Tompkins County Energy Focus Area Study

Prepared By: TRC Engineers and Taitem Engineering

March 13, 2017 Version 3.2

Table of Contents

Executive Summary

Tompkins County Energy Focus Areas Study – Summary of Findings

Part 1

Question: Can the existing electrical and natural gas infrastructure support anticipated growth in four key areas of the County: Downtown Ithaca, South Hill, East Hill, and the area in South Lansing around the Ithaca-Tompkins Regional Airport?

Answer: Electric and gas infrastructure is generally sufficient to support growth in all four areas with the exception of natural gas in the Airport area which is currently under a moratorium for new gas hookups. This analysis looked at electrical circuit and transformer capacity, as well as ability of existing natural gas infrastructure to serve the projected development, and does not mean that localized infrastructure improvements might not be required to support some projects in these areas.

Part 2

Question: Are all-electric buildings a feasible alternative for new construction? Specifically are they competitive in terms of technical viability, initial and lifetime cost, tenant comfort, lifetime maintenance cost and lifespan? Is the technology proven? Does it reduce carbon emissions? Can the electric grid handle more all-electric buildings?

Answer:

a) *Technical Feasibility*: Modern air source heat pumps are able to maintain heating capacity when outside air temperature goes as low as -22 F.

b) *Cost*: Heat pump installation is more expensive in areas where gas is available but may be less expensive if the cost of extending pipes for gas service from existing distribution pipelines to the site is included. Regardless, heat pump operating costs are cheaper than operating a gas furnace for heat and central air conditioning for cooling given current gas and electric prices. Over a 20 year period the higher initial costs are offset by lower operating costs making air source heat pumps less expensive on a 20-year lifecycle cost basis. Heat pumps are much less expensive than a propane furnace and central air.

c) *Tenant comfort*: Heat pumps are easier to zone and have more precise control over supply air temperature yielding comfort equal to or greater than alternatives.

d) *Maintenance and lifespan*: Heat pumps and furnaces both have a 20-year economic life. Heat pumps have fewer maintenance requirements than a system with a gas furnace and central air. Overall maintenance costs are similar.

e) *Proven technology*: All electric buildings have been built and more are planned. Within the past few years, 775 housing units have been built or proposed to be built in the Ithaca area. Heat pumps plus green building technology have proven to be a cost-effective construction technique, both in terms of first cost and operating expense and maintenance.

f) *Carbon emissions*: Even without accounting for methane emissions associated with natural gas production, transmission and distribution, using the current electricity generation mix in NY State an electric air source heat pump decreases emissions 66 percent compared to a natural gas furnace. Including even modest estimates of methane leakage increases the CO2 equivalent emissions from a natural gas furnace by a factor of two to three times.

g) *Electric grid capacity*: Currently in Tompkins County all circuits are capable of serving robust growth associated with electric buildings. Smart grid technology can also increase this capacity and is in the process of being implemented by NYSEG.

All-electric buildings align well with REV policy goals, and they may offer advantages to utilities that can serve additional customers without adding costly infrastructure. Electric buildings may also offer advantages as we move toward distributed electric generation.

Barriers include lack of awareness of current heat pump technology for heating and concern about higher initial cost. These could be overcome with a combination of education, technical assistance and incentives.

Question: Can targeted energy efficiency within existing buildings free up capacity of constrained natural gas infrastructure to serve new demand?

Answer:

Plausible levels of efficiency gains in existing buildings: NYSERDA studies have identified feasible savings in natural gas consumption through efficiency in existing buildings of about 11%. Applying this to just the estimated residential load in the Village of Lansing would be sufficient to meet the moderate growth demand for natural gas in the Airport Energy Focus Area. It would fall short of the build-out demand. However, build-out includes residential and commercial construction that could be developed as all-electric buildings. If the 11% savings could be achieved in existing residential buildings it would be sufficient to cover projected demand for natural gas from build-out of the Airport Area commercial and manufacturing sectors.

Introduction

Tompkins County, New York has contracted with TRC Engineers to study the natural gas and electric distribution infrastructure in four selected "Energy Focus Areas" in the greater Ithaca area. These areas include: 1) Airport Area, 2) Downtown, 3) East Hill and 4) South Hill. For detailed maps of the focus areas please refer to Appendix A.

The Energy Focus Areas were strategically selected by County, Ithaca City and Town planners as they are projected to be the locations of significant additional growth within the next five to ten years. Some Focus Areas have already experienced challenges with energy infrastructure or have known energy capacity constraints. For example, the area around the airport is known to have natural gas constraints that may have impacted development decisions. Additionally, real estate developers with projects located in other Energy Focus Areas have reported concerns about NYSEG's ability to provide adequate information or new service for their proposed or newly constructed properties in a timely manner. It is unclear whether or not these concerns are justified as in some cases it appears that developers have failed to file the appropriate NYSEG application for service and / or failed to provide NYSEG with critical information in a timely manner. Regardless of cause or validity, concerns related to energy infrastructure and available capacity have the potential to negatively impact growth in the Ithaca area.

This study was commissioned to better understand the extent of both current and potential future energy infrastructure constraints in the four Energy Focus Areas. The information gathered in this study will assist County, Town and City planners in their decision making processes and allow them to make more informed decisions. NYSEG, a key collaborator on the project, may also benefit from this data to better understand, plan and invest to meet future energy demand in these areas. Traditionally, planners involved in the land use planning process have had little insight into the utility's planning for local energy infrastructure. Conversely, those planning utility infrastructure have had little insight into planned new construction projects that could significantly increase demand on their system. To assist with this, the study also sought to increase the level of communication between NYSEG and the County through creating additional channels of communication.

Part 1: Ability of Current Electric and Natural Gas Infrastructure to Meet 10 year Future Demand – Methodology

Using data provided by Tompkins County, the City of Ithaca, Town of Lansing, Town of Ithaca planners and various other sources (including conversations with developers, environmental impact statements and press releases for planned new construction projects) TRC totaled the square footages of proposed construction projects and other anticipated development for the various Energy Focus Areas in the study. The square footages were taken from information gathered from the developers or, when this data was not available, from the square footages of the proposed plots of land using appropriate floor area ratios. In such cases, the aggressive and moderate scenarios were estimated as a percentage of build out for those areas. For the purposes of this report, all confidential data has been removed, including the names, locations, and tax parcels of planned new constructions, as well as any NYSEG distribution data that was shared with TRC for purposes of this study, but not authorized for public

distribution. The findings are summarized by each of the four Focus Areas, with aggregate data for each building type.

TRC then used the projected square footages of the proposed and potential developments in the area to estimate the electrical and natural gas demand growth for the next 10 years based on average energy use values from US Energy Information Administration (EIA) for different facility types. The information sources and square footage for each projected new construction project are indicated on the associated tab for each area in the Tompkins County Energy Focus Areas Master Workbook September 2016[1]. This was done for three different scenarios: moderate growth, aggressive growth, and build out (maximum construction as permitted). Using these data TRC worked with NYSEG to determine if these loads could be met with the existing distribution infrastructure in the area. The areas of potential growth were mapped out and then overlaid with utility distribution maps in order to identify the circuits and capacities. The figures below summarize the projected growth in square footage, peak electric and peak natural gas for each of the Focus Areas. For example, the south hill area can expect to see an increase in peak demand of 2,401 kW under the moderate growth scenario across all sectors and an increase of 11.6 MMBtu/hr for natural gas peak demand across all sectors.

South Hill Area Summary

Aggregate Load Growth by Sector:		From Itemized Assumptions					
		Peak Electric (kW)			Peak Natural Gas (MMBTU/hr)		
Sector	SqFt	Build Out	10 Year - Aggressive	10 Year - Moderate	Build Out	10 Year - Aggressive	10 Year - Moderate
Residential	2,592,600	1,838	1,522	709	23.5	18.7	8.3
Commercial	371,633	1,301	1,091	492	1.8	1.6	0.6
Light Manufacturing	307,017	3,822	1,884	1,200	2.1	0.8	-
Light Manufacturing - Process	307,017	-	-	-	15.2	6.5	2.6
Parking	71,900	13	13	-	-	-	-
Total	**3,343,150**	**6,973**	**4,510**	**2,401**	**42.6**	**27.6**	**11.6**

Figure 1: South Hill Projected Sq. Footage and Peak Electric and Natural Gas Increases

Airport Area Summary

Aggregate Load Growth by Sector:		From Itemized Assumptions (table below)					
		Peak Electric (kW)			Peak Natural Gas (MMBTU/hr)		
Sector	SqFt	Build Out	10 Year - Aggressive	10 Year - Moderate	Build Out	10 Year - Aggressive	10 Year - Moderate
Residential	335,000	237	237	104	3	3	1
Commercial	279,859	1,134	1,134	583	1	1	1
Light Manufacturing	128,000	842	842	263	1	1	0
Light Manufacturing - Process	128,000	579	-	-	1	1	-
Parking	-	-	-	-	-	-	-
Total	**742,859**	**2,214**	**2,214**	**951**	**6.5**	**6.5**	**2.1**

Figure 2: Airport Area Projected Sq. Footage and Peak Electric and Natural Gas Increases

[1] This Microsoft Excel Workbook has been provided to the Tompkins County Planning Department. Access to this workbook is limited as it contains confidential information provided by NYSEG.

East Hill Summary

Aggregate Load Growth by Sector:		From Itemized Assumptions (table below)					
		Peak Electric (kW)			Peak Natural Gas (MMBTU/hr)		
Sector	SqFt	Build Out	10 Year - Aggressive	10 Year - Moderate	Build Out	10 Year - Aggressive	10 Year - Moderate
Residential	1,275,000	904	904	578	12	12	7
Commercial	325,000	961	961	961	1	1	1
Light Manufacturing	-	-	-	-	-	-	-
Light Manufacturing - Process	-	-	-	-	-	-	-
Parking	-	-	-	-	-	-	-
Total	**1,600,000**	**1,865**	**1,865**	**1,539**	**12.8**	**12.8**	**8.6**

Figure 3: East Hill Projected Sq. Footage and Peak Electric and Natural Gas Increases

Downtown Area Summary

Aggregate Load Growth by Sector:		From Itemized Assumptions (table below)					
		Peak Electric (kW)			Peak Natural Gas (MMBTU/hr)		
Sector	SqFt	Build Out	10 Year - Aggressive	10 Year - Moderate	Build Out	10 Year - Aggressive	10 Year - Moderate
Residential	1,340,059	1,703	1,703	1,703	10.5	10.5	10.5
Commercial	416,460	1,458	1,458	1,458	2.5	2.5	2.5
Light Manufacturing	-	-	-	-	-	-	-
Light Manufacturing - Process	-	-	-	-	-	-	-
Parking	320,000	56	56	56	-	-	-
Total	**2,076,519**	**3,217**	**3,217**	**3,217**	**13**	**13**	**13**

Figure 4: Downtown Projected Sq. Footage and Peak Electric and Natural Gas Increases

Part 1: Ability of Current Electric and Natural Gas Infrastructure to Meet 10 year Future Demand - Conclusions

For the electric side, NYSEG was able to specify how much additional load could be placed on each circuit, and whether the limiting factor was the transformer or the circuit capacity. These results can be found in the "New Load by Circuit" tab of the Tompkins County Energy Focus Areas Master Workbook September 2016. This workbook has been provided to the Tompkins County Planning Department. However, due to the confidential nature of the data, this information has been left out of this report.

Unfortunately, given the interconnected nature of natural gas distribution systems, excess capacity in the gas pipelines could not be provided by the utility. For our build-out growth projections, NYSEG was able to tell us which areas could support the projected load and which areas could not. This confirmed the known natural gas constraint in the Airport Energy Focus Area and did not identify any additional gas constraints.

TRC's primary task under the Energy Focus Area project was to project growth, develop associated load profiles and compare those projected loads to the existing energy infrastructure. This analysis revealed more than adequate capacity for the electric distribution infrastructure in the four Energy Focus Areas,

even under the most robust "build-out" scenario, which may be seen in Figure 7, below. No additional gas constraints beyond the known natural gas constraints in the airport area were uncovered.

Total Growth and Load Projections

	Square Feet				
Sector	**Total**	**Downtown**	**South Hill**	**Airport Area**	**East Hill**
Residential	5,542,659	1,340,059	2,592,600	335,000	1,275,000
Commercial	1,392,952	416,460	371,633	279,859	325,000
Light Manufacturing	435,017	-	307,017	128,000	-
Light Manufacturing - Process	435,017	-	307,017	128,000	-
Parking	391,900	320,000	71,900	-	-
Total	7,762,528	2,076,519	3,343,150	742,859	1,600,000

Figure 5: Build Out SF Projection Summary

	kW Build Out				
Sector	**Total**	**Downtown**	**South Hill**	**Airport Area**	**East Hill**
Residential	4,682	1,703	1,838	237	904
Commercial	4,854	1,458	1,301	1,134	961
Light Manufacturing	4,664	-	3,822	842	-
Light Manufacturing - Process	579	-	-	579	-
Parking	69	56	13	-	-
Total	14,269	3,217	6,973	2,214	1,865

	MMBTU/hr Build Out				
Sector	**Total**	**Downtown**	**South Hill**	**Airport Area**	**East Hill**
Residential	48.6	10.5	23.5	3.0	11.6
Commercial	6.9	2.5	1.8	1.3	1.2
Light Manufacturing	3.0	-	2.1	0.9	-
Light Manufacturing - Process	16.5	-	15.2	1.4	-
Parking	-	-	-	-	-
Total	75.0	13.0	42.6	6.5	12.8

Figure 6: Build-Out - Electric and Natural Gas Summary. Green indicates no constraint. Red indicates constrained area.

Part 2: Ability to Address Natural Gas Constraints in Airport Area with All-Electric Buildings and Energy Efficiency - Methodology/Questions Asked

The County then tasked TRC to perform an initial analysis of proposed "non-pipe alternatives" to address the known natural gas constraint in the Airport Focus Area. The solutions evaluated are described below.

A) Solution Evaluated: Promoting the Development of all-electric buildings

For the purpose of this study, all-electric buildings are considered those that use electricity as their primary heating source. This eliminates the use of fossil fuels onsite for heating and domestic hot water. This approach takes advantage of ample electric distribution infrastructure while not requiring additional natural gas utility infrastructure in constrained areas. Electric heat is typically associated with very high operating costs. However, new electric heating technologies and high performance building practices are proving that electric heat is extremely viable and competitive compared to traditional gas-fired heating equipment. Promoting and supporting all electric buildings can support the following goals:

1. Promote economic development and new construction in areas where natural gas is simply not available or capacity is constrained. Lack of natural gas availability is a barrier for developers considering new construction projects. Electricity or other alternatives such as oil or propane may be seen as non-competitive in terms of costs. A proven business case for all-electric buildings can help overcome this barrier.

2. All-electric represents an opportunity for buildings to be part of a zero carbon or carbon neutral solution. Electric fueled buildings paired with renewable electric generation can be carbon neutral.

Key Questions Considered:

Are all-electric buildings viable?

a. Is electric heating technology viable in terms of performance?

Yes, modern electric heating technology refers to heat pumps that use electricity to move heat, rather than old-fashioned electric resistance heat that uses electricity to make heat. Heat pumps do the job of both heating and air conditioning, eliminating the need for separate heating and cooling systems. Air source heat pumps have become more efficient, most significantly they are now able to maintain heating capacity when outside air is as cold as -22 F. The Northeast Energy Efficiency Partnerships (NEEP)[2], a non- profit regional energy efficiency organization (REEO) funded by the Department of Energy has created Cold Climate Air Source Heat Pump Specifications with additional requirements that

[2] http://www.neep.org/initiatives/high-efficiency-products/emerging-technologies/ashp/cold-climate-air-source-heat-pump#Listing Products

seek to ensure adequate cold climate performance. Their website maintains a list of qualified Cold Climate Heat Pumps for reference.

b. What is the initial cost and lifecycle cost?

The initial cost of installing an air source heat pump system, which does both heating and cooling, is typically more than the cost of installing a gas-fired system with a furnace for heating and central air conditioning for cooling. If the cost of adding new natural gas service piping is included for building sites that are not already served by natural gas, then electric heat pumps may have a lower initial cost.

The energy cost to operate electric heat pump heating compared to natural gas furnace heating depends on the relative cost of electricity compared to natural gas. Currently, using typical gas rates and typical electric rates without demand charges, electric heat pumps are cheaper to operate than natural gas furnaces. A NYSERDA Study on Heat Pump Potential[3] for energy savings found that the Upstate NY area was the most cost effective for heat pump use due to lower equipment and labor costs as well as the lowest winter electric costs in the state.

Using typical residential rates for electricity, natural gas, and propane, over a 20-year period, the higher initial cost for a heat pump system is offset by lower operating costs, and the heat pump system has a lower 20-year lifecycle cost. This also assumes that current costs of these fuels will remain the same.

Table: Estimated Costs for New Residential Construction

Technology Type	Installation Cost, $/sf	Energy Cost, $/sf/year	Maintenance Cost, $/sf/year	20 Year Lifecycle Cost, $/sf
Air-Source Heat Pumps	$8.00	$1.14	$0.10	$32.80
Natural Gas Furnace with Air Conditioning	$6.00	$1.36	$0.10	$35.20
Propane Furnace with Air Conditioning	$6.00	$1.80	$0.10	$44.00

Furthermore, electric heat pump heating may become increasingly attractive in a rising natural gas price environment. In recent years, natural gas has been at historic lows. In 2016, the EIA reported the lowest natural gas prices in nearly 20 years and some analysts believe that natural gas prices will remain low for the foreseeable future. However, there are numerous market forces, such as rising LNG exports, an increasing number of natural gas-fired power plants, reduced drilling and exploration (due to low commodity prices) that could increase natural gas fuel costs within the near future and certainly within the 20 year horizon. It is also plausible to see the emergence of a carbon tax at some point over the

[3] Bower, Steve. "Heat Pumps Potential for Energy Savings in New York State *NYSERDA*." N.p., n.d. Web. <https://www.nyserda.ny.gov/About/Publications/EA-Reports-and-Studies/EERE-Potential-Studies>.

next 20 years. A number of carbon taxes have been enacted or proposed around the world, including in Canada, Ireland, Australia, Chile, Scandinavia, and Washington State.[4]

c. *What about Tenant comfort*?

Heat pumps are easier to zone than furnaces, and have more precise control over supply air temperature. As a result, tenant comfort tends to be equal or greater than alternatives.

d. What about maintenance cost and lifespan?

Heat pumps and furnaces are both considered to have a 20-year economic life. Overall maintenance costs are approximately the same for both systems.

e. Is this technology proven?

Yes, many all-electric buildings have been built and are planned. Heat pumps combined with green building techniques that reduce the heating and cooling loads have been proven to be a cost-effective construction technique, both in terms of first cost and in terms of operating expense and maintenance.

Several local, high-profile building projects which use electric heat have been announced to the public in the news media recently.

a. Breckenridge Place, a 5-story, 50-unit apartment building completed in 2014 has heating and cooling for all interior spaces provided by electric heat pumps, and is LEED certified.
b. Village Solars Apartments, a 6-building, 78-unit apartment complex has passive solar design and electric heat pumps for heating and cooling. Phase I was completed in 2015, and Phase II is under construction.
c. HOLT Architects office, a 7,500 sf office space in a renovated building completed in 2016 is all-electric and expects to generate as much electricity as it uses with solar panels installed on the roof..
d. Ecovillage at Ithaca TREE Common House, a 4-story, 15-unit apartment building built in 2016 is all-electric, uses about 1/10th the energy of a typical apartment building, and had construction costs the same as a typical multifamily building..
e. Maplewood Apartments, a 440-unit apartment complex, will be all-electric with electric heat pumps for heating and cooling; completion is planned for 2018.
f. City Centre, an eight-story, 192-unit apartment building will have all-electric heating and cooling; completion is planned for 2019.
g. The feasibility study for the proposed Ithaca-Tompkins Regional Airport Industrial/Business Park determined that electric heat pumps are a feasible technology to use to develop the business park.

[4] According to the non-profit organization Carbon Tax Center www.carbontax.org.

2. *Are these buildings reducing carbon or increasing it? All-electric buildings may produce zero emissions on site but may produce more carbon than fossil fueled buildings when factoring in carbon produced by fossil fuel power plants. How does the proposed solution address this?*

The source energy factor is a unit of evaluation that enables an apples to apples comparison of building energy use. Buildings require electricity and heat; the source energy traces the energy requirements of a building back to raw input fuel, accounting for losses associated with generating and delivering this fuel source to the building. For the Eastern Region of the United States, the source energy factor for electricity is 3.34, and source factor for natural gas nationally is 1.09[5]. The typical efficiency for an air source heat pump providing winter heating in the Ithaca climate region is 3.0 COP (coefficient of performance), or 300% efficiency. The typical efficiency for a high efficiency natural gas furnace providing winter heating in the Ithaca climate region is 95% annual fuel utilization efficiency (AFUE). This results in a site energy factor of approximately 1.1 for both electric air source heat pump heating and gas furnace heating. The site energy factor is calculated as the source energy factor/ efficiency.

There are different methods for calculating greenhouse gas emissions for electricity and natural gas. Under current standard accounting practices, the CO2 emissions for natural gas are based on the CO2 created when burning the gas at the site of the end use. The CO2 emissions figure for electricity can be either for baseload emissions (the emissions from power plants that run all the time), or non-baseload generation (power plants that are brought online as necessary to meet demand). Non-baseload electricity is used to meet peak demand, which occurs during hot summer weather and is driven by demand for cooling. The baseload emissions figure is used to compare electrically heated buildings with gas heated buildings, because electric heating in the winter does not contribute to peak system demand.

The emissions factor for baseload electricity in upstate New York is 0.000185 metric tons CO2 per kWh[6]. The emissions factor for natural gas is 0.005302 metric tons CO2 per therm. The emissions for heat produced in the building is 0.0558 metric tons CO2 per MMBtu for a 95% Annual Fuel Utilization Efficiency (AFUE) gas furnace, and 0.0187 for a 2.9 COP electric heat pump. Therefore, based on the current electric generation mix in New York State, using an electric heat pump instead of a gas furnace decreases carbon emissions by 66 percent.

In addition, natural gas (methane) is a roughly 80 times more potent greenhouse gas than CO2 over a twenty-year time period, and natural gas infrastructure has leaks which contribute significantly to global warming. Adding even modest estimates of methane leakage during production, transmission and distribution to the equation increases the CO2 equivalent emissions from natural gas heating by a factor of two to three.

[5] Deru, M. "Source Energy and Emissions Factors for Energy use in Buildings." *NREL*. N.p., n.d. Web. <http://www.nrel.gov/docs/fy07osti/38617.pdf>

[6] <https://www.epa.gov/sites/production/files/2015-10/documents/egrid2012_ghgoutputrates_0.pdf>

3. *Does this solution now place more constraints on the electric grid? If we started to see more and more electric buildings, can the electric grid handle it?*

The potential limiting factor is the electric distribution capacity. Currently in the Tompkins County Area, all circuits are capable of meeting robust growth associated with electric buildings; they all currently have excess electric distribution capacity.

Highlighting this excess capacity, you can look more closely at what constitutes distribution capacity. Distribution capacity is determined by the Bank Capacity: the electrical capacity associated with the transformers, and the Circuit Capacity: the capacity associated with the distribution wiring.

Smart grid technology is also available as a method to increase the capacity of the power grid, and is in the process of being implemented by NYSEG in the Airport Area. Active network management increases capacity at a much lower cost than upgrading the grid.

4. *How does the solution fit under the broader REV framework?*

All-electric buildings align with several of the REV policy goals especially with respect to reducing carbon emissions.

REV Policy Goal: Make Significant Strides toward Reducing Carbon Emissions – all-electric buildings are compatible with rooftop and community solar systems, distribution-level demand response, energy efficiency, and providing high-resolution data about energy use to enable consumers to conserve energy and reduce peak load. Even without any of the additional energy efficiency technologies and renewable energy technologies that are possible with electric systems, replacing gas heat with an electric heat pump greatly reduces carbon emissions.

5. *Is this better, worse, or neutral from a utility perspective?*

It appears to be positive from the utility perspective but answering this question is complex as the current regulatory framework is evolving under REV.
In simple terms, the utility can add new customers without upgrading the natural gas distribution network. New customers are added to the utility system and serve as sources of revenue without requiring expensive infrastructure upgrades. As distributed generation grows, all electric buildings may also provide system benefits by connecting local users with local generators.

6. *What barriers exist in the marketplace? Can you recommend strategies for the County to consider now?*

Barriers

- Lack of knowledge or awareness – developers or design professionals are simply not familiar with newer air-source electric heat pump technologies or not comfortable with specifying them in their designs.

- Lack of trust – heat pumps are perceived as new and unproven technology. There are concerns related to performance and maintenance.
- Cost concerns or focus on initial cost – there is a perception that initial costs are much higher than other alternatives. A focus on initial cost vs lifecycle costs.
- Marketability concerns – tenants may have concerns about electric heat due to negative perceptions or prior experience with the technology.
- Lack of knowledge / comfort in recommending / specifying the technology within the installation contractor network.

Strategies to Consider

- Engage in a "voice of the customer" exercise with developers / design professionals to fully understand the real or perceived barriers. Determine if barriers listed above are real and identify barriers that are most significant.
- Implement strategies to build awareness and knowledge of the technology within the developer / design professional community.
    - Educational workshops
    - Local / regional case studies that include actual performance data and testimonials
    - Include actual installed costs and lifecycle costs for case studies. Include increased asset valuation.
- Provide technical assistance to developers / design professionals
- Develop strategic partnerships with AVANGRID to support their Energy Smart Community or NYSERDA as they seek to develop and promote municipal "tool kits" under REV.
- Offer economic development incentives for high performing, all electric buildings.

B) Solution Evaluated: Targeted Energy Efficiency within Existing Buildings to Free Up Capacity on Constrained Infrastructure

Targeted energy efficiency would involve building upgrades or retrofits to existing buildings located within a highly targeted geographic area. Upgrades could range from single measure upgrades, such as a boiler replacement, to whole building energy upgrades that may include building shell improvements. Under a Reforming the Energy Vision (REV) framework, this would be considered a distributed energy resource (DER) or "non-pipe alternative".

What problem does this solve?

Natural gas infrastructure is in place, however new or expanded service is being denied due to capacity constraints. Building-level efficiency gains could help relieve constraints on that system and free up additional capacity for new service.

According to a January 2017 letter NYSEG submitted to the PSC regarding natural gas in an area that includes the Airport Area, the constraints on natural gas distribution in the airport area are due to low pressure on the distribution system in the area on very cold weather days. Peak design day pressures are predicted to drop below levels necessary to ensure maintenance of service. This means that should the temperatures drop to very low levels, there is a risk that natural gas design pressure needed to satisfy all existing loads could not be maintained at peak hours. NYSEG is proposing to build additional distribution in the area but is having trouble obtaining easements from property owners. In the January 2017 letter, NYSEG outlines a possible compressor station solution, as well as soliciting demand reduction solutions from third-party developers to address new demand in a region that includes the Airport Area.

Key Questions Considered:

Engineering / Technical Viability

1. *What level of gas efficiency gains are plausible within existing buildings? Within the various building / uses located in the area? (e.g. small commercial, large commercial, industrial, residential)*

A 2014 study by NYSERDA[7] on the economic potential for natural gas energy efficiency found that there was an achievable potential of 11% of the 2030 forecasted natural gas load. The low savings potential for natural gas can be attributed to the low avoided costs for natural gas which in turn decreases the cost effectiveness of natural gas efficiency measures. For comparison, the study found that the achievable potential for electric was 18% of the projected 2030 forecast. The graph below shows the achievable natural gas potential by building type. The majority of the potential for savings is located in the multifamily and single family building types, which make up over 50% of the savings potential for natural gas.

[7] Mosenthal, Philip. "Energy Efficiency and Renewable Energy Potential Study of New York State." *NYSERDA*. N.p., n.d. Web. <https://www.nyserda.ny.gov/About/Publications/EA-Reports-and-Studies/EERE-Potential-Studies>.

Figure 7: Natural Gas Efficiency Potential[8]

2. *What are the types of energy efficiency upgrades and those that represent the highest opportunity?*
    a. Within the residential sector, there are three main areas to target for energy efficiency upgrades. Water Heating, Space Heating, and Appliances. The savings potentials are shown below as a percent of total potential.

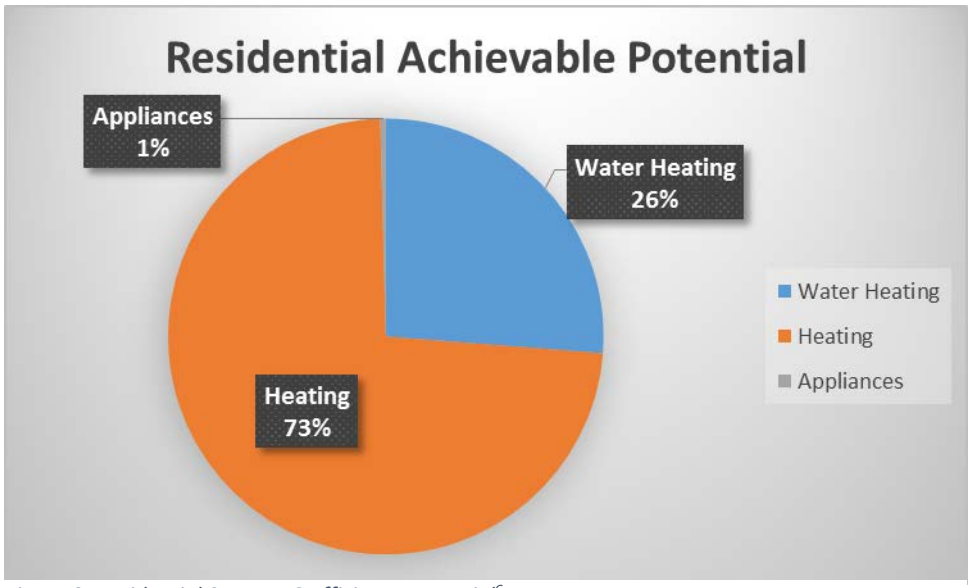


Figure 8: Residential Sector NG Efficiency Potential[6]

[8] Mosenthal, Philip. "Energy Efficiency and Renewable Energy Potential Study of New York State." *NYSERDA*. N.p., n.d. Web. <https://www.nyserda.ny.gov/About/Publications/EA-Reports-and-Studies/EERE-Potential-Studies>.

b. The space heating energy efficiency measures include measures such as insulating and sealing the building shell, as well as technologies such as condensing hot water boilers and condensing furnaces. Condensing-style space heaters can maximize the useful heat created by burning natural gas by condensing the exhaust gases formed during combustion. Depending on the application, condensing furnaces and boilers can reach efficiencies varying between 88% and 95%. These heaters provide savings from 10 % to 15% over traditional systems. Additionally using smart thermostats and controls can provide additional savings of up to 10%.
c. The water heating energy efficiency measures include condensing storage and tankless hot water heaters as well as low flow aerators on showers and faucets. Installing low flow aerators on shower heads and faucets can reduce water consumption by up to 55% and consequently eliminate the energy that would have been required to heat the extra water. While it is not economically feasible to replace functioning natural gas water heaters with electric heat pump water heaters, it is feasible to do so at end of life. Promoting such products can help to decrease the load but it will come as additional electric load. For the area in question, however, electric capacity is currently not an issue.

3. *Using the statewide market potential research, what savings would be realized in the Airport Area? Describe how you arrived at that estimate.*

We cannot answer this question to a high degree of accuracy without additional data. NYSEG has not provided any detailed information about gas loads in the area. They have stated that the dynamic nature of gas infrastructure makes it difficult to provide loads and capacity of the gas infrastructure in the airport area. To date, NYSEG has been a strong collaborator on the Energy Focus Area project and has provided detailed load information about their electric distribution, however, has stopped short of providing detailed loads and capacities for natural gas. NYSEG could provide billing data for customers in the focus area in a format where customers remain anonymous to avoid consumer privacy concerns. However, peak gas demand is our concern and since customers are not billed for peak on the gas side NYSEG simply does not have this data. The data analysis effort could also be significant, as the existing building types and square footages, natural gas loads, and end uses would be required for a detailed estimate.

However, using some basic assumptions we can begin to estimate the load in the constrained area. The Village of Lansing within Tompkins County makes up the majority of the constrained Airport Area. It had a population of 3417 as of the 2010 census with 1620 households. Assuming the median square footage of 2338 from census.gov, we can estimate the residential load of Village of Lansing using a residential square footage of 3,787,569 gives roughly 34 MMBTU/Hr peak using the same assumptions used in phase 1 of the study. As discussed in question 1, there is an 11% achievable potential for natural gas reduction, which if achieved through targeted efficiency programs would allow for 3.74 MMBTU/Hr of additional load. Our 10 year moderate growth projection would only require 2.1 MMBTU/Hr of

additional peak loads. However, this is still well short of the aggressive load projection of 6.5 MMBTU/Hr.

Natural gas efficiency strategies will likely lead to deferring distribution system upgrades on a utility scale level, however, targeted "non-pipe solutions" to address natural gas constraints are relatively new and lack a proven track record of results. Nonetheless, the fact that they are new and emerging does not necessarily mean they cannot be effective. Market innovation has shown that non-wire alternatives can effectively defer investments in electric infrastructure. More and more utilities are considering "non-pipe alternatives". Vermont Gas Systems, for example, builds energy efficiency program results into its integrated resource planning stating that natural gas energy efficiency programs would reduce gas purchases as well defer investments in infrastructure. Unfortunately, we are aware of no studies published on targeted natural gas energy efficiency for deferred infrastructure investment. There are many studies that have proven that targeted energy efficiency projects intended to delay electric infrastructure investments are effective. Developing a targeted solution for the Airport Area would require additional information and cooperation from the utility as well as a detailed cost-benefit analysis to quantify the economic, social, and environmental benefits. We recommend that targeted energy efficiency be considered as a key component of a multiple faceted solution.

Environmental Benefits

4. *Explain the basic relationship of energy efficiency upgrades within buildings and the reduction in carbon emissions?*

The figure below represents New York State's natural gas consumption by end use. Aside from the natural gas used to produce electricity, the largest end user of natural gas in New York State is the residential sector. As shown below, 34% of all natural gas used in New York State is used for residential buildings including space heating, domestic hot water, and cooking. Nearly 60% of the natural gas is used in the commercial and residential sectors making them prime candidates for targeted energy efficiency measures.

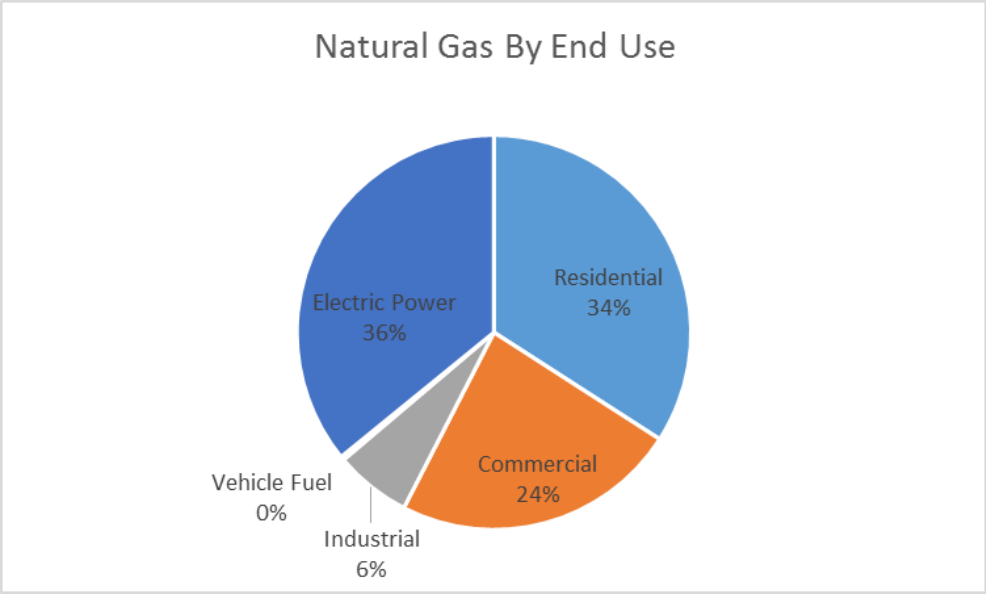


Figure 9: EIA State Data NG by End Use 2014

Approximately 40% of the power produced in New York State comes from traditional fossil fuel combustion, with the remaining percentages composed of primarily hydroelectric and nuclear. So it is important to understand that while consumer sentiment in the area may not want additional natural gas infrastructure in the area, the electricity used to heat facilities instead will in part be generated from fossil fuels. This generation mix is likely to change as New York State has established a goal of 50% renewable generation by 2030.

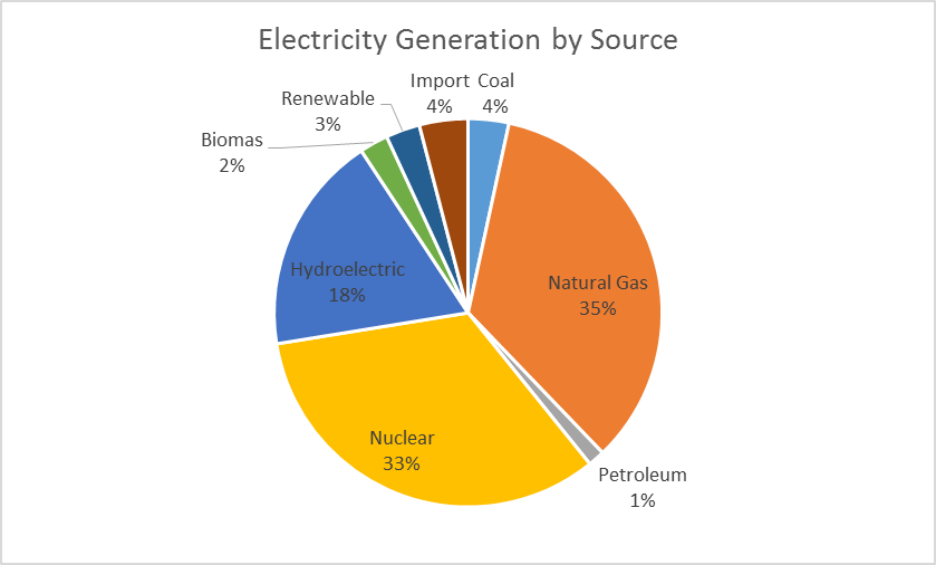


Figure 10: Electricity Generation by End Use - EIA State Data 2014

Aside from logistical concerns for developers and county planning officials, there are also environmental impacts that need to be considered, as well as interactions within the distribution system, energy policy and consumer sentiment.

Additionally, New York State's move towards natural gas has produced a net decrease in CO2 emissions as coal and oil power plants are replaced with natural gas. However, this does not account for methane leakage associated with Hydraulic Fracking. The majority of New York State's natural gas comes from the Marcellus Shale site which relies on fracking for extracting natural gas. Estimates suggest that the State emissions could increase by up to 25% if methane leakage is accounted for[9]. New regulations are in place to mitigate leakages, however, only apply to new facilities.

[9] Anthony J. Marchese, Methane Emissions From United States Natural Gas Gathering and Processing. American Chemical Society, 2015 Web. < http://pubs.acs.org/doi/pdf/10.1021/acs.est.5b02275>.

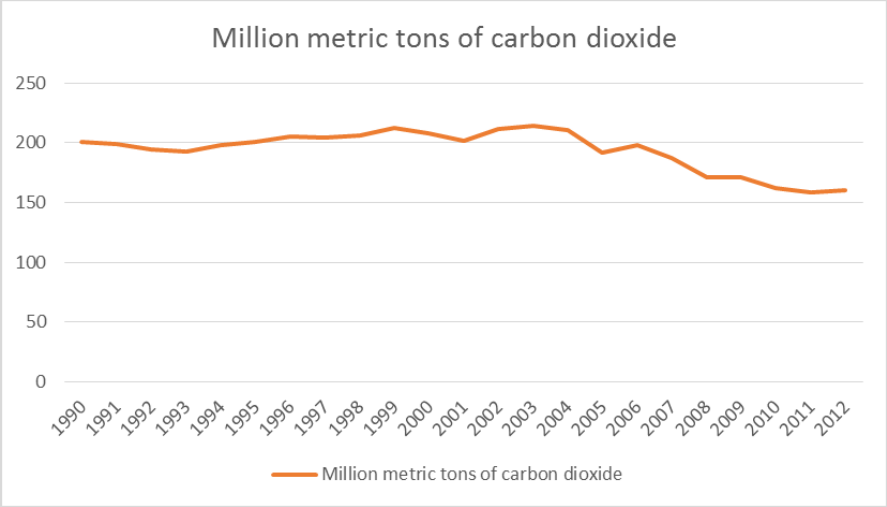
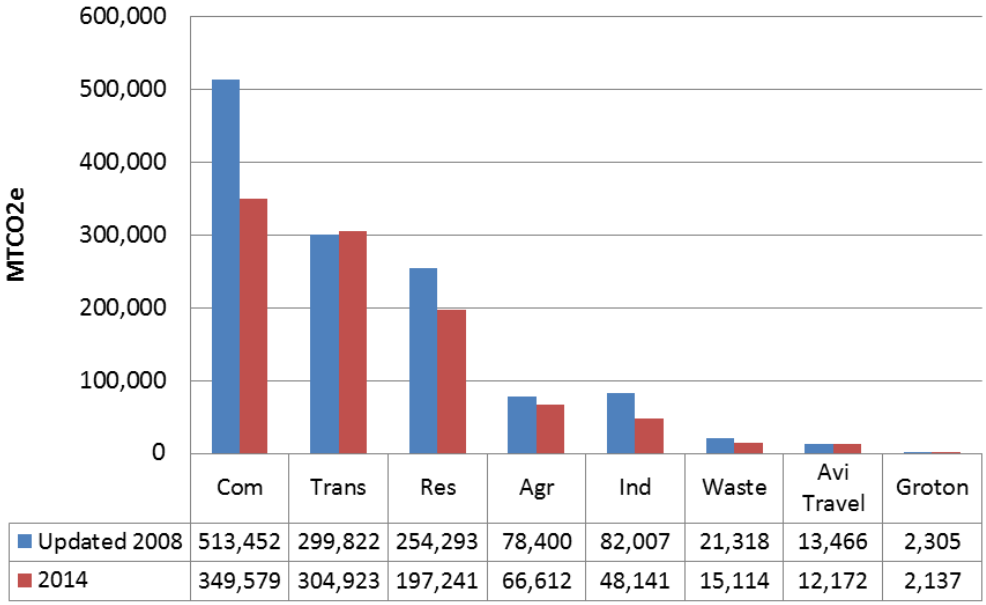


Figure 11: New York State Emissions - EIA State Data 2014

Trends in Tompkins County have followed a similar decrease in emissions as shown below.



	Com	Trans	Res	Agr	Ind	Waste	Avi Travel	Groton
Updated 2008	513,452	299,822	254,293	78,400	82,007	21,318	13,466	2,305
2014	349,579	304,923	197,241	66,612	48,141	15,114	12,172	2,137

However, when the GHG data is analyzed with the inclusion of methane leakage, the reduction is not so evident. Additionally, if the leakage is closer to 19% percent estimate the County will have seen an increase in GHG emissions of 143% since 2008.

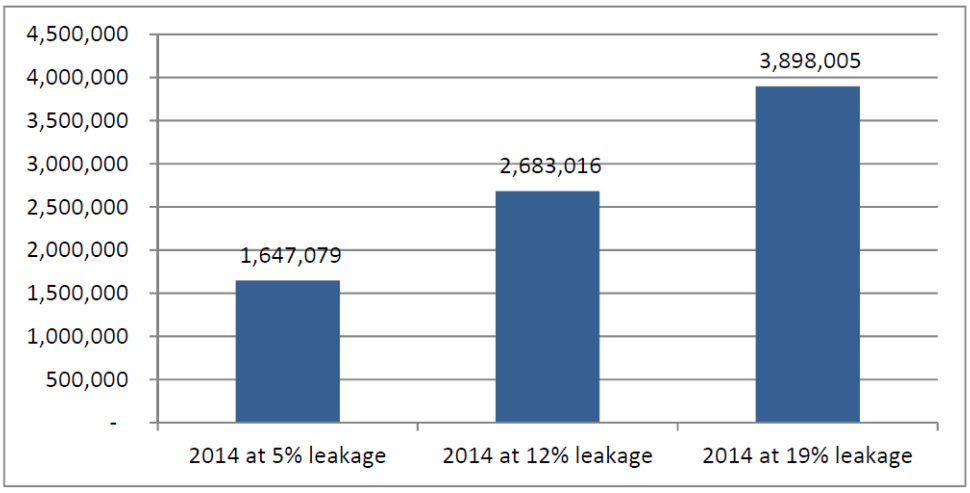


Figure 12: 2015 Emissions at 5%, 12%, and 19% Methane Leakage and GWP of 86[10]

	2014 with 100-yr GWP and without Leakage	2014 New Accounting 5th IPCC 20-yr GWP for Methane with 5% Leakage	2014 New Accounting 5th IPCC 20-yr GWP for Methane with 12% Leakage	2014 New Accounting 5th IPCC 20-yr GWP for Methane with 19% Leakage
MTCO2e from Leaked Methane	n/a	651,161	1,687,098	2,902,087
Total Community MTCO2e with Leakage	995,918 without	1,647,079	2,683,016	3,898,005

Figure 13 2015 Emissions at 5%, 12%, and 19% Methane Leakage and GWP of 86[8]

Economic Viability

5. *Explain the payback / ROI at the building level*

There are several factors that will influence the Return on Investment (ROI) of natural gas energy efficiency measures. Primarily it is the cost of natural gas, the more expensive the cost of natural gas the higher return on investment a measure will see. Currently, upgrading natural gas boiler systems to condensing boilers will have a payback typically of 15 – 25 years depending on the age and efficiency of the existing boiler. In general these kinds of investments are not made unless the boiler is reaching the end of its useful life. Making sure the most efficient system is selected when replacing boilers is still an effective means of reducing natural gas usage. Large commercial and residential projects require engineering evaluations on a case by case basis, but in general, there is no financial case for replacing a newer non-condensing boiler with a condensing boiler without incentives or significant increases in the cost of natural gas. Additionally, larger multifamily buildings with higher supply and return water temperatures do not see the efficiency gains of smaller facilities since less energy can be extracted from

[10] 2014 Tompkins County Greenhouse Gas Emissions and Energy Inventory

the flue gasses. Upgrading furnaces and boilers in single family homes is more straightforward and typically have a payback of 7-10 years. NYSEG currently gives rebates of up to $300 for condensing furnaces and up to $450 for condensing boilers for residential installations.

Installing low flow shower heads and faucets typically has a payback of a few months and has the potential for substantial savings because they are used easily every day. Currently NYSEG is offering free installation of energy-efficient faucet aerators and showerheads in multifamily buildings.

6. *Explain the payback / ROI from the utility perspective*

NYS Investor Owned Utilities (IUOs), including NYSEG, have historically had energy efficiency targets set by the NYS Public Service Commission. These include natural gas energy savings goals and dedicated gas efficiency funding. Currently, IOUs in NYS are eligible for additional financial incentives to achieve energy efficiency targets. When considering incentivizing the installation of energy efficiency projects, utilities typically evaluate the costs of upgrading transmission and distribution infrastructure against the costs of incentivize customers to upgrade equipment. In this fashion they can accommodate additional customers without investing in infrastructure.

Note that the REV seeks to move beyond the current performance incentive to a new rate structure that will motivate utilities to promote and realize energy efficiency as part of their core business. This is still emerging and yet to be formally released.

7. *How viable is fuel switching? There appears to be a strong case for all electric buildings for new construction. Is there a viable option to fuel switch larger existing users? For example, if the airport (and other large users) were to switch to ground source heat pumps?*

In general, the cost to heat a building using advanced electric technologies, such as ground source heat pumps or new low temperature air source heat pumps, has about the same cost of operation with the highest efficiency models costing slightly less than natural gas heat. A market potential study from NYSERDA that evaluated the potential for fuel switching from fossil fuels to heat pumps concluded that it was not financially feasible due to the relatively low cost of natural gas[11]. In addition, the study found that in all scenarios air source heat pumps were more cost effective than ground source heat pumps meaning that while ground source heat pumps save more energy, the additional savings do not make up for the additional associated costs at the current price for natural gas. The study evaluated average costs and savings, therefore it is possible that in certain cases a ground source heat pump would be more cost effective, however, it would require an engineering study and energy model. In general, fuel switching to electric from natural gas for most facilities is not an option purely in financial terms, however the Governor recently announced new financial incentives for ground source heat pumps which may change this equation for some.

[11] Mosenthal, Philip. "Energy Efficiency and Renewable Energy Potential Study of New York State." *NYSERDA*. N.p., n.d. Web. <https://www.nyserda.ny.gov/About/Publications/EA-Reports-and-Studies/EERE-Potential-Studies>.

8. *What barriers exist in the marketplace? Can you recommend strategies for the County to consider now?*

Barriers to Entry

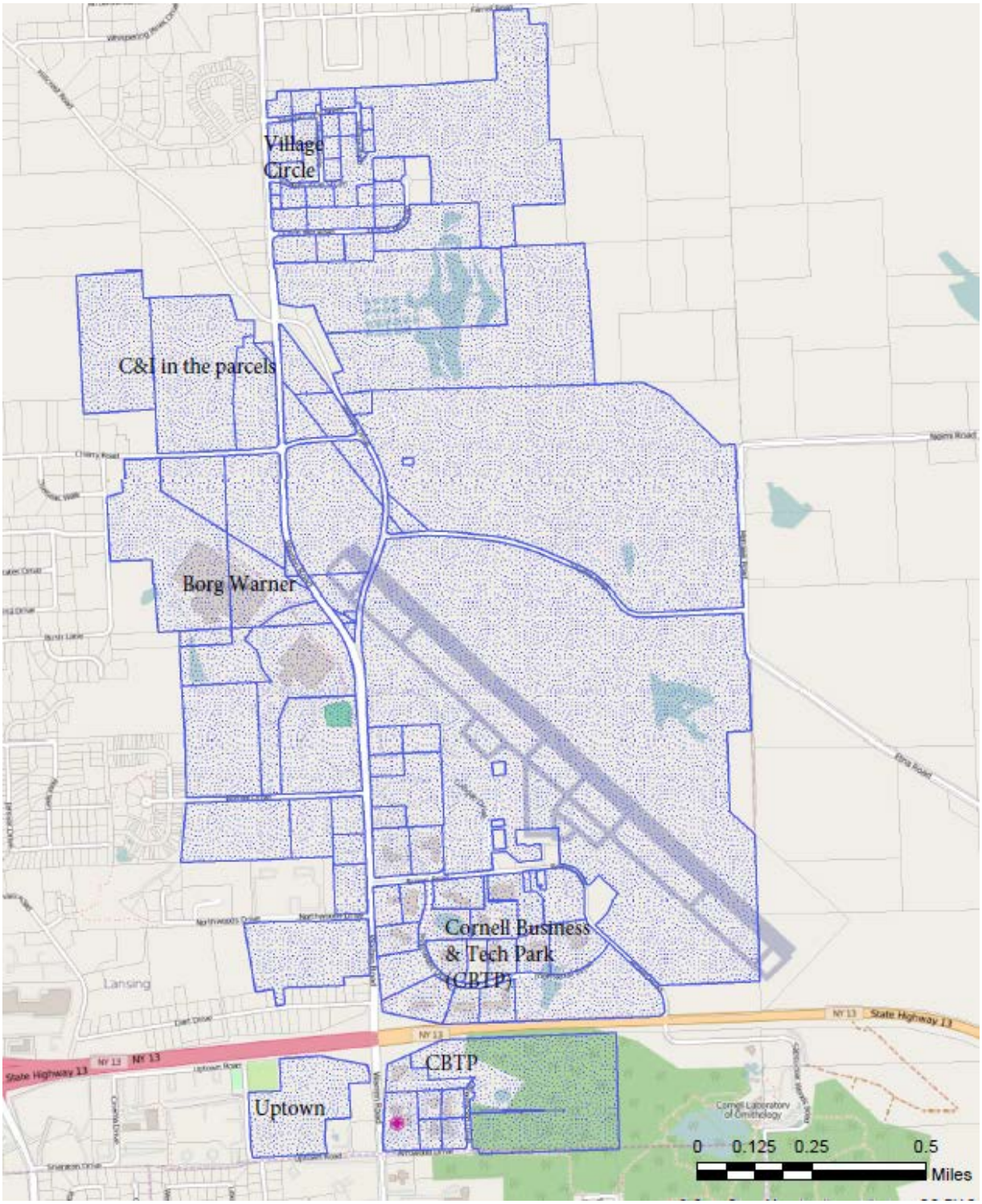
- Few to no examples nationally of targeted gas efficiency to address capacity constraints. Note that there has been notable success of "non-wire" alternatives to address electric capacity contract. Market innovation may deliver viable solutions to gas constraints as well.
- Key large energy users located in airport focus area must be willing to invest in energy efficiency upgrades. The business case from a financial perspective is currently weak due to historically low natural gas prices
- NYSEG and their current portfolio of efficiency programs have been designed to serve customers across an entire service territory – not target a focus area.
- In the current regulatory framework, NYSEG may not be properly incentivized to promote efficiency over new infrastructure. NYSEG has an obligation to their customers but also has an obligation to shareholders.
- Limited data available to quantify impact of gas efficiency in the focus area.
- Savings may not be realized in a timely manner. Energy savings within buildings require action and investment by numerous market actors.

Strategies to Consider

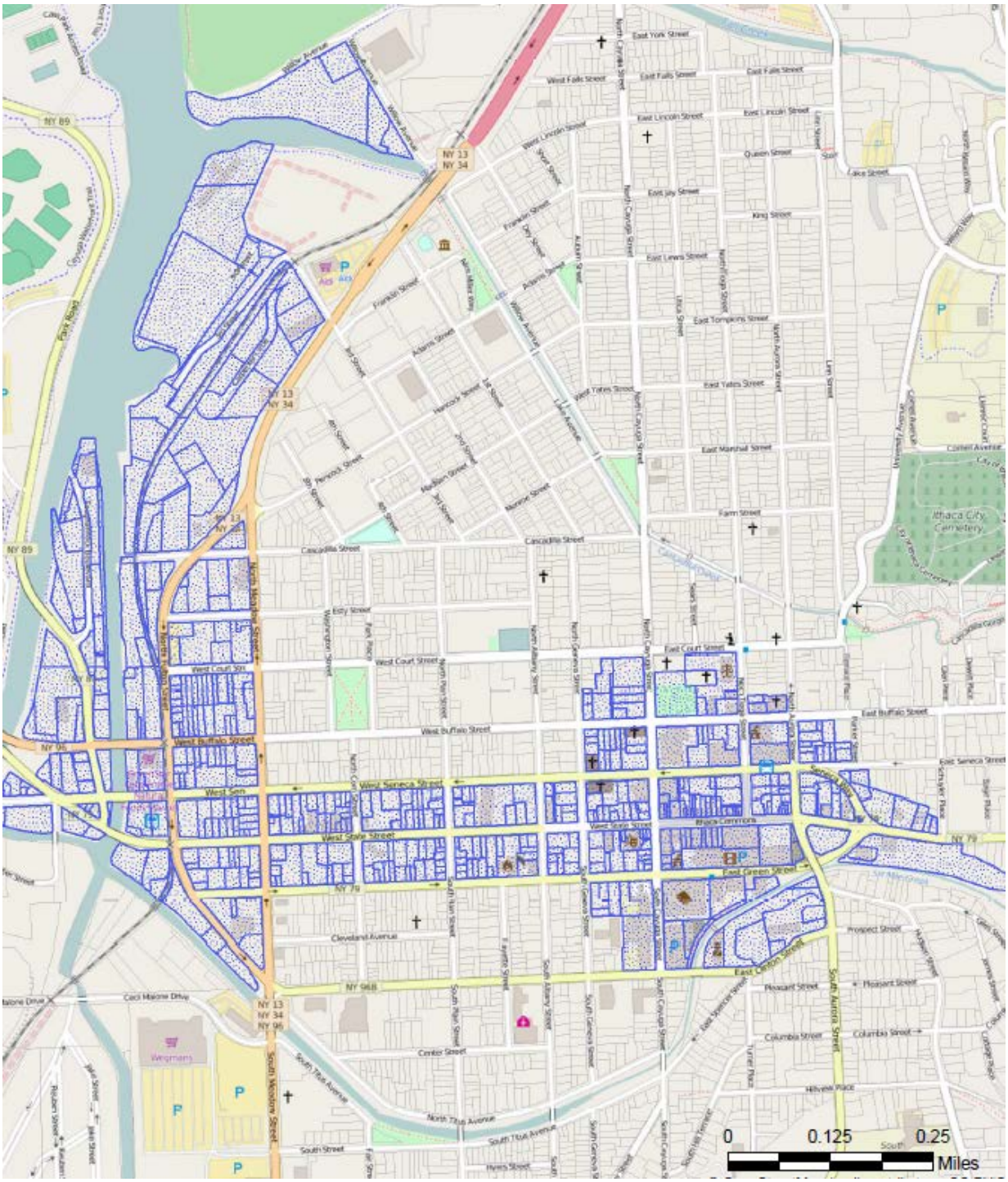
- Collaboration with Avangrid's Energy Smart Community (ESC) and/or NYSEG's existing portfolio of energy efficiency programs. For example, offer a special gas incentive "bonus" for upgrades completed in the targeted area. This approach is similar to Con Edison's Brooklyn Queens Demand Management (BQDM) project, where special incentives were granted for electric peak load management in the area.
- Information / resource exchange to connect customers with existing energy efficiency resources / programs at Avangrid and NYSERDA.
- Targeted outreach campaigns in the area to connect customers with existing AVANGRID and NYSEG energy efficiency programs. This could include social norming strategies (e.g. Solarize or HeatSmart).
- Community Choice Aggregation pilot to lower the costs of energy efficiency upgrades and make the procurement process (contractor and equipment selection) easier for building owners.
- Technical services support – primarily for Commercial & Industrial facilities (look for existing resources at Avangrid and NYSERDA)
- Procurement strategies to solicit "non-pipe solutions" from the marketplace.

Appendix A

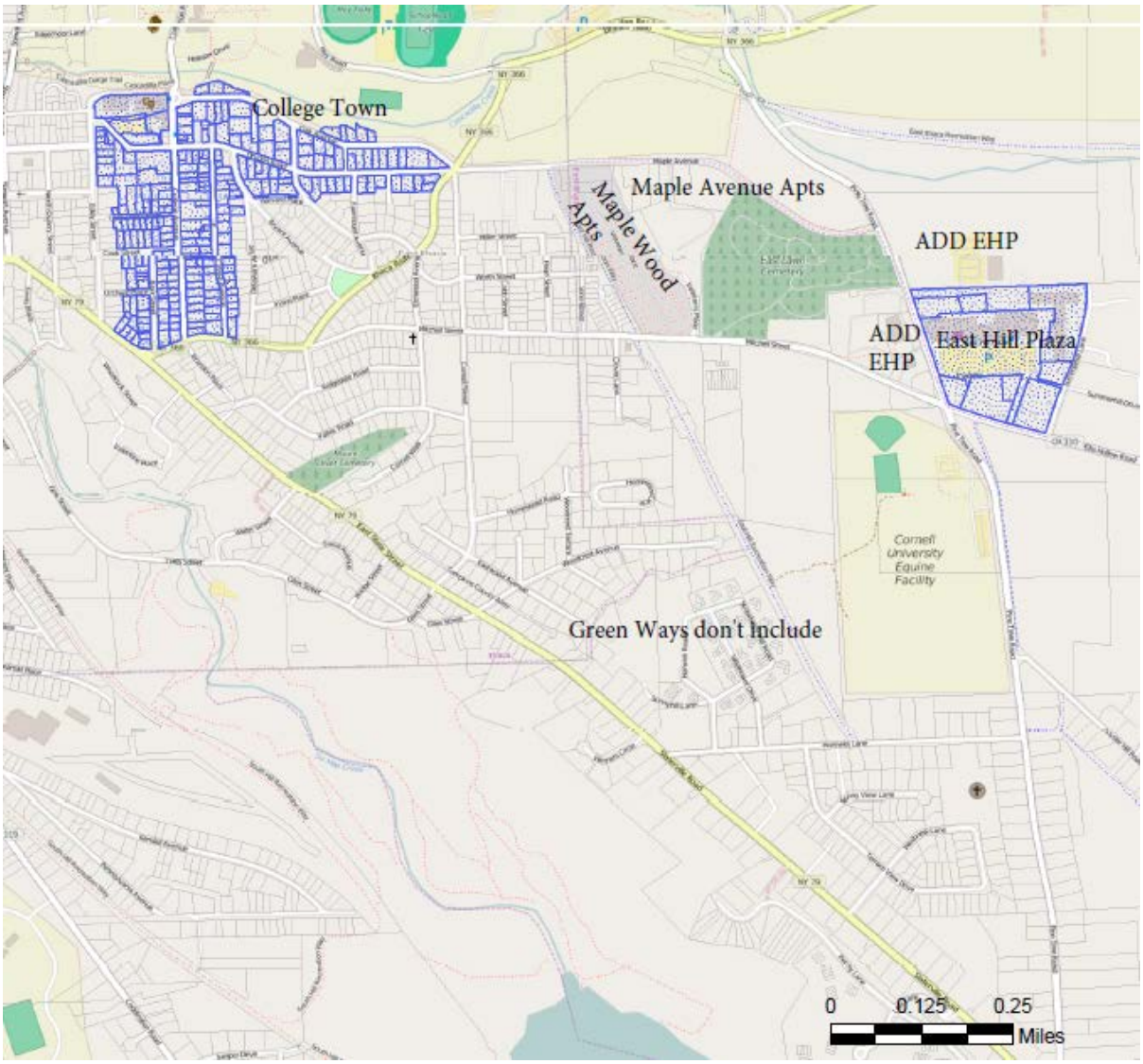
Airport Area Map



Downtown Area Map



East Hill Area Map



South Hill Area Map