combustion of oil, gas, and garbage in Sheridan Hollow, the current heating and cooling system of the Empire State Plaza complex may have represented state-of-the-art technology when it was first designed in the 1960's. But today it is antiquated technology. Likewise, a co-generation plant that burns fossil fuels to create heat and power might have represented a noteworthy efficiency improvement in the 70's or 80's. However, that is not the case in 2019.

Rather than continuing to invest in outdated technology, New York should place itself on the cutting edge of applied science by investing in geothermal technology and developing an effective system of thermal advantage load sharing for the Empire State Plaza complex. We discuss this at length in Section VI.

Conflict with State Energy Objectives

Finally, even if one supposes that NYPA could demonstrate that its original proposal provides a slight improvement in efficiency or reduction in greenhouse gas emissions, it would do so *at the expense* of New York's aggressive goals for combatting climate change, including those codified in law through the 2019 Climate Leadership and Community Protection Act (CLCPA). Those statutory mandates require slashing net greenhouse gas emissions statewide 85% by 2050, completely carbon-free electricity by 2040, and substantial improvements in building efficiency.¹⁴



A CHP project that inextricably ties the production of both heat and power to fossil fuel combustion stands in the way of New York meeting its climate commitments. If built, the project would continue operating after much more significant greenhouse gas reductions will have to be made and emission-free electricity is required.¹⁵ Furthermore, the proposed CHP project would perpetuate the disproportionate exposure of Sheridan Hollow to fossil fuel combustion, contravening a key principle of the CLCPA regarding the protection of disadvantaged communities.

Increasingly dire reports by the Intergovernmental Panel on Climate Change about the consequences of continued fossil fuel combustion, as well as significant climate changes already being observed in New York, demonstrate that "baby steps" are not enough.¹⁶ Bold action is needed, which includes embracing renewable energy for heat and power, starting today.

¹⁴ Climate Leadership and Community Protection Act (CLCPA) adopted by the NYS Senate and Assembly during the 2019 legislative session; S6599/A8429. <https://legislation.nysenate.gov/pdf/bills/2019/S6599>

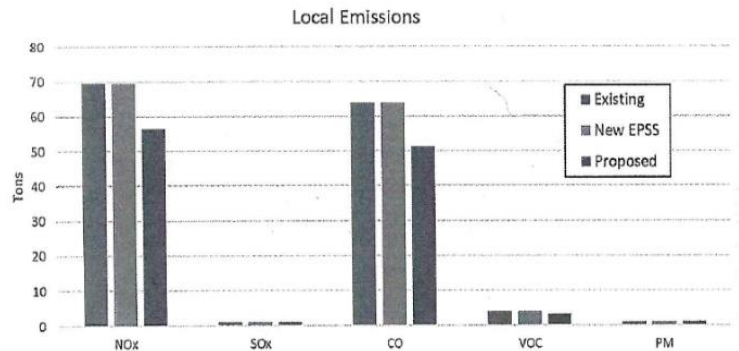
¹⁵ In information online, NYPA claims that greenhouse gas emissions associated with the Empire State Plaza have already been reduced 40%, without providing an explanation of how this was achieved. If those reductions are attributed in part to switching sources of electricity serving the Plaza from coal to combined-cycle gas, renewables, or nuclear power on the external grid, then it would have to be revised downward to account for predominantly gas-fired generation in Sheridan Hollow.

¹⁶ For example, see the IPCC Special Report on the consequences of a 1.5 degree Celsius rise in global temperature. Among its findings, the report states that limiting global temperature to a 1.5 degree rise with little or no overshoot requires that global carbon emissions drop 45% from 2010 levels by 2030. <https://www.ipcc.ch/sr15/>

IV. AN UNJUST PROPOSAL

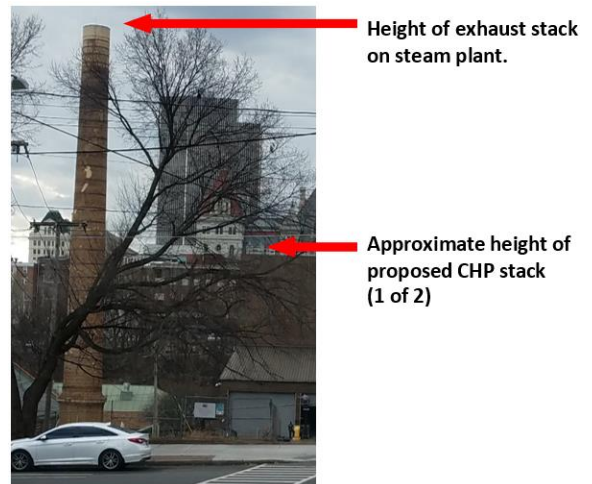
In an attempt to win public support for its originally proposed project, NYPA has suggested that the level of some criteria pollutants like nitrogen oxide (NOx) and carbon monoxide (CO) may be reduced by about 15 or 20 percent.¹⁷ However this presumes that continuing to expose residents within Sheridan Hollow to 80 or 85 percent of current pollution levels is acceptable. SHARE maintains that it is not. Nor is it credible to suggest that *reducing* pollutants harmful to human health can only be achieved by *increasing* the amount of gas burned within the community by nearly 50 percent.

As seen in the adjacent figure from NYPA, projected annual emissions of NOx and CO would remain high with the nominal reductions advertised. For example, CO levels are estimated at approximately 51 tons per year. This appears, in part, to be because the Taurus 70 gas turbines proposed by NYPA been specified *without* CO oxidation catalysts.¹⁸ NOx emission would also remain high.



Regarding these levels, the RFP issued by NYPA provides only a limited amount of information on how calculations were performed, insufficient to determine whether or not projections are valid or representative of all conditions. However, even if the nominal NOx and CO levels predicted by NYPA are assumed correct, this does not necessarily mean that residents would be exposed to less pollution.

NYPA estimated pollutants by total volume at the stack, rather than as concentrations at potential receptor locations. Significantly, combustion emissions from the Sheridan Avenue Steam Plant today are expelled from exhaust stacks that are 160 ft tall. However, with NYPA's proposal, most emissions would be produced by gas-fired turbines installed inside the former ANSWERS building and expelled from two, much *shorter* exhaust stacks. In fact, according to specifications contained in the feasibility study for NYPA's proposal, the new stacks would be at elevations of 80 ft and 85 ft, (only 15 feet higher than the top of the building). This is roughly half the height of exhaust stacks at the Sheridan Avenue Steam Plant (and much lower than the original ANSWERS plant exhaust stack). The consequence of this is that with emission sources closer to

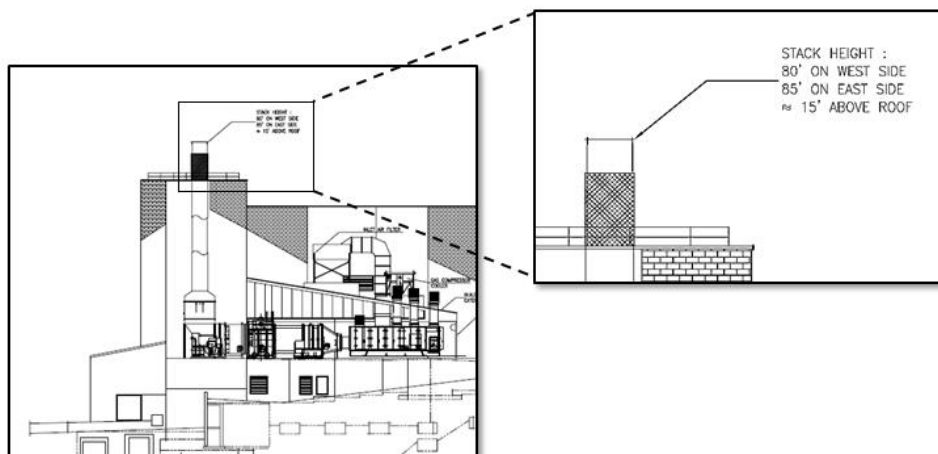


¹⁷ NYPA states in the January 3, 2018 project overview on its website that the proposed project would result in a 15% reduction in NOx and a 20% reduction in CO and VOC's locally.

¹⁸ The Taurus 70 turbine is also used in compressor stations recently built within the Dominion Pipeline—except that Dominion equipped its turbines with CO catalysts. With an oxidation catalyst, the Taurus 70 turbine produces 2.4 tons per year of CO, whereas without a catalyst, it produces roughly ten times this amount. Tragically, far more people live in Sheridan Hollow, in very close proximity to the ANSWERS building where turbines proposed by NYPA *without* CO catalysts would be installed, compared to the sparsely-populated rural areas where compressor stations using the same turbines are located which are equipped *with* CO catalysts.

the ground, residents could effectively be exposed to pollution concentrations that are as high, or higher, than before.

**Equipment layout diagram of Taurus 70 turbines in ANSWERS building
(from Cogen Technology feasibility report)**



This is compounded by the fact that Sheridan Hollow is a growing community located within a topographic ravine. Significantly, in 1986 researchers found that the former ANSWERS incinerator plant had a substantially greater risk of causing cancer among residents in Sheridan Hollow and Arbor Hills particularly because the facility was located within a ravine basin and released emissions at an elevation which could impact surrounding communities.¹⁹ However, the two turbine exhaust stacks in NYPA's proposal are roughly *one third* of the height of the smokestack used by ANSWERS. Those new emission sources would be located even lower inside of the same basin and closer to current and future residents who could be harmed. These communities of color should not be forced to endure continued exposure to levels of pollution that are significantly higher than places with a different racial demographic. Moreover is unconscionable to consider their past exposure to pollution as license for a lesser standard of protection in the future.



Sheridan Hollow today (left) and in the future (right) illustrating a growing threat to residents

¹⁹ Harvey Lipman, *Garbage Problems Pile Up*, Times Union, October 5, 1986.

Dirty Diesels

NYPA has said that its proposed microgrid would allow for the replacement of very old emergency diesel generators that have been a burden on the residents of Sheridan Hollow for decades. However, this can and should occur regardless of how electricity is provided to the Empire State Plaza during normal operation.

At issue are two 3.25 Megawatt diesel engine generators that comprise the Plaza's Emergency Power Supply System (EPSS). These are located in a building next to the Sheridan Avenue Steam Plant, and have short exhaust stacks that sit very close to the ground. Since their sole purpose is to provide backup electricity for critical loads during an interruption of service, the generators are rarely actually needed. However they are tested at least once a month for a period of time that can last several hours. When this occurs, residents often report seeing dense blue smoke that lingers at ground level for extended periods, along with loud noise and strong odors.

SHARE agrees that these dirty diesel generators must be eliminated, and we believe this should happen immediately. Indeed, the fact that they have operated for so long at ground level next to buildings in Sheridan Hollow where families live is further evidence of the systemic disregard for the welfare of this community.



Exhaust stacks of EPSS diesel generators next to Sheridan Avenue Steam Plant

NYPA has said it could replace the current EPSS equipment on Sheridan Avenue with modern, less-polluting 3MW diesel generators. It may also be possible for their emissions to be routed through the tall exhaust stacks of the steam plant to better protect the surrounding community. SHARE does not oppose this aspect of NYPA's proposal, provided that whatever fossil fuel generators are installed in Sheridan Hollow continue to be used for emergency purposes only. As discussed in Sections VI and VII, this can also be compatible with a solution for meeting energy needs of the Plaza with renewables during non-emergencies. SHARE would also support locating emergency backup generators outside of Sheridan Hollow.

Irrespective of future decisions about how electricity is generated for the Plaza under normal circumstances, the existing diesel generators in Sheridan Hollow should be removed or replaced without delay.²⁰ Residents must not be denied immediate relief from a harmful situation to which they should never have been exposed. However, it would also be wrong for state agencies to use these circumstances to extort acceptance of a CHP project that would burn even more fossil fuels in Sheridan Hollow than today and perpetuate the disproportionate exposure of residents to pollution long into the future.

Environmental justice will not be brought to Sheridan Hollow by burning more fossil fuels in the community, but instead by pursuing alternative forms of energy to meet the day-to-day needs of government buildings in Albany. Nonetheless, SHARE understands that backup generation may be needed during emergencies. Removing or replacing the outdated diesel generators in Sheridan Hollow with less polluting, modern equipment should be a priority.

²⁰ According to NYPA, the diesel generators being considered for use in the proposed microgrid project would be wired differently from the current system (in an N + 1 configuration). However this does not preclude configuring them presently in a manner compatible with the existing system, recognizing that the capacity of the new and old generators are nearly the same.

V. AN UNJUSTIFIED PROPOSAL

According to NYPA, a major benefit of the proposed microgrid would be improved reliability and resiliency. However, no substantive analysis has been provided to evaluate what deficiencies affecting grid reliability or resiliency actually exist, or what is the most appropriate way of addressing those deficiencies, if they exist. Nor has any evidence been provided indicating that credible reliability or resiliency concerns had been raised by state agencies or emergency service providers prior to the imagining of NYPA's proposal.

Reliability

Reliability relates to the ability of a power system to deliver a dependable quantity and quality of electricity expected by end-users. Regarding this, SHARE concurs with comments submitted by National Grid to the Public Service Commission (PSC) in September 2017:

"National Grid provides electric service to the ESP [Empire State Plaza] today through its robust electric distribution system in downtown Albany. National Grid has had no outages in this area in the past six years, including during the two significant natural disasters in this period, Hurricane Irene and Superstorm Sandy. OGS' installation of two new electric distribution lines as part of its proposed qualifying facility's "related facilities" to deliver electricity from the new CHP plant to the Plaza will not improve the reliability of electric service to the Plaza during normal operations because the Company's Albany electric grid is already extremely reliable as noted above, and the ESP will remain interconnected to the Company's grid."²¹

Significantly, the Plaza currently receives power from four circuits that deliver electricity from different locations. Notably, even the RFP issued by NYPA states: "With multiple 34.5 kV electrical feeds into the main substation, the ESP [Empire State Plaza] electrical system is very reliable and outages are rare."²² National Grid and state regulators are to be commended for having developed a robust and secure electricity network for the state capital.

Resiliency

Resiliency relates to the ability of a power system to withstand, recover from, or adjust to adverse impacts. According to NYPA, the proposed project could improve resiliency because electricity produced by gas turbines in Sheridan Hollow would allow the Empire State Plaza to function as an "island" during a loss of power from the external grid. It has also been suggested that the Plaza could serve as an emergency shelter. Yet, regardless of whether deficiencies relating to resiliency exist or whether parts of the complex could become a shelter, these considerations clearly do not require that the Plaza receive 90 percent of its electricity from the burning fossil fuels in Sheridan Hollow during normal operation (non-emergency conditions).



²¹ Case 17-M-0534 – Petition for a Declaratory Ruling that the CHP Facility at the Sheridan Avenue Steam Plant will not be Subject to Commission Jurisdiction and for a Limited Waiver of National Grid's Rule 47—Comments of Niagara Mohawk Power Corporation d/b/a National Grid; September 21, 2017.

²² See RFP for NYPA proposal, page 443.

As with any study of preparedness, a realistic assessment of emergency scenarios and risk is important to avoid overdesign and waste. This should include an analysis of failure modes associated with the existing grid and potential improvements to ensure that outside power can be rapidly restored in the event of an outage, that multiple transmission paths exist for delivery, and that facilities providing emergency services receive load priority. It should also include an assessment of existing emergency shelter facilities and provisions that are present in the area to accommodate disaster relief. Once that comprehensive analysis occurs, prudent decisions can then be made about what kind of preparedness improvements are warranted, and what kind of grid improvements, additional backup generation, or energy storage is needed to address any deficiencies. No such analysis has been provided.

Relating to this, if parts of the Empire State Plaza are being considered for use as an emergency shelter, then an analysis of energy needs associated with this should be performed. It is imprudent to assume that 16 Megawatts of generation capacity would be required simply because that is how much electricity the entire Plaza complex uses during regular daily activities. For example, it is unlikely that the legislature would be in session or that offices within high-rises of the complex would be in use during a disaster that leaves downtown Albany without power for an extended period of time. It is reasonable to require load shedding of non-essential functions under these circumstances.

If NYPA and OGS truly believe that public safety concerns rise to the level of significance that require greater capacity for onsite generation than already provided for at the Empire State Plaza, then the state should be willing to pay for the installation and maintenance of generators that only operate if and when those emergencies arise. It must also be recognized that any "islanding" capability that relies on natural gas will also be limited by the availability of gas in the pipeline supplying it.

The desire for a microgrid project that can operate as a self-sufficient island during emergencies is understandable. However, creating a microgrid for emergency service should not become a subterfuge for adding 16 megawatts of additional gas-fired capacity to the state's electrical grid and burning fracked gas in Sheridan Hollow around the clock. The next section of this report describes a feasible microgrid architecture that would only rely on electricity from fossil fuels during very rare extended outages, and that would be capable of meeting all energy needs of the Empire State Plaza with renewables during normal operation.

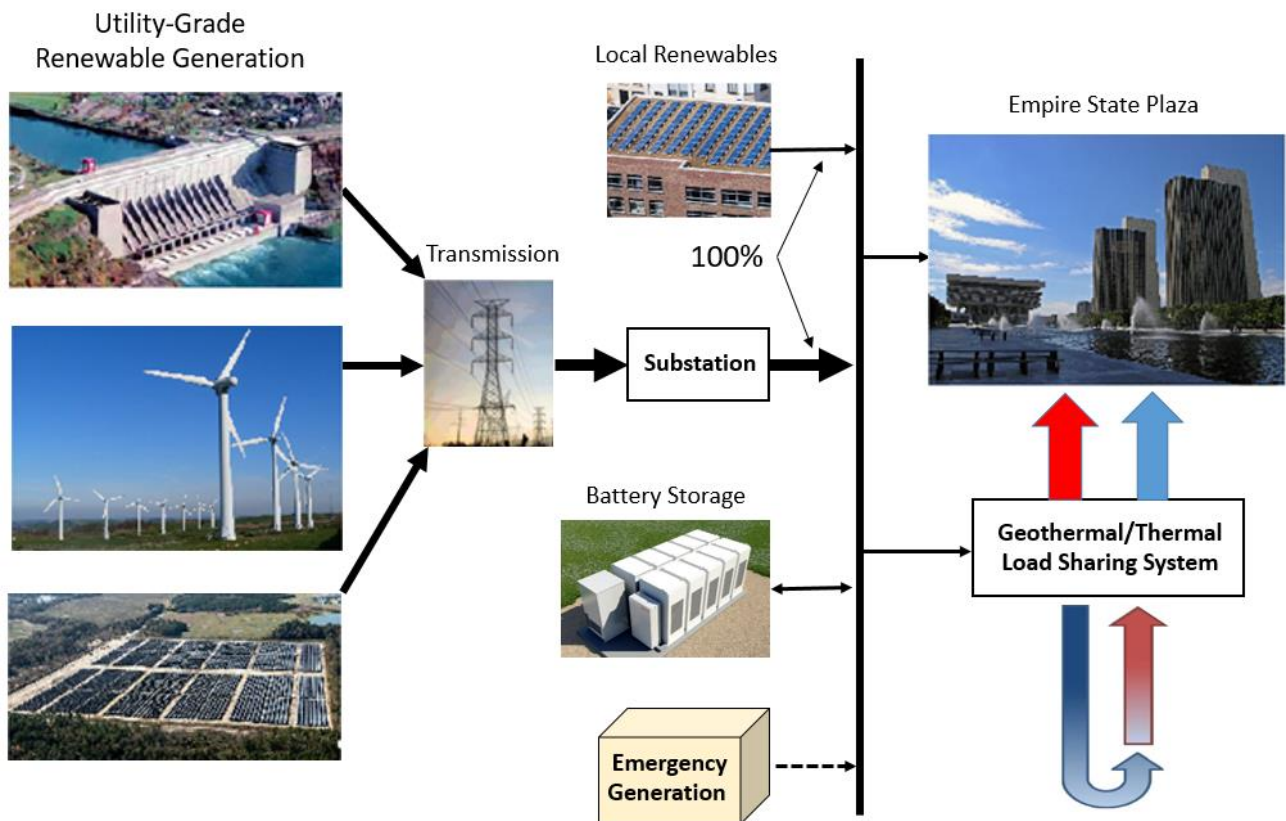
VI. A BETTER WAY

Rather than building a CHP plant that ties the production of both heat and power to fossil fuel combustion for years to come and continues to disproportionately target an environmental justice community with pollution, SHARE urges state leaders to pursue a project for the capital of New York that will truly showcase the state's commitment to a better future.

Re-envisioning the proposed microgrid, it is possible to meet energy needs of the Empire State Plaza with renewables during normal operation, while also ensuring that provisions are maintained for resiliency during emergencies and improving power quality. In this section, we discuss how this can be accomplished for electricity, heating, and cooling. We also respond to disparaging statements that have been made about the feasibility of renewable energy solutions, citing examples of relevant large-scale projects that have been successfully implemented in the United States and elsewhere.

The figure below depicts a renewable network with microgrid capability applicable to the Plaza.

Renewable Network with Microgrid



An Architecture for the Future

To be clear, the deployment of renewables necessary to meet energy needs of the Empire State Plaza does not have to occur all at once. It can happen in phases, and capital costs may even necessitate this. However, it is critical that whatever steps taken do not inhibit the timely realization of those renewable energy goals. As previously discussed, a fundamental problem with NYPA's proposal is that it would inextricably tie electricity, heating, and cooling to the combustion of fossil fuels—not only for emergency purposes, but *continuously* for normal operation. By prolonging an outdated steam-based system of heating and cooling, NYPA's prior proposal would forego modern, far more efficient heat pump technology. Furthermore, the heating and/or cooling demand would require continuous operation of that gas-fired CHP system, thus limiting the future penetration of renewables for electricity as well. In short, NYPA's previously proposed project would condemn the capital of New York to a future of fracked gas.

It is well understood by energy experts that substantially decarbonizing our energy system requires "beneficial electrification" (also known as a plan to "electrify everything").²³ This requires replacing "end-user" equipment, such as furnaces for homes, businesses, and office complexes with efficient zero-emission alternatives, such as air-source, water-source, or ground-source heat pumps that are powered by electricity. Likewise, it requires replacing fossil fuel power plants with carbon-free sources of electricity. This is what SHARE is advocating for the Empire State Plaza, as discussed below.



Electricity During Normal Operation

Meeting electricity needs of the Empire State Plaza with renewable energy is eminently doable, but it requires re-envisioning how the proposed microgrid would work.



Like almost any populated urban area with a concentrated demand for energy, downtown Albany does not have enough physical space to meet its entire electricity needs with locally deployed renewables. This is because both solar and wind have low energy density—meaning that they require generators of electricity (solar panels and wind turbines) distributed over a larger physical area. This fact has been pointed out by NYPA, and SHARE does not dispute it. Indeed, meeting current demand of just the Empire State Plaza (111 gigawatt hours annually) with photovoltaic solar panels would require over 400 acres of dedicated land, not including storage.²⁴

²³ <https://www.vox.com/2016/9/19/12938086/electrify-everything>

²⁴ Based on 3.7 acres/GWh/yr total area for fixed photovoltaic solar array panels using NREL data.
<https://www.nrel.gov/docs/fy13osti/56290.pdf>

However, contrary to NYPA's original response, this does not mean that a renewable solution is impossible.²⁵ Unless a major hydroelectric facility happens to be nearby, powering virtually any type of urban area with all, or nearly all, renewables will require a combination of resources deployed **both locally and outside of the immediate area**.



For Albany, this could involve solar panels on buildings and in open spaces downtown, larger solar arrays throughout the city, and other renewable resources such as existing upstate hydropower and additional wind or solar located farther from the city. All of these would collectively contribute to the larger "macro" grid to which Albany and the Empire State Plaza are connected.

With respect to a microgrid, this requires that electricity sources and loads during normal operation differ from sources and loads when the system is in "island" mode. Some electricity used by the Plaza could certainly be provided by locally-cited renewables. However, as proposed by SHARE, **the Plaza would receive most of its electricity from the external "macro" grid during normal operating conditions**.



For example, if 10 Megawatts of PV solar panels can be installed on buildings and in open space areas downtown, this would provide about 20 Gigawatt-hours of electrical energy over the course of a year, meeting approximately 12% of the Plaza's current annual consumption. Moreover, when the sun is shining, 10MW would actually provide a much larger portion of the Plaza's instantaneous power.²⁶ These locally-cited renewables could be connected to the internal microgrid (although they would not have to be), and the remainder of the Plaza's electricity would be sourced from the external grid.



Maple Ridge Wind Farm - Lewis County, NY

As previously discussed, a significant portion of upstate New York's electricity is already renewable (largely hydropower), and this will increase over time as New York continues to green its grid. Therefore, such a configuration that relies on locally generated renewables to the extent possible—and grid-delivered electricity for the balance—provides maximum flexibility for growing the amount of electricity that the Plaza receives from renewables over time.

Importantly, unlike NYPA's proposal, **the concept proposed by SHARE does not involve the continuous combustion of fossil fuels for electricity during normal operating conditions**.

²⁵ See NYPA 12/6/2017 response the "Frequently Asked Questions"; Project Facts, No. 3a, bullets 1 and 2.

²⁶ According to 2016 load service data, the average load of the Empire State Plaza in July was 12.2 MW. Therefore, during the day in full sun, solar PV with an aggregate nameplate capacity of 10MW could meet about 80% of this current monthly load. See NY Prize Stage 1 Feasibility Assessment, Appendix I "Monthly Energy Loads." Note that this reflects current electrical load conditions. It does not include future loads, which could include electricity to support efficient geothermal heat pump technology.

Electricity in "Island" Mode

In the rare event of a loss of power from the external grid, the Empire State Plaza would switch to microgrid "island" mode for the purpose of supplying electricity to essential loads. As proposed by SHARE, these loads would include at least those which NYPA had planned to serve using the new diesel generators proposed in its 2017 RFP.

Although batteries could potentially meet demand during a short-term outage, local backup generation from a fossil fuel source will likely be necessary for a longer disruption of service. This source could potentially be the same two 3.0 MW diesel generators proposed by NYPA. Alternatively, if the Plaza is used for other emergency purposes, additional local electricity generation could be provided.²⁷ We discuss this further in the next section. But regardless of the particular implementation, a key provision of SHARE's proposal is that any locally-installed generator that consumes fossil fuels should operate **only when the system is in emergency "island" mode**—that is, when the external "macro" grid has failed.

Although SHARE's proposal would dramatically reduce local pollution by avoiding fossil fuels consumption during normal operation, special attention is still needed ensure that any combustion-source located in downtown Albany, even one installed only for emergency purposes, minimizes impact to public health. Ideally, considering past history and the community's location with a geographically low area, the emergency generator system described above would be installed outside of Sheridan Hollow completely. However, if located on Sheridan Avenue, the most stringent emission controls should be required, including catalytic oxidation and selective catalyst reduction. Detailed dispersion modeling should also be performed. Instead of releasing emissions near the ground like the existing diesel generators in Sheridan Hollow presently do, elevated smokestacks (such as those from the steam plant) should be required, to limit public exposure. The duration and frequency of periodic testing should be limited as well.

Although not essential to SHARE's proposal, we recommend that battery storage be considered to address momentary or short-term outages. Several manufacturers of large-scale batteries are available, including for example the Tesla "Power Pack" system, which is scalable in increments of 50 KW (peak power) and 200KWh (storage). Although size and cost limitations will likely prevent batteries from meeting peak load conditions for the entire Plaza, they could potentially be a source of backup electricity for a subset of Plaza functions.²⁸

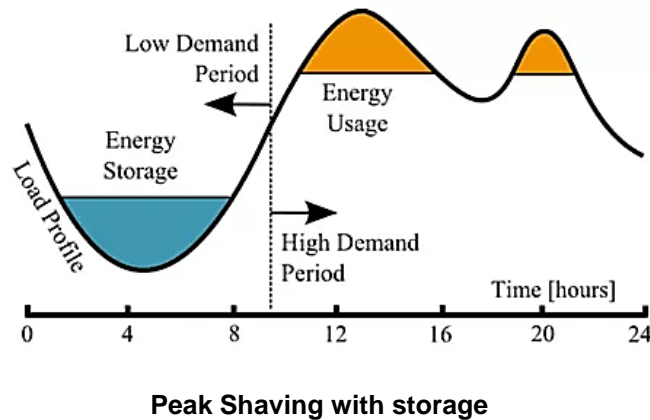


Tesla "Powerpack" storage system

²⁷ Alternatively, backup electricity could be provided by fuel cells, which would produce less pollution when operating than a combustion-based generator. In theory, a solid oxide fuel cell (SOFC) could also provide supplemental heat for a subset of Plaza functions when in island mode. Also a fuel cell that runs on hydrogen (rather than natural gas) could avoid fossil fuel consumption, provided that the hydrogen is produced using a process that does not require fossil fuels for energy or natural gas as a raw material. Although a natural gas fuel cell creates less pollutants harmful to human health than a combustion-based generator, significant GHG emissions (carbon dioxide) are still produced in the primary electro-chemical process.

²⁸ For example Tesla offers a configuration of 54 Powerpack units for \$3,217,000 that provides 2500KW of electricity for 2.2 hours. This is only slightly less than the capacity of the two 3.0MW diesel generators proposed by NYPA. <https://insideevs.com/tesla-energy-reveals-powerpack-pricing/>

Aside from providing power during a short-term outage, there is another reason battery storage could be a useful component of energy infrastructure for the Plaza. Battery storage can play a valuable role in peak shaving and load normalization. This is because during times of light demand, electricity from the grid can be used to charge batteries, which can then supply extra electricity to the grid during peak periods. Solar panels installed locally can also help with peak shaving—for example on sunny days in the summer when demand for air-conditioning is high.



Achieving Reliability and Resiliency

As discussed in Section V of this report, the Empire State Plaza already enjoys the benefits of a reliable and resilient electrical grid. If additional resiliency is desired, it should be provided without building a power plant in Sheridan Hollow that burns fossil fuels during normal operation.

Presently, the Plaza's EPSS is capable of generating electricity for critical functions in the rare event of a loss of power from the external grid. As such, it is already essentially a "microgrid" for emergencies, capable of providing 6.5MW from two 3.25MW diesel generators that operate in tandem—but as NYPA has said (and as we agree), these diesel generators are at the end of their useful life and must be replaced.

According to NYPA, "life-safety and critical loads" at the Plaza can be reduced to 2.6MW, which is why it has proposed installing two new 3.0MW diesel generators in a N+1 configuration.²⁹ However, it may also be possible to configure these two new generators in tandem to supply 6.0MW of power. Alternatively, for maximum flexibility, perhaps one generator could be allocated to life-safety and critical loads, and the other allocated to a second load tier—with the capability of switching to life-safety and critical loads if the first generator fails. If not a permanent solution, this could potentially be a temporary one as the state further evaluates a comprehensive strategy for meeting energy needs of the Plaza with renewables.

As emphasized in Section V, SHARE maintains that any additional provision of local electricity generation for resiliency must be based on a sound evaluation of actual need and only used in emergencies. For example, if there is interest in using the Plaza as an emergency shelter, then OGS should first prepare a detailed analysis of deficiencies in the city's current emergency management plans to determine what

²⁹ See RFP for NYPA proposal, page 120 Section 9, Subsection 11 *Emergency Power Supply System Replacement*.

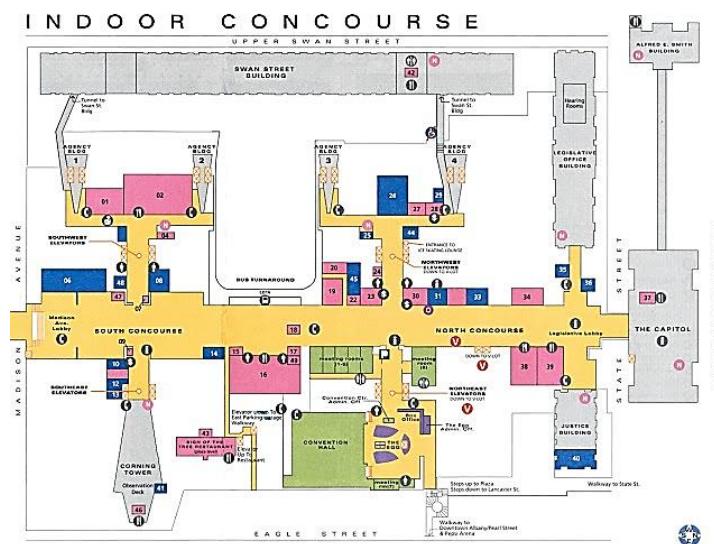
additional sheltering needs, if any, are required. This should be coupled with a shelter feasibility study to address the various aspects of creating an emergency management plan for the Plaza and how to equip parts of it with necessary provisions (medical supplies, cots, food rations, etc.) to function in this capacity. If using the Plaza as a shelter is a real consideration, then this level of prudent evaluation and planning is warranted before investing very large sums of public money to install equipment for electricity generation that may otherwise be unnecessary.

Furthermore, as discussed in Section V, it is not realistic to assume that the entire Plaza complex, including all of its high-tower buildings, would be used for an emergency shelter. The amount of electricity required in a shelter scenario should be less than peak demand for the entire Plaza, and any additional backup generation sized accordingly. For example, if research found that designating the concourse or other common areas of the Plaza as an emergency shelter would be useful, then the electrical system of the Plaza should be configured to deliver power to those particular areas when in "island" mode, instead of the entire complex.³⁰



Empire State Plaza Concourse

By carefully planning for both emergency and non-emergency conditions, it is possible to design an electrical system for the Plaza that maximizes the use of renewable energy during normal operation while ensuring resiliency for critical support functions.



³⁰ We recognize that emergency generation may have to support heating and cooling of shelter areas as well. Alternatively, a backup source of fossil-fuel heating could be provided for emergency purposes. (See discussion of this in the next section.)

Heating and Cooling

By far, the greatest opportunity for applying renewable energy and efficiency to the Empire State Plaza is by replacing the Plaza's inherently inefficient steam-based system of heating and cooling—one that requires fossil fuel combustion throughout the year—with a modern, efficient system of heating and cooling that utilizes state-of-the-art geothermal heat pump technology and effective thermal advantage load sharing. This would not only dramatically reduce the Plaza's carbon footprint; it would also eliminate—once and for all—a major source of pollution from a community which has suffered with combustion emissions to serve government buildings in Albany for more than a century.

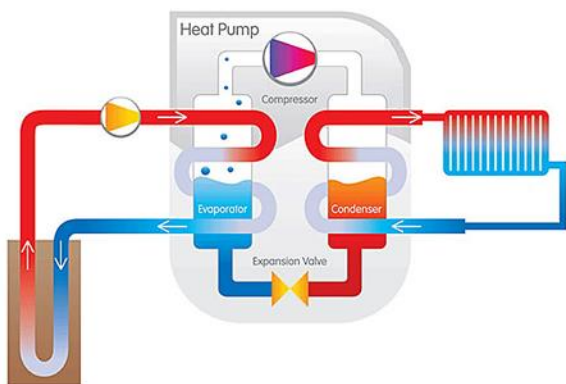
Over the past year, SHARE has worked closely with Jay Egg, an expert in the design and retrofit of large-scale projects, to evaluate the outstanding potential for this at the Plaza. With over thirty years of experience in the industry, Egg has successfully brought numerous high-profile geothermal projects to fruition around the country, and is currently involved with several in New York State.³¹ Egg is also a technical consultant for NYSERDA, provides expert training, and has written two books and numerous trade-journal articles on geothermal technology.



In April 2018, SHARE participated in a day-long meeting with NYPA, NYSERDA, and a team of design experts convened by Egg to discuss how energy needs of the Plaza could be met with renewables energy, particularly for heating and cooling. As we discuss below, the dialogue was instrumental in dispelling perceived limitations and misconceptions about large-scale geothermal design.

Triple Digit Gains in Efficiency

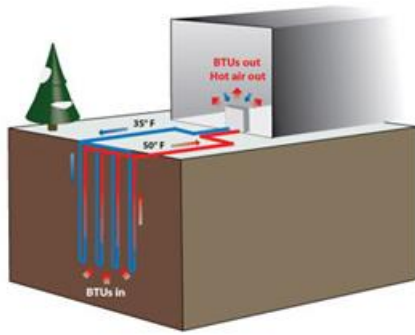
The fundamental advantage of a heat pump is that it *moves*, rather than *creates* thermal energy. Instead of burning fossil fuels to produce warmth, a heat pump collects existing heat from the environment—either the ground, water, or air—and transfers it into a building. Conversely, for cooling, a heat pump transfers thermal energy within a building to the outside environment which functions as a heat sink.



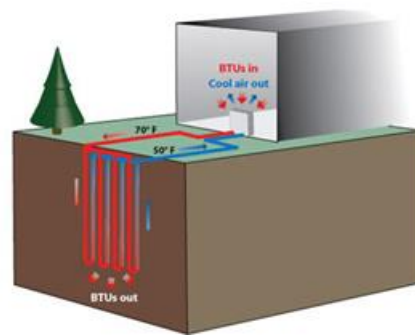
Like a refrigerator, a heat pump uses electricity, which operates a compressor, and Carnot-cycle thermodynamics to maximize thermal energy delivered per volume. However since heat is transferred rather than created, efficiencies exceed 100%. In fact, a well-designed ground-source or water-source geothermal system typically achieves a Coefficient of Performance (COP) between 3 and 5, corresponding to heating efficiencies of 300% to 500%. This means that three to five times as many BTUs of beneficial thermal energy is provided compared to the amount of electricity required to run the system.

³¹ Driven by a commitment to the environment and to environmental justice, Jay Egg has provided his expertise and advice at no expense to SHARE, and he has recused himself of any potential financial benefit associated with a project for the Empire State Plaza.

Vertical closed loop system (NSERDA)



Heating mode



Cooling mode

Ground-Source Geothermal

Several techniques exist for thermal exchange with the outside environment. A common method involves drilling vertical geothermal bore-holes that allow for the transfer of thermal energy to and from the earth through the circulation of a fluid in a closed-loop. Each well is typically a few hundred feet deep and, depending on the geologic formation, may also provide thermal storage. (Another technique involves installing a horizontal loop field within an excavated area, though this typically requires more land.)

Closed-loop geothermal wells are commonplace for systems of every size, ranging from single-family residential homes to very large-scale projects in which buildings are linked together in one or more districts—the largest of these being Ball State University in Muncie, Indiana. Examples of district projects in New York State that employ ground-source technology include Skidmore College in Saratoga Springs and Cornell University on Roosevelt Island.



District ground-source geothermal system at Skidmore College



Roosevelt Island Cornell Tech when complete showing public open space where geothermal wells are located

Aside from greater efficiency, an advantage of ground-source geothermal heat pump technology over air-source heat pumps is that all outdoor infrastructure is below the surface. This makes it invisible and highly resilient. Wells can be located within open greenspace areas and courtyards, under sidewalks, and beneath parking lots without interfering with aesthetics or creating any permanent surface impact. They can potentially even be drilled directly below buildings.

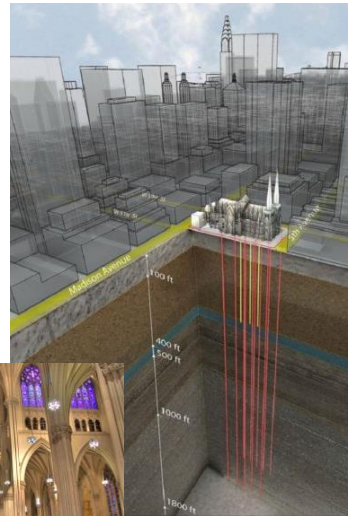
For the Empire State Plaza, one concern previously raised by NYPA is that construction impacts associated with drilling geothermal wells might be too "disruptive." However, such technology has been successfully deployed throughout the world, including within urban environments far more challenging than Albany. Notably, in 2017 Saint Patrick's Cathedral, located on 5th Avenue and 51st Street in Manhattan, replaced its system of steam heating and 1960's era air-conditioning with a modern geothermal system, drilling vertical wells that are over 2000 feet deep. Saint Patrick's Cathedral is comparable in size to the New York state capitol building.



Construction is a regular part of city life. Moreover, with respect to "disruption," it should be apparent that the existential threat of disruptive climate change resulting from the continued consumption of fossil fuels is of far greater consequence.



Saint. Patrick's Cathedral, Manhattan



Significantly, Oklahoma has been operating its State Capitol, a 400,000 sq ft building with six floors, with geothermal technology for almost 30 years. The closed-loop system uses 370 geothermal bore holes and replaced a combustion-based steam plant.³² Currently, the state of Michigan is also renovating its capitol building with a closed-loop geothermal system.³³

As explained by Jay Egg, it is not possible to estimate how many ground-source wells would be needed for a multi-structure complex like the Empire State Plaza by simply counting BTUs required for heating and cooling today, since this does not account for efficiencies achievable with a fully integrated design that incorporates thermal load sharing and other techniques. (See subsequent discussion of this.) It is also likely that the best design could involve a combination of geothermal heat sinks and sources, such that well bores may be just one component. An in-depth analysis by professionals with experience in the design and retrofit of complex systems will be required to identify the most effective strategy moving forward.

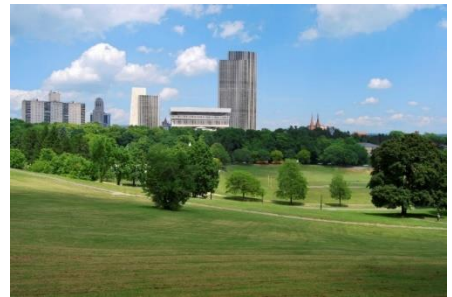
Likewise, the identification of suitable locations for geothermal wells proximate to the Plaza will require a detailed analysis of many issues. However, it is apparent that several potential areas may be available if this type of solution is pursued.



East lawn of the Capitol



View from the Corning Tower



Lincoln Park

³² <https://files.climate-master.com/lc314-climate-master-commercial-oklahoma-capital-building-case-study.pdf>

³³ <https://michiganbattleofthebuildings.org/geothermal-energy-comes-michigans-state-capitol-building/>

Water-Source Geothermal

Among the various options that exist for geothermal heating and cooling in Albany, perhaps most interesting is the possibility of using the Hudson River as a heat sink and source. This concept was first described in a 2017 article by Jay Egg titled "CHP Project for Empire State Plaza Misses the Mark" that appeared in the trade journal *Renewable Energy World*.³⁴ A closed-loop water-source geothermal system operates fundamentally the same way as a ground-source system, except that heat exchange occurs with a body of water using submerged coils or plate exchangers. Alternatively, an open-loop system would involve drawing water from the river and bringing it to heat exchangers located at (or near) the Plaza.



Empire State Plaza seen from



Nashville Airport

Water-source geothermal systems are very practical because they eliminate or reduce the need for ground-source wells, cooling towers, and other facilities that may be costly and occupy space. Nashville Airport in Tennessee is an example of a very large public complex—like the Empire State Plaza—that was successfully converted to geothermal heating and cooling using lake-plate heat exchangers within a nearby quarry. At an even larger scale, the city of Drammen in Norway built a geothermal system that obtains heat from sea water to serve more than 200 commercial buildings.

Closer to home, the master-planned community of Newport, located in downtown Jersey City, New Jersey, is currently evaluating the feasibility of a river-sourced geothermal exchange system for heating and cooling several very large buildings. Bigger than the Empire State Plaza, the mixed-use waterfront complex consists of high-rises adjacent to the Hudson River and millions of square feet of conditioned space. The project promises to be an excellent example of large-scale modern geothermal technology and innovation.



Newport Master Plan Expansion



³⁴ <http://www.renewableenergyworld.com/articles/2017/11/chp-project-for-empire-state-plaza-misses-the-mark.html>

Significantly, the Empire State Plaza already pipes water in from the Hudson River for several purposes: to create steam at the Sheridan Avenue Steam Plant, for Rankine cycle cooling required to operate steam-driven centrifugal chillers in the Central Air Conditioning Plant (CACP), and for removing heat from chillers at the CACP. It is therefore likely that the same conduits—or passageways that carry them—can be repurposed for conveying water to a set of electric-driven heat pumps for both heating and cooling.

Initially NYPA feared that rejecting heat to the Hudson River could be a concern by some environmental advocacy groups. However, the concept described above would actually reduce thermal impacts by eliminating waste heat associated with the use of steam. Although the river is used today as a sink for removing heat at the CACP, this thermal effect would also likely be reduced since the existing chillers would be replaced by modern heat pumps and integrated into a more efficient system of thermal load-sharing throughout the complex. (See discussion of this in a subsequent section.)

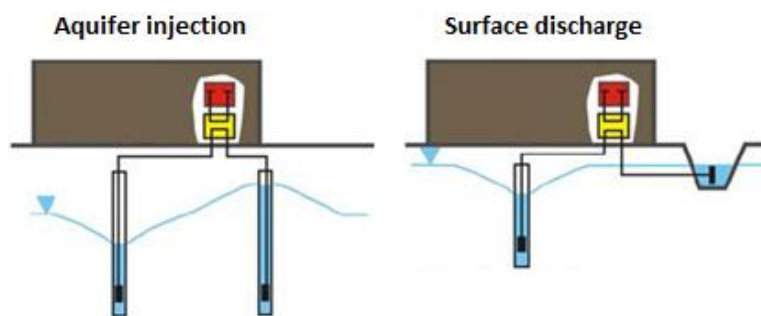
Misplaced fear that water-based heat exchangers could freeze, stop working, or break down are refuted by the fact that such systems have been effectively designed and deployed throughout the world, including in climates much colder than Albany. Moreover, even if it were found that the Hudson will not provide effective heat exchange for a few days or weeks in the winter, this does not preclude using it for this purpose the rest of the year. It is possible that some combination of water-source and ground-source technology may be the best approach for the Plaza.



Cold-climate lake-plate exchanger

Aquifer-Source Geothermal

Another potential heat sink and source for geothermal exchange is the aquifer. This concept involves pumping ground water from one or more wells into a heat exchanger and discharging back to the aquifer in an "open-loop" configuration. A variation of this approach is to extract from the aquifer and discharge to a surface water body.



This open-loop technique is a common and very effective method for accomplishing thermal exchange. Notably, the state of Colorado cools its capitol with an open-loop aquifer-source system installed in 2013 that involved drilling two 850 ft wells.³⁵

³⁵ <https://www.colorado.gov/pacific/capitol/geothermal>

A good example of aquifer-source geothermal with surface water discharge is the Galt House East Hotel and Waterfront Office Building complex in Louisville, Kentucky.³⁶ Also comparable to the Empire State Plaza, the project provides heating and cooling for hotel rooms, apartments, a large office building, and other public areas totaling 1,740,000 sq ft of conditioned space. The system, which serves both new and retrofitted buildings, extracts 2800 gallons per minute of ground water from four 130 ft wells to fill a 140,000 gallon reservoir used for thermal exchange. Discharge is through stormwater conveyance to the Ohio River.



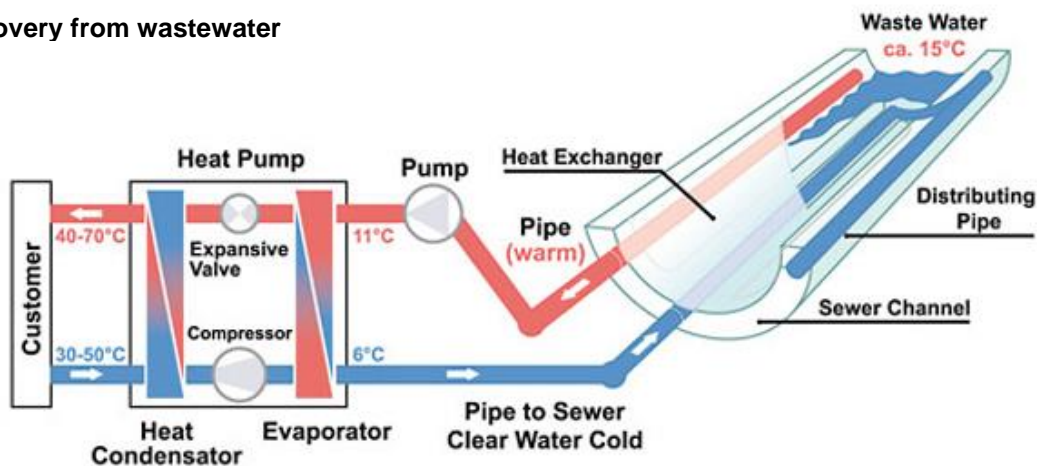
Galt House & Waterfront Complex

Infrastructure Heat Exchange and Recovery

Finally, a form of heat exchange particularly applicable within an urban setting involves the use of municipal infrastructure, such as water mains, stormwater drainage, and even sewer lines. In fact, heat recovery from wastewater can be particularly effective because of the temperature gradient. Essentially any flowing body of water or wastewater can serve as a potential heat sink or source.

Depending on the location of facilities, heat recovery can occur at the building complex, at the water or wastewater treatment plant, or within the underground conduits that carry potable water, effluent, or stormwater. In all cases, a closed-loop system of heat exchange is used so that there is never a physical interaction between the fluid circulated for heating/cooling and potable water or other medium that serves as the heat sink or source.

Heat recovery from wastewater



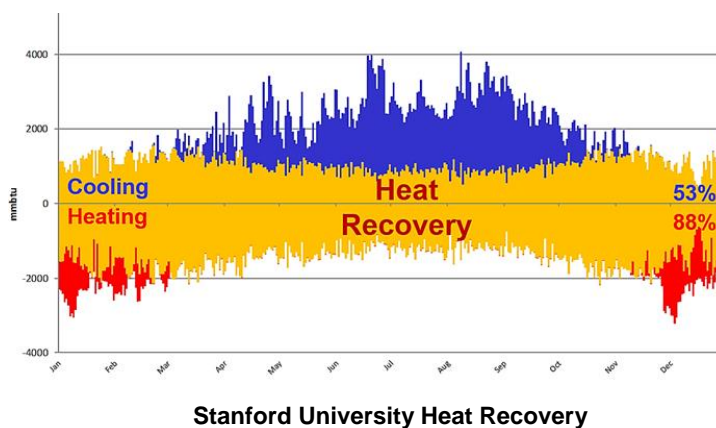
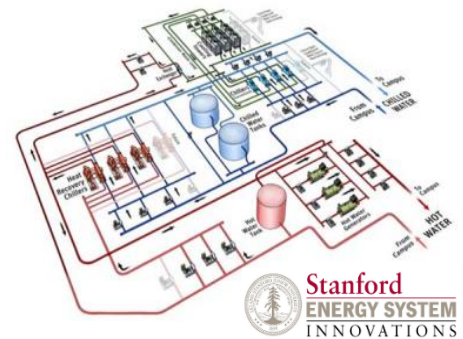
³⁶ <https://www.geothermal-energy.org/pdf/IGAstandard/WGC/1995/3-pinckley.pdf>

Thermal Advantage Load Sharing and Thermal Storage

In addition to geothermal technology, which provides for efficient heat exchange between a building and the outside environment, an important consideration for any large-scale system like the Empire State Plaza is how heat transfer and circulation occurs within the complex itself. This is because the amount of thermal energy within different rooms or buildings inside of a large complex can vary widely at any given time due to various factors including solar loading, occupancy, and other internal sources of heat (a computer data center, for example). Consequently, a conventional heating and cooling system often relies on combustion heating in some areas at the very same time that other areas are being cooled with forced-air.

Through the use of **thermal advantage load sharing**, these inefficiencies can be avoided by moving thermal energy from areas with excess heat to those parts of a complex where additional heat is needed. Any system that provides a common thermal loop, or separate cold and warm water loops with thermal exchange between them, have the capacity to accomplish this. Likewise, with **thermal storage** it is possible to retain heat energy in reservoirs of warm (or cold) water, which can be used later. (As previously mentioned, it may also be possible to build-up a certain amount of seasonal storage within the bedrock that surrounds closed-loop geothermal wells.)

The Stanford Energy Systems Innovations (SESI) project, completed in 2015, is a premier example of these techniques. Prior to that time, Stanford University found that the majority of its energy for heating and cooling had been spent on combustion heat—from a gas-fired CHP steam plant—that occurred simultaneously with Carnot-cycle cooling. The SESI project eliminated this plant and replaced it with a system that transfers heat between different parts of the campus through cold and warm water loops, a central heat exchanger, and water reservoirs for thermal storage.³⁷



Even without drilling any geothermal wells to exchange heat with the outside environment, Stanford found that thermal load sharing and storage provided significant heat **recovery**, allowing the new system to be 70 percent more efficient than the one it replaced.³⁸ (See yellow region plotted over a year in the adjacent graph.) In a future phase, the university plans to add a geothermal system to eliminate combustion heating completely. As previously mentioned, the Galt House project in Louisville, KY also utilizes thermal load sharing and storage.

³⁷ Along with the elimination of combustion-based CHP, Stanford has reduced its carbon footprint for electricity with significant investments in on-site and off-site renewables.

³⁸ Links with useful information on the Stanford SESI project:

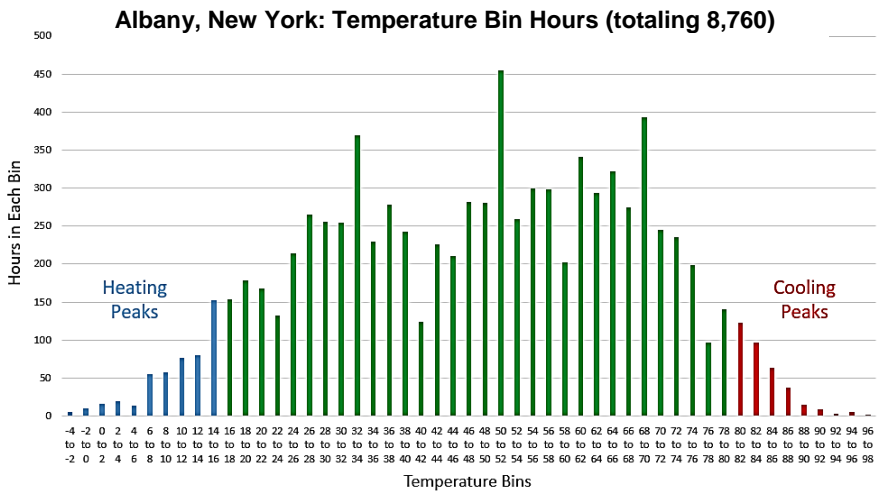
<https://sustainable.stanford.edu/campus-action/stanford-energy-system-innovations-sesi> ;

<https://sustainable.stanford.edu/campus-action/energy/stanford-energy-system-innovations-sesi/cogeneration-heat-recovery> (see video);

<https://www.enr.com/articles/39005-editors-choice-best-energyindustrial-stanford-energy-system-innovations>

Significantly, when BTUs are transferred within a building complex, heating and cooling systems that utilize thermal advantage load sharing require less heat exchange with the outside environment. This can potentially produce effective overall COPs that are upwards of 8 to 10.³⁹ In the case of the Empire State Plaza, it could also reduce the amount of external geothermal infrastructure needed.

The relevance of this is seen in the graph below, depicting a bell-curve distribution of temperatures within Albany over the course of a year. For the Plaza, it is very possible that temperature regulation can be achieved using thermal load sharing and storage much of the time, with external heat exchange only required during peak "shoulder" periods. This is further supported by the fact that the Plaza is "cooling dominant" most of the year and that the Hudson River already serves as a heat sink for existing chillers in the CACP.



By installing modern electric heat exchangers ("reverse chillers") and designing an effective system of thermal load sharing between cold and warm water loops, it is very likely that heating and cooling needs of the Empire State Plaza can be met entirely without fossil fuels. However, even if it were determined that a small amount of supplemental heat from combustion may be needed on very cold days, the performance benefits of such a system based on geothermal heat and cooling are tremendous.

VII. Phasing in a Renewable System

As previously discussed, the deployment of renewable energy for heating, cooling, and electricity at the Empire State Plaza will likely need to be phased in. However, it is critical that whatever action occurs be consistent with that vision—and that steps taken are in a forward direction. A CHP project that perpetuates outdated steam technology and reinforces long-term dependence on fossil fuel combustion for both heat and power is a technological dead-end, incapable of achieving that future. On the other hand, converting New York's center of government to a platform that does not require fossil fuels during normal operation would be a model of real innovation.

We also recognize that sequencing the necessary conversions involved in a project of this scale is a formidable task, especially since the Plaza must remain operational during the transition. But as with Ball

³⁹ Based on modeling using the Building Efficiency System Tool (BEST) by Hydronics Industry Alliance showing the dynamically increased COPs of equipment in a thermal advantage state; <http://www.iapmo.org/HIAC>

State University and other major institutions that have transitioned away from fossil fuels, success is possible with proper planning and involvement by those with experience in these type of complex, large-scale endeavors. SHARE recommends development of a comprehensive master plan and schedule for implementation. Without further analysis, it is impossible to say whether or not \$88 million, which had been previously budgeted, will cover the entire conversion. However, this amount will clearly make a significant contribution, thus putting the Empire State Plaza on a credible path to a zero or near-zero carbon future over time.

There may be several workable approaches for phasing in renewable heat and power. But in any scenario, replacement of the Plaza's 50-year-old steam-driven chillers—which are approaching the end of their life—with modern electrically-driven heat pumps that are capable producing chilled or warm water is key. Existing chillers at the CACP use water from the Hudson River as a heat-sink, so it may be possible for this same water to also function as a source of heat extraction—if not always, then much of this time. This could be augmented or replaced with closed-loop ground exchange or open-loop withdrawal from the aquifer if those are better sources than the river during cold months. Heat exchange with municipal water, wastewater, or stormwater infrastructure is also possible.



Maintenance of old CACP chillers



We note that one of the five chillers at the CACP can be powered by electricity, rather than steam, under half-load conditions.⁴⁰ So if this chiller were operated in electric mode and given priority, steam production could be throttled back even today.⁴¹ As more chillers are replaced with heat pumps, steam production at the Sheridan Avenue Steam plant can be progressively reduced over time and eventually eliminated.

Chillers for heat and cooling at Ball State University

It is likely that the existing chilled water loop can be retained for cooling. For heat, existing steam or hot water radiators would be replaced with appropriately-sized convection heating that utilizes a warm water loop connected to heat pumps at the CACP. Heat exchangers between the chilled water and warm water loops can also be phased in to support heat recovery and thermal load sharing. If it is determined that the Plaza would benefit from thermal storage, water reservoirs (or additional ground-source wells) can be integrated into the system. We note that the lowest parking level beneath the Plaza has significant space and vertical clearance (over 15ft), which could be a useful location for this. Another approach that could be applicable to parts of the Plaza may involve the installation of forced-air heat pumps within some buildings or rooms, with connection to the chilled and warm water loops, or to a common loop, for heat exchange.

⁴⁰ Cogen Technology Feasibility Report, p. 21. ("One chiller also has an electric motor drive which can power about half of its design output if required.")

⁴¹ If the five chillers operate typically at 50% load, this could reduce steam demand 10% when operating.

A well-designed geothermal system is unlikely to require combustion heating. But if found to be necessary on very cold days, a supplemental boiler could be installed on the warm water loop. To avoid losing heat during an outage of the main electrical grid, backup electricity generation should be properly sized to keep some heat pumps operating. A supplemental boiler may be useful in this situation as well. Alternatively, since boilers already exist at the steam plant on Sheridan Avenue, some elements of the old combustion system could be retained for very cold days or backup heat in an emergency. SHARE understands that these are practical considerations which do not conflict with the goal of achieving a zero or near-zero carbon footprint during normal non-emergency conditions.

Another key requirement for geothermal energy to work effectively is a secure, insulated building envelope. A system-wide evaluation of the entire complex should be performed early in the process and improvements made as necessary to optimize building efficiency and reduce heat losses.

As previously discussed in this report, a substantially renewable solution will require that the Empire State Plaza receive most of its electricity from the external grid during normal operating conditions. However, it is also clear that a certain amount of backup electricity generation (from fossil fuels) will be necessary to support essential functions in the event of an emergency, and that the diesel EPSS generators currently in Sheridan Hollow need to be replaced. To eliminate harm caused by the frequent testing of those generators, the state should make the immediate replacement of those a priority. If additional fossil fuel generation (strictly for backup) is desired to provide other services at the Plaza during an emergency, such provisions can be incorporated after those needs or benefits have been thoroughly studied.



Solar panels at University of Albany

Although the total amount of watt-hours of *electricity* that can be generated with solar panels or other forms of renewables in downtown Albany will be limited by space constraints, whatever capacity exists should be maximized. Doing so will add to other carbon-free sources of electricity on the larger external grid, and can occur in parallel with the installation of a modern renewable heating and cooling system. Though not essential, local battery storage would also be beneficial for peak shaving, and could potentially power essential functions during a short-term outage.

Finally, meeting the Plaza's demand for energy without fossil fuels will require that the state vigorously pursue the deployment of renewables sources of electricity—wind, water, and sun—on the larger macro-grid, both within the capital region and statewide. Although greening the grid must be part of a concerted effort to achieve renewable energy goals of the entire state, there may also be value in power purchase agreements or other mechanisms to procure renewable electricity for the capital region itself. Opportunities at the Plaza to reduce demand with more efficient lighting and appliances, as well as traditional conservation, should also be evaluated.



Hardscrabble Wind Farm, Herkimer

Through the beneficial electrification of heating and cooling with geothermal technology, ongoing deployment of renewables for electricity—both locally and on the larger macro-grid—and demand reduction techniques, it is possible for the Plaza to wean itself entirely or almost entirely off of fossil fuels.

VIII. Conclusion

For over a century, the steam tunnel between Sheridan Hollow and government buildings in Albany has been an instrument of segregation, separating those who receive the benefits of energy from people who bear the brunt of pollution caused by its consumption. Pursuing a project for the Empire State Plaza that burns even more fracked gas in Sheridan Hollow than today would perpetuate that injustice far into the future.

Moreover, investing many millions of dollars in a system architecture that is inherently dependent on fossil fuels for both heat and power is a technological dead-end, inconsistent with aggressive renewable energy and greenhouse gas reduction goals adopted by the state. Rather than relying on outdated energy approaches of the past, SHARE supports 21st century solutions for renewable heat and power that can achieve New York's bold climate objectives and eliminate, once-and-for-all, the disproportionate exposure of Sheridan Hollow residents to harm.

This report has shown that a renewable answer for the Empire State Plaza is eminently doable by re-envisioning the microgrid concept proposed by NYPA and OGS. Installing solar panels in the downtown area, while useful, will make only a minor contribution to total energy needs of the Plaza complex. However, by continuing to receive most of its electricity from the external grid during normal operating conditions and limiting local generation from fossil fuels to emergencies, the Plaza can maintain and expand the use of scalable sources of clean energy, including renewables deployed over a larger geographic area. Furthermore, by investing in modern geothermal technology for both heating and cooling, applying thermal load sharing techniques, and optimizing the use of available resources like the Hudson River, it is possible to end the Plaza's reliance on combustion-based steam and retire polluting facilities on Sheridan Avenue.

As described in this report and other material from SHARE, there are numerous examples of large-scale public and private institutions, building complexes, and campuses that have successfully made the switch from combustion heat and fossil fuels. We urge NYPA and OGS to abandon its former CHP project and commit to developing a comprehensive master plan for doing this at the Plaza. We also strongly encourage the state to issue a formal *renewable* Request for Proposals, or Request for Information, so that professional firms with significant experience in large-scale conversion projects can access data about the Plaza's existing system and provide meaningful technical input.

SHARE understands that a project of this size and complexity may need to occur in phases. However, it is critical that steps be in a forward direction, reduce the combustion of fracked gas in Sheridan Hollow, and contribute to a foreseeable future in which normal daily energy needs of the Plaza can be met without fossil fuels. Moreover, progress must occur at a timely pace, responsive to the climate crisis.

Ending environmental injustice and taking real action on climate change requires a departure from ways of the past. By earnestly pursuing renewable energy solutions to heat, cool, and power the state's center of government, New York can establish itself as a model of true innovation for the nation and the world. SHARE stands ready to support state agencies in that endeavor.



We are now faced with the fact that tomorrow is today. We are confronted with the fierce urgency of now. In this unfolding conundrum of life and history, there is such a thing as being too late. This is no time for apathy or complacency. This is a time for vigorous and positive action.

Martin Luther King, Jr.