Energy Supply and Demand
Tompkins County, New York

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Executive Summary

This report outlines the findings from a 2011-2012 graduate student study of energy supply and demand conditions in Tompkins County. The specific objective of the project is to provide an overview of the present energy supply structure and the energy demand situation in Tompkins County. The intent is to enable the Tompkins County Planning Department to develop and analyze scenarios for efficiently meeting the county's future energy needs.

Tompkins County is positioned well with regards to energy supply and demand. The county procures a significant portion of its electricity from non-greenhouse gas emitting hydro and nuclear stations, and it benefits from the high efficiency of the Cornell Combined Heat and Power Plant (CCHPP). Tompkins County has very few large polluters and two of its largest energy users, Cornell University and Ithaca College, are extremely transparent in their energy use and have committed to aggressive emissions reduction goals. The county is also home to a municipal electric department in Groton, which provides residents of the village with inexpensive power and enables the village to defer revenue away from carbon intensive electricity sources towards hydro power through a power purchase agreement in place with the New York Power Authority (NYPA) through 2025.

Despite Tompkins County's strong overall energy supply and demand positioning, several challenges still exist. Though not necessarily attributable to Tompkins County from an emissions inventory standpoint, the emissions from the coal-fired AES Cayuga power plant in Lansing nevertheless have adverse air quality consequences for the county. The plant's economic challenges could result in its eventual closure, and while this would improve local air quality, it would also have significant negative ramifications for local employment and tax revenues. This places the county in a difficult predicament that puts environmental and public health goals at odds with local economic objectives. Another obstacle the county faces is converting the more than 17,000 occupied housing units that still rely on inefficient heating sources such as fuel oil, kerosene, and propane to less emissions intensive and more cost effective sources.[1] The county must also work to accelerate the development of supporting infrastructure for alternative fuel vehicles, which at present is nearly non-existent across Central New York.

Looking forward Tompkins County has numerous opportunities to meet its energy needs more efficiently. Of particular note, the proposed Black Oak wind farm and the potential for widespread installation of distributed combined heat and power systems at the individual facility level represent scalable low greenhouse gas emitting energy solutions that can also be sound long-term financial investments.

In terms of future obstacles, county officials and other stakeholders must stay engaged as the Energy Recovery Linear Accelerator (ERL) project moves forward at Cornell University to ensure that the power for the accelerator, which current projections show would use a base load of ~19 megawatts (MW), is procured in the cleanest possible manner. On a more macro level,

[1] New York State Energy Research and Development Authority. Patterns and Trends: New York State Energy Profiles 1995-2009. Albany: New York State Energy Research and Development Authority, 2011.

the tenuous current economic environment could restrict investment in energy efficiency and renewables locally.

Several recommendations were developed for the Tompkins County Planning Department based on the key findings of this project.

Key Finding #1 – Tompkins County does not have a formal system for collecting energy data.

Little to no energy information is publically published below the NYISO Zone C level (see Appendix 7 for a map of NYISO Zones), basically Central New York, meaning that Tompkins County is highly reliant on NYSEG for obtaining energy data at the county level. The NYISO is a non-profit entity that operates the electricity grid and wholesale power markets in New York State. The Tompkins County government does not maintain a formal, ongoing data reporting relationship with NYSEG, however, and as a result the county typically depends on outside consultants to gather energy data. The efficacy of these consultants is largely determined by NYSEG's willingness to cooperate with them and the end result is that updated data may be extremely difficult or even impossible to obtain, as was experienced during this project with numerous emails and phone calls to NYSEG representatives going unreturned. Moreover, even when data is provided, the methodology behind how it was derived is opaque and can complicate analysis. For example, a fuel mix provided by NYSEG is included in the energy and greenhouse gas amendment to the County Comprehensive Plan, but no information is offered as to whether the fuel mix is based on net generation, installed capacity, or some other metric. This is just one of many examples where greater engagement with NYSEG would be highly beneficial. Put simply, NYSEG is the keyholder for nearly all things energy in the county, and with that in mind the Tompkins County government must establish a partnership with NYSEG.

Recommendation #1 – Engage NYSEG to determine the feasibility of frequent, standardized energy data reporting and to outline a way forward for a closer working relationship.

Improving relations with NYSEG will help the county develop better awareness of Tompkins County's current energy landscape and of energy opportunities and constraints in the area. An initial point of contact is NYSEG's regional manager for community outreach and development, whose information will be provided to representatives of the Tompkins County Planning Department.

Key Finding #2 – Individual facility and district CHP systems present an opportunity for Tompkins County to substantially increase energy efficiency in a cost effective manner.

CHP has efficiency, reliability, and environmental benefits. These include reduced fuel use, availability of backup power during outages, decreased transmission and distribution congestion, and lower emissions.[2] Also, CHP is a good technical fit for a variety of facility types that are found in Tompkins County, including apartment complexes, fitness clubs, healthcare centers, office buildings, and schools. Perhaps most important, however, are the economic benefits of CHP systems. CHP projects typically have positive net present values, making them a sound

[2] Environmental Protection Agency. Combined Heat and Power Partnership. March 15, 2012. http://www.epa.gov/chp/basic/index.html (accessed May 16, 2012).

long-term investment. In fact, CHP projects generally result in an immediate reduction in operating costs, given reduced fuel use. The challenge with deploying CHP more broadly has little to do with the technology itself, but rather with the upfront capital expenditure required and the inherent risk of owning and operating a distributed resource. This is in contrast to the readily available substitute of simply procuring power and thermal energy from a utility, which requires little to no capital investment and carries minimal risk. Nevertheless, for users with a long-term investment outlook CHP can produce significant savings and substantial environmental benefits.

Recommendation #2 – Enlist the assistance of a graduate intern or consultant in evaluating the potential for CHP in Tompkins County, both at the facility and district levels.

A comprehensive study will enable the Tompkins County Planning Department to understand the technical potential for CHP in the county and the economic, regulatory, and other opportunities and constraints impacting its potential deployment. This information can be used to engage potential candidates for facility-level CHP systems, to facilitate analysis of the potential for district energy in the county, and to ultimately advance the use of CHP technology locally.

Finding #3 – Education on the potential economic benefits of energy efficiency and renewable energy initiatives, and on available incentive programs, is critical to stimulating more widespread adoption.

Education and access to capital were identified as two key impediments to broader implementation of energy efficiency and renewable energy initiatives, particularly in the commercial and industrial sectors. Specifically, key local energy users suggested that information gaps exist at several points in the building design and construction value chain. These gaps range from a lack of general knowledge about energy efficiency and renewables to limited awareness of how to identify and capture financial incentives at the local, state, and federal levels.

Recommendation #3 – Form an energy efficiency working group to identify and develop a comprehensive understanding of the incentive programs that are likely to be most beneficial for Tompkins County, and to develop a model for communicating information about those programs and about energy efficiency in general to key stakeholders, including architects, engineers, contractors, and end-users.

Developing a systematic approach to energy efficiency education will increase overall awareness, helping to mitigate current information gaps, and more importantly will help end-users access financial incentives for energy efficiency and renewables, helping to overcome barriers to accessing capital. The working group should include representatives from the private and public sectors whose organizations have undertaken energy related initiatives, representatives from the local energy industry such as renewable energy installers and energy auditors, representatives from the building design and construction industries with green building experience, local planners and policy makers, and representatives from other relevant entities such as Cornell Cooperative Extension. Participation by local municipalities is critical as they have authority over construction permitting, building codes, land use, taxation, and other areas

that could be used as instruments for incentivizing energy efficiency and renewables initiatives. Areas of possible exploration could include the following.

- Identifying the most impactful incentive programs for Tompkins County and the relevant stakeholders for promoting the programs (e.g. architects, engineer, contractors, policymakers, end-users, etc.)
- Compulsory energy audits as part of the permitting process for retrofit or construction of large facilities
- Streamlined permitting for energy-related construction initiatives
- Local loan guarantee programs
- County certification of local architects, engineers, and contractors as experienced green builders
- Identifying more visible means of recognizing local organizations that have undertaken energy efficiency and renewables initiatives
- Establishment of a repository of local organizations that have undertaken energy efficiency or renewables initiatives and are willing to engage with other organizations seeking advice on projects

Key Finding #4 – While natural gas accounts for 83% of overall thermal fuel usage in Tompkins County, fuel oil and propane still account for 29% of fuel usage in the residential sector.

At 47% of overall consumption the residential sector is the largest thermal fuel user in the county. As discussed in the Thermal Usage section of this report, continued reliance on fuel oil, kerosene, propane, and electricity for heating has adverse environmental and economic consequences, namely higher fuel costs for energy consumers and increased overall emissions.

Key Recommendation #4 – Target households without access to natural gas distribution for energy efficiency incentive programs in the short-term, and engage NYSEG about the feasibility of expanding local natural gas distribution as a long-term solution.

NYSERDA has several programs designed to offset the cost of residential energy efficiency initiatives, many of which are targeted towards lower income families who likely represent a significant percentage of those households without access to natural gas distribution. For example, the EmPower New York grant program will cover 100% of retrofit costs. An important task of the energy efficiency working group proposed in Recommendation #3 should be to develop a means of targeting households without access to natural gas distribution for participation in the NYSERDA programs deemed most viable. Meanwhile, in accordance with the NYSEG partnership outlined in Recommendation #1, county officials should engage NYSEG about the feasibility of expanding natural gas distribution in the local area in order to reduce dependence on fuel oil, propane, and other more emissions intensive resources.

Key Finding #5 – Geothermal could present an opportunity to reduce thermal fuel consumption in Tompkins County.

The potential for geothermal deployment in Tompkins County was beyond the scope of this project and was not assessed as part of the other graduate projects for 2011-2012. As a clean thermal resource it should be evaluated in greater depth.

Recommendation #5 – Enlist the assistance of a graduate intern to assess the potential for geothermal in Tompkins County.

Understanding the technical potential for geothermal in the county, as well as the economic, environmental, and other benefits and concerns related to the technology will enable the Tompkins County Planning Department to better design and analyze scenarios for meeting the county's future thermal energy needs with lower costs and emissions.

Introduction

In 2008 the Tompkins County Legislature passed an energy and greenhouse gas amendment to the Tompkins County Comprehensive Plan, which was adopted in 2004. The amendment established a goal of reducing greenhouse gas emissions in the county by at least 80% from 2008 levels by 2050. In August 2010 the Tompkins County Planning Department released the Tompkins County 2020 Energy Strategy, which outlined a series of interim actions toward achieving the county legislature's emissions reduction goals. The creation of an Energy Road Map for the county was included among the ten new local measures outlined in the 2020 Energy Strategy. The Energy Road Map "would create an integrated approach to assessing energy demand and supply for the residential and commercial sectors in the entire county today and in the future under the development framework and the objectives established in the County Comprehensive Plan."[3]

This past fall the Tompkins County Planning Department enlisted the help of four Cornell University graduate students to advance the work necessary for preparing the Energy Road Map. Specifically, the students undertook four separate projects, including an assessment of current energy supply and demand conditions in the county, as well evaluations of the potential for biomass, solar, and wind energy deployment in Tompkins County. This report outlines the findings from the study of current energy supply and demand conditions in the county.

The specific objective of the project is to provide an overview of the present energy supply structure and the energy demand situation in Tompkins County, in order to enable the Tompkins County Planning Department to develop and analyze scenarios for efficiently meeting the county's future energy needs. The project methodology included interviewing sixteen energy professionals and key local stakeholders, in addition to conducting secondary research using sources such as the Environmental Protection agency (EPA), the New York Independent System Operator (NYISO), and many others. Initial findings were presented to the Tompkins County Planning Department during a public session held at the Tompkins County Library on 30 April 2012 and feedback from that meeting was incorporated into the preparation of this report.

[3] Tompkins County Planning Department. Tompkins County 2020 Energy Strategy. Ithaca: Tompkins County Planning Department, 2010.

Electricity

Power Generation

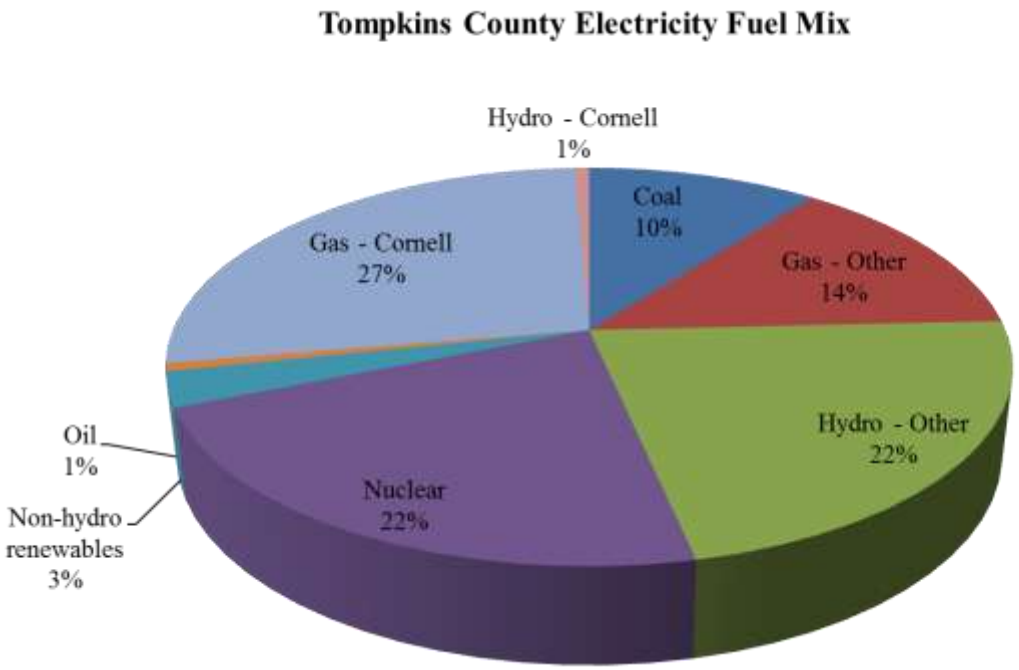
Fuel Mix

It is commonly assumed that Tompkins County's electricity is provided primarily by AES Cayuga, a 323 MW coal-fired power plant located in Lansing, but the county's electricity is actually generated from a diverse group of sources, most of which are located outside of the local area. While AES Cayuga does at times provide significant amounts of electricity to the area, the financial challenges facing the plant, which are described in greater detail in the Local Power Generators section of this report, have caused it to run only intermittently since last summer.[4] Moreover, even when AES Cayuga is online, the power it produces may be transmitted outside of Tompkins County to meet power demand elsewhere. Given these considerations, Tompkins County is generally more reliant on the grid mix produced by power plants located throughout Upstate New York than it is on one particular plant such as AES Cayuga. This makes it extremely difficult to determine a precise electricity fuel mix for Tompkins County.

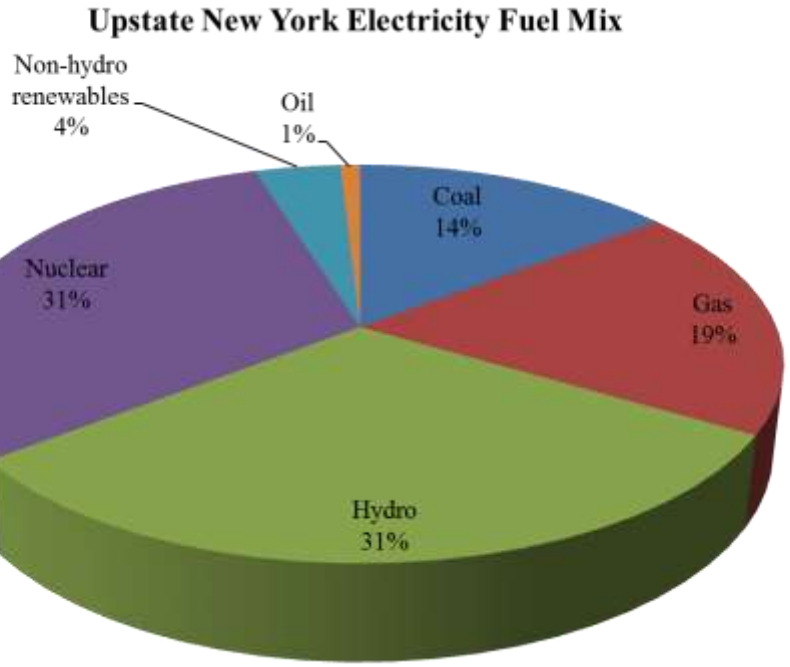
Electrons are indistinguishable from one another once they are fed into the grid, making it impossible to determine the exact source of the electricity being imported into the county from outside generating stations. The fuel mix for the region, however, provides a reasonable proxy with one noteworthy caveat. Since Cornell University has its own substation, the school's central energy and hydro plants produce what is commonly referred to as direct-use power, meaning the power is consumed on-site and is therefore part of Tompkins County's fuel mix. In other words, the electricity is used here in the county, not exported elsewhere. Note that the hydro power purchased by the Groton Electric Department, which is discussed further in the Transmission and Distribution section of this report, is not directly included in the county's fuel mix since that purchase agreement is a financial transaction and does not necessarily mean that the Village of Groton is physically using hydro power. Put more simply, the electricity that Groton buys is different from the electricity the village actually uses. This is due to the aforementioned characteristics of the grid, where electrons are indistinguishable from one another. See Appendix 6 for a diagram illustrating the difference between power market transactions and physical power flow.

[4] Casler, Andrew. AES Cayuga shut down since March. May 03, 2012. http://www.theithacajournal.com/article/20120503/NEWS01/205030377/AES-Cayuga-shut-down-since-March?odyssey=tab%7Ctopnews%7Ctext%7CFRONTPAGE&nclick_check=1 (accessed May 14, 2012).

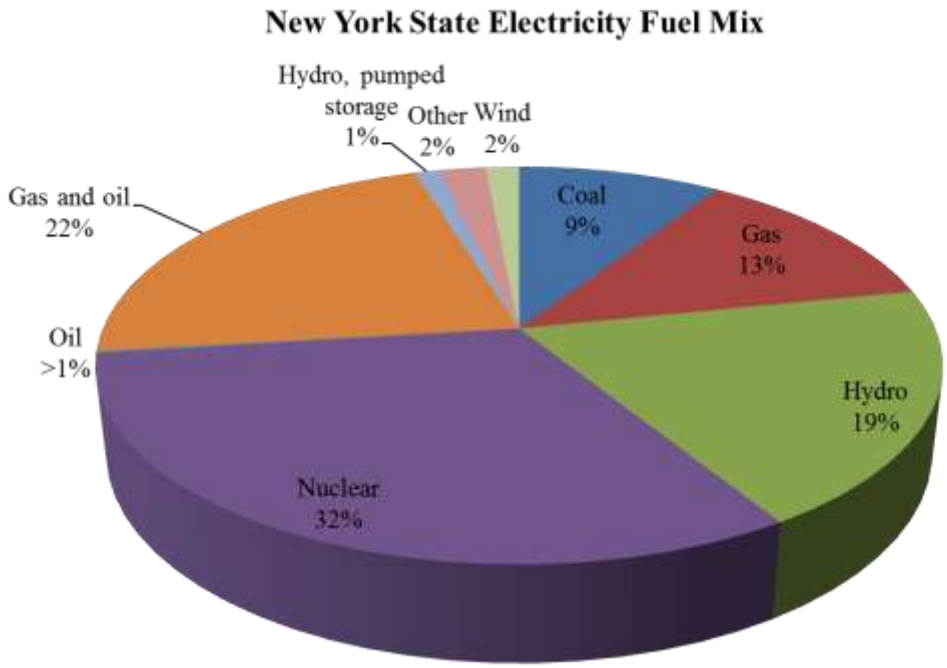
The estimated fuel mix for Tompkins County is illustrated below. The fuel mix was obtained from the EPA's eGrid Profiler, which uses data from 2009, with carve-outs for the Cornell central energy and hydro plants based on information provided in the Cornell Energy Resources Handbook. The fuel mix calculations are included in Appendix 2.



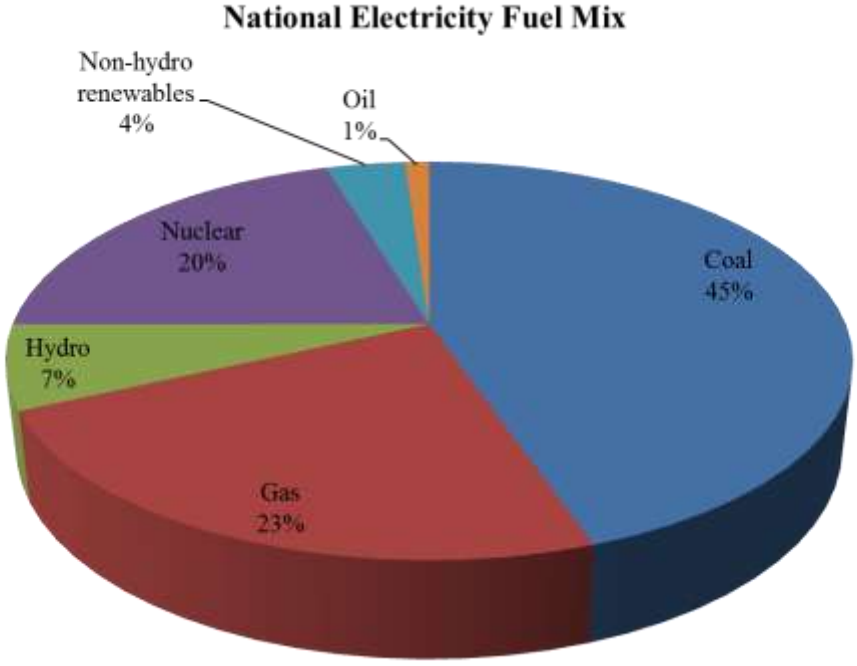
Source: EPA eGrid Profiler and Cornell Energy Resources Handbook



Source: EPA eGrid Profiler



Source: NYISO "Gold Book" 2010 (net electricity generation data from 2009)



Source: EPA eGrid Profiler

As illustrated in the charts, Tompkins County and New York State as a whole rely considerably more on hydro and nuclear power, and much less on coal, than the rest of the United States. This has positive implications for greenhouse gas emissions and overall air quality. Moreover, with

the retirement of the nearby coal-fired AES Greenidge and Westover plants in March 2011, and the reduced recent operations of AES Cayuga, all of which occurred after the most recent update to the EPA's eGrid Profiler data, Tompkins County's electricity supply has likely become even less emissions intensive than the data suggests.[5] Tompkins County's higher reliance on natural gas than the rest of New York State is due to Cornell's significant power production and usage. Given the efficiency of the Cornell Combined Heat and Power Plant (CCHPP), which is outlined in more detail in the Local Power Generators section of this report, the county's claim to Cornell's power is beneficial.

Local Power Generators

AES Cayuga and Cornell University are the two power generators physically located in the county with nameplate capacities larger than 1 MW.

AES Cayuga:

AES Cayuga, formerly known as the Milliken Station, was commissioned in 1955. It was purchased by AES from NYSEG in 1999 as part of a transaction involving six coal-fired facilities, four of which have since been shuttered.[6] Its operating parameters, according to 2009 data from the EPA's eGrid database, are listed below.

- Fuel: Coal
- Nameplate capacity: 322.5 MW
- Net electricity generation: 1,630,107 MWh
- Capacity factor: .577
- Annual NOx emissions: 2,110 tons
- Annual SO_2 emissions: 2,198 tons
- Annual CO_2 emissions: 1,711,295 tons
- Annual CH_4 emissions: 38,586 pounds
- Annual N_2O emissions: 57,879 pounds

AES Cayuga was designed and built to operate as a base load plant, meaning it would normally run almost continuously. The plant does not currently have a power purchase agreement, however, so there is no guaranteed buyer for its output. Consequently, AES Cayuga only operates when it is able to sell its power on the merchant market, which has proven challenging for the plant given its high operating costs compared to competing natural gas generators.[7] The plant's financial woes led AES Cayuga to sign a payment in lieu of taxes, or PILOT agreement, with the Tompkins County Industrial Development Agency (IDA) in 2009. The PILOT has been adjusted several times to account for AES Cayuga's mounting economic troubles, with the most recent change occurring in February 2012, when the IDA agreed to a plan that will lower the

[5] NYISO. 2011 Load & Capacity Data - "Gold Book". Albany: NYISO, 2011.
[6] POWERnews. AES New York Subsidiary Declares Bankruptcy on Coal Woes. January 04, 2012. http://www.powermag.com/POWERnews/4291.html (accessed May 14, 012).
[7] Goodenough, Jerry, interview by Frank Nicklaus. General Manager - AES New York (February 16, 2012).

plant's valuation from $112.5 million currently to $60 million by 2014.[8] The reduced valuation will decrease the amount of local taxes AES Cayuga pays annually from $3.2 million in 2011 to $1.7 million in 2014.[9] Meanwhile AES Cayuga's parent company, AES Eastern Energy, declared bankruptcy in December 2011, citing "reduced power prices brought on by low natural gas prices, increased costs for coal, and significant costs for air pollution controls."[10] AES Eastern Energy reached an agreement on 24 February 2012 as part of a bankruptcy settlement to sell AES Cayuga to NewCo, which is an "entity sponsored by holders of pass-through trust certificates issued in connection with a leveraged lease transaction that financed the acquisition of the plants."[11,12] As of 03 May 2012 none of the plant's 68 employees had lost their jobs.[13]

If AES Cayuga were to shut down permanently the disruption to the local electricity supply would likely be minimal to non-existent. In 2010 NYSEG completed the Ithaca Transmission Project, which significantly reduced dependence on local generation assets, namely AES Cayuga, to meet electricity needs in Tompkins County. The project is described in detail in the Transmission and Distribution Overview section of this report. Also, New York State has substantial reserve capacity and has seen low load growth, particularly Upstate, essentially meaning that an excess supply of electricity exists.[14] Perhaps the most compelling evidence of the stability of the electricity supply in the area, even in the absence of AES Cayuga, is the simple fact that the plant has shut down periodically since summer 2011 without creating reliability issues.

The possibility of retrofitting AES Cayuga to a gas-fired facility or upgrading it to a pumped storage site was discussed with Jerry Goodenough, AES New York General Manager, during an interview at the plant on 16 February 2012.[15] Mr. Goodenough saw a retrofit as unlikely, saying that combined cycle natural gas plants make more sense in the New York City Metropolitan Area, where electricity demand and prices are higher. He added that the only physical asset at the existing facility of meaningful value in a conversion scenario would be the grid interconnection. With regards to pumped storage, Mr. Goodenough noted that ecological considerations would make it a "tough sell" and that the differential between peak and non-peak pricing in Upstate New York is minimal.

[8] Lynch, Marcia E, and Dan Veaner. AES Value Nearly Halves Over Four Years. February 10, 2012. http://www.lansingstar.com/news-page/8166-aes-value-nearly-halves-over-four-years (accessed April 30, 2012).
[9] *Ibid*.
[10] POWERnews. AES New York Subsidiary Declares Bankruptcy on Coal Woes. January 04, 2012. http://www.powermag.com/POWERnews/4291.html (accessed May 14, 012).
[11] *Ibid*.
[12] NYISO. "Motion to Intervene of the New York Independent System Operator, Inc." Rensselaer: NYISO, May 04, 2012.
[13] Casler, Andrew. AES Cayuga shut down since March. May 03, 2012. http://www.theithacajournal.com/article/20120503/NEWS01/205030377/AES-Cayuga-shut-down-since-March?odyssey=tab%7Ctopnews%7Ctext%7CFRONTPAGE&nclick_check=1 (accessed May 14, 2012).
[14] NYISO. "NYISO Market & Performance Metrics." NYISO. February 2011, 12. http://www.nyiso.com/public/webdocs/newsroom/other_reports/NYISO_Market_Performance_Metrics_IRC_RSC_Meeting_S_Whitley_021211.pdf (accessed May 2012, 14).
[15] Goodenough, Jerry, interview by Frank Nicklaus. General Manager - AES New York (February 16, 2012).

Cornell University:

Cornell University generates electricity at its hydroelectric plant and at its central energy plant. The hydroelectric plant was built in 1904, creating Beebe Lake on campus, and the central energy plant was constructed in 1922. The Cornell Combined Heat & Power Plant, which represents the newest and most significant addition to the central energy plant, was commissioned in December 2009. The operating parameters for both as provided by the Cornell Energy Resources handbook and the EPA's eGrid Database are provided below. Note that emissions data is not included for the Central Energy Plant because CCHPP was only operational for one month of the EPA's 2009 data set, which is the most recent available.

Central Energy Plant (from Cornell Energy Resources handbook):

- Fuel: Natural gas
- Nameplate capacity: 37.5 MW
- Net annual electricity generation: ~210,000 MWh (estimate, not based on specific period)

Hydroelectric Plant (from EPA's 2009 eGrid Database):

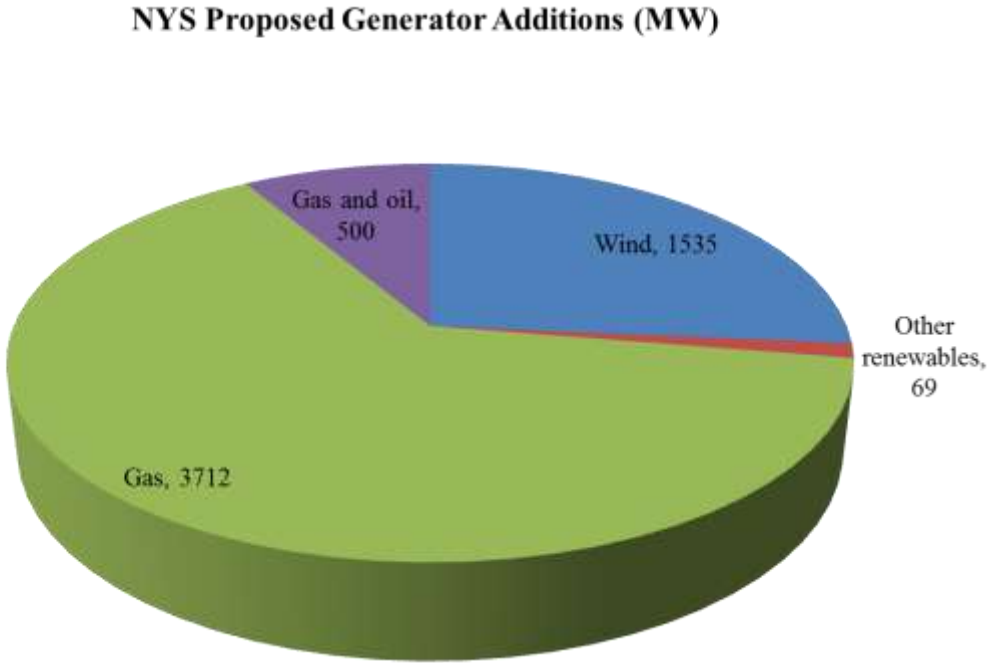
- Fuel: Hydro
- Nameplate capacity: 1.9 MW
- Net annual electricity generation: 4,173 MWh
- Capacity factor: .2507

The central energy and hydroelectric plants combine to meet ~86% of the university's annual electricity needs, which total ~250,000 MWh annually, leaving ~35,000 MWh to be purchased through the university substation each year.[16] The CCHPP has an operating efficiency of ~79%, compared to 30-51% for separate production of electricity and thermal energy, and it requires ~29% less fuel than separate production.[17]

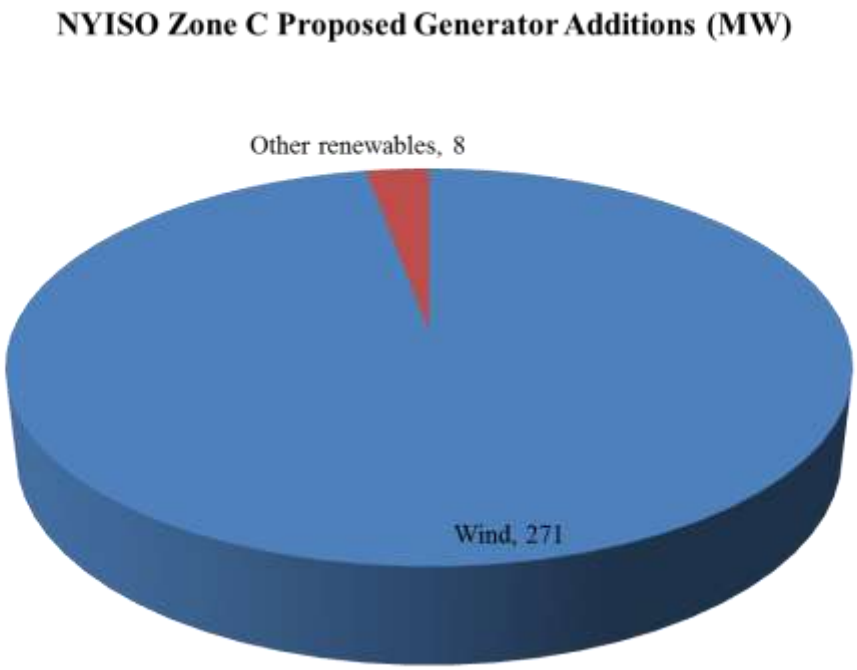
[16] Cornell University. Cornell Energy Rsources. Ithaca: Cornell University, n.d.
[17] Gold, Lauren. Combined heat and power project receives EPA award. February 08, 2011. http://www.news.cornell.edu/stories/Feb11/EPAaward.html (accessed May 15, 2012).

Proposed Generator Additions

Numerous projects are underway that will impact how electricity is produced in New York State. The charts below and on the next page show the fuel sources for projects the NYISO expects to be commercially operable by 2014. See Appendix 3 for a complete list of the projects and Appendix 7 for a map of NYISO Zone C.



Source: NYISO, "Gold Book" 2011



Source: NYISO, "Gold Book" 2011

As the charts illustrate, natural gas and wind dominate as fuel sources for impending capacity additions in New York State.

Local Power Generation Projects Being Considered

Several smaller-scale power generation projects are under consideration in Tompkins County. The largest is the Black Oak Wind Farm, which is sited near a 115 kilovolt (kv) transmission corridor in Enfield and is projected to have a rated capacity of approximately 20 MW. The project's developers have collected several years of meteorological data, have initiated the permitting process, and have held preliminary discussions with several local organizations about the potential purchase of power from the wind farm. The first of three grid interconnection studies has been completed with a favorable outcome for Black Oak, and the project manager expects a draft Environmental Impact Statement to be submitted to the Town of Enfield this spring.[18] Black Oak is currently seeking a $1 million private placement, a significant portion of which has already been raised, in order to fund remaining development costs. Pending successful completion of the permitting process, Black Oak will seek a purchaser for its power before attempting to raise $40 million through an intra-state offering to cover capital costs, namely wind turbines and construction. A wind turbine make and model has not been finalized yet. Black Oak's developers hope to begin the offering by late 2012 or early 2013. The project manager predicts that the project will be commercially operational sometime between the end of 2013 and the end of 2014.[19]

[18] Wells, Marguerite, interview by Frank Nicklaus. Project Manager - Black Oak Wind Farm (April 17, 2012).
[19] *Ibid.*

At least two CHP projects are also being seriously evaluated in Tompkins County. Cayuga Medical Center completed the first phase of a CHP feasibility study last fall and has decided to move forward with a technical study. The technical study will include an assessment of whether district heating for structures near the medical center could be incorporated into the system. Cayuga Medical Center's Vice President of Facilities, Lou LoVecchio, estimates that construction could begin by late 2013.[20] The peak electricity load for Cayuga Medical Center is ~2.2 MW.[21] Ithaca College is also interested in determining the feasibility of a central energy plant and will begin a formal study in 2013.[22] Ithaca College's peak electricity load is ~6 MW.[23]

Transmission and Distribution

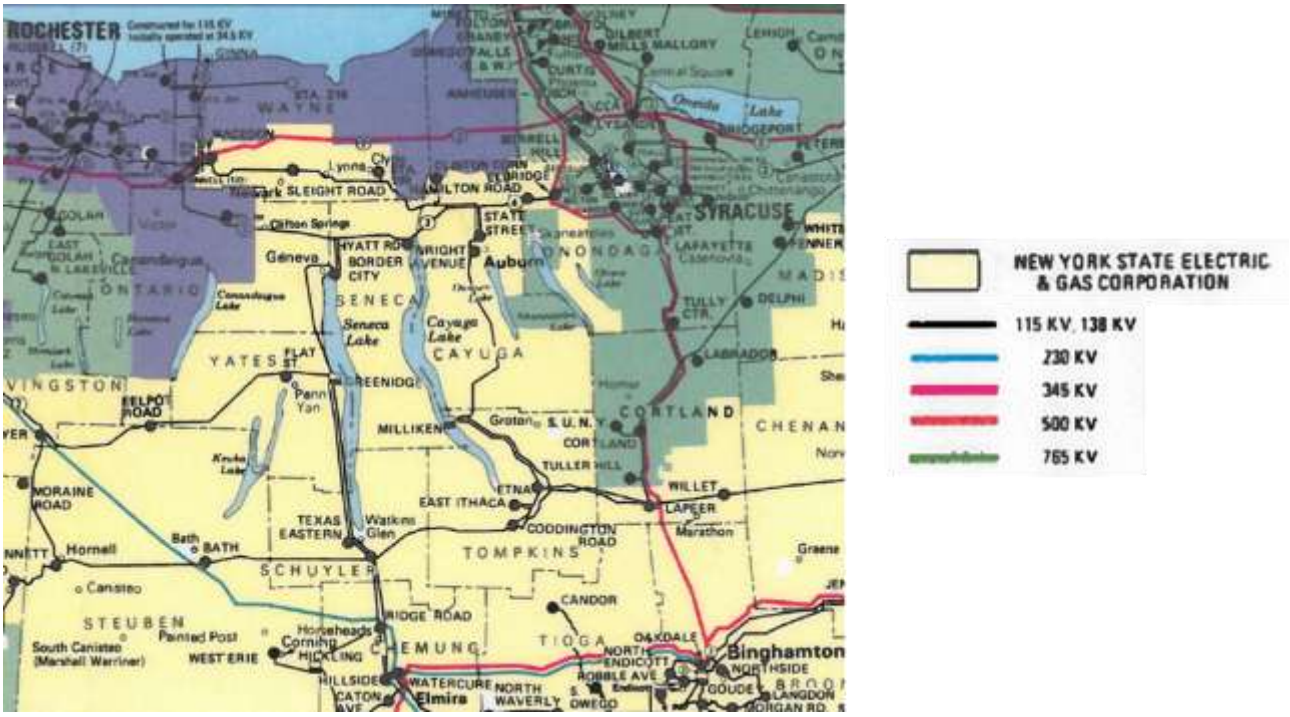
Overview

NYSEG owns the transmission and distribution system in Tompkins County and throughout most of Central New York. A noteworthy exception in Tompkins County, however, is the Village of Groton, which owns and operates the distribution system within the village. More detail is provided on the Village of Groton Electric Department later in this section.

[20] LoVecchio, Lou, interview by Frank Nicklaus. Vice President of Facilities - Cayuga Medical Center (May 03, 2012).
[21] *Ibid*.
[22] Jones, Michelle, interview by Frank Nicklaus. Energy Manager - Ithaca College (March 07, 2012).
[23] Ithaca College. Electric Cost and Usage Graphs 2010-2011. 2011. http://www.ithaca.edu/facilities/docs/energydata/electric/ (accessed May 15, 2012).

The map below shows the transmission system in Central New York. The map is somewhat dated but it still provides an accurate overall depiction of the system. The New York Public Service Commission (PSC) restricts access to newer versions of the system map, and emails and phone calls to the Geographic Information System (GIS) contact at that agency went unreturned.

Central New York Electricity Transmission System



Source: NYISO

In 2010 NYSEG completed the Ithaca Transmission Project. This project included constructing a 345 kv to 115 kv substation in Lapeer (Cortland County), adding a 115 kv line from the Etna substation to the Lapeer substation, and rebuilding the existing line along the same corridor.[24] The primary purpose of the project was to alleviate the Ithaca load pocket.[25] A load pocket is an area of the system where "the transmission capability is not adequate to import capacity from other parts of the system and demand is met by relying on local generation."[26] The overall impact of the Ithaca Transmission Project has been to reduce transmission congestion in the area, which enhances reliability by lowering dependence on AES Cayuga and increases the potential for new grid interconnections such as wind farms. NYSEG maintains data, which is not publically available, on the exact available capacity in a given transmission line. General indicators, however, suggest that transmission is not constrained in the area. Specifically, the

[24] NYSEG. Now in service, NYSEG's Ithaca Transmission Project will enhance reliability across the region. August 26, 2010. http://www.nyseg.com/OurCompany/News/2010/082610itpinservice.html (accessed May 15, 2012).
[25] NYISO. NYISO Review of the System Reliability Impact Study for Queue #225 Ithaca Transmission Project. Albany: NYISO, 2007.
[26] ISO New England. Glossary & Acronyms. 2012. http://www.iso-ne.com/support/training/glossary/index-p4.html (accessed May 15, 2012).

initial interconnection study for the Black Oak wind farm showed that adequate capacity is available for the ~20 MW project, which would connect to the 115 kv line that runs between Watkins Glen and Etna.[27] Moreover, given AES Cayuga's limited operation, excess capacity is likely to exist on the line running from Auburn to Ithaca and the same likely holds true for the line from Lapeer to Ithaca, given that the Ithaca Transmission Project was completed only two years ago.

Note on the Village of Groton Electric Department

The Village of Groton Electric Department was established in 1896. It has undergone several transformations since and today owns and operates the electricity distribution system within the village. The department has full utility responsibilities that include billing, maintenance, and metering. It employs a three-person line crew full-time and has dedicated vehicles and equipment. The distribution system was upgraded eight years ago and has significant reserve capacity as a result.

The Groton Electric Department does not generate power. Groton purchases 4,483 kWh of hydro power monthly through a power purchase agreement with the New York Power Authority (NYPA) that is in place through 2025. [28] NYPA is a state power organization that operates generating facilities and transmission lines. The village purchases incremental power as needed through the New York Municipal Power Agency (NYMPA). NYMPA is a joint action agency with 34 municipal members that provides support to municipal electric departments. A charge is paid to NYSEG for transmission.

Groton's arrangement with NYPA is beneficial to Tompkins County since it provides the residents of Groton with low electricity rates and defers revenue from carbon intensive generators to hydro power.

Potential Future Impacts on Transmission and Distribution

The NYISO's interconnection queue, which is a list of power generation and transmission projects under consideration for development, shows 1,097 MW of potential new capacity for NYISO Zone C, including a 451 MW wind farm in Watkins Glen proposed by NextEra Energy Resources, one of the largest wind developers in the country.[29] See Appendix 4 for a complete list of Zone C projects currently in the queue. It is uncertain whether these projects will actually be completed, but the Watkins Glen project in particular should be monitored by energy stakeholders in Tompkins County, as it would have positive ramifications for the region's fuel mix and greenhouse gas emissions, but could also constrain available transmission for the Black Oak wind farm, particularly since Black Oak will be constructed along the transmission line running from Watkins Glen to Etna. When transmission becomes constrained generators can be

[27] Wells, Marguerite, interview by Frank Nicklaus. *Project Manager - Black Oak Wind Farm* (April 17, 2012).
[28] Rankin, Chuck, interview by Frank Nicklaus. Village Administrator - Groton (February 21, 2012).
[29] NYISO. "NYISO Interconnection Queue." NYISO. 2012. http://webcache.googleusercontent.com/search?q=cache:z36XPtJ2FecJ:www.nyiso.com/public/webdocs/services/planning/nyiso_interconnection_queue/nyiso_interconnection_queue.xls+&cd=1&hl=en&ct=clnk&gl=us (accessed May 15, 2012).

forced to curtail, or take their systems offline, which results in lost revenues and reduced overall efficiency. The order of curtailment is subject to complex contractual arrangements.

The interconnection of distributed generation assets such as combined heat and power, solar, and wind could also impact the transmission and distribution system in Tompkins County. At lower penetration levels, the effect of distributed generation on the grid is likely to be negligible.[30] As penetration levels increase beyond approximately 10%, however, distributed generation will become more impactful, creating benefits for the electric system as well as challenges that must be actively managed.[31] The reliability benefits include the following, as excerpted from a report by Arthur D. Little Consulting:[32]

- Adding generation capacity at the customer site for continuous power and backup supply
- Adding system generation capacity
- Freeing up additional system generation, transmission and distribution capacity
- Relieving transmission and distribution bottlenecks
- Supporting power system maintenance and restoration operations with generation of temporary backup power

As mentioned, distributed generation can also create reliability challenges. For a utility to ensure reliable power it must balance generation with demand, in addition to controlling the voltage and the frequency of the electricity system. A 2005 study conducted by the Carnegie Mellon Electricity Industry Center identified several characteristics of distributed generation systems that can affect a utility's ability to maintain these balances.[33] The key findings are paraphrased below.

- Size: If a distribution system is overly dependent on a single large distributed generator it may be vulnerable. Conversely, the contribution of smaller generators may not be significant enough to have a material effect on reliability.
- Location: Clustering generating units at the sub-station level will not mitigate a fault further down the distribution line (the site of most incidences, but not the cause of major outages). Placement of a distributed generation asset on a distribution feeder, however, can cause stability and power flow problems for line operation.
- Dispatchability and Intermittency: Intermittent resources, such as solar PV and wind, can reduce the need for generation from other sources, but can also create reliability issues since they cannot be dispatched on demand. Simply put, without storage intermittent resources cannot be depended upon to provide grid support whenever it is needed.
- Controllability: The controllability of a distributed resource, specifically the time necessary to connect or disconnect the system and the time required to ramp it up or down, is an important reliability consideration. Technologies with fast switching times can potentially provide a wider variety of reliability support, but if a technology has a slower response time,

[30] NYISO. Envisioning a Smarter Grid for New York Consumers. Albany: NYISO, 2012.
[31] *Ibid*.
[32] Arthur D. Little Consulting. Reliability and Distributed Generation. Arthur D. Little Consulting, 2000.
[33] Apt, Jay, and Granger Morgan. Critical Electric Power Issues in Pennsylvania: Transmission, Distributed Generation and Continuing Services When the Grid Fails. Pittsburgh: Carnegie Mellon Electricity Industry Center, 2005.

it may be necessary to modify the operation of other components in the system, potentially degrading one measure of reliability even as another is increased.

- Unit Reliability: The reliability characteristics of the distributed generation system itself will impact its contribution to system reliability. A distribution system that is dependent upon a distributed generation unit with a high forced outage rate would likely provide unacceptable performance compared to reliance upon the grid alone or deploying an alternative technology.

The impact of an individual distributed generation project on system reliability is assessed by NYSEG on a case-by-case basis during the interconnection process, with the application process becoming more rigorous for projects over 25 kw.

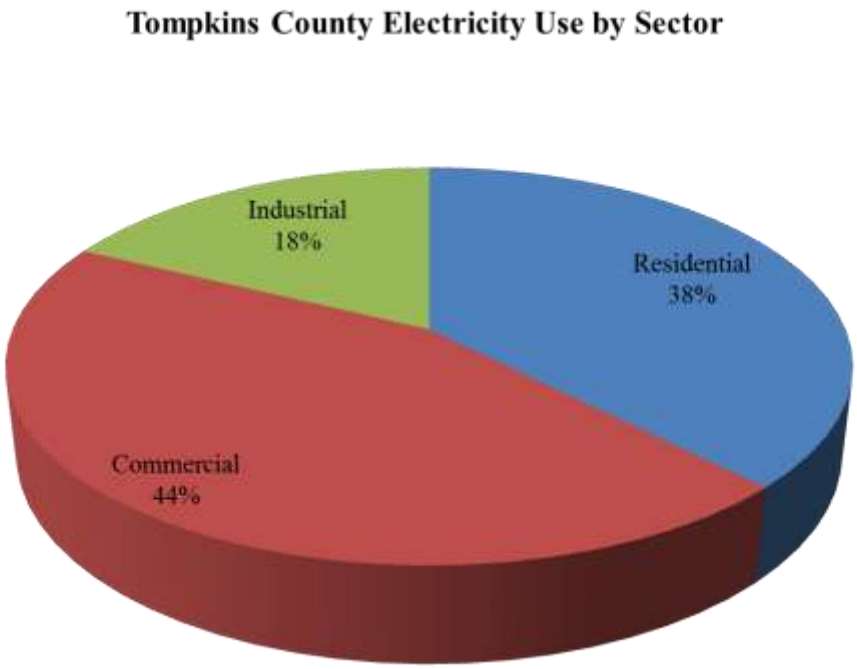
The NYISO recognizes that distributed generation is likely to become more widely deployed in the future and has begun assessing long-term opportunities to mitigate reliability issues associated with distributed resources, particularly variable renewable assets. The initiatives being evaluated by NYISO include using flexible conventional generation, such as hydro and gas turbines, to manage variability, deploying advanced energy storage technologies as they become more technically and economically feasible, upgrading information technology to improve system response time and efficiency, and increasing load-side management through demand response measures and energy storage, for example in electric vehicles.[34]

End-use

Key Usage Statistics

Tompkins County's total electricity usage across all sectors in 2008, the most recent year for which data is available, was 779,501,347 kWh.[35] The breakdown by sector is as follows.

[34] NYISO. Envisioning a Smarter Grid for New York Consumers. Albany: NYISO, 2012.
[35] Tompkins County Planning Department. Tompkins County Greenhouse Gas Emissions Report, 1998-2008. Ithaca: Tompkins County, 2010.



Source: Tompkins County Community Greenhouse Gas Emissions Report, 1998-2008

Residential energy usage in the county averages 7,837 kWh per household versus 7,320 kWh for New York State as a whole and 11,496 kWh for the rest of the United States.[36] See Appendix 2 for the Tompkins County calculations. The density of the New York City Metropolitan Area contributes to the lower statewide average. The lowest average annual consumption for a state is Maine at 6,252 kWh and the highest Tennessee at 16,716 kWh.[37]

Educational institutions account for a significant portion of commercial usage. Cornell University represents ~250,000,000 of the 347,834,037 kWh used annually for commercial purposes, or about 72% of the commercial total.[38] Ithaca College represents around 8% of the total, with usage of ~29,000,000 kWh, though it should be noted that Ithaca College's usage data is based on the 2010-2011 fiscal year, and is therefore not perfectly congruent with the data set for overall county usage, which is for 2008.[39]

With regards to industrial consumption the closure of the Ithaca Emerson plant in 2009, after the most recent county electricity data was published, will likely cause a decline in future countywide industrial usage.

Future Developments

[36] Energy Information Administration. Average monthly electricity consumption, prices, and bills by state. Washington: Energy Information Administration, 2010.
[37] *Ibid*.
[38] Cornell University. Cornell Energy Resources. Ithaca: Cornell University, n.d.
[39] Ithaca College. Electric Cost and Usage Graphs 2010-2011. 2011. http://www.ithaca.edu/facilities/docs/energydata/electric/ (accessed May 15, 2012).

An important project to monitor in consideration of future energy use in the county is the proposed construction of an energy recovery linear accelerator (ERL) at Cornell. The ERL project would put Cornell at the forefront of global x-ray research but would also have a base load electricity use of ~19 MW, which would increase Cornell's peak load by ~53% from 36 to 55 MW.[40]

The application to the federal government for funding of the ~$500 million project is currently on hold. Once it is submitted the approval process is estimated to take three years which would be followed by a five year construction period.[41] Cornell has held preliminary discussions with NYPA about purchasing power for the accelerator, but given the long time horizon for completion of the project no formal plan has been established for power procurement.[42]

[40] Rice, Dave, interview by Frank Nicklaus. Technical Director - Cornell Laboratory for Accelerator Based Sciences (February 23, 2012).
[41] *Ibid*.
[42] Wilson, Ed, interview by Frank Nicklaus. Sustainable Energy Team Manager - Cornell University (March 14, 2012).

Key Energy Decision Drivers

Key energy users in Tompkins County were interviewed from the education, healthcare, manufacturing, and retail sectors. See Appendix 5 for a list of all individuals interviewed during the project. Three important themes emerged during these discussions.

First, economics drives energy decisions. All of the parties interviewed indicated that their energy procurement decisions were based primarily on economic factors, with reliability and environmental stewardship as important additional criteria. Even non-profit entities with robust emissions reduction goals such as Cornell University are interested almost exclusively in projects with a positive net present value. As Ed Wilson, Cornell's Sustainable Energy Team Manager stated, "we are not in a position to do projects that are not economically justifiable."[43] Cost must be a critical consideration for any future local energy planning and policy making.

Second, education and access to capital are the most significant impediments to broader implementation of energy efficiency initiatives and deployment of renewable resources. With regards to education no systematic process, such as compulsory energy audits for the renovation or construction of large facilities, exists to ensure that architects, engineering firms, contractors, and end-users are aware of the potential economic and environmental benefits of various energy efficiency and renewables initiatives. End-users who completed energy-related projects typically first became aware of the opportunity through informal means such as contact with associates in their respective industries. Access to capital is another hindrance, as capital expenditures not related to energy are continually competing for scarce financial resources.

Third, energy efficiency and renewables incentives are difficult to identify and capture. End-users generally expressed concern that funding programs, such as those from NYSERDA, were extremely difficult to navigate. Most end-users were dependent on consultants to help them leverage the programs, and smaller organizations and residential users may not have access to these resources. The difficultly expressed in accessing programs is a function of both the aforementioned educational component, basically learning about the programs in the first place, and of actually capturing program funding, which is obstructed by cumbersome paperwork requirements and limits to the number of entities that can participate in a given program annually.

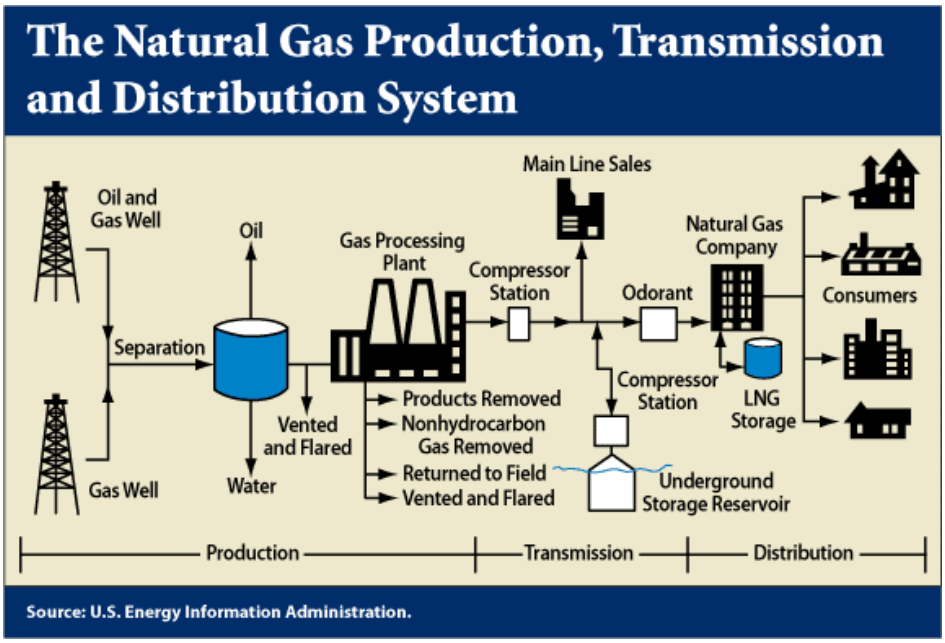
[43] Wilson, Ed, interview by Frank Nicklaus. Sustainable Energy Team Manager - Cornell University (March 14, 2012).

Thermal

Supply Overview

Tompkins County uses numerous fuel sources for thermal energy including fuel oil, natural gas, propane, and wood. Electricity is also used for heating and cooling applications in the county. This report will focus on fuel oil, natural gas, and propane as these are the predominant fuel sources in the county.

Fuel oil and propane are provided to users in Tompkins County through a series of independent distributors. Natural gas is delivered through a pipeline network. The chart below provides a basic overview of the natural gas delivery system. An example of a main line user in Tompkins County would be the Cornell Central Energy Plant. Most users consume at the distribution level.



Natural gas transmission assets in Tompkins County are operated by Dominion Transmission. The distribution system is operated by NYSEG.

The map below provides an illustration of the transmission pipeline network in the county. The map was generated using the public map viewer of the National Pipeline Mapping System. Note that local government officials can request access to the Pipeline Information Management Mapping Application, which enables the creation of more detailed maps. The two types of transmission pipelines in Tompkins County are natural gas and liquids. The natural gas pipelines transport gas to NYSEG for distribution and to main line users such as the Cornell Central Energy Plant. The liquid pipelines transport petroleum products to distributors.

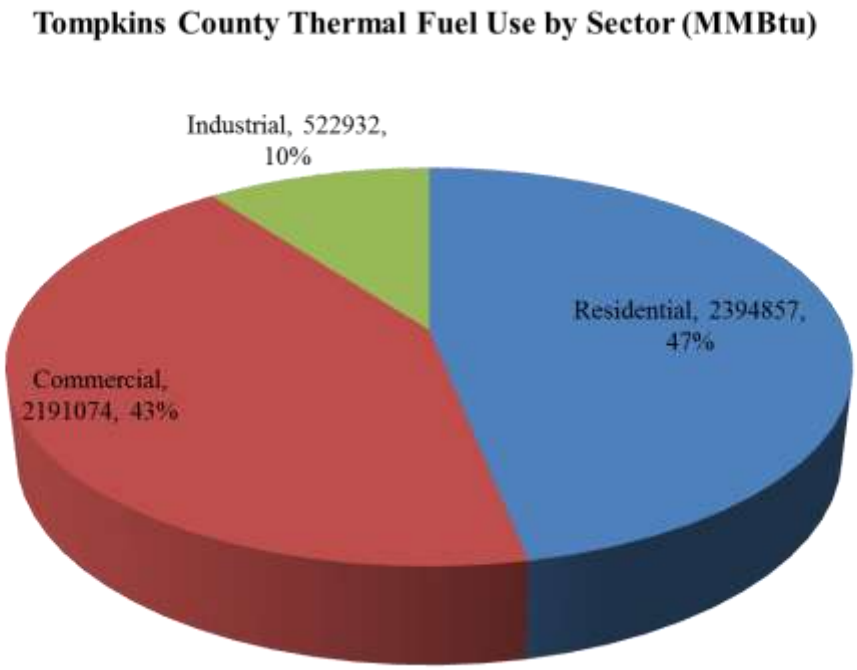
Tompkins County Gas and Liquid Pipelines

Source: National Pipeline Mapping System

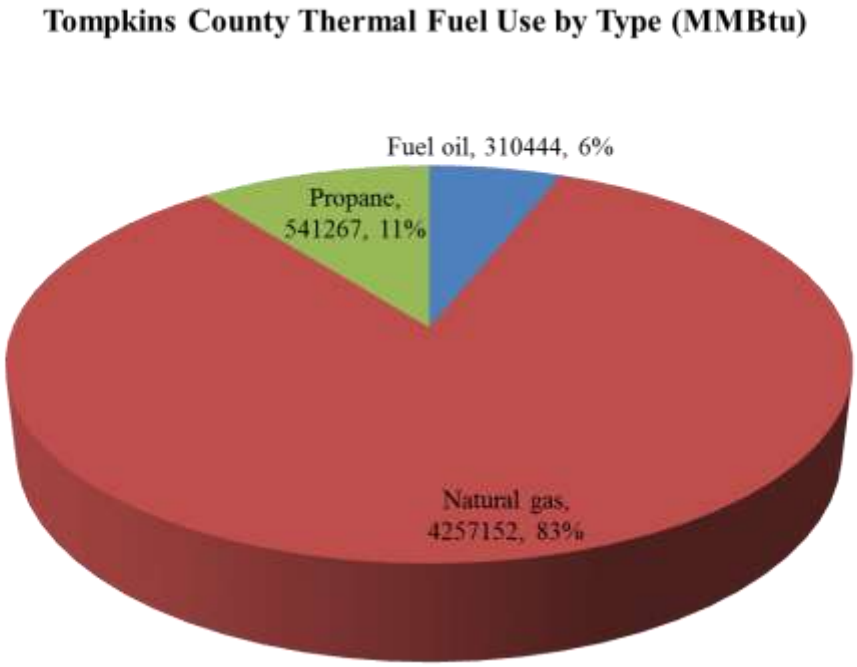
Usage

Thermal fuel usage in Tompkins County totaled 5,108,863 MMBtu in 2008, the most recent year for which data has been published.[44] The charts below illustrate the breakdown of thermal fuel usage by sector and fuel type.

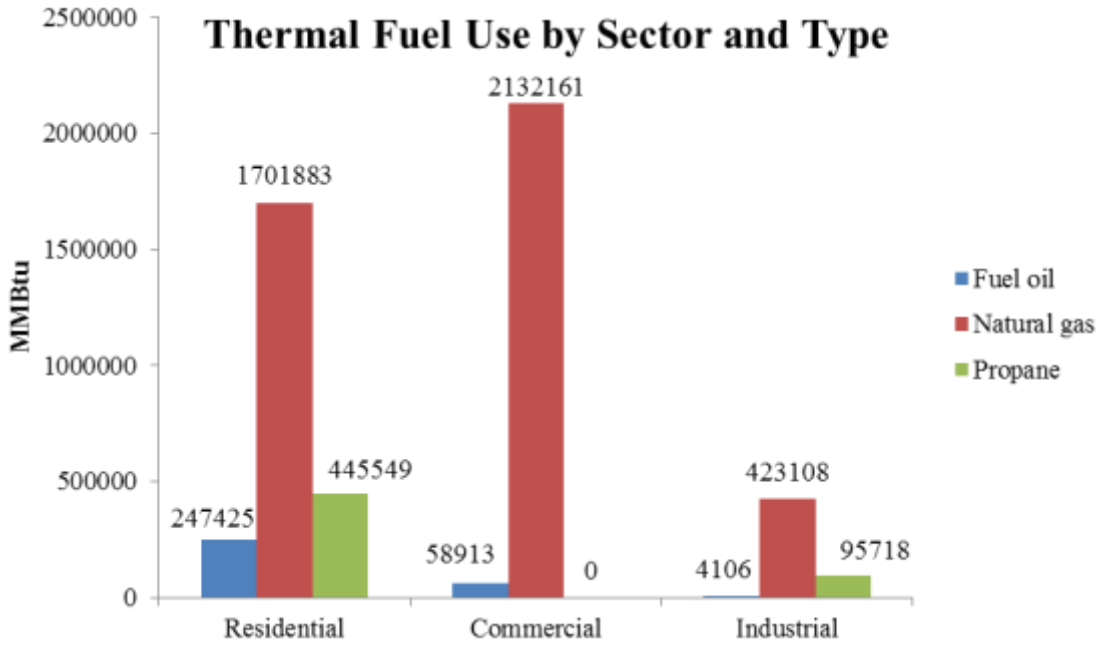
[44] Tompkins County Planning Department. Tompkins County Greenhouse Gas Emissions Report, 1998-2008. Ithaca: Tompkins County, 2010.



Source: Tompkins County Community Greenhouse Gas Emissions Report, 1998-2008

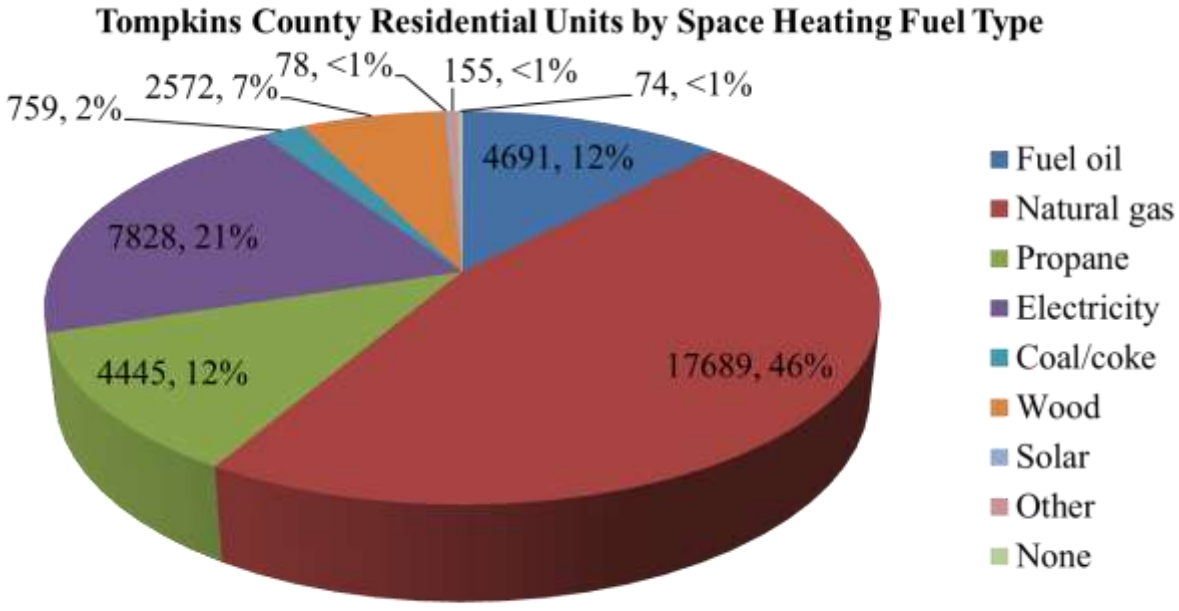


Source: Tompkins County Community Greenhouse Gas Emissions Report, 1998-2008



Source: Tompkins County Community Greenhouse Gas Emissions Report, 1998-2008

As demonstrated in the charts, natural gas provides the majority of thermal energy in Tompkins County. The residential sector, however, which accounts for the majority of thermal fuel usage in the county, still relies heavily on fuel oil and propane, in addition to electricity. The chart below, which is based on 2009 data, breaks down occupied housing units in Tompkins County by thermal fuel type.



Source: NYSERDA Patterns and Trends: NY State Energy Profiles 1995-2009

As displayed in the chart, more than half of the occupied residential units in Tompkins County do not use natural gas for heating. Heating with fuel oil, kerosene, or propane is more emissions intensive than heating with natural gas. Combustion of natural gas releases ~53 kg of CO_2 per MMBtu, compared to 79 kg for fuel oil, 72 kg for kerosene, and 63 kg for propane.[45] Moreover, households that rely on fuel sources other than natural gas can face significantly higher heating costs on a per MMBtu basis. The Energy Information Administration's (EIA) Heating Fuel Comparison Calculator is a useful tool for comparing the cost of different heating fuels. The most recently available data for the tool shows average costs per MMBtu of $36.02 for fuel oil, $35.11 for electricity, and $40.01 for propane, versus just $13.24 for natural gas.[46] Switching thermal energy users away from electricity, heating oil, kerosene, and propane towards natural gas and possibly geothermal would have clear economic and environmental benefits.

[45] Energy Information Administration. Fuel Carbon Dioxide Emission Coefficients. January 31, 2011. http://www.eia.gov/oiaf/1605/coefficients.html (accessed May 16, 2012).

[46] Energy Information Administration. "Heating Fuel Comparison Calculator." EIA. May 23, 2012. http://www.google.com/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&ved=0CGAQFjAA&url=http%3A%2F%2Fwww.eia.gov%2Fneic%2Fexperts%2Fheatcalc.xls&ei=0py-T9PNNOOe6AHv8cCDDQ&usg=AFQjCNEI3O4-

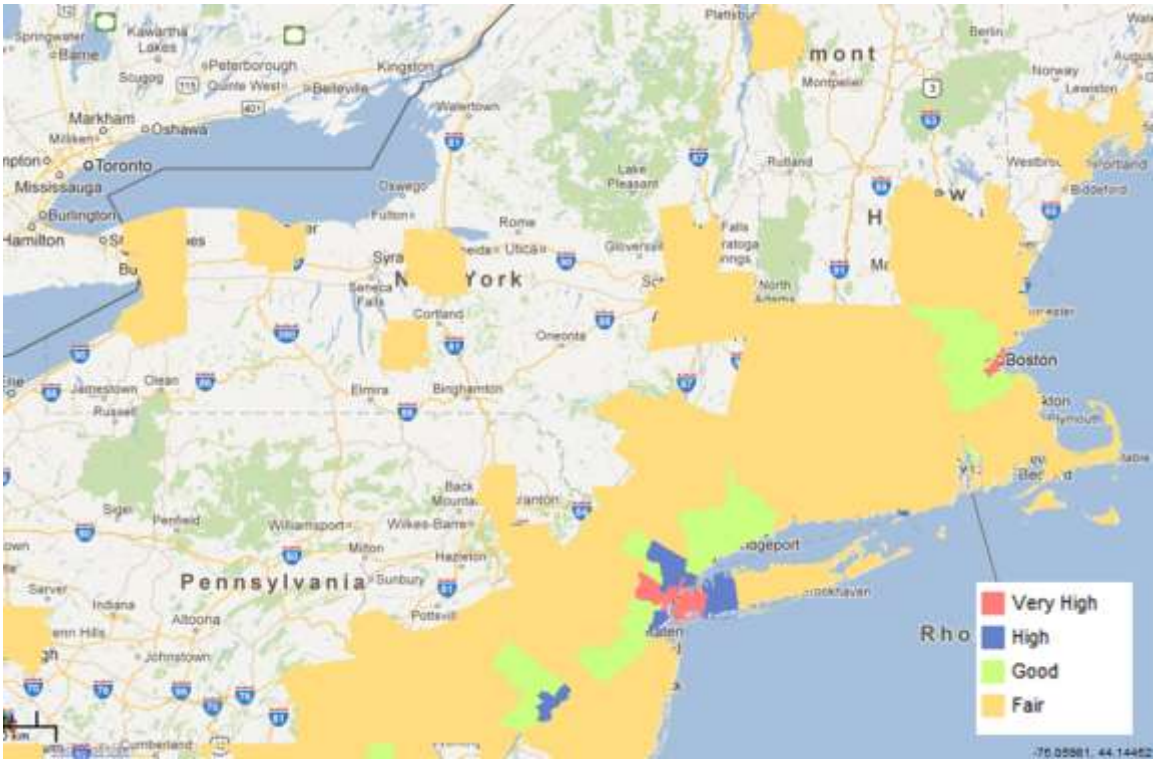
Note on Transportation Fuels

Analysis of the transportation sector was limited during this project and requires further research. Some compelling data points were uncovered, however, and are briefly shared in this note in order to help inform further study.

In 2008 the transportation sector accounted for the largest share of Tompkins County's energy use at 35%, making it integral to achieving the county's overall emissions reduction goals.[47] Reducing emissions from this sector will require, among other initiatives, increasing the adoption of alternative fuel vehicles and building the necessary supporting infrastructure. The map below shows the general density of hybrid and electric vehicles in New York State and surrounding areas based on 2009 data. Ranges are based on number of vehicles per 5 square miles.

- Very High represents a vehicle density greater than 139 vehicles / 5 square miles
- High represents a vehicle density between 139 and 91 vehicles / 5 square miles
- Good represents a vehicle density between 91 and 45.5 vehicles / 5 square miles
- Fair represents a vehicle density between 45.5 and 5 vehicles / 5 square miles

Hybrid and Electric Vehicle Density

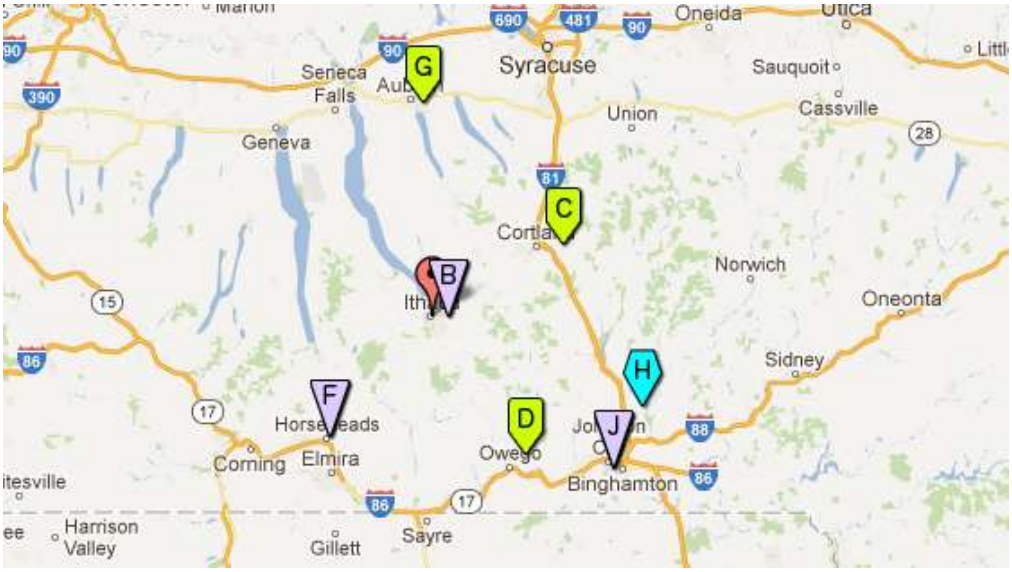


Source: National Renewable Energy Laboratory Trans Atlas

[47] Tompkins County Planning Department. Tompkins County Greenhouse Gas Emissions Report, 1998-2008. Ithaca: Tompkins County, 2010.

As illustrated, penetration of hybrid and electric vehicles in Tompkins County is higher than in surrounding areas, but is still only considered "Fair" by the National Renewable Energy Laboratory's (NREL) metrics. In the case of electric vehicles, this could be due at least in part to the lack of alternative vehicle refueling stations in and around Tompkins County. The map below, which is updated monthly by the U.S. Department of Energy, shows the availability of stations in the area.

Alternative Vehicle Refueling Stations in Central New York



Source: U.S. Department of Energy Alternative Fueling Station Locator

- B - Maguire Nissan, Ithaca, electric, 1x public and 1x private
- C - New York State Department of Transportation, Polkville, CNG, government only
- D - New York State Department of Transportation, Owego, CNG, government only
- F - Simmons Rockwell Nissan, Horseheads, electric, 1x public and 1x private
- G - New York State Department of Transportation, Auburn, CNG, government only
- H – Mirabito, Castle Creek, E85, public
- J – Serafini Nissan, Vestal, electric, 1x public and 1x private

The only public electric vehicle charging stations available in the area are at Nissan dealerships, which are supplying the technology in support of the all-electric Nissan Leaf. The only other available alternative vehicle refueling station on record with the Department of Energy is for E85 ethanol at Mirabito in Castle Creek. Improvements to alternative vehicle refueling infrastructure will be critical for increasing penetration of low to no tailpipe emission vehicles.

Analysis: Key Findings & Recommendations

Key Finding #1 – Tompkins County does not have a formal system for collecting energy data.

Little to no energy information is publically published below the NYISO Zone C level (see Appendix 7 for a map of NYISO Zones), basically Central New York, meaning that Tompkins County is highly reliant on NYSEG for obtaining energy data at the county level. The NYISO is a non-profit entity that operates the electricity grid and wholesale power markets in New York State. The Tompkins County government does not maintain a formal, ongoing data reporting relationship with NYSEG, however, and as a result the county typically depends on outside consultants to gather energy data. The efficacy of these consultants is largely determined by NYSEG's willingness to cooperate with them and the end result is that updated data may be extremely difficult or even impossible to obtain, as was experienced during this project with numerous emails and phone calls to NYSEG representatives going unreturned. Moreover, even when data is provided, the methodology behind how it was derived is opaque and can complicate analysis. For example, a fuel mix provided by NYSEG is included in the energy and greenhouse gas amendment to the County Comprehensive Plan, but no information is offered as to whether the fuel mix is based on net generation, installed capacity, or some other metric. This is just one of many examples where greater engagement with NYSEG would be highly beneficial. Put simply, NYSEG is the keyholder for nearly all things energy in the county, and with that in mind the Tompkins County government must establish a partnership with NYSEG.

Recommendation #1 – Engage NYSEG to determine the feasibility of frequent, standardized energy data reporting and to outline a way forward for a closer working relationship.

Improving relations with NYSEG will help the county develop better awareness of Tompkins County's current energy landscape and of energy opportunities and constraints in the area. An initial point of contact is NYSEG's regional manager for community outreach and development, whose information will be provided to representatives of the Tompkins County Planning Department.

Key Finding #2 – Individual facility and district CHP systems present an opportunity for Tompkins County to substantially increase energy efficiency in a cost effective manner.

CHP has efficiency, reliability, and environmental benefits. These include reduced fuel use, availability of backup power during outages, decreased transmission and distribution congestion, and lower emissions.[48] Also, CHP is a good technical fit for a variety of facility types that are found in Tompkins County, including apartment complexes, fitness clubs, healthcare centers, office buildings, and schools. Perhaps most important, however, are the economic benefits of CHP systems. CHP projects typically have positive net present values, making them a sound long-term investment. In fact, CHP projects generally result in an immediate reduction in operating costs, given reduced fuel use. The challenge with deploying CHP more broadly has little to do with the technology itself, but rather with the upfront capital expenditure required and

[48] Environmental Protection Agency. Combined Heat and Power Partnership. March 15, 2012. http://www.epa.gov/chp/basic/index.html (accessed May 16, 2012).

the inherent risk of owning and operating a distributed resource. This is in contrast to the readily available substitute of simply procuring power and thermal energy from a utility, which requires little to no capital investment and carries minimal risk. Nevertheless, for users with a long-term investment outlook CHP can produce significant savings and substantial environmental benefits.

Recommendation #2 – Enlist the assistance of a graduate intern or consultant in evaluating the potential for CHP in Tompkins County, both at the facility and district levels.

A comprehensive study will enable the Tompkins County Planning Department to understand the technical potential for CHP in the county and the economic, regulatory, and other opportunities and constraints impacting its potential deployment. This information can be used to engage potential candidates for facility-level CHP systems, to facilitate analysis of the potential for district energy in the county, and to ultimately advance the use of CHP technology locally.

Finding #3 – Education on the potential economic benefits of energy efficiency and renewable energy initiatives, and on available incentive programs, is critical to stimulating more widespread adoption.

Education and access to capital were identified as two key impediments to broader implementation of energy efficiency and renewable energy initiatives, particularly in the commercial and industrial sectors. Specifically, key local energy users suggested that information gaps exist at several points in the building design and construction value chain. These gaps range from a lack of general knowledge about energy efficiency and renewables to limited awareness of how to identify and capture financial incentives at the local, state, and federal levels.

Recommendation #3 – Form an energy efficiency working group to identify and develop a comprehensive understanding of the incentive programs that are likely to be most beneficial for Tompkins County, and to develop a model for communicating information about those programs and about energy efficiency in general to key stakeholders, including architects, engineers, contractors, and end-users.

Developing a systematic approach to energy efficiency education will increase overall awareness, helping to mitigate current information gaps, and more importantly will help end-users access financial incentives for energy efficiency and renewables, helping to overcome barriers to accessing capital. The working group should include representatives from the private and public sectors whose organizations have undertaken energy related initiatives, representatives from the local energy industry such as renewable energy installers and energy auditors, representatives from the building design and construction industries with green building experience, local planners and policy makers, and representatives from other relevant entities such as Cornell Cooperative Extension. Participation by local municipalities is critical as they have authority over construction permitting, building codes, land use, taxation, and other areas that could be used as instruments for incentivizing energy efficiency and renewables initiatives. Areas of possible exploration could include the following.

- Identifying the most impactful incentive programs for Tompkins County and the relevant stakeholders for promoting the programs (e.g. architects, engineer, contractors, policymakers, end-users, etc.)
- Compulsory energy audits as part of the permitting process for retrofit or construction of large facilities
- Streamlined permitting for energy-related construction initiatives
- Local loan guarantee programs
- County certification of local architects, engineers, and contractors as experienced green builders
- Identifying more visible means of recognizing local organizations that have undertaken energy efficiency and renewables initiatives
- Establishment of a repository of local organizations that have undertaken energy efficiency or renewables initiatives and are willing to engage with other organizations seeking advice on projects

Key Finding #4 – While natural gas accounts for 83% of overall thermal fuel usage in Tompkins County, fuel oil and propane still account for 29% of fuel usage in the residential sector.

At 47% of overall consumption the residential sector is the largest thermal fuel user in the county. As discussed in the Thermal Usage section of this report, continued reliance on fuel oil, kerosene, propane, and electricity for heating has adverse environmental and economic consequences, namely higher fuel costs for energy consumers and increased overall emissions.

Key Recommendation #4 – Target households without access to natural gas distribution for energy efficiency incentive programs in the short-term, and engage NYSEG about the feasibility of expanding local natural gas distribution as a long-term solution.

NYSERDA has several programs designed to offset the cost of residential energy efficiency initiatives, many of which are targeted towards lower income families who likely represent a significant percentage of those households without access to natural gas distribution. For example, the EmPower New York grant program will cover 100% of retrofit costs. An important task of the energy efficiency working group proposed in Recommendation #3 should be to develop a means of targeting households without access to natural gas distribution for participation in the NYSERDA programs deemed most viable. Meanwhile, in accordance with the NYSEG partnership outlined in Recommendation #1, county officials should engage NYSEG about the feasibility of expanding natural gas distribution in the local area in order to reduce dependence on fuel oil, propane, and other more emissions intensive resources.

Key Finding #5 – Geothermal could present an opportunity to reduce thermal fuel consumption in Tompkins County.

The potential for geothermal deployment in Tompkins County was beyond the scope of this project and was not assessed as part of the other graduate projects for 2011-2012. As a clean thermal resource it should be evaluated in greater depth.

Recommendation #5 – Enlist the assistance of a graduate intern to assess the potential for geothermal in Tompkins County.

Understanding the technical potential for geothermal in the county, as well as the economic, environmental, and other benefits and concerns related to the technology will enable the Tompkins County Planning Department to better design and analyze scenarios for meeting the county's future thermal energy needs with lower costs and emissions.

Conclusion

Tompkins County, like most if not all counties in the United States, is highly reliant on public and private entities outside its borders to meet its current energy needs and shape its energy landscape looking forward. The Tompkins County Legislature and other local bodies have limited authority and resources to shape major energy-related developments outside of the county. Moreover, even within the county major initiatives may not be feasible due to capital and other constraints. The findings and recommendations outlined in this report recognize these challenges, and are intended to provide an actionable path for local stakeholders to take towards meeting the county's energy needs through the most economically, environmentally, and socially responsible means available. These initiatives are also designed to increase Tompkins County's energy independence, which will in turn provide local planners, policy makers, and citizens with more control over the county's energy future.

Appendices

Appendix 1 – Acronyms

CCHPP – Cornell Combined Heat and Power Plant
CHP – Combined heat and power
EIA – Energy Information Administration
EPA – Environmental Protection Agency
ERL – Energy recovery linear accelerator
GIS – Geographic Information System
IDA – Industrial Development Agency
kv - Kilovolt
kw - Kilowatt
kWh – Kilowatt hour
MMBtu – Million British thermal units
MW – Megawatt
MWh – Megawatt hour
NREL – National Renewable Energy Laboratory
NYISO – New York Independent System Operator
NYMPA – New York Municipal Power Agency
NYPA – New York Power Authority
NYSEG – New York State Electric and Gas
NYSERDA – New York State Energy Research and Development Authority
PSC – Public Service Commission

Appendix 2 – Fuel mix calculation

1 MMBtu = 293.071070172222 kWh					
Tompkins County 2008 electricity usage (from GHG emissions inventory)					
	MMBtu	kWh	Per cap		
Residential	1,001,266	293,442,098			
Commercial	1,186,859	347,834,037			
Industrial	471,644	138,225,212			
Total usage	2,659,769	779,501,347			
Number of households	37,443	(from 2008 GHG inventory)			
Usage per household	7,837				
Cornell electricity production (estimate from Cornell Energy Resources Handbook, not for particular performance year)					
Cornell CEP output		210,000,000			
Cornell hydro		5,000,000			
Cornell total production		215,000,000			
kWh imported from outside county		564,501,347			
EPA eGrid Profiler (2009 data, assumption that Tompkins overall usage stayed relatively stable from 2008 to 2009)					
	Upstate NY fuel mix	Tompkins kWh*	Tompkins fuel mix**	National fuel mix	
Non-hydro renewables	3.9%	22,015,553	2.8%	3.6%	
Hydro - Other	30.8%	173,866,415	22.3%	6.8%	
Nuclear	30.6%	172,737,412	22.2%	20.2%	
Oil	0.9%	5,080,512	0.7%	1.1%	
Gas - Other	18.9%	106,690,755	13.7%	23.3%	
Coal	14.5%	81,852,695	10.5%	44.5%	
Gas - Cornell	N/A	210,000,000	26.9%	N/A	
Hydro - Cornell	N/A	5,000,000	0.6%	N/A	
		* kWh imported x fuel %	**Tompkins kWh / total usage		

Appendix 3 – New York State proposed generator additions from NYISO "Gold Book" 2011

Unit	Owner / Operator	Zone	Rating	Type
CPV Valley Energy Center	CPV Valley, LLC	G	753	Combined cycle (CC) Gas
Astoria Energy II	Astoria Energy II, LLC	J	617.2	CC Gas
Berrians GT III	NRG Energy, Inc.	J	789	CC Gas
Berrians GT	NRG Energy, Inc.	J	200	CC Gas
Berrians GT II	NRG Energy, Inc.	J	90	CC Gas
AP Dutchess	Cricket Valley Energy Center, LLC	G	1115	CC Gas
Co-op City	Riverbay Corporation	J	40	CC Gas
South Pier Improvement	Astoria Generating Company	J	108	Combustion (gas)
Bayonne Energy Center	Bayonne Energy Center, LLC	J	500	Dual (gas and oil)
Seneca Energy II, LLC	Seneca	C	6.4	Methane
Nanticoke Landfill	Broome Energy Resources, LLC	C	1.6	Methane
Modern Innovative Plant	Innovative Energy Systems, Inc.	A	6.4	Methane
Upton Solar Farms	Long Island Solar Farm, LLC	K	32	Solar
Taylor Biomass	Taylor Biomass Energy, LLC	F	22.6	Solid Waste
Steel Winds II	Steel Winds, LLC	A	15	Wind
Ellenburg II Windfield	Noble Environmental Power, LLC	D	21	Wind
Jordanville Wind	Jordanville Wind, LLC	E	80	Wind
Howard Wind	Howard Wind, LLC	C	62.5	Wind
Prattsburgh Wind Farm	ECOGEN, LLC	C	78.2	Wind
St. Lawrence Wind Farm	AES-Acciona Energy NY, LLC	E	79.5	Wind
Marble River Wind Farm	Marble River, LLC	D	84	Wind
Marble River II Wind Farm	Marble River, LLC	D	132.3	Wind
Roaring Brook Wind	PPM Roaring Brook, LLC / PPM	E	78	Wind
Cape Vincent	BP Alternative Energy NA, Inc.	E	210	Wind
Bay Hill Windpark	Noble Bay Hill Windpark, LLC	A	90	Wind
Allegany Wind	Allegany Wind, LLC	A	72.5	Wind
Ripley-Westfield Wind	Ripley-Westfield Wind, LLC	A	124.2	Wind
West Hill Windfarm	NY Windpower, LLC	C	31.5	Wind
Arkwright Summit Wind Farm	New Grange Wind Farm, LLC	A	79.8	Wind
Alabama Ledge Wind Farm	Alabama Ledge Wind Farm, LLC	B	79.8	Wind
Moresville Energy Center	Moresville Energy, LLC	E	99	Wind
Stony Creek Wind Farm	Stony Creek Wind Farm, LLC	C	88.5	Wind
Cody Road	Green Power	C	10	Wind
Beekmantown Windfarm	Duer's Patent Project, LLC	D	19.5	Wind

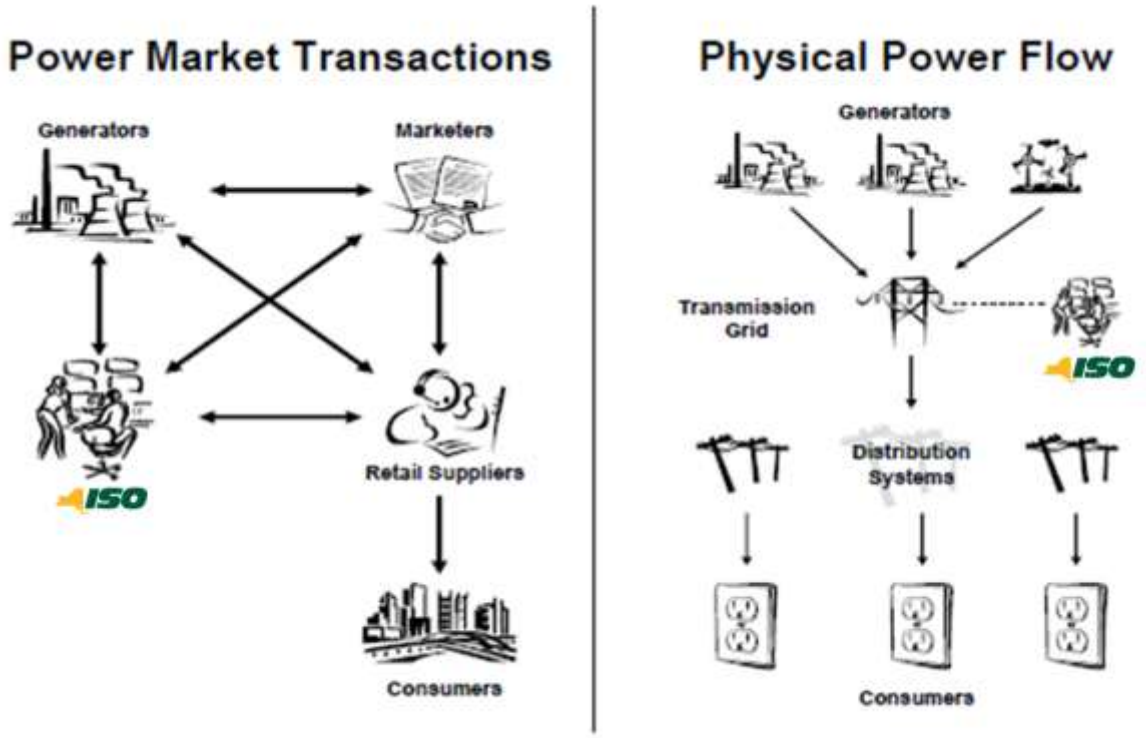
Appendix 4 – NYISO Interconnection Queue Zone C projects

Queue Pos.	Owner/Developer	Project Name	SP (MW)	Type/ Fuel	Location County/State	Z	Interconnection Point	Utility	Proposed In-Service Original	Proposed In-Service Current
119	ECOGEN, LLC	Prattsburgh Wind Farm	78.2	W	Yates, NY	C	Eelpot Rd-Flat St. 115kV	NYSEG	2005/02	2013/12
147	NY Windpower, LLC	West Hill Windfarm	31.5	W	Madison, NY	C	Oneida-Fenner 115kV	NM-NG	2006/Q4	2012/09
180A	Green Power	Cody Rd	10	W	Madison, NY	C	Fenner - Cortland 115kV	NM-NG	None	2013/Q4
182	Howard Wind, LLC	Howard Wind	57.4	W	Steuben, NY	C	Bennett-Bath 115kV	NYSEG	2007/10	I/S
216	Nine Mile Point Nuclear, LLC	Nine Mile Point Uprate	168	NU	Oswego, NY	C	Scriba Station 345kV	NM-NG	2010/Q3	2012/06
231	Seneca Energy II, LLC	Seneca	6.4	M	Seneca, NY	C	Goulds Substation 34.5kV	NYSEG	2009/07	2012/10
250	Seneca Energy II, LLC	Ontario	5.6	M	Ontario, NY	C	Haley Rd. - Hall 34.5kV	NYSEG	2009/10	2012/11
263	Stony Creek Wind Farm, LLC	Stony Creek Wind Farm	94.4	W	Wyoming, NY	C	Stolle Rd - Meyer 230kV	NYSEG	2010/01	2012/12
276	Air Energie TCI, Inc.	Crown City Wind Farm	90	W	Cortland, NY	C	Cortland - Fenner 115kV	NM-NG	2011/12	2014/12
284	Broome Energy Resources, LLC	Nanticoke Landfill	1.6	M	Broome, NY	C	Nanticoke Landfill Plant 34.5kV	NYSEG	2008/07	2012/12
289	New York State Electric & Gas	Corning Valley Trans.	N/A	AC	Steuben, NY	C	Avoca and Hillside 230kV	NYSEG	2010/12	I/S
319	AES Energy Storage, LLC	Cayuga Energy Storage	20	ES	Onondaga, NY	C	Milliken 115kV	NYSEG	2010/07	N/A
336	Enfield Energy, LLC	Black Oak Wind	50	W	Thompkins, NY	C	Black Oak Rd 115kV	NYSEG	2010/10	2013/10
360	NextEra Energy Resources, LLC	Watkins Glen Wind	300.8	W	Schuyler, NY	C	Hillside - Meyer 230 kV	NYSEG	2013/09	2013/06
366	NextEra Energy Resources, LLC	Watkins Glen East	150.6	W	Schuyler, NY	C	Montour Falls Substation	NYSEG	2013/Q3	2014/Q2
376	Ridgeline Energy, LLC	Troups Creek Wind	32	W	Steuben, NY	C	Troupsburg Substation	NYSEG	2014/06	2014/06
			1097							

Appendix 5 – Project resources

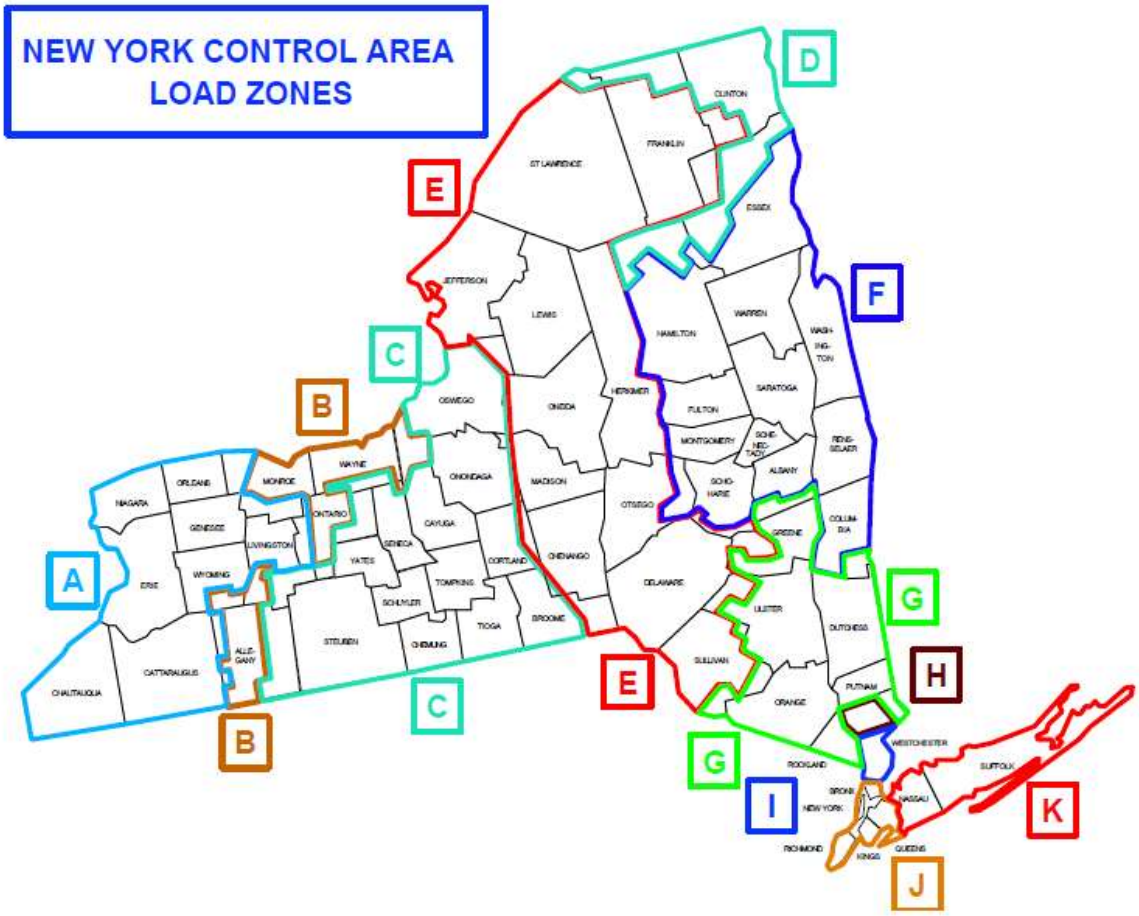
Name	Title & Organization
Heather Filiberto	Director of Economic Development Services - Tompkins County Area Development
Jerry Goodenough	General Manager - AES NY (Cayuga and Somerset plants)
Michelle Jones	Energy Manager - Ithaca College (current) Project Manager – NYSEG (past)
Jamease Leonard	Associate - GE Energy (current) Energy Trader - The Energy Authority (past)
Lou LoVecchio	Vice President of Facilities – Cayuga Medical Center
Jeff Lucas	Equipment Service Manager – Tompkins County Highway Department
Phil Maguire	Owner / Dealer Principal - Maguire Cars
George May	Facilities Manager – Therm, Inc.
Leo McGrattan	Chief Financial Officer – Therm, Inc.
Bob Morey	Mechanical Engineer – Cornell University Wilson Lab (current) Mechanical Engineer – AES and NYSEG (past)
Tim Peer	Manager – Cornell University Central Energy Plant
Chuck Rankin	Administrator – Village of Groton
Dave Rice	Technical Director – Cornell Laboratory for Accelerator Based Sciences and Education
Marguerite Wells	Project Manager – Black Oak Wind Farm
Ed Wilson	Sustainable Energy Team Manager – Cornell University
Tim Winderl	Key Account Manager - NYSEG

Appendix 6 – Power market transactions versus physical power flow



Source: New England Power Generators Association (modified with NYISO logo)

Appendix 7 – NYISO Zone Map



Source: NYISO

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