Ithaca Green Building Policy

Final Project Report 4/25/18

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Table of Contents

1 Executive Summary

Climate change is a real and significant threat to our community, as it is to the nation and world.

Local goals for reducing greenhouse gas emissions 80% by 2050 are roughly consistent with state, federal, and international goals, even if federal activity is currently weaker. The building sector, responsible for more than half of greenhouse gas (GHG) emissions locally, is a critical sector to address. The most affordable and cost-effective time to reduce GHG emissions is when a building is built, rather than at a time of later retrofit.

Thus, the City of Ithaca and the Town of Ithaca – with assistance from consultants STREAM Collaborative, Taitem Engineering, and Randall + West Planners – have conducted a comprehensive examination of our existing and future building stock, as well as green building standards for new construction and potential economic, social and environmental impacts of policies which incentivize or mandate those standards. This report provides background and results of the studies and makes recommendations for a green building policy to be implemented as soon as possible.

1.1 Green Building Policy and Social Impacts Study

The project team reviewed current approaches and best practices for green building policies. On the basis of this review, we propose a green building policy that emphasizes affordability, measurably reduces carbon emissions, lends itself readily for compliance review, and provides flexibility and choice to developers. The policy focuses on an approach that would be incorporated into site plan review and the building code, requiring either a certain number of points to be achieved, or whole-building compliance with energy requirements of a third-party certification system such as LEED. The proposed policy comprises a set of mandated and incentivized new construction standards, to be required in addition to compliance to the New York State Energy Conservation Construction Code (also Energy Code or Energy Conservation Code). The policy was developed through a series of open meetings of an advisory panel, and a subsequent set of outreach meetings, followed by a public comment period.

1.2 Education and Outreach

An important part of implementing any new policy is to perform outreach to educate and gather input from key stakeholders. The project team has met with a project steering committee and advisory committee throughout the duration of the project to help guide and inform the process. The team also participated in several presentations with energy and sustainability minded groups as well as town and city committees and boards to present the overall project goals, preliminary findings and recommendations for the implementation of the Green Building Policy. A public information session was held in late March 2018 to reach out to members of the general public with special invitations to key stakeholder groups such as developers, landlords, realtors, and architects. Additional personal communications between the project team members and interested individuals has been ongoing and suggested feedback has been incorporated into the recommendations.

The consultant team established a project website www.ithacagreenbuilding.com to store the core information generated by the project including draft reports, meeting agendas, minutes, presentations, reference materials and case studies. The website is a key tool for sharing information with the news media and any interested member of the City and Town of Ithaca.

One goal of the project was to increase the diversity of active participants in Ithaca sustainability efforts. Through the steering and advisory committees, through many outreach sessions, and through individual conversations with stakeholders, new voices were incorporated into the local sustainability conversation. We recommend ongoing efforts in this area.

1.3 Building Stock Survey and Development Forecasts

To help the community and our team understand the implications and potential levers for change that can help the Town of Ithaca and the City of Ithaca to achieve energy and water savings goals, Randall + West developed a Survey of Existing Buildings and a Development Forecast. This analysis helps us to understand the context for a Green Building Policy in the City of Ithaca and Town of Ithaca.

Our building stock survey detailed the type, location, size, and age of every building in the Town of Ithaca and City of Ithaca. We gathered available local and regional information on building energy and water use, and analyzed the permitting databases used by the City and Town. The trend in permitting and building area show that a Green Building Policy for new construction will be one important component in reducing community level greenhouse gas emissions, and that additional incentives and/or mandates will need to address existing buildings, renewable energy development, and transportation energy use in order to meet the City and Town goals for greenhouse gas emissions.

Based on data made available from local, state, and national sources, our projections suggest significant growth and development continuing into the foreseeable future. This projection is based on population and employment growth projections by Woods & Poole Economics, Inc., a well regarded economic projection firm, through the year 2050 based on market demand, the competitive position of Ithaca for certain types of development, as well as the City's and Town's respective Comprehensive Plan Future Land Use Maps (see 4.7 Projections in the Context of Local Plans). Our projections suggest modest but substantial growth and supports the findings of the building stock survey: new buildings are a small but important component of the City and Town wide future building stock.

1.4 Recommendations

The project team recommends a combination of energy efficiency requirements, and related incentives, to substantially reduce carbon emissions in all new buildings while emphasizing and supporting affordability. The proposed requirements are in addition to compliance with the New York State Energy Conservation Code. The project team also recommends further study and policy work in the area of existing buildings.

The proposed requirements allow developers to either comply with a simple point-based scoring system, or with a whole-building certification. There are underlying mandatory requirements for water conservation. The requirements apply to all new buildings, as well as major renovations, and large new additions. Small building additions and limited renovations are proposed to comply with a more modest energy-efficiency standard. Historic buildings are exempt from the requirement. A summary of the proposed requirements is included in the abbreviated table on the next page.

Energy efficiency requirements are proposed to go into effect as soon as possible, to become more stringent in 2025, and finally to transition to a requirement for net-zero energy buildings in 2030.

In order to further reduce carbon emissions and to promote the early adoption of best practices, a variety of incentives are proposed for those buildings that significantly exceed the initial requirements. These incentives will sunset in 2030.

Other major recommendations deriving from the study include:

1. Consider conducting a similar study and policy for existing buildings.
2. Consider adopting a benchmarking policy to require the tracking of energy usage for existing buildings.
3. Consider evaluating an institutional compliance path, to address such issues as institution-wide renewable energy capacity and district heating systems.
4. Develop requirements for buildings with large internal loads (such as labs), which might not be able to comply with the proposed whole-building requirements.

Detailed recommendations can be found in Section 2.20 of the report.

Ithaca Green Building Policy - Summary Table

To comply with the Ithaca Green Building Policy, all new buildings must meet the requirements of the Easy Path OR the Whole Building Path, AND meet the water efficiency requirement, in addition to still meeting requirements of the New York State Energy Conservation Code. See Chapter 2 for general background. See section 2.14 for detailed requirements; this table is a limited summary.

EASY PATH - Buildings must achieve six points			
Category	**Improvement**	**Points**	**Details**
EFFICIENT ELECTRIFICATION			
EE1	Heat pumps for space heating	2 - 4	2 points (Commercial) or 3 points (Residential) for air source heat pumps. 3 points (Commercial) or 4 points (Residential) for ground source heat pumps.
EE2	Heat pumps for domestic hot water	1	1 point for water heating systems that use heat pumps (Residential).
EE3	Electric stove and ventless heat pump clothes dryer	1	1 point total for electric stoves AND ventless heat pump clothes dryers (Residential). Requires EE1 as prerequisite, and no fossil fuels in the building.
AFFORDABILITY IMPROVEMENTS			
AI1	Smaller building/room size (residential/hotel)	1 - 2	1 point for building/room size 15% smaller than reference size. 2 points for building/room size 30% smaller than reference size.
AI2	Heating systems in heated space	1	1 point for placing heating/cooling systems and distribution inside actively heated and finished spaces.
AI3	Efficient building shape	1	1 point if exterior surface area divided by gross floor area is less than maximum value provided in table.
AI4	Right-lighting	1	1 point for reducing overlighting and other lighting improvements (Commercial).
AI5	Modest windows with views and natural light	1	1 point for overall window-to-wall ratio less than 20% (individual spaces may exceed 20%).
RENEWABLE ENERGY			
RE1	Renewable energy (non-biomass) systems.	1 - 3	**Electric Systems** (on-site or remote): 1 point per 1.2 kwh/sf/year renewable energy capacity (Residential) or per 2.4kwh/sf/year (Commercial). Thermal Systems: 1 point per 4.0 kBtu/sf/yr renewable energy capacity (Residential) or per 8.0 kBtu/sf/year (Commercial).
RE2	Renewable energy biomass	3 - 4	3 points (Commercial) or 4 points (Residential) for approved biomass space heating systems.
OTHER POINTS			
OP1	Development density	1	1 point for density of more than 7 dwelling units per acre.
OP2	Walkability	1	1 point if the property is on the walkability map.
OP3	Adaptive reuse	1	1 point for substantial re-purpose of existing building.
OP4	Meet NY Stretch Code	1	1 point for complying with 2015 NY Stretch Energy Code
OP5	Custom energy improvement	1 - 2	1 point for each 1.2 kwh/sf/year (Residential) or 2.4 kwh/sf/year (Commercial) reduction in energy use. Prerequisite: no fossil fuels.
WHOLE BUILDING PATH			
WB1	Comply with recognized high performance building standard	N/A	Commercial: Passive House OR min. 17 energy points per LEED V4. Residential: Passive House OR RESNET HERS/ERI max. 40 points OR National Green Building Standard min. 80 energy efficiency points
WATER EFFICIENCY REQUIREMENTS			
WE1	Use EPA Water Sense/ other efficient fixtures	N/A	All buildings must meet this requirement, regardless of which compliance path is used.

Table 1. Easy Path Summary Table

1.5 Projected Impacts

The projected energy impacts of the green building policy are shown in the following graphs. The three lines shown represent business as usual (blue), the impact of the green building policy in new buildings (red), and the impact of both the green building policy in new buildings and energy efficiency in existing buildings (green). "Business as usual" assumes energy use intensity for new buildings reflects the current energy code. The impact of the green building policy assumes 40% savings for buildings through 2025, 80% savings for buildings built in the period 2025-2030, and zero energy buildings after 2030. The impact of both the green building policy in new buildings and energy efficiency in existing buildings (green) assuming 25% reduction in energy use by 2030 and 50% reduction by 2050.

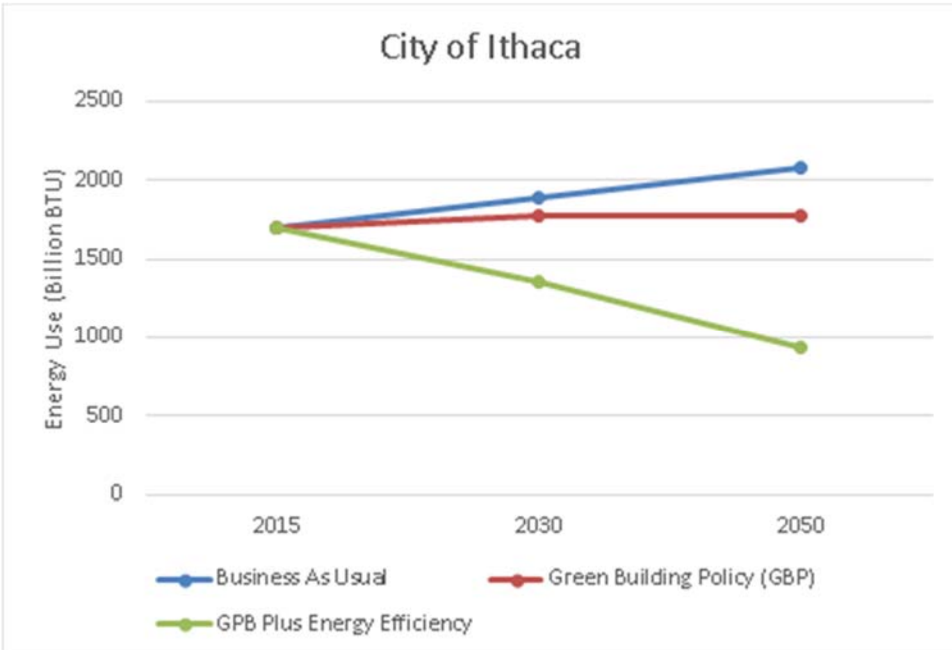


Figure 1. Projected impacts of green building policy in City of Ithaca

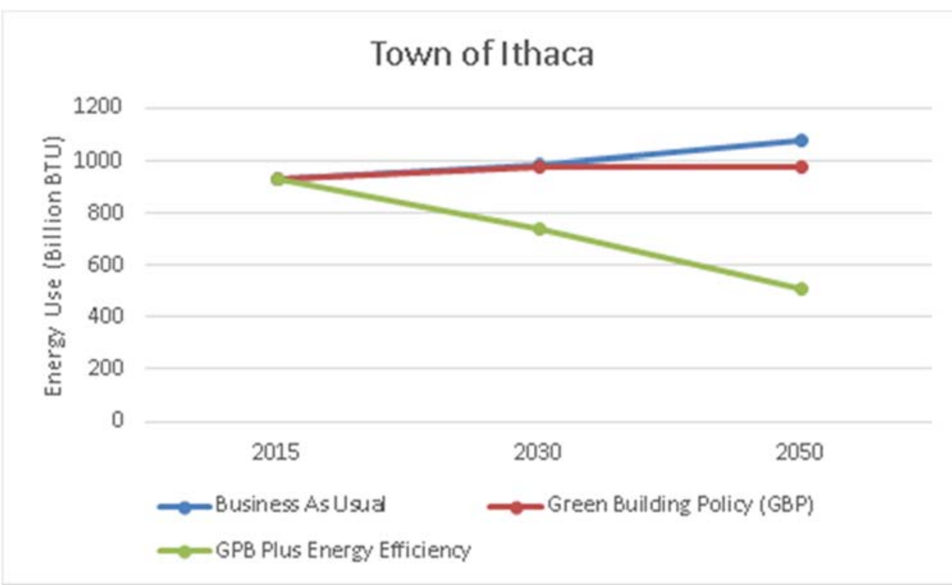


Figure 2. Projected impacts of green building policy in Town of Ithaca

Possible interpretations of these projections include:

1. The green building policy is required to slow the growth of energy use.
2. A separate policy will be required to deliver energy efficiency in existing buildings.

1.6 Frequently Asked Questions (FAQ)

Q. Is the Ithaca Green Building Policy different from the NYS Energy Conservation Code?

A. Yes. The proposed Ithaca Green Building Policy would be a supplement to the NYS code that requires a property owner to take steps to lower the overall greenhouse gas emissions of new or renovated buildings in order to help meet the energy goals of the City and Town Comprehensive Plans. The NYS code is a minimum standard and it does not effectively achieve the goals.

Q. How do I comply with the policy?

A. New construction and substantially renovated existing buildings will need to choose either an "Easy Path" based on an estimated yet carefully calibrated point system OR the Whole Building Path with third-party verification such as LEED, Passive House or other energy modeling to demonstrate compliance above and beyond NYS Energy Code.

Q. How do I get points if I want to use traditional efficiency approaches, such as more insulation?

A. Points for more insulation and other traditional efficiency approaches are possible through the NY Stretch Code which is part of the Easy Path. Or the "Custom Energy Improvement"" points may be pursued. Or the Whole Building Path can be used.

Q. Will the green building policy make buildings more expensive?

A. If the Easy Path is chosen, points can be achieved using improvements that reduce energy use AND reduce construction cost. So it is possible for a building to meet the requirements and cost the same or less than a conventional building. If the Whole Building path is chosen, for wider flexibility in design and construction, we anticipate the added cost might be 5-8% more than a conventional building. We also anticipate that such added costs will continue to come down, as we have seen significant cost reductions in areas such as LED lights, solar energy systems, and other energy-efficient technologies.

Q. Do I need a special energy consultant?

A. Not if the Easy Path is chosen. If the Whole Building path is chosen, an energy consultant is required. Costs of energy consultants can sometimes be covered through state (NYSERDA) or utility or other energy programs.

Q. Can I use fossil fuels in my new building?

A. Fossil fuels are discouraged in several ways. But fossil fuels are not prohibited.

Q. Are green building approaches such as deconstruction and reused materials, light pollution, indoor environmental quality, gray-water reuse, rainwater harvesting, electric vehicle chargers, solar-ready roofs, and others a part of the green building policy?

A. The initial focus of the green building policy is energy and water, as both of these impact carbon emissions and relate to recommendations in the City and Town Comprehensive Plans. We recognize the importance of other green building characteristics and will recommend that these be examined in the future. The initial focus of the policy is limited to energy (and, specifically, carbon emissions) and water.

2 Green Building Policy Study and Social Impacts Study

2.1 Goals

Goals for energy efficiency, renewables, and reductions in carbon emissions are emerging at the national, state, and local levels.

Global sustainability efforts are aimed at meeting or exceeding the ambitions of the Paris Climate Agreement, which will require a reduction of greenhouse gas (GHG) emissions of 80% or more by 2050. The U.S. is a signatory to the Paris agreement, but may be withdrawing; however, New York State is one of 14 states that intends to comply with the agreement.

Nationally, the voluntary Architecture 2030 Challenge advocates for all new construction and major renovation buildings to be "carbon-neutral" buildings in 2030. Carbon neutral buildings are defined to be buildings that use no fossil fuel, greenhouse gas (GHG) emitting energy to operate. The schedule of targets for Architecture 2030 is:

- 70% GHG-emitting, energy consumption reduction below the regional (or country) average/median for that building type.
- 80% in 2020
- 90% in 2025
- Carbon-neutral in 2030 (using no fossil fuel GHG emitting energy to operate)

New York State has also adopted the goal of decreasing GHG emissions 80% by 2050, as well as the mid-term goal of reducing emissions 40% by 2030. In 2015, New York adopted its important and current "50 by 30" renewable energy goal, which targets 50% of the State's electricity to come from renewable sources like solar and wind power by the year 2030. Other state goals include a 23% decrease in energy consumption in existing buildings from 2012 levels, also by 2030. (https://energyplan.ny.gov/)

The state of California's revised Title 24 energy code includes ambitious energy-related performance requirements and goals for residential and commercial buildings. It states that all residential buildings must be zero net energy (ZNE) by 2020 and all commercial buildings must achieve ZNE by 2030. The code applies to retrofit projects that pass certain thresholds. The California Energy Commission and the California Public Utilities Commission jointly released a New Residential Zero Net Energy Action Plan 2015-2020. This plan outlines the path for reaching the residential ZNE goals and key strategies to get there, including building awareness of value and benefits of ZNE, and aligning regulations, policies, incentives, etc.

At the local level, the City of Ithaca, the Town of Ithaca and Tompkins County all have goal of 80% reduction in GHG emissions by 2050. The Tompkins County Energy Roadmap was created to evaluate the local energy resources in the area and develop scenarios to meet the county's greenhouse gas emission reduction goal and projected energy needs through 2050. The report recommends constructing new buildings that are extremely energy efficient, aiming for a 70% reduction in energy use compared to the national median for comparable buildings, and increasing to net zero carbon emissions between 2030 and 2050, which is in line with the nationwide goals of Architecture 2030 and the Ithaca 2030 District. Another recommendation is a 35% reduction in energy use in existing buildings through retrofits and upgrades by 2050.

2.2 Criteria of a Successful Green Building Policy

In short, a successful green building policy should be FAIR:

- **F**lexible: Allow flexibility and creativity for developers, building design professionals, and builders.
- **A**ffordable: Maximize positive social impacts and minimize negative social impacts. Most importantly, but not exclusively, should allow for affordable buildings, to allow home-ownership and affordable rents.
- **I**mpactful: Result in buildings that measurably use less energy and reduce carbon emissions.
- **R**eachable: Not add unreasonably to work for City and Town building departments, developers, design professionals, and builders.

A successful green building policy should also:

- Be adaptable, to change in coming years, as carbon emission goals become more ambitious.
- Complement the existing New York State energy code.
- Deal with new buildings as well as renovations.
- Harmonize with other energy programs, such as NYSERDA, PACE financing, Federal tax credits, etc.
- Promote best practices in energy-efficient design and construction, to show the path forward as the energy code itself becomes more challenging, and to serve as a model for other municipalities.

2.3 Social Impacts

As we consider options for a green building policy, it is important to keep in mind possible social impacts. Some of these include:

- Human Health: Reduced air pollution is good for human health and the health of the planet, in the broadest sense, with benefits ranging from reduced lung disease to reduced impacts of climate change.

- Lower energy costs: Lower energy costs are a major benefit of a green building policy. And energy costs are not only those of building owners, but also of tenants in rented spaces. Energy costs are also often borne by building owners who did not develop a building, and so who were not responsible for its first cost.
- Construction and Living Costs: Construction costs have generally been viewed as being higher for green buildings, resulting in higher costs of buildings, housing, mortgages, and/or rent for tenants. Interestingly, and importantly, there are a number of energy improvements that also *reduce* the construction cost of buildings. These are addressed in a separate discussion in this report and are a major component of the proposed policy.
- Maintenance costs: Some green building improvements reduce maintenance costs. For example, more efficient lighting can mean fewer light fixtures, and so fewer lamps to replace. Also, LED lamps last longer than other types of lighting, and so replacement labor is reduced. Other improvements, such as solar photovoltaic systems, increase maintenance costs.
- Transportation Equity: Locating buildings in urban areas and close to public transportation reduces both the carbon emissions from, and the costs of transportation.
- Resilience: In general, green buildings are generally more resilient, in other words they will stand up better to storms, power outages, and other unusual scenarios. Most importantly, energy-efficient buildings will stay warmer for much longer (for example, for days instead of hours) during winter power outages, and will stay cooler for longer during summer power outages.
- Security: There are not many links between green building policy and security, but there are a few. For example, motion sensors for outdoor lighting save energy and are viewed as being good to ward away intruders.
- Safety: Insofar as green buildings use less fossil fuels, the risk for poisoning from carbon monoxide or explosion from natural gas or other fossil fuels is reduced. Several hundred people die in the U.S. each year from either carbon monoxide poisoning or gas explosions. Green buildings can reduce the risk of flame spread as they are tighter (less infiltration), and can reduce mold and moisture, which is better for human health and also preserves building components.
- Jobs: Green building creates new jobs in the design and construction industry.

Throughout the study, Ithaca-specific needs were at the forefront of considerations, including needs of a college town, climate-specific needs (cold climate), geographic constraints of Ithaca (bounded by the lake and three hills), and well-recognized needs for affordable housing and transportation.

2.3.1 Do green buildings cost more?

High-performance buildings are estimated to cost between 0 and 15% more than minimally code-compliant buildings. Generally, the higher the energy efficiency (in other words, the lower the energy use), the higher the cost. Examples, drawn from local projects, are shown in Figure 14.

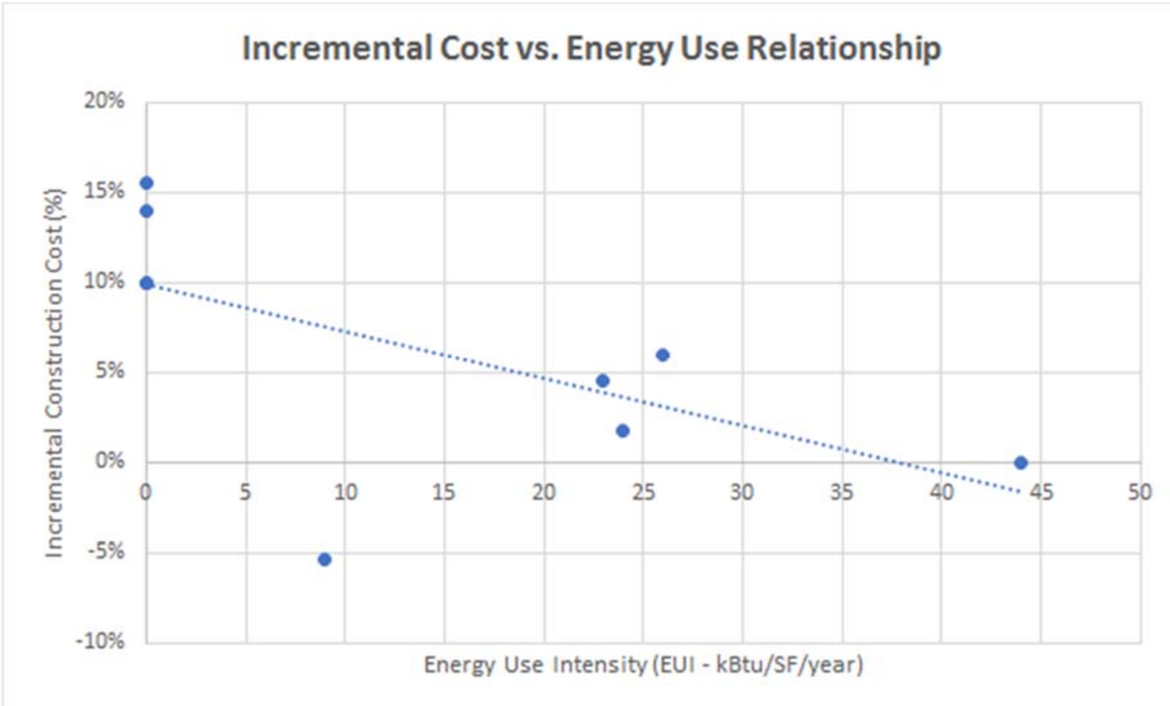


Figure 3. Relationship between energy use and incremental construction cost.

Buildings meeting high-efficiency passive house standards (approximately 24 EUI) are estimated to cost 2-6% more than conventional buildings.

Buildings that are zero-energy (0 EUI) are estimated to cost 10-15% more than conventional buildings. As a reality check, if a conventional building were supplied with 100% of its energy from commercially available solar energy, without any other building improvements the added cost would be 14%, using prices for currently-available solar photovoltaic systems.

Added costs for energy-efficient construction continue to drop, for two reasons:

a. The above estimates do not account for energy improvements that not only reduce energy use but also reduce construction cost. See the separate discussion of affordable energy improvements. If affordable energy improvements are chosen, their savings in construction cost can be applied to the added cost of improvements that do add cost to a building, but the overall added cost will be less than 10-15% for a zero-energy building. The potential for affordable high-performance design and construction are shown with two points on the above graph. Ecovillage TREE's 4-story apartment building, with 15 apartments, delivered extremely low-energy performance (EUI = 9, viewed as close to zero-energy) at a construction cost 5% LESS than a typical equivalent building. And a single-family home on Perry City road is operating at zero-energy performance despite costing only 10% more to build than a comparable home.

b. The costs of individual components of high-performance buildings are dropping as demand increases. Examples of these are shown in Figure 15. Solar photovoltaic system costs have dropped by over 75% over the past seven years. Air source heat pump costs have dropped by over 60% over the past seven years, and it is strongly believed that costs will continue to drop as demand increases. LED lamp costs have dropped by over 60% in the last four years alone.

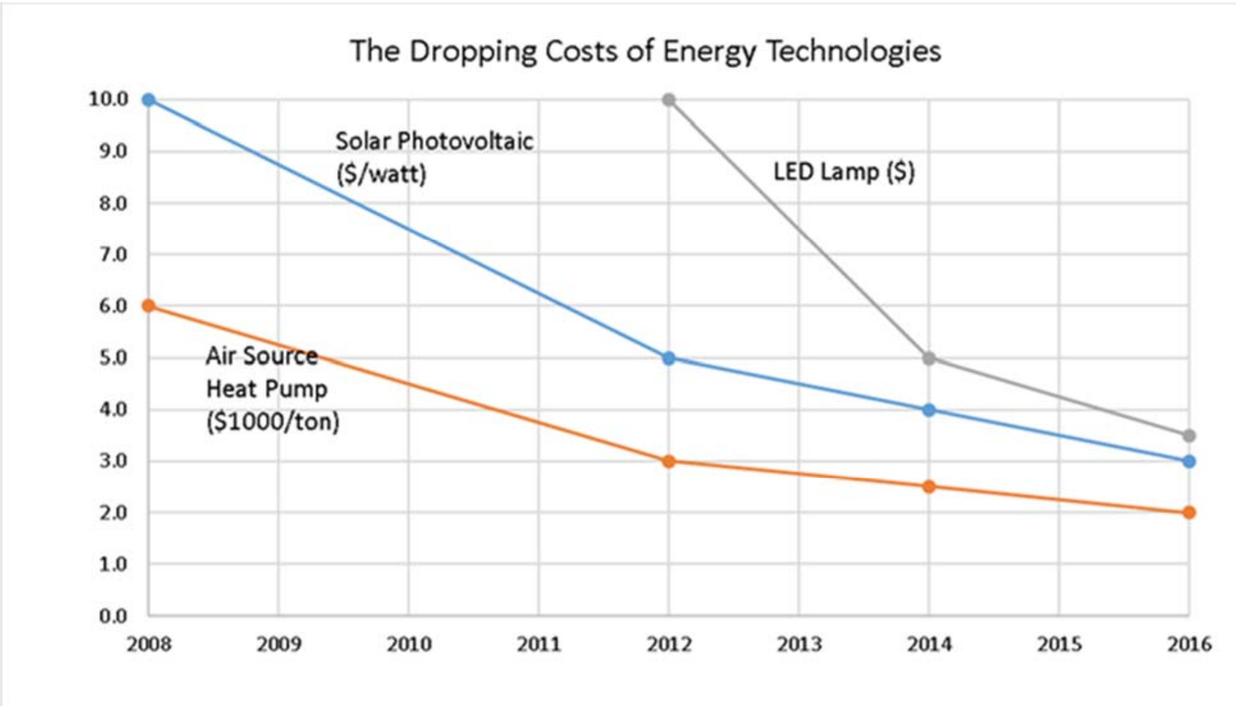


Figure 4. The dropping costs of energy technologies. (Footnote: The future impact of recently imposed tariffs on imported solar panels is as yet unknown.)

With net-zero buildings being built for less than 15% over the cost of than conventional buildings, and with the costs of energy-efficiency and renewable energy still dropping steadily, we predict that net-zero buildings will cost less than 5% more than conventional buildings, as the market for net-zero buildings grows, and could even be built at no additional cost, if attention is directed to affordability through improvements that both reduce energy use and reduce construction cost.

Another lens through which costs can be viewed is as life cycle costs, accounting not only for the "first" cost, or capital cost, but accounting also for operating costs, including energy and maintenance. Viewed through this lens, the life cycle cost of energy-efficient buildings is typically shown to be lower than the life cycle cost of conventional buildings. This lens is convincing to some early adopters, but is typically not convincing to most developers. Since the operating costs of buildings typically do not fall on developers, but rather on tenants and on future building owners (either directly or indirectly), the lower life cycle cost of energy-efficient buildings can be viewed as a consumer protection issue, in addition to being an environmental issue. (https://www.wbdg.org/resources/life-cycle-cost-analysis-lcca)

2.4 Certifications

The built environment has extensive direct and indirect impacts on our environment. Whether during demolition, construction or operation, either in the residential and commercial sector, all building types use significant natural resources, require embodied energy (energy used in making construction materials), create waste, and, most significantly, use energy during their lifetime. However, one way to urge movement toward a more sustainable building design practice is through green building certifications. These certifications are a set of independent third-party guidelines and criteria against which the design, construction, and/or performance of a building are evaluated.

Green building certifications offer several benefits:

1. The criteria and threshold requirements end up guiding local energy codes in the long run or even being integrated (e.g. HERS into the NYS IECC for homes).
2. They serve as high-performance building best practice guidelines.
3. They allow people the opportunity to do better-than-code design and construction, and so obtain a certificate to be proud of, be seen as a model and be used as inspiration.
4. Certifications can be used as mandatory requirements, and have been by such entities as universities or municipalities. For example, the City of Evanston, Illinois, requires that city-owned/city-financed commercial or residential buildings over a certain square footage be LEED-Silver certified.
5. Ensure that project goals are delivered. It is possible for a high-performance building that is not a certified project to get off track and not meet goals, and so certifications provides checkpoints, with third party verification.
6. Environmental stewardship through reduced carbon emissions, and reduced impacts on the environment through the extraction, development, and transportation of fossil fuels.
7. For positive community relations, to show that a developer is a good neighbor and cares about their building.
8. It is common that most of the standards are created through a consensus process and evolve through a three-year development cycle, so they are well-vetted, and periodically update.

While there are plenty of advantages, there are several concerns about green building certifications. Chiefly, the two common criticisms not to pursue a certification (such as LEED) are the perception of increased construction cost and the documentation path is long and arduous. It has also been reported that some owners and developers argue that certifications do not deliver on the results due to the lack of post-occupancy reporting and bridging the gap between design and performance. In some cases, it has even been suggested that plaques should not be issued until a building can prove actual energy usage. The Living Building Challenge certification has taken this step and grants certification after one full year of data has been submitted. There also seems to be a trend of clients wanting "certifiable" projects but not actually wanting to commit to a certification. A lot of the same reasons mentioned above apply in the motivation for not pursuing a certification and cost is always a huge contributing factor. It seems the perception of cost could be misplaced, however. For instance, much of the incremental cost is doing the documentation, energy modeling, etc. which would be necessary to verify performance goals are met regardless of pursuing a certification or not. Meeting and project coordination are also time and money spent, but a necessary requirement for any high-performance building. A certification can keep the project team accountable and on track to help achieve their ultimate performance goals. It could also be the natural tendency of a team to jump into a program checklist with a narrow "checklist mentality," and so providing a shortsighted interpretation of requirements and goals. Instead, success can be more deeply achieved if a project team approaches certification from a holistic standpoint, keeping broader goals in mind, and even by defining who they are as an organization and what they want to stand for in their project.

Over the past 20 years, there has been a significant number of building certifications and programs that have been rolled out. Some have gained traction and others came and fizzled out. Several certification programs have been more successful, and in fact transformative in the built environment. We have examined many of these certification programs, both for residential and commercial buildings, including LEED, EPA Energy Star, DOE Zero Energy Ready Home, HERS, Passive House, and others.

In considering certifications, we also recognize the energy code as a type of certification. Developed by the International Codes Council, the International Energy Conservation Code is the basis for energy code requirements in New York State. The state typically adopts the IECC with minor state-specific modifications. The latest version was adopted in October 2016, and is based on the 2015 version of the IECC. The next IECC version is already due in 2018, and might well be adopted by New York State.
In parallel, NYSERDA recently developed a "stretch" energy code (2015), based on the IECC, but even more energy-efficient. Developed in code-ready language, the stretch code is intended to be ready for use by municipalities in New York State to take energy efficiency performance beyond the current code to further reduce the impact of buildings on the environment. The main objective is to produce a model code that is adoptable with minimal changes by local governments and that is one cycle ahead of the current New York State energy code. The final language was originally set to be issued in 2017, but has been delayed. We believe that the stretch energy code will be roughly 10% more energy-efficient than the current energy code. Work has already begun on the next stretch energy code, informally referred to as the 2018 Stretch Energy Code, targeting 20% lower energy use than the energy code. The stretch energy code has a set of mandatory requirements, separate core requirements, and a set of additional energy efficiency options from which one must be chosen. The core requirements are met through either "prescriptive" compliance (for example, additional insulation) or "performance" compliance (meeting specific performance goals on a whole-building basis).

In choosing possible certifications, a variety of criteria should be considered:

- Ease of compliance
- Ease of reviewing/approving compliance
- Cost
- Use of independent third party verifiers
- Impact on design and construction schedule

- Energy and water use reductions

The project team reviewed a wide number of certifications, compared them to the criteria listed, and chose certifications that best met the policy's goals.

2.5 Overall Approach

There are many options for green building policies. The diagram below somewhat arbitrarily arranges these on a continuum from "carrot" (positive incentives) to "stick" (code requirements, mandates, etc.). "Penetration" indicates the market penetration of various approaches, in other words, the success or adoption rate of the approaches

	Approach	Examples	Penetration
8 Carrot	Incentivize	Tax credits, rebates	12% penetration for Energy Star homes, 2% penetration for solar.
7	Recognize	Energy Star, LEED, Architecture 2030 / District 2030	2-3% for LEED.
6	Encourage	Bulk purchasing, Solarize, HeatSmart, model behavior by targeting net-zero for new city buildings	Solarize and HeatSmart have so far seen market penetration below 1%.
5	Finance	PACE, performance contracting, other	PACE no market penetration yet.
4	Support	Training (contractors, building operators, building code officials, others), Cooperative Extension navigators	
3	Advocate	Web sites, Green Building Tour, discourage fossil fuels	
2	Pressure	Require energy score to be shown on listings, benchmarking	
1 Stick	Require	Code requirements, ordinances	U.S. DOE estimates 80-90% compliance

Figure 5. Diagram of policy approaches

Experience with other government and utility energy programs has generally found that a single approach to reducing energy use or carbon emissions is not as effective as a balanced and comprehensive multifaceted approach. For example, code requirements can be ineffective unless combined with training for design professionals, contractors, and code officials. Otherwise, new code requirements are not complied with, even if they are law.

Market penetration is important to evaluate and predict for any policies under consideration. It is important to recognize that experience with high-performance buildings, so far, has primarily been on a demonstration basis, targeting "early adopters". We see that LEED, widely regarded to have been a huge success, has nonetheless only seen market penetration in the 2-3% range, for new buildings. By using incentives such as rebates, states have achieved almost 12% average market penetration with the

Energy Star program for new homes. Penetration for the Energy Star program for new homes has been higher in a small number of states, as high as 42% in Maryland and 60% in Arizona, but the highest in our northeast climate has only been 12%, in Pennsylvania.

The urgency to respond to the effects of climate change is calling for us to move from demonstrations and early adoption to widespread implementation. The only approach that can guarantee broad market penetration is through code requirements. Incentives can be used to supplement mandated code requirements, to accelerate the process and to ease the cost burden.

We propose a policy that combines many of the approaches listed above including a strong mandate.

2.6 Timing of Interventions / Processes

Another aspect of policy interventions and processes is their timing. For new buildings, options may be visualized as follows. The interventions shown are for example only, and do not represent final recommendations for policies. What is important is that early interventions have the greatest chance of impacting projects.

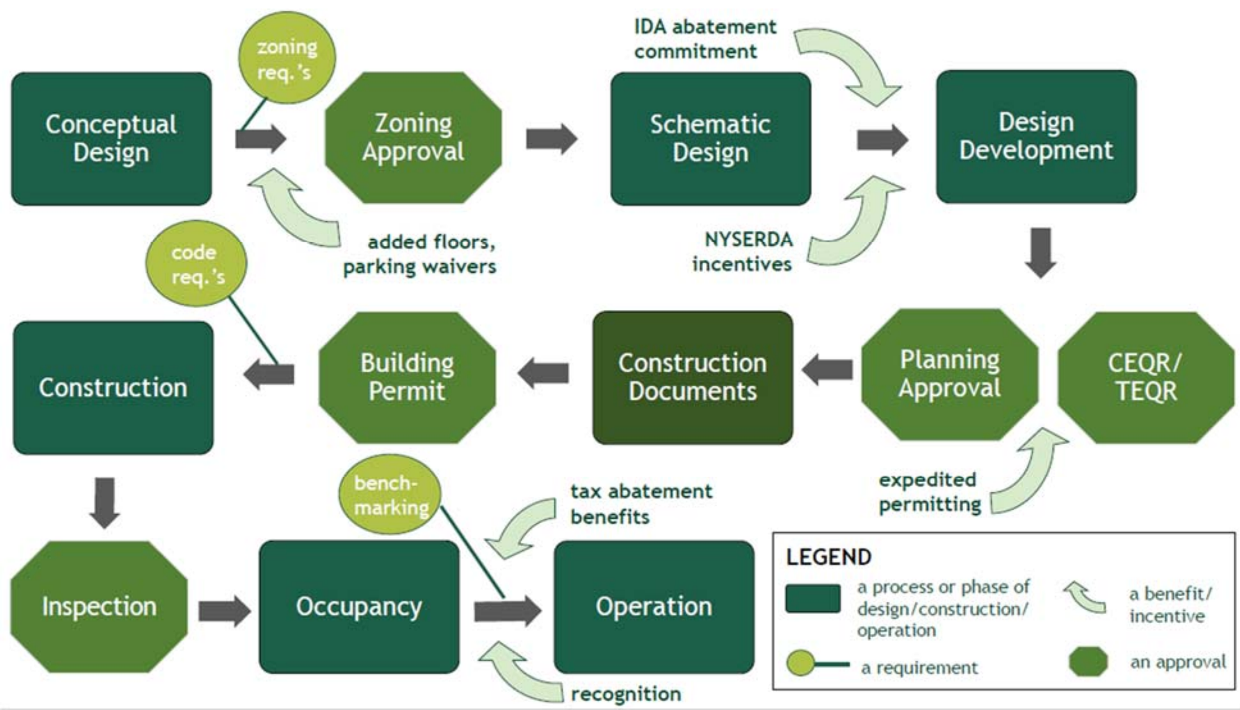


Figure 6. Timing of Interventions

2.7 Fossil Fuels

Should fossil fuels be discouraged as heating fuels as part of a city/town policy?

A natural question in considering policies to reduce and eventually eliminate carbon emissions in the City and Town is whether to discourage the use of fossil fuels as heating fuels for space and water heating. Fossil fuels used for space and water heating make up a large fraction of the city and town's carbon emissions. Fossil fuels are also higher in carbon emissions than other forms of space and water heating, such as heat pumps, and this difference will only increase as the electric grid is increasingly composed of more renewably-generated electricity.

We examine the pros and cons of discouraging fossil fuels for space and water heating:

2.7.1 Pros of Discouraging Fossil Fuels

- Reduce carbon emissions
- Reduce risk of stranded assets: New fossil fuel infrastructure may well only end up lasting a few decades as a transition to electricity is strongly anticipated.
- Consumer protection: As the cost of heat pumps has come down and is now roughly at parity with fossil fuel systems, there is no longer an installed-cost (construction cost) benefit to fossil fuel heating systems. For some fossil fuels, such as fuel oil and propane, consumers suffer significantly increased energy costs, at no benefit in lower construction cost.
- Safety - reduced risk of carbon monoxide poisoning and explosions from gas leaks
- Support NYSEG's new pilot project, which has the goal of providing adequate natural gas service to the region without building a new gas pipeline. A big part of this effort is to reduce gas use in current and future buildings. NYSEG and the New York State Department of Public Service have cautioned that if too much gas is drawn from the system to feed downtown Ithaca, then the non-pipe alternative approach to meeting Lansing's gas needs could fail, and a new pipeline will be needed. We are all connected and what the City and Town do has impacts elsewhere.

2.7.2 Cons of Discouraging Fossil Fuels

- If natural gas prices drop or if electricity prices rise, we might risk preventing the lowest-cost heating fuel.

2.7.3 Basis for Discouraging Fossil Fuels

Historically, consumer protection has been a widely justified basis for banning or limiting certain heating systems. The energy code, for example, significantly limits the use of electric resistance heat, primarily because it is so expensive for consumers.

There is a strong emerging consensus among energy policy-makers at the national, state, and city (such as New York City) levels that to meet greenhouse gas reduction goals, we will need to transition to high-efficiency electric space and water heating systems (as opposed to natural gas or other fossil fuels). As a result, New York State has new incentives for both ground source heat pumps and air source heat pumps. This essentially discourages the use of fossil fuels for space heating.

Architecture 2030 has set as a goal the elimination of fossil fuels in new buildings by 2030.

2.7.4 Options for Discouraging Fossil Fuels

Options for discouraging fossil fuels include:

- Providing incentives for non-fossil options, such as heat pumps.
- Using a rating system that accounts for carbon emissions, that gives points for non-fossil alternatives such as heat pumps. Therefore, if gas is chosen to be used, a building would need to be measurably more energy-efficient in other ways.

Recommendation: We are discouraging fossil fuels through a point system, for which additional points are obtained if fossil fuels are not used.

2.8 Benchmarking

Should a benchmarking ordinance be a part of a green building policy?

As the old adage goes, "if you can't measure it, you can't manage it." Benchmarking is the collecting, reporting, and sharing of measured energy usage in buildings. This data is typically reported annually through the free online tool EPA Energy Star Portfolio Manager, and allows you to compare energy usage against other buildings. The purpose of benchmarking and other transparency policies is to bring awareness of building energy consumption and performance and identify opportunities to help inform building owners/operators and tenants how to make their buildings more efficient.

New York City adopted Local Law 84 (NYC Benchmarking Law) in 2010, the first energy benchmarking requirement of its kind. Many other States and municipalities have since adopted a benchmarking and transparency policies as a way to quantify and evaluate building energy usage their building stock.

The advantages of a benchmarking ordinance is that it is good for seeing where buildings are, for establishing best practices and "benchmarks", and for encouraging (some would say "shaming") building owners to design and operate more efficient buildings. Another advantage is to provide better data to enable better policy around reducing building energy use.

Disadvantages of considering benchmarking as a green building policy include that it is really more of an "existing building" policy, rather than a policy for new buildings, which is the focus of this study. In other words, benchmarking is not something that is captured on design drawings and submitted to the building department for review, in order to get a building permit. Also, a benchmarking program is fairly time-consuming to define and implement. As implemented in other cities, such as New York, benchmarking is only applied to larger commercial buildings. So benchmarking might not be able to be cost-effectively implemented for all buildings.

Recommendation: We are not recommending a benchmarking requirement in the green building policy, because it applies to existing buildings more than to new buildings. We strongly recommend that a benchmarking policy be examined separately.

2.9 Ithaca Neighborhood Housing Services (INHS) - New Buildings: Local examples of what is possible and is already being done.

Ithaca Neighborhood Housing Services (INHS) maintains a unique database of energy performance for their portfolio of buildings. Because INHS builds locally, is committed to high-performance buildings, and is committed to affordability and other positive social impacts, this dataset can be a helpful reference for the green building policy effort.

INHS is a not-for-profit, specializing in affordable housing. INHS recently expanded its service area from the City of Ithaca to all of Tompkins County. Their buildings include a variety of low-rise wood-frame multi-family buildings, as well as medium-rise masonry buildings such as Breckenridge Place.

A sample of new buildings from the last 10 years found an average Energy Use Index (EUI) of 44. This is highly energy-efficient, approximately equal to the current energy code, even though the buildings were all designed and built before the new code. EUI's range from 33 to 65. All of the buildings in the sample were designed and built to high-performance standards such as Energy Star or LEED, except one. Interestingly, the one building that was not designed and built to a high-performance standard is the one that has the highest EUI (65), and the EUI for which is measurably higher than all the others: The second-highest EUI is 49.

For reference, the current average local multifamily building stock has an EUI of 78, and the average new multifamily building likely, designed to the fairly efficient energy code of 2016, has an EUI of approximately 44. The Passive House standard is approximately 23, and the current Architecture 2030 target (through 2020) is approximately 24.

INHS reports that their strategies for green building design and construction include: Air sealing, added insulation, high efficiency heating (better than code), high efficiency appliances (ENERGY STAR), and high efficiency lighting (LED, etc.).

Takeaways from this analysis include:

1. High-performance design and construction is feasible locally, and indeed is already being done.

2. INHS's data set confirms that high-performance certifications such as Energy Star and LEED appear to work. And a building by the same reputable developer that was not certified did not deliver the same level of energy efficiency. The best practices and quality control that accompany certifications do appear to deliver energy efficiency.

2.10 Affordability-Driven Energy Efficiency Approach

There is an important but perhaps not widely-recognized group of energy improvements to buildings that interestingly (and perhaps counter-intuitively) both reduces construction cost, and reduces energy use. There is another group of improvements that is generally cost-neutral, while, again, reducing energy use. Examples of cost-reducing and cost-neutral improvements include:

- Building orientation (optimize for solar gain)
- Reducing floor area
- Reducing surface area (simple shape)
- Using ductless air source heat pumps, which appear to be close to parity for construction cost with conventional systems for many types of buildings, and for which prices continue to drop
- Using fewer light fixtures due to reduced lighting loads, resulting from optimized design
- Combining multiple uses or tenants in one building rather than in several smaller buildings
- Reducing window size and quantity (reduce "window-to-wall" ratio). This does not mean eliminating windows, but rather avoiding over-glazing, while maintaining views and daylighting. See discussion below.

These affordable energy improvements may not be widely recognized because they are not incentivized by government and utility energy programs, and so are not widely promoted. In fact, it is not possible to incentivize them. How can one provide a tax credit or rebate for something that costs less to install?

A small number of these affordable energy improvements have started to find their way into codes and standards. For example, the 2015 International Energy Conservation Code, which serves as the basis for NY State's 2016 energy code, limits the window-to-wall ratio of commercial buildings to 30% (with some exceptions allowed). LEED version 4 provides extra credits for homes that are smaller than a reference (typical) size, which varies by the number of bedrooms, and conversely penalizes homes that are bigger. This requirement also appears in other residential high-performance standards (Energy Star, DOE Zero-Ready Homes, etc.).

We increasingly see examples of these affordable improvements in high-performance buildings. For example, the Ecovillage Tree common building, a 20,000 SF four-story with 15 apartments and common areas (common area kitchen, laundry, community area, etc.) was built for a remarkably affordable $124/SF (including foundation, structural, interior finishes, siding, mechanical, electrical including the service/distribution/lighting, plumbing, stairs, elevator, insulation and soundproofing, the common kitchen, doors and windows, sprinkler system, and permits). (See References: Green Energy Incentives, p. 18.) The building adopted a number of these cost-reducing improvements, such as:

- Reduced surface area (simple shape)
- Smaller apartment size. Studio apartments in TREE are 450 SF, compared to the national average new studio size of 512 SF in 2015; one-bedroom apartments in TREE are 690 SF, compared to the national average new one-bedroom apartment size of 751 SF.
- Low window-to-wall ratio

(https://www.rentcafe.com/blog/rental-market/us-average-apartment-size-trends-downward/)

Benefits of affordability-driven energy improvements include:

- Lower energy use
- Lower construction cost
- Complements the energy code and high-performance standards, such as LEED. For example, as the energy code becomes more stringent over time, the affordability-driven improvements deliver additional energy savings.
- Promotes best practices
- Savings persist well over time
- Adapt to energy code changes well over time
- Prevent pushback from those who are concerned that reducing energy use drives building costs up.
- Innovative – we are not aware of any jurisdiction (federal, state, local) that has tried anything in this area, other than the two examples mentioned earlier (commercial energy code limit of window-to-wall ratio, and LEED's credits for avoiding large homes).

A description of improvements that deliver more significant energy savings follows.

2.10.1 Reduce building size

A smaller building uses both less energy and costs less. The impact of smaller buildings on energy use is almost linear, due to energy uses that scale with size: heating, cooling, lighting, etc.: A 10% smaller building is expected to use slightly less than 10% less energy, as some energy uses remain constant regardless of building size.

Are smaller buildings acceptable? This is obviously an owner-specific question. For example, the size of the average new American home ballooned from 1,660 SF in 1973 to over 2,600 SF in 2016, before reportedly beginning to become smaller again. Homes overseas are significantly smaller: 1,200 SF in the Netherlands, 1,000 SF in Japan, and 800 SF in the U.K. LEED and other high-performance residential building standards recognize the importance of building size, and provides credits for smaller homes.

Promoting smaller buildings is only possible for those building types that have a metric for size: number of bedrooms for homes and apartments, hotel room size, etc. The reference (typical) building size for residential buildings is shown in Appendix B. The reference hotel room size is 330 square feet (https://www.orourkehospitality.com/average-hotel-room-size-is-shrinking/).

2.10.2 Placing heating/cooling systems within the heated space

Many heating/cooling systems are placed outside the heated space (on roofs, in attics, in unheated basements, in crawl spaces, etc.), and as a result lose significant energy. Even when an unheated basement is located inside the thermal envelope, losses of 10% or more are typical.

2.10.3 Reducing hot water energy use

High-efficiency water fixtures typically do not cost more than regular-efficiency fixtures. EPA's Water Sense program requires water flow rates that are 20% less than required by code for shower heads, and 30% less than required by code for bathroom faucets.

Hot water energy savings could be further delivered through requirements for Energy Star ratings for major water-using appliances, such as dishwashers and clothes washers, at modest cost increase.

In a simplified analysis of a 2000 square foot house, reducing hot water energy use by 20% reduces the overall building energy use by 8%. This would be more applicable for buildings with significant shower and faucet hot water use (homes, apartments, hotels), and less applicable for buildings with low hot water use such as offices, and so would likely only be offered as an option to applicable buildings (residential and hotels).

2.10.4 Efficient building shape

Buildings with high exterior surface area require more energy to heat and cool, because they have more exterior surface area through which heat is transferred. Such buildings also cost more to build. Reducing a building's ratio of surface area to floor area by 20% is estimated to reduce overall building energy use by 10%. This can be done by avoiding complex shapes, avoiding overly-tall ceilings, and other approaches.

2.10.5 Avoiding overlighting

Most commercial buildings are overlit, far exceeding recommendations of the Illuminating Engineering Society of North America (IESNA). By sizing lighting correctly, on a space-by-space basis, buildings can be right-lit instead of overlit. Right-lighting reduces construction cost by avoiding the installation of more light fixtures than necessary. Right-lighting also reduces maintenance costs over time. Right-lighting also reduces energy costs for air conditioning, and can reduce the construction cost for air conditioning systems as well, by allowing smaller systems.

Reducing overlighting by 25% is projected to reduce overall energy use in commercial buildings by 8%. Savings in residential buildings are less because lighting use in homes is far less than in commercial buildings.

To be clear, this does not mean reducing lighting below levels recommended nationally by the Illuminating Engineering Society (IES). Rather, it means avoiding overlighting, in full compliance with IES-recommended lighting levels.

2.10.6 Modest window-to-wall ratio while retaining views and natural light

Windows cost more per unit area than the wall they displace, due to a combination of the window and the framing required around the window. Windows also cause high energy losses due to heat transfer, despite these losses being very modestly offset by gains from daylighting, gains which are themselves being lost due to the development of energy efficient lighting such as LED as well as efficient lighting controls. There are also modest solar gains from south-facing windows, if not shaded, but these accrue only if the south-facing windows are optimally sized.

In a small sample survey of new commercial buildings in Tompkins County, high-performance buildings (TREE common house, HOLT Architects new office) were all found to have a window-to-wall ratio less than 20%, and standard code-compliant buildings (a hotel, an apartment building, and an office building) were all found to have a window-to-wall ratio over 30%. In a small sample of residential buildings, findings were the same.

To show the power of the window-to-wall ratio, in a simplified analysis of a 2000 square foot house, reducing the window-to-wall ratio from 30% to 20% reduces the overall building energy use by a significant 8%.

As mentioned, the new energy code limits commercial buildings to 30% window to wall ratio, with exceptions that allow it to go up to 40%.

A frequent concern voiced about lowering window-to-wall ratio is “Will the building be dark? Will it lack in views or daylighting? Will it be unattractive?”

Green building standards are clear that, for views, we do not need a window-to-wall ratio of 30% or more, that 20% is sufficient, and that we only need views in regularly occupied spaces. The green building standard BREEAM (Building Research Establishment Environmental Assessment Method) defines views as being able to see the sky from desk height, and further defines a "view out" as being a minimum window-to-wall ratio of 20%. And a case can also be made that views do not need to be provided for all types of spaces. Views might be considered optional for spaces such as mechanical rooms, laundry rooms, other utility-type spaces, corridors, stairwells, bathrooms, and more. Similarly, the green building wellness certification system WELL (International Well Building Institute) only requires a minimum 20% window-to-wall ratio, and only in regularly occupied spaces (which would mean an overall minimum window-to-wall ratio less than 20%), in addition to proximity of workstations to windows.

Large windows are also not needed for daylighting. Gains from daylighting are offset by window thermal losses, and there is an optimum window size and shape for maximum energy efficiency. With the introduction of extremely high-efficiency lighting such as LED, and artificial lighting increasingly controlled (dimmed or turned off), the optimum window-to-wall ratio for energy efficiency has plummeted, and is likely far below 20% for most spaces.

Buildings with modest window-to-wall ratios can still have attractive facades. Despite the TREE common house having a modest window-to-wall ratio (approximately 16%), the building has a dramatic and attractive south-facing façade with significant windows:

Figure 7. The Sustainable Living Center at EcoVillage South wall

The building achieved a low window-to-wall ratio by locating fewer windows in rooms that do not need windows, and limiting glazing on the north side, east, and west side of the building. Here is a photo of the building's west elevation:

Figure 8. The Sustainable Living Center at EcoVillage West wall

Many attractive buildings have window-to-wall ratios even lower than 15%. This is common in buildings such as the beautiful brownstones in the cities of the Northeast. Covering our buildings with glazing is relatively recent phenomenon. Consider a brownstone in Brooklyn:

Figure 9. Brooklyn brownstone

Its front facade window-to-wall ratio is 29% (shown above), its two sides have no windows (due to common walls), its rear facade has a window-to-wall ratio of 22%, and its overall window-to-wall ratio is 14%.

2.11 Renewables

Renewable energy installed on or near buildings is referred to as on-site or site-located (as distinct from remote-located) and includes, most commonly, solar photovoltaic electricity. Less common is solar thermal energy (mostly solar hot water, but can also include solar-heated hot air). Another option is wind-generated electricity.

Renewable energy has been growing rapidly, and is expected to continue to grow.

Why not simply allow or require renewable energy to provide all the energy needed by a building, without requiring the building to be energy-efficient, in other words not requiring good insulation, windows, heating, etc.?   There are several reasons to not just allow renewable energy to meet all a building's energy needs, without better buildings:

- Renewable energy systems can fail, making a building revert to relying on non-renewable backup energy.
- Renewable energy systems take energy, themselves, to be fabricated. This is referred to as embodied energy, and offsets some of the savings of the renewable energy system.

- Renewable energy systems cost money to maintain, and this cost offsets some of the energy cost savings.

In order to address these limitations of renewable energy systems, it is not unusual to encourage a balance of efficient building design and renewable energy. The voluntary Architecture 2030 system, for example, limits renewable energy to 20% of its goal to eliminate fossil fuel use by 2030. The 20% is relative to a baseline of energy use in the early 2000's, for each of a variety of building types, and for different geographic locations.

Requiring the use of on-site renewable energy is problematic because not all buildings are suited to on-site renewable energy. Many buildings are shaded by adjacent buildings or other things.

As a result, we recommend:

1. Encourage renewable energy systems, but limit the credit given for them, to prevent a building from over-relying on renewable energy. This approach is consistent with most widely-accepted green building certification schemes, such as Architecture 2030 and LEED.
2. Allow either on-site renewable energy or remote renewable energy.

Biomass

Biomass used for space heating (direct thermal energy) is considered to be renewable. For space heating, the most common forms of biomass are cord wood, pellets, and chips, all of which rely on waste wood from other logging operations. Having a market for the low-grade timber prevents high-grade logging (taking only the very best trees and leaving the rest, which makes for very unhealthy forests). Our forests in NYS are growing at a rate of more than 2.5 times the rate of harvest. Also, in the case of pellets, they are made up of roughly 85% waste wood from other lumber operations (sawdust and offcuts), which are waste from an existing industry (and pose a fire hazard if left on-site). As referenced in the Tompkins County Energy Road Map, our forests throughout the Northeast and New York State are also, for the most part, fully mature, which means that they are not growing much, and therefore not sequestering nearly as much carbon as managed forests could, with a mix of older and younger forest stands. Woody biomass contributes to improved forest health, carbon sequestration rates, and forest biodiversity; generally keeps energy dollars local; creates a market for low-quality trees; and if offsetting fossil fuels, clearly reduces carbon emissions. One area of legitimate concern is air quality. Older and not-well-operated wood stoves and outdoor wood boilers can produce pollution. Therefore, requirements for biomass systems should include provisions for air quality. Biomass does require energy for harvesting and transportation, but this is a small fraction of its useful energy, even for wood pellets. NYSERDA considers biomass for heating applications to be carbon neutral.

2.12 Incentives

Financial incentives are a common way to promote energy efficiency. For example, the federal government gives a 30% investment tax credit for solar energy, and furthermore allows accelerated depreciation for commercial capital investments in solar energy systems. NYSERDA gives rebates for solar energy systems. New York State furthermore gives its own 25% state tax credit for residential solar energy systems, with a cap of $5,000.

When considering financial incentives, it is important to target the incentive in such a way as to motivate people to invest in energy savings (incentives need to be sufficient to change behavior) but not so high as to waste taxpayer money. We have seen government and utility programs in which energy efficiency is given away, and yet some people still do not participate. We have also seen programs in which incentives were so small that participation went to zero.

The following conceptual graph illustrates these issues.

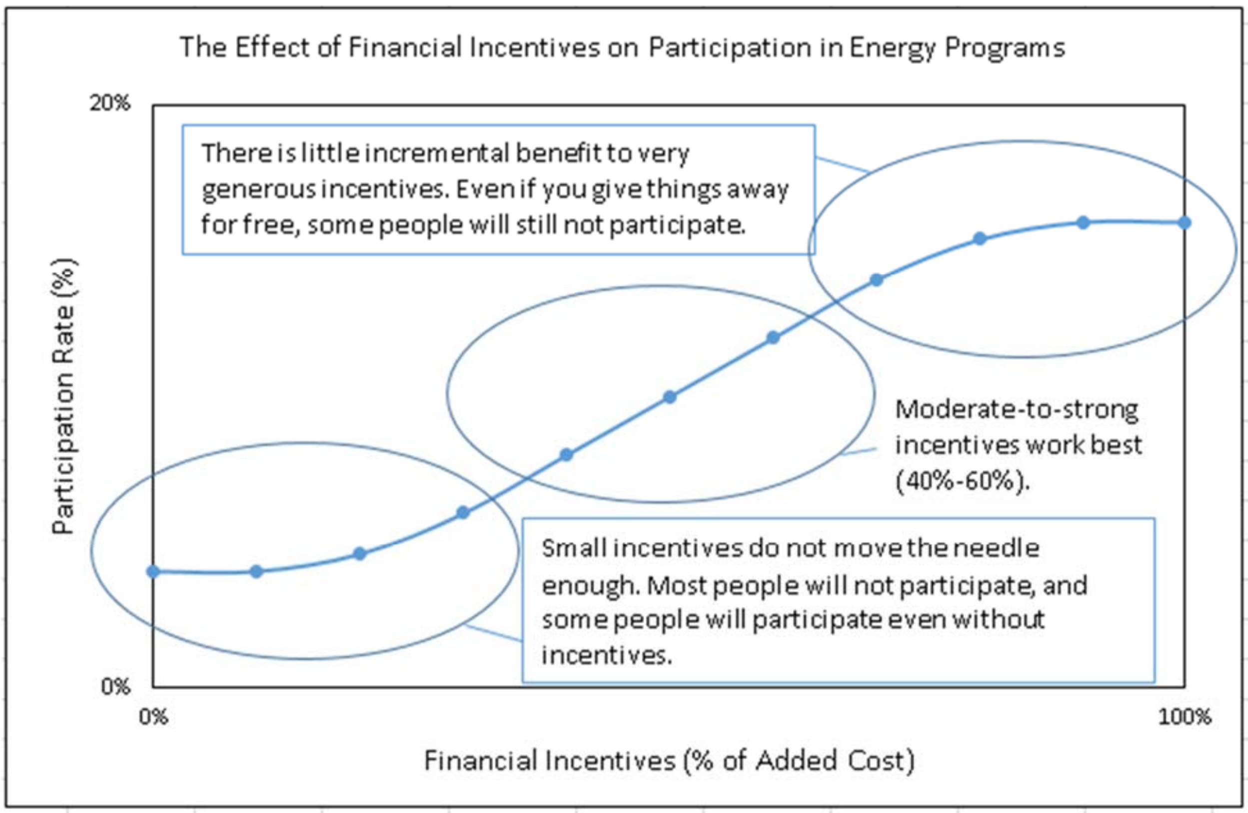


Figure 10. The Effect of Financial Incentives on Participation in Energy Programs

As mentioned earlier, even successful incentive programs typically do not achieve deep market penetration rates. For example, the combined incentives for solar photovoltaic systems have exceeded 50% of the installation cost, for over 10 years, and these have been sufficiently attractive to launch the industry in a substantial way (almost 80,000 completed projects in New York State by 2017), but cumulative market penetration is still less than 5% (https://www.nyserda.ny.gov/All-Programs/Programs/NY-Sun/Data-and-Trends).

A specific technology can be supported, such as high efficiency lighting, high efficiency heating, or renewable energy systems. Or incentives can be on a whole-building basis, for example if a building achieves a certain LEED score or HERS score. Finally, incentives could be awarded if buildings achieve a specific number of points under a custom scoring system.

It is also important to consider other incentive programs, where possible, such as those offered by NYSERDA, New York State government (other than NYSERDA), the federal government, local utilities such as NYSEG, and others.

2.12.1 Reduction or fee waiver of Building Permit and/or Site Plan Review fees

Like many municipalities in New York State, both the City and Town of Ithaca, respectively, charge fees for building permits and Site Plan Review (for projects subject to Site Plan Review). These fees are typically established by resolution of the City's Common Council or the Town's Board. The City of Ithaca currently charges $1.50 per $1,000 of construction cost for Site Plan Review as well as $7.00 per $1,000 of construction cost for a building permit. For example, a new seven-story, $11.5M commercial project (approximately 75,000 square feet) adjacent to the Commons paid approximately $80,500 in Building Permit fees as well as another $12,250 in Site Plan Review fees in 2014.

2.12.2 Amend City Environmental Quality Review (CEQR) and Town Environmental Quality Review (TEQR) Thresholds

The Department of Environmental Conservation, charged with overseeing the State's Environmental Quality Review Act (SEQRA) is currently conducting a review of those regulations. Proposed in the new draft regulations (proposed 6 NYCRR §§ 617.5(c) (19)-(22)) is the reclassification of Infill Development (occurring on previously disturbed sites) as a Type II Action. The rationale is that development on sites that have been previously disturbed and that have existing infrastructure would categorically result in significantly less environmental impact than developing undisturbed sites.

One action the City and Town could take independently – but complementary to the proposed SEQRA amendments – would be to amend their respective local SEQRA thresholds – the City Environmental Quality Review (CEQR) and Town Environmental Quality Review (TEQR) – to classify smaller projects demonstrating energy and location efficiency as Type II Actions. For example, the City of Ithaca could amend Chapter 176: Environmental Quality Review (§ 176-4 (k) to reclassify 'Construction of 15 or more residential units' from a Type I Action to a Type II Action for projects that meet the following criteria: be located within the 'Walkable Neighborhoods – Green Building Policy Map'; commit to energy benchmarking; and earn at least a minimum number points on the checklist. Of course, if the project met other listed Type I Action thresholds, such as proximity to a Critical Environmental Area, the action would still be Type I.

2.13 Net-Zero Energy Buildings

Net-zero energy buildings use renewable energy to generate as much (or more) energy as they consume, on an annual-average basis.

There are already multiple net-zero energy buildings in and near Tompkins County. Several homes in the Ecovillage TREE neighborhood are net-zero. HOLT Architects new office was designed to net-zero, and in practice is reportedly operating close to net-zero. A new home on Perry City Road was designed to net-zero and appears to be operating at net-zero. Nearby, Lime Hollow has a new education center that was designed to net-zero and is operating at net-zero.

Net-zero buildings using on-site renewable energy depend on the ability to site the renewable energy system. This is not always possible. In most cases, the on-site renewable energy is solar energy, and many buildings do not have either unshaded roof area or unshaded site area for adequate solar energy. In these cases, off-site solar energy is now possible, through community solar or remote net-metering, although these programs and offerings are new relatively new.

It might be noted that adequately sized and sited renewable energy systems also do not guarantee net-zero operation. For example, if a renewable energy system fails, then a building might revert to buying energy, and so no longer makes as much energy as it uses. For this reason, efficient buildings are important. Architecture 2030, for example, limits the amount of renewable energy that can be used, on its path to carbon-neutral buildings.

Our main questions relating to net-zero were:

1. Should we have a goal for net-zero being required for buildings?
2. If so, by when?
3. And, if so, what types of renewable energy will be required/allowed?

A possible guide to answer these questions is the Architecture 2030 program, which targets the year 2030 for carbon-neutral buildings, by incrementally increasing energy efficiency and renewables every five years between the present and 2030. As the number of buildings that are already net-zero increases steadily, and as we see that this is no longer an unreasonable or unaffordable goal, 2030 is clearly realistic as a goal for net-zero.

Any net-zero goal must allow remote renewable energy, because not all buildings have access to renewable resources such as on-site solar or wind power.

It is inevitable that we will need to end up requiring net-zero energy buildings. As populations grow and communities develop, the only way to control carbon emissions in the long term is with net zero buildings. We take our lead from Architecture 2030, which has set a goal of net zero by 2030, and from the State of California, which is targeting 2020 for net-zero homes and 2030 for net-zero commercial buildings. The Tompkins County Energy Roadmap also strongly affirmed the need for net-zero energy new buildings.

What types of renewable energy should be required/allowed? The most common form of renewable energy is solar energy, either photovoltaic or solar thermal. Solar thermal must be located onsite (either roof-mounted or ground-mounted), but photovoltaic systems can be located either onsite or remotely, under provisions of New York State regulations covering remote photovoltaic systems. Wind (electric) systems are another type of renewable energy system that can be either onsite or remote. Biomass for space heating is also viewed as being renewable and close to carbon-neutral, even accounting for the energy required to harvest and transport biomass feedstock.

2.14 Pulling it All Together: Recommendations

We recommend that a local ordinance be passed requiring that all new buildings, including major renovations and new additions, comply with the green building policy. Two compliance paths are provided:

1. The **Easy Path** emphasizes energy improvements that also reduce construction cost, such as smaller building size. This is a point system. A building must meet 6 points.
2. The **Whole-Building Path** allows more flexibility in building design. Commercial buildings must obtain a minimum of 17 LEED Energy points, residential buildings must achieve a HERS score of 40 or less, or a minimum score of 80 Energy Efficient points using the National Green Building Standard. Alternatively, all buildings may comply by designing and constructing to the Passive House standard.

All new buildings shall use efficient water fixtures:

Fixture	**Requirement**	**Source**
Toilet (including tank or flush valve)	1.3 gpf	TABLE P2903.2 , 2017 UNIFORM CODE SUPPLEMENT (New York State)
Urinal	0.5 gpf	EPA Water Sense
Shower	2.0 gpm	EPA Water Sense
Bathroom Faucet	1.5 gpm	EPA Water Sense

Notes:

1. gpm: gallons per minute gpf: gallons per flush
2. Exception: Unless code requirements are more stringent, such as 0.5 GPM for faucets in public bathrooms.

Table 2. Water fixture requirements

(It should be noted that all of the above requirements were recently adopted in the 2017 code supplement. We have decided to keep the requirements, even though some are already mandatory, because awareness of the new code requirements appears to be very low.)

In addition to the requirements of this policy, all new buildings shall still comply with the New York State Energy Conservation Construction Code.

Where possible, roofs should be designed to be “solar-ready”: A. Maximize area available for solar collection systems. For pitched roofs, place roof-mounted components or structures (plumbing vents, exhaust fans, access hatches, etc.) on north-facing roof surfaces, to keep south-facing surfaces available for solar collection systems. Where this is not possible, or on flat roofs, cluster roof-mounted components and structures such as to allow the maximum possible contiguous area for solar collector systems. B. Design roof structures to support future solar collector systems. C. Orient one roof surface to the south, plus/minus 30 degrees, to maximize potential for solar energy.

2.14.1 Easy Path

A building must achieve a minimum of 6 points, from among the following. Each point represents a reduction of 6-10% in greenhouse gas (GHG) emissions, very roughly, when compared to NYS Energy Code and documented local building practices. The points were developed based on simplified energy models, assuming average building characteristics as the “baseline” against which savings are measured.

EPA factors are used for calculating greenhouse gas emissions based on energy usage. Six points is estimated to deliver 40-50% reductions in greenhouse gas emissions.

Points in the Easy Path that are labelled "Residential" apply to all buildings covered by the New York Residential Energy Code, AND ALSO residential buildings that are four stories and higher that are covered by the New York Commercial Energy Code. Points that are labelled "Commercial" apply to all buildings covered by the New York Commercial Energy Code EXCEPT residential buildings that are four stories and higher. Mixed-use buildings, where a portion of the building is residential and a portion of the building is commercial, should be evaluated based on the criteria for the use that covers a majority of the building's floor area. If more than 50% of the floor area is residential then the buildings should be scored using residential criteria, if more than 50% of the floor area is commercial then the building should be scored using commercial criteria.

2.14.1.1 Points for Efficient Electrification:

These points are intended to reward reductions in carbon emissions with the use of efficient electric technologies, which is expected to become increasingly lower in carbon emissions over time as the electric grid becomes more renewable. The cost of these technologies are rapidly dropping, and in many cases are already lower than fossil fuel technologies, or are expected to drop below the cost of fossil fuel technologies. In many cases, higher product costs are offset by lower installation costs (no gas pipe required, no venting required).

3 points (residential), or 2 points (commercial buildings) - use air source heat pumps for space heating. 4 points (residential) and 3 points (commercial) for ground source heat pumps. (Water loop boiler/tower heat pumps do not comply, as these heat pumps rely on fossil fuels. Also, packaged terminal heat pumps do not comply, because of their low energy efficiency.) Ventilation must also not be fossil-fuel heated. To allow flexibility for small rooms, electric resistance heat is allowed for up to 10% of the building's projected annual space heating load. Air source heat pumps shall comply with the NEEP Cold Climate requirements.

For more information on heat pumps, see the Reference section, at the end of this report.

1 point (residential) - heat pump water heaters. The heat pump water heaters shall initially be set on heat pump-only mode.

1 point (residential) - use both electric stoves and ventless heat pump clothes dryers (see Glossary). This point requires the use of heat pumps or biomass for space heating, and additionally requires no fossil fuels in the building.

2.14.1.2 Points for Affordability Improvements:

1 point - Building size more than 15% smaller than the reference size. See the table below for residential buildings. The reference size is 330 SF for hotel rooms. Or: 2 points - Building size more than 30% smaller than the reference size – see the table below for residential buildings, or more than 30% smaller than 330 SF for hotel rooms. (Building size points are not available for buildings other than residential or hotels.) For the purpose of this point, multifamily buildings are defined as buildings with two or more units in a single building. For hotels or multifamily buildings, the size is the average of all units or rooms; individual units or rooms may exceed the requirement.

Conditioned (heated) floor area of reference home, by number of bedrooms, in square feet.

	Studio	1	2	3	4	5	6	7	8 or more
Floor area (square feet) - Single Family	Not applicable	1,000	1,600	2,200	2,800	3,400	4,000	4,600	+ 600 ft² per additional bedroom
Floor area (square feet) - Multifamily Family	480	700	990	1160	1360	1560	1760	1960	Not applicable
For multifamily buildings, home size includes only *in-unit space.*									

Table 3. Residential reference sizes.

1 point - Heating systems in the heated space. Place heating/cooling systems inside actively heated and finished spaces. No heating systems, ductwork, or water piping shall be located in unheated or unfinished basements, in unheated attics, in crawl spaces, outdoors, on roofs, in exterior wall cavities, above the ceiling of the top floor of a building, or through-wall such as packaged terminal equipment or window-mounted systems. Outdoor units of split system heat pumps may be located outdoors and there are no limitations on the location of refrigerant piping. Examples of where equipment, ductwork, and water piping can be located: In heated spaces, in interior wall cavities, in mechanical rooms that are not in unheated/unfinished basements/attics/outdoors, in closets in finished spaces, above ceilings that are not on the top floor of buildings.

1 point - Efficient building shape. Exterior surface area divided by gross floor area is less than the maximum value provided in the table below. For the exterior surface area, include the above-grade exposed insulated surface, typically including above-grade walls, floor of vented attics (or roofline if insulated at the roof), floors above vented crawl spaces. Include windows and doors as part of walls,

include skylights as part of roofs. Include exposed floors, such as below a cantilever. Include walls between heated spaces and unheated spaces, such as between a house and an attached garage. The table was developed for a simple rectangular building shape for different ranges of building size (floor area), for an optimum number of stories, assuming a 9 foot floor-to-floor height, with an allowance to give flexibility for slightly more complex shapes or taller ceilings.

Gross Floor Area (SF)	Maximum (wall+roof)/floor area ratio	Gross Floor Area (SF)	Maximum (wall+roof)/floor area ratio	Gross Floor Area (SF)	Maximum (wall+roof)/floor area ratio
100-199	4.7	1500-1599	2.1	10000-14999	1.05
200-299	3.9	1600-1699	2.1	15000-19999	0.94
300-399	3.5	1700-1799	2.0	20000-29999	0.84
400-499	3.2	1800-1899	2.0	30000-39999	0.75
500-599	3.0	1900-1999	2.0	40000-49999	0.68
600-699	2.8	2000-2499	1.9	50000-59999	0.64
700-799	2.7	2500-2999	1.7	60000-69999	0.61
800-899	2.7	3000-3999	1.6	70000-79999	0.58
900-999	2.6	4000-4999	1.5	80000-89999	0.55
1000-1099	2.5	5000-5999	1.4	90000-99999	0.53
1100-1199	2.4	6000-6999	1.3	100,000-199,999	0.46
1200-1299	2.3	7000-7999	1.2	200,000-299,999	0.39
1300-1399	2.2	8000-8999	1.2	300,000-399,999	0.35
1400-1499	2.2	9000-9999	1.1	> 400,000	0.33

Table 4. Maximum wall plus roof to floor area ratio

1 point - Right-lighting. Commercial buildings only. Reduce overlighting (25% lower lighting power density than the energy code). Perform photometric lighting design on a space-by-space basis, using the space-by-space lighting power density method (not the whole-building method), designing to the mid-range of IESNA foot-candle targets, unless the building is for primary use by the elderly. Construction documents shall include a table of space-by-space lighting power density. Use LED lighting where possible. Use reflective surfaces where possible, with a preferred target reflectance of 90% for ceilings, 70% for walls, and 50% for floors. Require motion sensors for all exterior lighting, combined with photocells to ensure that lighting stays off during the day. Require motion sensors for interior lighting in the following spaces: offices, conference rooms, kitchenettes, corridors, stairwells, bathrooms, lobbies. Require short off-delay for occupancy sensors (1 minute or less), and commissioning of lighting controls. Provide for manual control to allow lights to be kept off. Both requirements of this section must be met (e.g. reduced overlighting AND lighting controls) in order to obtain the point.

1 point - Modest windows with views and natural light. Overall window-to-wall ratio less than 20%. Windows in individual regularly-occupied spaces are allowed to be more than 20%. For calculations,

include glazed portions of doors in the window area, but not opaque portions of doors. Include glazed portions of curtain walls, but not spandrel/opaque areas.

2.14.1.3 Renewable Energy:

3 points - non-biomass renewable energy capacity (4 points starting in 2025):

Residential buildings

a. 1 point for each 1.2 kwh/sf/year (electric systems, e.g. solar photovoltaic)
b. 1 point for each 4.0 kBtu/sf/year (thermal systems, e.g. solar domestic hot water)

Commercial buildings

a. 1 point for each 2.4 kwh/sf/year (electric systems, e.g. solar photovoltaic)
b. 1 point for each 8.0 kBtu/sf/year (thermal systems, e.g. solar domestic hot water)

Non-biomass renewable energy points are capped at 3 points maximum (4 points starting in 2025).

Off-site (remote) renewable energy generation is allowed. Documentation must be provided for contractual commitment to either ownership or long-term (20 years minimum) commitment.

3 points (Commercial) or 4 points (Residential) - biomass space heating systems. All eligible biomass equipment must comply with NYSERDA's Renewable Heat NY guidelines. To be eligible, a pellet stove must produce less than 2.0g/h particulate emissions and be on the EPA's list, available at https://www.epa.gov/compliance/list-epa-certified-wood-stoves. A list of eligible residential and small commercial pellet boilers (less than 300,000 Btu/h) is available through the link at https://www.nyserda.ny.gov/All-Programs/Programs/Renewable-Heat-NY/Small-Pellet-Boiler. They must have a thermal efficiency of at least 85%, particulate emissions of less than 0.080 lb/mmBtu, and carbon monoxide (CO) emissions less than 270 ppm at 7% O_2. Requirements for larger pellet boilers can be found at https://www.nyserda.ny.gov/All-Programs/Programs/Renewable-Heat-NY/Large-Commercial-Pellet-Boiler. Requirements for residential and commercial cord wood boilers can be found at https://www.nyserda.ny.gov/All-Programs/Programs/Renewable-Heat-NY/Advanced-Cordwood-Boiler.

For more information on biomass, see the Reference section, at the end of this report.

2.14.1.4 Other Points:

1 point for lots developed at more than 7 dwelling units per acre density (the threshold to support frequent transit service). Projects should be built at this density or greater to contribute to the existing

or future transit accessibility and walkability. Non-residential development can be converted to units by dividing the area of conditioned space, in square feet, by 1000.

1 point for being within 1/4 mile (walking distance) to at least 5 of the following destinations: schools, stores, cafes/restaurants/pubs, dentist/doctor's offices, libraries/community services, or within the development priority areas mapped in the walkable neighborhoods map. We recommend that the City and Town update the map on an annual basis. The draft map, included below, was developed based on a ¼ mile buffer from existing service hubs where a resident could accomplish multiple errands on foot, or where the Town of Ithaca has planned future mixed use neighborhoods. Adoption of the final map for implementation of this policy will require more complex review of locations including university campuses where different walkability metrics may apply.

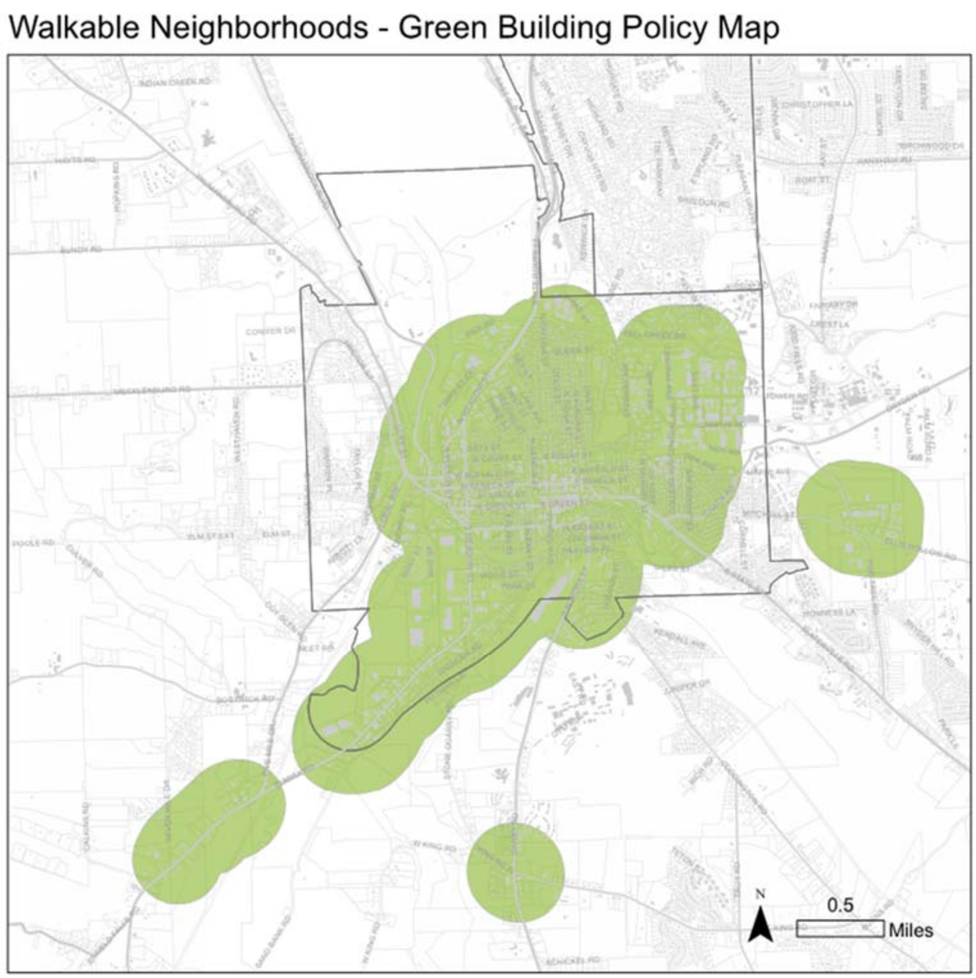


Figure 11. Walkability map

1 point - adaptive reuse. When a building is kept and re-purposed for a different use (for example, when an old school is adapted for use as apartments). A major renovation of a building and re-use for

the same purpose (e.g. old apartments are renovated) is not eligible for this point. Maintain at least 50% (based on surface area) of the existing building structure and envelope.

1 point - comply with the 2015 New York State Stretch energy code. (This will be increased to 2 points if/when the next version of the energy code is released, anticipated to be in 2019, when the stretch code targets 20% energy reduction.)

2 points - Custom Energy Improvement. Can only be applied to buildings that do not use fossil fuels. Reduce energy use by 1.2 kwh/SF/year per point (residential buildings) or 2.4 kwh/SF/year per point (commercial buildings). Cannot be provided by renewable energy savings. Savings must be shown through energy analysis performed by an experienced energy professional. For a baseline, use the NYS Energy Code, latest edition. If the baseline condition is not addressed by the NYS Energy Code, use baseline conditions as defined in ASHRAE Standard 90 Appendix G, or RESNET HERS. Savings must be calculated after applying all other proposed energy improvements to the proposed design. Simplified calculations (e.g. spreadsheet) are acceptable. Multiple improvements may be combined to achieve each point under this improvement. The proposed energy improvement shall be submitted in writing to and approved by the AHJ before proceeding with design.

2.14.2 Whole Building Path

In lieu of accruing points, the developer can choose to comply with a recognized whole-building high-performance certification, such as:

1. For commercial buildings, 17 energy points (Optimize Energy Performance) based on LEED Version 4, to be demonstrated either with LEED review/certification or by other third party certification of the energy model, such as NYSERDA. The energy model (printed complete input and output reports) shall be submitted with the design documents with the application for a building permit, with a statement by the energy modeler that the energy model meets the requirements for 17 energy points based on LEED Version 4.
2. For low-rise residential buildings, RESNET HERS/ERI (with a maximum score of 40). Compliance shall follow procedures defined for the ERI compliance path in the New York State Energy Conservation Code.
3. For residential buildings (single-family, multifamily low-rise or high-rise): National Green Building Standard ("NGBS", also known as ICC/ASHRAE 700-2015) with a minimum of 80 NGBS Energy Efficiency points. The professional documenting compliance will provide a statement that the design meets the intent of a minimum 80 Energy Efficiency points per ICC/ASHRAE 700-2015, and documentation supporting these points.
4. For commercial or residential buildings, Passive House. Submit approved pre-certification from either PHIUS or Passive House International, according to current-version standards of either organization, when submitting construction documents in application for a building permit.

This whole building compliance path allows more flexibility, but typically requires more insulation, higher-efficiency heating and cooling, and extensive other energy improvements. Note that for the whole building path, definitions of residential and commercial buildings adhere to definitions in the energy code, unlike the Easy Path in which residential buildings include buildings 4 stories and higher.

2.14.3 Renovations and Additions

Renovations that consist of the removal of interior or exterior finishes for more than 50% of an existing building shall comply with the requirements for new buildings (Easy Path or Whole Building Path).

Additions over 500 square feet shall comply with the requirements for new buildings (Easy Path or Whole Building Path). Additions shall be treated on their own, and not as part of a larger building. For the window area point, treat the shared wall area (where the addition meets the existing building) as part of the new addition's exterior wall. For the building shape point, the area of the shared wall (or floor of the addition, if above the existing building) is not counted as part of the exposed above-ground wall/roof area.

New additions less than 500 square feet shall comply with the 2015 New York State Stretch Energy Code, in addition to the above requirements for water conservation.

All other renovations that trigger the energy code, such as heating system replacement, lighting replacement, bathroom renovations, kitchen renovations, etc. shall comply with the 2015 New York State Stretch Code, in addition to the above requirements for water conservation.

Building owners are encouraged to replace fossil fuel space and water heating systems with heat pump systems.

2.14.4 Exemptions

Consistent with the New York State energy code, historic buildings are exempt from the green building policy. In renovation of a historic building, steps to reduce carbon emissions are encouraged that preserve the historic fabric of the building, such as rehabilitation of windows, installation of heat pumps for space and water heating, insulation and air sealing, and high-efficiency lighting where lighting needs to be replaced.

2.14.4 Future

On January 1, 2025, the requirements are proposed to change to:

1. Easy path: 12 points
2. Whole building path:
    a. LEED: 17 energy points (LEED version 4) AND 7 of the Easy Path points (excluding the Stretch Energy Code and lighting point)
    b. HERS Score Maximum 40, AND 7 of the Easy Path points (excluding the Stretch Energy Code and lighting point), OR a HERS Score Maximum 20
    c. National Green Building Standard ("NGBS", also known as ICC/ASHRAE 700-2015) with a minimum of 80 NGBS Energy Efficiency points, AND 7 of the Easy Path points (excluding the Stretch Energy Code and lighting point)
    d. Passive House, AND 3 of the Easy Path points (excluding the Stretch Energy Code and lighting point)

On January 1, 2030, the requirements are proposed to further change to net-zero building designs that are free of fossil fuels. The fossil-fuel-free requirement will allow exceptions for commercial cooking and industrial applications for which no electric options are available, such as emergency generators. The standard by which net-zero is defined will be established before January 1, 2024.

2.15 Compliance

A successful green building policy is one that does not place a significant burden on those who will review and approve building planning, design, and construction. We propose the following compliance documentation:

1. For the proposed point system, a checklist that shows which points are sought, and support for each point. For example, if a developer is seeking the size credit for a house design, the checklist would show the house area (square feet), number of bedrooms, required house size, and proposed house size, to show that the house meets the size requirement.
2. For the proposed whole-building compliance, a report by an accredited third-party energy consultant, at the time of planning review and again when applying for a building permit.

We propose that at the planning review phase, a preliminary green building checklist be submitted, indicating which green compliance items are proposed/planned. This will serve to show the planning department how compliance is planned, but will also serve to bring the green building requirements to the attention of the developer and their design professionals. A final checklist will be required to be submitted with the construction documents, prior to the building department issuing the building permit.

2.15.1 Incentive Package Recommendations

In order to receive incentives a new building should meet a significantly higher bar to lead the building community toward the long term goal of net zero energy. The proposed mandatory standards ratchet up in 2025 and 2030. We propose that buildings seeking incentives be required to meet the proposed 2025 minimum level of points or whole building certification levels in the years before 2025, and starting in 2025 buildings would need to meet the 2030 performance level to receive the incentive package. After 2030 incentives for green building would phase out because all buildings would be required to be net zero. In order to receive the incentive package building owners would also commit to sharing energy use data by granting the city or town permission to access energy consumption data through NYSEG that could be tracked in a future benchmarking program or evaluation study. Buildings would also be required to be located within the priority area (see walkability map) and be 100% fossil fuel free.

The high bar for incentives and the strong municipal priority for meeting energy goals should result in a broad and attractive package of incentives. Projects meeting these ambitious goals are providing a significant community benefit and deserve recognition and municipal support. Incentives that could be considered in a package include: the NYS Green Building Tax Exemption (more details on this are below), priority application processing, designation as a Type 2 action in CEQRA and TEQRA, permit fee reduction, height bonus, minimum parking reduction, and area requirements reduction (lot size, setbacks, coverage).

Another possible incentive is a recognition system, such as an award and associated certificate, perhaps given in conjunction with an existing program, such as the Pride of Ownership award. An administrative fee could be charged for this recognition, in order to cover the costs of administering the awards.

2.16 Harmony with Other Requirements, Incentives, and Programs

The proposed green building policy harmonizes with other program requirements as follows:

1. PACE (Property Assessed Clean Energy) financing. PACE financing supports renewable energy and energy efficiency improvements with financing that flows through property taxes. The proposed policy would work fine with PACE financing. Affordability-related energy improvements obviously do not require financing, because they lower construction costs instead of adding to them.
2. NYSERDA. NYSERDA provides financial and other support for high-performance design and construction. Homes and other low-rise residential construction meeting NYSERDA's Tier III program would meet the requirements for the whole-building compliance path, and so be eligible for financial incentives. Buildings following the affordable-related energy improvements would not be eligible for NYSERDA assistance but, again, do not need assistance because they reduce construction cost.

3. TCIDA Energy Tax Abatement. The Tompkins County IDA has been offering an energy tax abatement incentive for buildings that qualify for IDA tax abatements for economic development, since 2016. The whole-building requirements for commercial buildings in this proposed Green Building Policy are similar to the IDA requirements. The question arises, “If the green building policy is roughly equal to the TCIDA requirements, why incentivize TCIDA buildings?” Therefore, if this green building policy proceeds as proposed, TCIDA may want to consider raising the bar for its incentives. For example, in the period until 2025, TCIDA may wish to offer its energy tax incentives for projects that achieve the 2025 targets. Similarly, in 2025, TCIDA may wish to again raise the bar to the 2030 targets. And in 2030, TCIDA could consider eliminating the incentive.
4. Solar incentives (Federal Investment Tax Credit, state residential tax credit, NYSERDA incentives). All these programs would assist in paying for renewable energy, if renewable energy is used under the point system.
5. The Energy Code. The Energy Code is a requirement for all new buildings and renovations. The proposed green policy harmonizes well with the Energy Code. Buildings meeting the whole-building requirements would typically automatically comply with the code, and so not need to submit separate compliance documentation. Buildings following the point system would still need to comply with the energy code, but there are no conflicts, and the point system only helps to comply with the energy code in several areas (window-to-wall ratio, water use, etc.).
6. Tompkins County Green Energy Property Tax Exemption. In 2012, the county passed a county property tax exemption for buildings that reach the LEED Silver, Gold, or Platinum certification levels, in alignment with a state law that enables this exemption. Only two buildings have reportedly obtained these exemptions. The proposed green building policy could potentially be aligned with this existing property tax exemption as follows:
    a. The city and town (and even the school district) could consider adopting the exemption.

2.17 Risks and Obstacles

As best practices become common practices, it is possible that developers could choose among improvements they were planning to do anyway. These are considered to be “free riders.” However, free ridership also happens with other approaches to energy efficiency, such as mandated requirements (energy code) and incentivized requirements (tax credits, rebates, etc.).

Checking for compliance, in addition to the requirements of the energy code, could place an additional burden on code officials, although Town and City code officials have indicated the burden would not be significant. It might be possible for compliance to be self-certified by design professionals, using a checklist, and then the code official only needs to double check compliance.

“Gaming” is another risk, in which developers or builders seek to circumvent requirements of the proposed green building policy. For example, low-flow water faucets and shower heads could be replaced with higher flow devices, after a building is built. Some points in the proposed point system can be more easily gamed (for example, water flow), some points can be gamed but at some difficulty and cost (for example, window size), and finally other points cannot be gamed (density/transportation, building shape, building size). Some gaming should be anticipated, and so 100% compliance should not be expected. Gaming is also possible with the regular energy code. The U.S. Department of Energy has observed 80-90% compliance with the energy code.

2.18 Indoor Comfort and Health

Indoor comfort and health are cornerstones of green buildings. If the whole building compliance path is chosen (LEED, Passive House, HERS), provisions are made within those certification systems to ensure indoor environmental quality, even while energy use is reduced. If the point system is used as the compliance path, none of the proposed points put indoor comfort or health at risk, and some points improve comfort and health. For example, heat pumps eliminate risks of poisoning from carbon monoxide, risks of explosion from leaking gas, and environmental hazards from leaking fuel oil or propane.

2.19 Items Not Included in the Green Building Policy

The green building field is vast, and areas of green buildings are almost endless. We made a difficult decision to not include many aspects of green buildings in the policy at this time. Priority was given to building improvements that reduce carbon emissions, in support of local, state, and national goals to reduce carbon emissions.

For example, some green building certification systems give credit for electric-vehicle chargers and/or for “solar-ready” buildings, buildings which have been designed and built to readily accommodate solar systems in the future. These two items were discussed. While both have merits, it was decided to not recommend either of them at this time, because neither guarantees substantial and actual reductions in carbon emissions, and both add cost to building construction.

A wide variety of other possible green building features were discussed, such as wastewater re-use, rainwater harvesting, indoor environmental quality, light pollution, building deconstruction, certified wood, beauty, and many more. Again, for a first green building policy, it was decided to focus on substantial reductions in carbon emissions, while strongly prioritizing building affordability. Other green building features are important and have merit, and could be considered in the future.

2.20 Other Recommendations

Other recommendations coming out of this study include:

1. Examine a benchmarking and disclosure policy for the City and Town of Ithaca, specifically with regard to benefits and costs
    a. Review experience with benchmarking in other cities: Compliance, costs to administer, benefits, shortfalls. Has benchmarking led to measurable decreases in carbon emissions? Has benchmarking yielded data that facilitated policy or program changes? Examples of a benchmarking policy might include a requirement that buildings be evaluated for their energy use, either at the time of sale, or on a periodic basis. This can either be applied for all buildings, or for types of buildings or for buildings of a minimum size. The energy use can be represented either with a full report of energy use, or as some form of simplified score.
    b. Develop requirements/recommendations.

2. Undertake a similar study for existing buildings and develop an associated policy for reducing carbon emissions in existing buildings. A possible focus could be on encouraging replacement of heating systems as they reach the end of their useful life, insulating roofs and siding when they reach the end of their useful life, replacing appliances with Energy Star appliances when they reach the end of their useful life, etc.

3. Consider evaluating an institutional compliance path, to address such issues as institution-wide renewable energy capacity (and allocating such capacity to specific new buildings) and district heating systems.

4. Develop requirements for buildings with large internal loads (such as labs), which might not be able to comply with the proposed whole-building requirements, in cooperation with large local institutions, as part of the next phase of this project.

5. Examine possible approaches to behavior, such as education, advocacy, and maintenance of energy systems in buildings, to supplement the building design and construction requirements of the Green Building Policy, in order to maximize energy savings and promote persistence of savings over time.

6. Examine ways in which to encourage use of recycled, local, renewable, and reusable materials.

7. Examine changing site plan review process to incorporate design guidelines as partner documents. Consider adding in elements such a requirement that developers provide documentation of energy use study and consideration of heat pump options.

8. Consider adding a reference to the DEC's "Guide for Assessing Energy Use and Greenhouse Gas Emissions in an Environmental Impact Statement, 2009." in the City and Town's CEQR and TEQR

requirements. This type of review is already allowed under existing rules, but specifically referencing this guide would help to make GHG impacts a more common review criteria.

9. Assess other strategies to reduce or offset carbon emissions, such as reforestation.

2.21 Green Building Policy Point System: Stress Test

As we consider a point-scoring system for a Green Building policy, how would recently-designed buildings score on the system? Would the proposed point system work for known high-performance buildings, in other words, would they have passed? Would the point system work for known ¬non-high-performance buildings, in other words, would they have failed? Would such a point system have impacted designs? Do "better" buildings score higher? Would the point system be unusually cumbersome and costly? We consider some examples.

In this discussion, we use the following nomenclature:

Net-zero buildings: Buildings that generate as much energy with renewable sources, such as solar power, as is used, over a whole-year measurement period.

Near-net-zero buildings: Buildings that use less than 10 kBtu/SF/year.

Somewhat high performance buildings: For example buildings that are LEED certified or Energy Star certified, but are neither net-zero or near-net-zero.

Not high performance buildings: Buildings that are designed and built to be minimally compliant with the energy code.

2.21.1 Low-Rise Residential Buildings

Hemsin House. Completed in January 2016, the Hemsin house is a single-family residence on Perry City Road. It was designed to be net-zero, and so far its performance is reportedly delivering on the net-zero design goal. The house was also reportedly highly affordable. Despite the net-zero design and solar photovoltaic system, the added green features reportedly only cost about 10% more than a code-compliant house. The building scores 3 points for heat pumps (although some electric resistance heat might disqualify these points), 1 point for a heat pump water heater, 1 point for an electric stove and heat pump clothes dryer (with no fossil fuels to the building), 1 point for a modest window-to-wall ratio, 1 point for modest floor area (2240 SF for a four-bedroom house), 1 point for including all heating equipment and distribution within the heated space, 1 point for modest surface area, and 3 points for on-site renewables (6.9 kw), for a total of 12 points (9 points if the heat pumps are disqualified due to the electric resistance heat). It easily passes the threshold of six points, as we would hope it would, and in fact scores very high in points, as we would also hope it does, as a net-zero building.

Overlook Apartments. Overlook Apartments (across from the hospital) were built in approximately 2007, as a high-performance project in NYSERDA's Energy Star program. But despite its high-performance design, it likely would not meet the proposed better-than-code whole-building requirement. It might only achieve 1 density/transportation points (if that). Heated with boilers, it would not get the heat pump points. It also would likely not get any of the affordability points (window size, floor area, building shape, etc.). We presume it would end up with perhaps 1 point, and so not come close to meeting the proposed requirements.

Demarest Spec House, Spencer Street. Downtown location, 1152 square feet for a 2-bedroom single family house, heat pumps, small window-to-wall ratio, and heating within the heated space all combine to deliver 9 points. It passes easily, and is anticipated to be a highly-efficient house.

Ecovillage TREE – Three single-family homes that have proven net-zero performance, and others designed to Passive House standards. Even though they might only get 1 point for density/transportation (if that), they would get one point for windows, likely two points for size, one point for shape, one point for heating in the heated space, and one point for solar energy, for a total of 6-7 points. Heating is electric resistance, so does not qualify for the heat pump points. In short, the buildings pass, as we expect they might, although do not get as many points as we might expect. Several of these buildings would also pass, separately, due to their whole-building Passive House certification, which some of them achieved.

Belle Sherman Cottages. Designed to Energy Star at the time, they are reportedly not much better than the current energy code. They use gas furnaces. Their location will likely earn them two density/transportation points, but they would not qualify for any other points, and so would fail. However, with such as heat pumps or a combination of other affordable improvements, they could pass.

Double Wide. A typical 55x25 double wide manufactured home, with 3 bedrooms, would get one point for modest windows and two points for modest size. The typical exposed floor (over the crawlspace) prevents such a home from getting the shape point. If it does not get the density points, it would fail, but heat pumps would allow it to pass.

2.21.2 Commercial and Large Multifamily Buildings

Ecovillage Tree Common House. This is a 15-apartment, 4-story, 20000 SF building, which has a proven performance of 9 site EUI (extremely low energy). It has 50 kw of solar PV. It would achieve maybe 1 point for density/transportation, 1 point for windows, 1 point for size (possibly two), 1 point for shape, and 2 points for renewables (just short of 3 points), for a total of approximately 6 points, and so would pass the point system. If the building had heat pumps, it would have achieved 9 points.

Marriott Hotel. The new Marriott would likely achieve 2 points for density/transportation. But it would likely not get any other points, and so would not pass without design modifications.

Carey Building. The Carey Building (multi-story residential above the old Meyers shop) would get 2 points for density/transportation, 3 points for heat pumps, and 1 point for heating within the heated space, so would pass, even though it would likely not get any other points. Its score (6) is not as high as a super-high-performing buildings, and we would also not expect its performance to be as good as these buildings. But its downtown location and heat pumps likely will deliver low-carbon operation. This building would not have required any modifications to pass the proposed rating system, from how it was designed/built.

Typical Building at Cornell Technology Park. The typical building at the Cornell Technology Park is of interest because it might be typical of commercial buildings in the Town of Ithaca: Single-story, ribbon windows, efficient combustion system or boiler/tower water loop heat pump. Such a building might only qualify for 1 point (building shape), and perhaps 1 density/transportation points, and so would fail unless the design were modified. Possible design modifications would include slightly lower window to wall ratio (1 point), use of heat pumps (2 points for a commercial building), heating within the heated space (1 point), and high-efficiency lighting (1 point).

Big Box Retail. As an example, Bed Bath and Beyond. It would get 1 point for window to wall ratio. Almost all big box stores would get this point, automatically. Its current shape does not qualify due to its tall ceilings. It might get 1 point for right-lighting, although there may be corporate standards that would prevent this. The rooftop HVAC could go with heat pumps for 2 points, although would not be eligible for the 1 point within the heated space. Density might get it the points it needs to pass. So the primary design change would be the heat pumps and these would deliver strong reduction in carbon emissions. If it used split heat pumps, it could get the heating-inside-envelope point, although this would need separate rooftop ventilation. This approach could be used for big box stores that do not meet the density requirement.

107 South Albany Street. Under construction. 14 apartments with heat pumps. Same situation as Carey Building – same points, same outcome, and no change to the actual design/construction would be required. It would pass as is.

Gateway Commons. Built in about 2006, Gateway Commons was one of the first LEED buildings in the City, achieving a LEED Silver rating, and so is an interesting test case: A high-performance building, but not very high-performance. This building would get 2 points for density/transportation, but likely would not get any other points – the windows are too large, floor area is too large, the heat pumps rely on a boiler so would not qualify, it does not have heat pump water heating, etc. It might get one point for building shape. So, the building would only get 2-3 points, and would not pass. Interestingly, the building was benchmarked in 2012 with an energy use index (EUI) of 47. This confirms that the building is high performing, but not very high-performing.

Breckenridge Apartments. 50 apartments in downtown Ithaca. Would get 2 points for density/transportation, and possibly 1 point for floor area. It does use heat pumps, except for ventilation which is gas-fired. The gas-fired ventilation disqualifies the heat pump points, so the building fails, with only 3 points, even though it is LEED Platinum. It would not be difficult to have modified the design to get the building to pass with 3 more points, for example with more modest windows or slightly smaller apartment sizes and/or a heat pump for the ventilation. Breckenridge's actual energy use index

(EUI) is 45, similar to Gateway Commons. Gateway Commons and Breckenridge confirm that high-performing buildings that are not very-high-performing do not pass the point system.

2.21.3 Major Renovations

HOLT Architects . HOLT Architects' major rehab of a building in the City's west end was designed as a net-zero building, with significant roof-mounted solar energy and other green features. Its performance has not reached net-zero, but has still reportedly been highly-efficient, and we would expect it to pass the rating system. This building would likely get 2 points for density/transportation, 3 points for renewables, 1 point for modest window-to-wall ratio, 2 points for heat pumps, and 1 point for heating within the heated space, for a total of 9 points. It scores well, and this is good because it is a proven high-performance building.

109 S. Albany. 109 S. Albany is a small 1625 SF commercial professional office building. Although not "gut-rehabbed" at one single point in time, extensive energy renovations over 15 years have been the equivalent of a major rehab, and the building uses 80% less energy than it did when last bought in 2002, with a site EUI of less than 25. It would receive 2 points for density/transportation, 2 points for solar (slightly shy of 3 points), and 1 point for low-energy lighting, and so would just fail pass the scoring system, although barely, with 5 points. This is another example of a high-performing building that fails because it is not very high-performing, and still relies on natural gas. It would pass with additional solar energy, or with heat pumps.

110 S. Albany. Renovated in 2009, it was also converted at that time from an apartment building to an office. It has received LEED Platinum certification. It would receive one fewer solar points than 109 S. Albany, and so would fail with 4 points. It is another example of a LEED Platinum building that does not pass the point system, largely because of its natural gas use, and its energy use index (EUI) of just over 60, which is good but still not very-high-performance. Required changes would include heat pumps, or more solar, in order to reach six points.

2.22 Conclusions/Takeaways

The point system as currently proposed appears to pass known high-performance buildings (Hemsin House, Ecovillage TREE homes and common house, HOLT Architects, Demarest house on Spencer Street).

The point system fails known <u>non</u>-high-performance buildings (Marriott, typical building at Cornell Technology Park), even if they have modest high-performance features like high-efficiency boilers.

The point system fails moderately high-performance buildings if they are not very high-performance (Gateway Commons, Overlook Apartments, Breckenridge, 109 and 110 S. Albany), although the building designs would pass with minor modifications.

The point system's most distinctive features are the density/transportation points and points for heat pumps. A residential or multifamily building can pass by primarily just meeting these two requirements (e.g. Carey Building, 107 South Albany Street), and using heat pumps that are located within the heated space.

In answer to our initial questions:

1. Would the proposed point system work for known high-performance buildings, in other words, would they have passed? Yes.
2. Would the point system work for known non-high-performance buildings, in other words, would they have failed? Yes.
3. Would such a point system have impacted designs? Yes. We see multiple examples where somewhat high-performance buildings would fail, but by pursuing extra points, could be brought to pass.
4. Do "better" buildings score higher? Yes.

Would the point system be unusually cumbersome and costly? No.

2.23 References

Green Energy Incentives, Final Report, Tompkins County Planning Department / Tompkins County Industrial Development Agency (TCIDA) / Tompkins County Area Development (TCAD). August 2016.

Heat pump references:
https://energy.gov/energysaver/heat-pump-systems/air-source-heat-pumps
https://energy.gov/energysaver/geothermal-heat-pumps

Biomass references:
https://www.epa.gov/rhc/biomass-heating-and-cooling-technologies
https://www.nyserda.ny.gov/All-Programs/Programs/Renewable-Heat-NY

3 Education and Outreach

3.1 Goals

The primary goal of the education and outreach campaign is to explain the process and methodology used to develop recommendations for the proposed green building policy regarding energy and water conservation.

Another goal of the campaign is to solicit input and feedback on the draft deliverables and recommendations.

3.2 Target Groups

The target groups include the following:

1. Homeowners
2. Landlords
3. Developers
4. Design professionals
5. Builders
6. Community leaders
7. Municipal staff
8. Elected officials

3.3 Strategy

The City and Town of Ithaca are in a unique position with a strong vocal community engaged in both green energy and social equity issues. Ithaca has the opportunity to be at the forefront of energy and water conservation policies that exceed the code minimums and push our communities toward a net-zero energy future. Implementing an effective policy will demonstrate leadership and set a positive example for other municipalities.

The process of developing the recommendations for a new policy includes regular meetings of the project team with meeting agendas and minutes which will be made available to the target groups.

A mailing list of the target groups and any interested parties will allow for regular communications to announce special presentations or events as well as notify people of new content on the website. The mailing list will be a primary method to solicit feedback on draft reports as well as preliminary and final recommendations.

3.3.1 Branding

The branding of a campaign can be an important part of effectively communicating the message to the target groups and ultimately achieving the project goals. A campaign need not be flashy or overly complex but it does require consistency. All communications should include a simple masthead with the name of the project and a tagline. A consistent use of font styles and colors will help build confidence and reinforce the underlying message.

For this campaign the project team has agreed on the name:

Ithaca Green Building Policy: Energy + Water

The font used is Calibri with the main name in bold and the Energy and Water regular.

The brand joins both the city and town together by just referring to "Ithaca" and the term/color "Green" has historically been used to represent sustainability. In spite of being somewhat overused and perhaps cliché, the term "Green" is simple and commonly understood. The terms "Energy" and "Water" provide focus and avoid any confusion about the policy possibly applying to other common green building practices such as sustainable sites, building materials or indoor air quality.

All communications will reference the Ithaca Green Building Policy name with the Energy + Water terms included on more formal documents.

3.3.2 Distribution

Information will be distributed primarily by way of presentations to various stakeholder groups and email announcements.

3.3.2.1 Website

A project website draft was ready for team and committee review on 9/22/17 and full launch in November 2017.

The website will be the main focus of the marketing strategy with all communications directing people there to review reports, agendas, minutes, resources and to make comments and ask questions through a contact form.

3.3.2.2 Presentations

Some of the public presentations given through the course of this project include the following. A complete list of events including agendas, attendees, and meeting minutes can be found on the project website at www.ithacagreenbuilding.com.

City Planning and Economic Development Committee - January 10
City Planning and Development Board - January 23
Town Planning Committee - December 21
Town Planning Board - January 16
TCCPI - January 26
Public Information Session - March 28

The outreach generated well over 200 comments on the draft report. Revisions to the report have been made to reflect the consultant's responses to these comments. The complete list of comments is included as an appendix to this report as well as on the project website.

3.4 Advisory Committee

3.4.1 Summary of Selection Criteria and Process

A preliminary list of possible committee members was generated through a brainstorming activity by the consultant with input from the client at a regular project meeting. The list included known individuals in the community who are active with design, construction, real estate, energy, planning, and social equity issues. Efforts were made to make the list as diverse as possible in terms of gender and race and to include people who are both familiar with green building practices and also those who are not. The list was then sorted into three groups of people who could best represent the three categories of economic development, ecology or social equity.

The entire client team and consultants were presented with an anonymous online survey where they were asked to select three possible committee members for each category to ensure a healthy and diverse mix of people. The results of the survey were then discussed by the project team with the nine people receiving the most votes added to the list of finalists. The project team then discussed some of the names who received fewer votes but may have been overlooked as good candidates. Four additional names were added through this discussion.

Once the final list of thirteen candidates was established the consultant reached out to each person to ask them if they would be interested in joining the committee. All of the candidates responded favorably with only one candidate suggesting an alternative person due to other commitments (the representative from Cornell University).

The following is the list of 13 Advisory Committee Members and the organizations they represent:

Peter	Bardaglio	Ithaca 2030 District; Tompkins County Climate Protection Initiative
Katie	Borgella	Tompkins County Department of Planning & Sustainability
Kirby	Edmonds	Building Bridges, The Dorothy Cotton Institute
Erik P.	Eshelman	Cornell University
Steve	Hugo	HOLT Architects
Jon	Jensen	Park Foundation
McKenzie	Jones	City of Ithaca Planning & Development Board
Brent	Katzmann	Warren Real Estate
Leslyn	McBean-Clairborne	Tompkins County Legislature; Greater Ithaca Activities Center
Heather	McDaniel	Tompkins County Area Development (TCAD)
Guillermo	Metz	Cornell Cooperative Extension
Scott	Reynolds	Ithaca Neighborhood Housing Services
Frost	Travis	Travis Hyde Properties

3.4.2 Agendas, Presentations, Minutes

Agendas, presentations, minutes, and other materials from each Committee meeting can be found in the appendix and on the project website www.ithacagreenbuilding.com.

4 Building Stock Survey and Development Forecasts

4.1 Introduction

In order to evaluate policy options and understand the possible outcome from different policies, it is necessary to first understand the built environment that exists in Ithaca, as well as the associated energy and water use relative to our policy goals. In addition, it is important to have a baseline of expectation for how development will proceed in the future and how the future City and Town building stock could be influenced by policy changes.

4.2 General Approach

To help the community understand the implications and potential levers for change that can help the Town of Ithaca and the City of Ithaca to achieve energy and water savings goals, Randall + West has developed the following Survey of Existing Buildings and a Development Forecast to project the future built environment.

Identifying the data available locally, reviewing its accuracy and completeness, and performing some basic analysis was the first step for this project. Using data made available by the Tompkins County Department of Assessment, the City of Ithaca Zoning Division, the City of Ithaca GIS Program, the Town of Ithaca Code Enforcement Department, and the Southern Cayuga Lake Intermunicipal Water Commission, we have processed and analyzed parcel land use data, local water consumption, and building permits. We have also estimated expected future energy use using data from the New York State Electric & Gas (NYSEG) 2010-2016 Ithaca Community Energy Report, the U.S. Energy Information Administration Residential Energy Consumption Survey (RECS) and Commercial Building Energy Consumption Survey (CBECS), and the New York State Energy Research & Development Authority (NYSERDA) New York State Residential Statewide Baseline Study (RSBS).

After reviewing all available local datasets, local plans, and other projections created for local studies and projects our team decided to base our future assumptions largely on economic and population projections from Woods & Poole Economics, Inc. This firm is well regarded in the field of economic and population projections and has been used locally in reports by TCAD and Tompkins County Planning. Woods & Poole's methodology differs from other projections by modeling the entire national economy as well as individual counties and statistical areas to better understand the interplay between economic conditions and "natural" changes related to birth, death, and aging. The projections include an expected breakdown of the future population based on a number of factors including economic sector, age, and gender. We believe that Woods & Poole's focus on trends within economic markets as predictors of population change is the best available method for creating a baseline of expectations for future building stock in a world where workers, and population in general, is increasingly mobile.

The outcome of any long-term prediction, particularly when working with imperfect data, is not an exact science. The development forecasts, and the land use demands they imply, are subject to variation due to the many factors driving future demand. That said, these projections provide a sense of the magnitude and proportion of change that can be expected in the long-term based on the best available information.

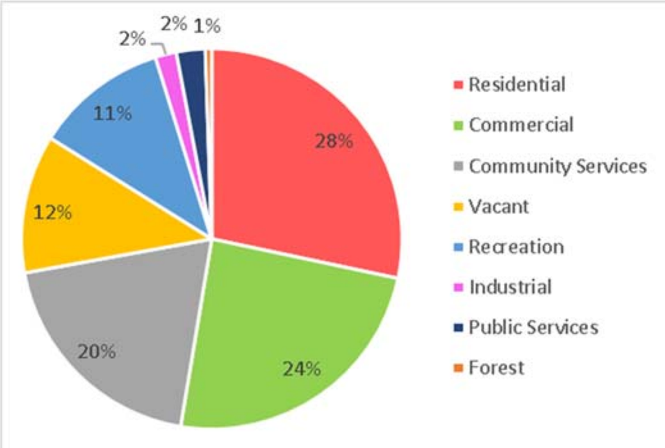
4.3 Building Stock Survey

In order to better understand the current stock of buildings, including the mix of uses, ages, sizes, and distribution, Randall+West started with a review and analysis of all pertinent data that the City of Ithaca and the Town of Ithaca were able to provide as well as available datasets from Tompkins County Department of Assessment, New York State Electric & Gas (NYSEG), and the aforementioned regional Residential Energy Consumption Survey (RECS) and regional Commercial Building Energy Consumption Survey (CBECS).

The evaluation of available data provides key insights into the built fabric of our community, the existing building stock, and trends of change over time. These data sources provide a background for understanding Ithaca's buildings; however, the development forecasts, and the land use demands they imply are subject to variation due to the many factors driving demand in the future. These projections are intended to provide a good idea of the magnitude and proportion of change that can be expected over time based on the best available information.

4.3.1 Land Use Area

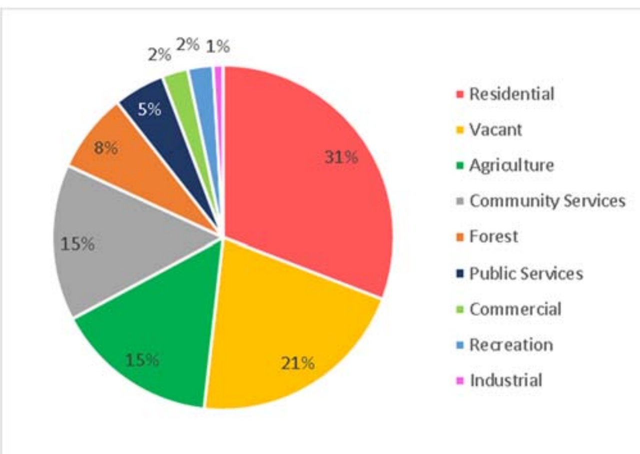
Urban land use greatly impacts the energy and water consumption of cities and towns. Data made available by the County Department of Assessment helps illustrate the amount of land dedicated to each of the land use types in the City and Town.



Land Use	Area (in acres)	Percentage of Area
Residential	826.3	28%
Commercial	708.5	24%
Community Services	569.41	20%
Vacant	343.12	12%
Recreation	330.05	11%
Industrial	52.32	2%
Public Services	71.35	2%
Forest	15.8	1%
Total	2916.85	100%

Figure 12 - City of Ithaca: Parcel Area Distribution of Land Uses

At 28% of the City's total parcel area, residential uses consume more land than any other use in the City of Ithaca, followed by commercial land use, and community services. In 2008, U.S. residential and commercial buildings used 73.2% of all electricity produced in the United States[1]. Thus the future energy and water demand in the City of Ithaca would be driven largely by energy and water needs of the residential and commercial land uses.



Land Use	Area (in acres)	Percentage of Area
Residential	5189.54	31%
Vacant	3529.94	21%
Agriculture	2596.06	15%
Community Services	2468.58	15%
Forest	1261.54	7%
Public Services	816.81	5%
Commercial	414.18	2%
Recreation	403.63	2%
Industrial	158.03	1%
Total	16838.31	100%

Figure 13 - Town of Ithaca: Parcel Area Distribution of Land Uses

In the Town of Ithaca, residential land use also occupies the largest parcel area. The energy demand for agricultural and community service land uses remains relatively stable over the years. Therefore the energy and water demand in the Town of Ithaca would be driven largely by its residential land use.

Water and energy demand depends not only on the land use, but also the size of parcels and the mix of uses, ages, sizes, and distribution of buildings within each land use. In order to predict the energy and

[1] http://digitalcommons.pace.edu/cgi/viewcontent.cgi?article=1791&context=lawfaculty

water requirements of the City and Town of Ithaca, a built area inventory was created to estimate the future development and usage of built space in the City and Town.

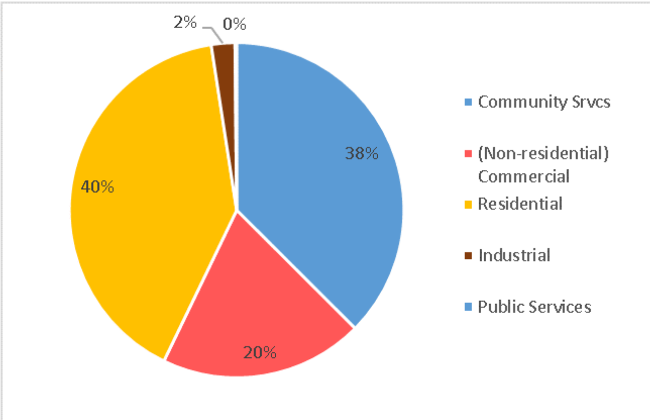
4.3.2 Building Area Inventory - Building Use Types

While land use area is useful for understanding how the City of Ithaca and Town of Ithaca have allocated their limited amount of land, to understand the impact of building policies we must understand the buildings that we have now and those we expect to be built in the future. Using County Department of Assessment data we have evaluated the amount of building area in the City of Ithaca and Town of Ithaca, respectively, based on the variety of use categories available. The inventory of building area was derived by processing data from the Tompkins County Department of Assessment 2017 tax year parcel data in ESRI ArcGIS 10.3. The Assessment Department data follows New York State Office of Real Property Services' Property Type Classification Codes, a uniform system used in assessment administration in New York State which includes the following numeric codes in nine categories:

- 100 - Agricultural - Property used for the production of crops or livestock.
- 200 - Residential - Property used for human habitation. Living accommodations such as hotels, motels, and apartments are in the Commercial category (400).
- 300 - Vacant Land - Property that is not in use, is in temporary use, or lacks permanent improvement.
- 400 - Commercial - Property used for the sale of goods and/or services.
- 500 - Recreation & Entertainment - Property used by groups for recreation, amusement, or entertainment.
- 600 - Community Services - Property used for the well being of the community.
- 700 - Industrial - Property used for the production and fabrication of durable and nondurable man-made goods. Parcels used for research aimed primarily at improving products are coded as Industrial, while parcels used for marketing research are coded as Commercial.
- 800 - Public Services - Property used to provide services to the general public.
- 900 - Wild, Forested, Conservation Lands & Public Parks - Reforested lands, preserves, and private hunting and fishing clubs

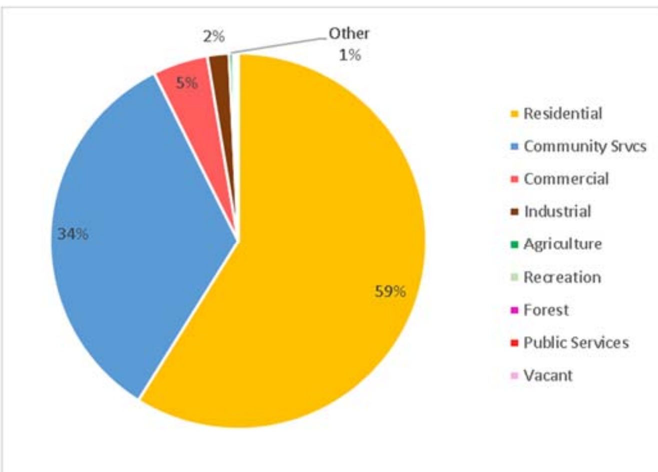
Within each of these nine categories are a number of specific uses. For example, within the 200 - Residential use category some of the specific use codes include: 210 - One Family Year-Round Residence; 215 - One Family Year-Round Residence with Accessory Apartment; and 220 - Two Family Year-Round Residence, among others. The Department of Assessment Property Class codes and associated improvement descriptions were used to assign parcels into the aforementioned land use categories used for this study.

Once the parcels in the City and Town were identified, we tallied square footage, building area for each type of development directly from the provided parcel data. Three property types make up the vast majority of built area in both the Town of Ithaca and the City of Ithaca; these types are Residential, Commercial, and Community Services. At this level of analysis, it is important to understand that some uses that most would consider residential are split between the 'Residential' and 'Commercial' land use codes. The 200s Residential use numbers includes one-, two-, and three-family homes, single mobile homes on a lot, and multiple mobile homes on a lot when the lot is not a commercial enterprise. The 400s Commercial land use codes include several housing types including apartments, mobile home parks where the land is leased or rented to mobile home owners as a business, rooming and boarding houses, and fraternity and sorority houses. In addition, it is worth pointing out that Community Services includes three of Ithaca's largest employment sectors - Government, Healthcare, and Higher Education (including university owned dorms, but not including fraternity/sorority houses).



Land Use-type	Building Area (in sq. ft)
Community Srvcs	10,055,643
(Non-residential) Commercial	5,286,263
Residential	10,841,450
Industrial	612,044
Public Services	41,576
Total	26,836,976

Figure 14. City of Ithaca: Building Area by use-type



Use-Type	Building Area (in sq. ft)
Residential	8,857,612
Community Srvcs	5,068,479
(Non-residential) Commercial	712,514
Industrial	278,962
Agriculture	50,174
Recreation	32,782
Forest	14,499
Public Services	11,313
Vacant	9,047
Total	15,035,382

Figure 15. Town of Ithaca: Building Area by use type

Residential, commercial, and community services land uses make up the vast majority of building area in both the Town of Ithaca and the City of Ithaca. Residential land use makes up one of the largest components of building area in the Town and City of Ithaca. The residential use building area is expected to increase with demand in the coming years. In the next section, we analyze the different kinds of residential uses as each type has a different water and energy requirement.

4.3.3 Residential Building Use Types

To better understand the distribution of building area devoted to uses that most people consider to be residential, we have created a sub-analysis of all residential uses including residential uses considered to be "Commercial" under New York State land use classifications. This data does not include dorms on university campuses which do not have a different property class to distinguish them from other campus buildings (considered Community Services) and are frequently not on their own parcels.

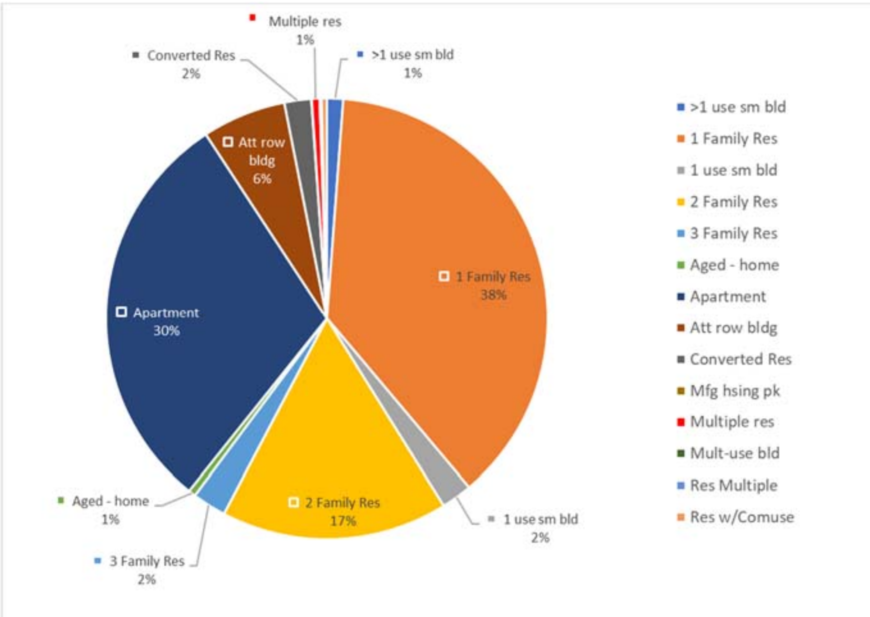


Figure 16. City of Ithaca: Residential Building Area - 2017

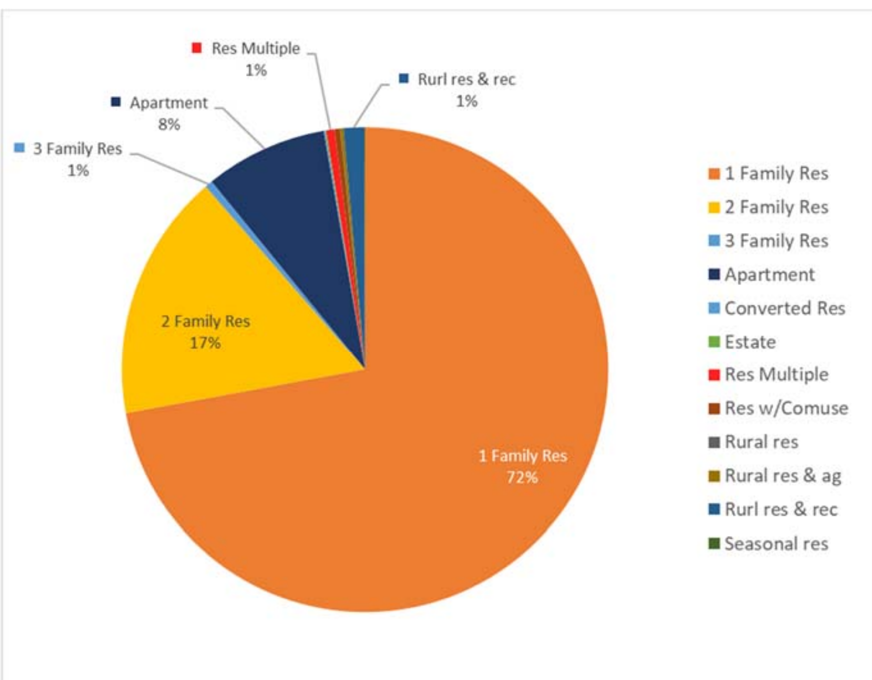
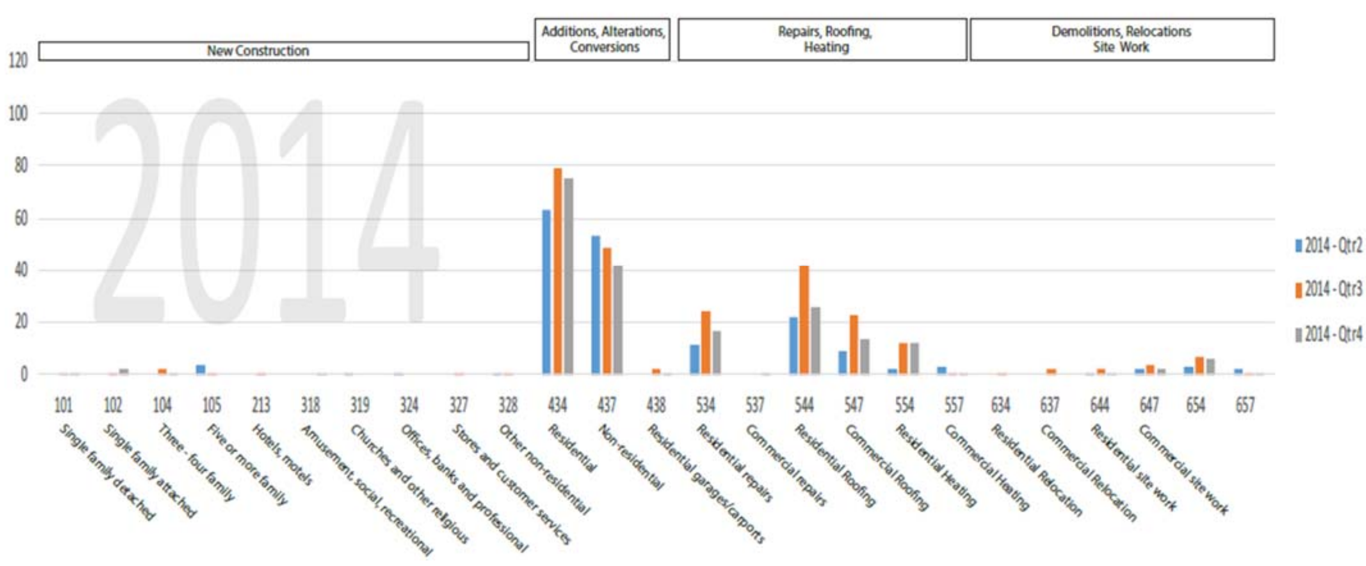


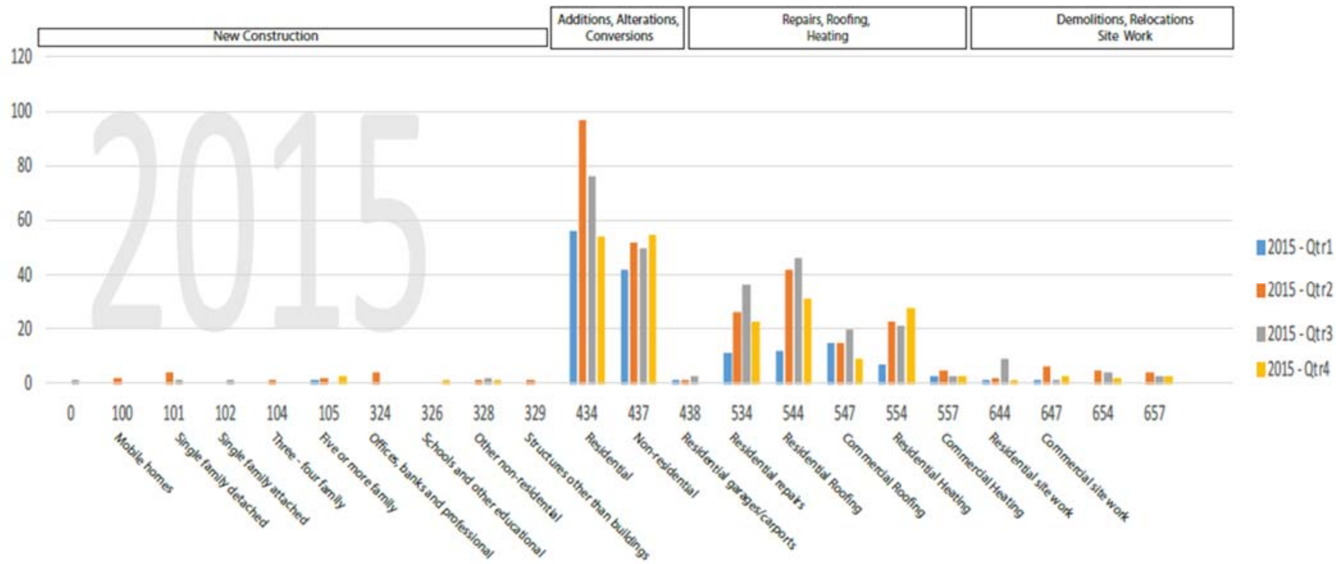
Figure 17. Town of Ithaca: Residential Building Area - 2017

Single-family residential buildings account for more building area than any other residential building type in both the Town of Ithaca and the City of Ithaca, followed by two family residential, and apartments. In the City of Ithaca, while single-family housing comprises more building area than other residential types, at 38% of the total residential building area it is less building area than the sum of the non-single-family residential building area. According to the 2015 Tompkins County Comprehensive Plan Housing section, “Within the City of Ithaca, 73 percent of households are renters, and countywide 44 percent of households rent their homes.” In the Town of Ithaca, single-family building area accounts for 72% of all residential building area.

4.3.4 Building permits and demolitions

Along with the building area of different property use types, the future energy and water demand also depends on the growth rate of the city or the town. In order to be able to make an informed estimate for a city’s growth rate, understanding the rate of new construction and demolitions are imperative. In this section, we take an overview of new constructions and demolitions in the City of Ithaca and Town of Ithaca. Both the City of Ithaca and the Town of Ithaca recently changed building permit database systems and are working to improve data entry and data gathering practices. The best analysis for this section would be to compare the building areas for new construction with any demolished building area to understand the net increase each year. Unfortunately, while data on number of demolished buildings is available, data on demolished building area is not and the vast majority of demolished buildings appear to be sheds, garages, and carriage houses. The building area affected by any given permit is also not currently tracked, although there is the potential in each new building permit database system to do so. Given the limited data available, we are able to draw some basic conclusions by tracking simple numbers of permits.





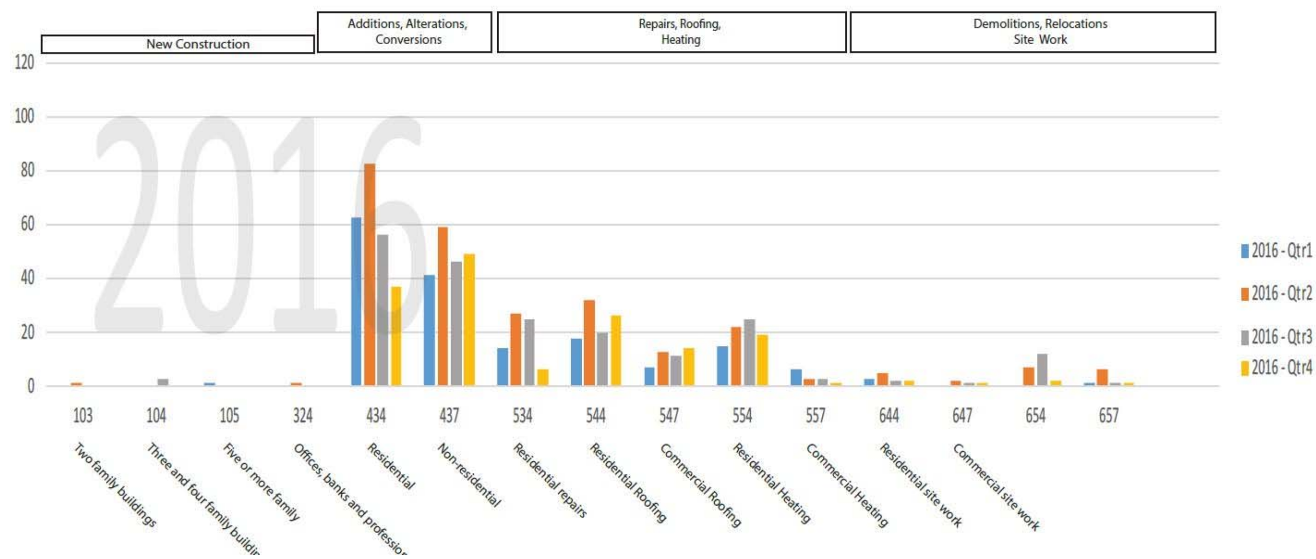


Figure 18. City of Ithaca Building Permit Data 2014, 2015, 2016

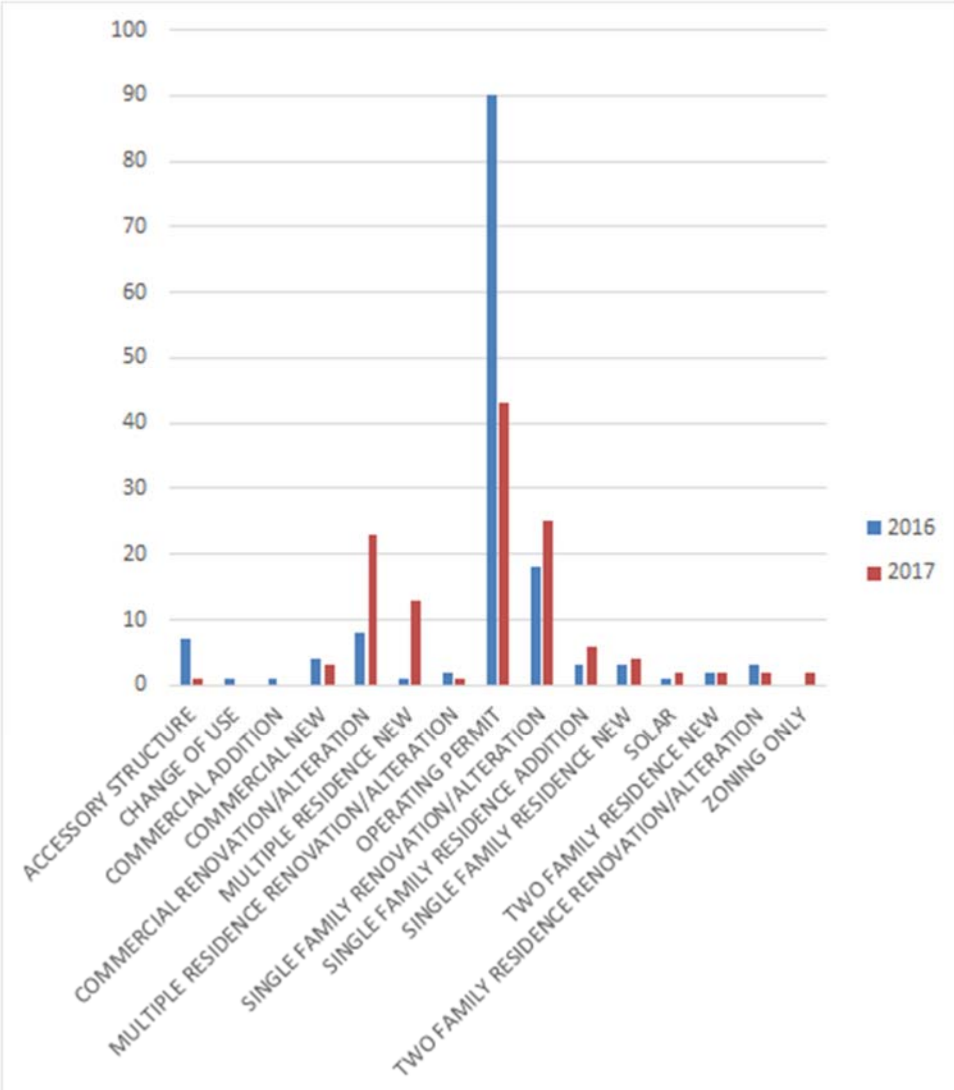


Figure 19. Town of Ithaca Building Permit Data 2016 and 2017 (through July 2017 when data was collected)

We find that new construction and demolitions are a small proportion of the total building permits issued over last three years as compared to other types such as additions, alterations, repairs, renovations, etc. While this project specifically focuses on a policy related directly to new construction, future work looking at standards for existing buildings and smaller renovations including roof replacements, and heating/utility upgrades could have a significant impact on overall energy use.

4.4 Building Area Forecast

In this section, we estimate the expected building area for residential, commercial, community service, and industrial land use for the City of Ithaca and the Town of Ithaca for 2030 and 2050. Building area by land use could be used to determine the energy and water needs of each land use in the City and Town.

To estimate the long-term expected changes for the community, we relied on the 2015 American Community Survey (ACS) for employment and demographic estimates, and Woods & Poole Economics, Inc. employment projections for Tompkins County. Readers should note that there are many unforeseeable events such as natural disasters (drought, earthquake, floods etc.), in-migration, or other significant economic, social, or political changes that could occur in the future. Changes due to these events are difficult to quantify in the present and have not been accounted for in this study.

4.4.1 Residential Development and Market Analysis

This section of the report presents the analysis of housing and population growth for 2030 and 2050 based. We first look at the population growth estimates for Tompkins County by Woods & Poole. Using the projected population, total residential building area is calculated for 2030 and 2050 for the City and Town of Ithaca assuming that future residents will use a similar amount of space per person that current residents use. As with any projection methodology we cannot be sure the assumptions will hold far into the future. One influencing factor is the increase of one- and two-person households; despite using smaller units, these tend to have more square feet per person as even the smallest apartment can't shrink certain critical features like the size of bathrooms that have to be ADA accessible.

4.4.2 Population growth

We used Woods & Poole[2] population projections for 2030 and 2050 for Tompkins County. Woods & Poole follow a standard economic approach for their regional demographic and economic projections called the 'export-base' approach. Given the availability of regional data, 'export-based' approach remains one of the most reliable projection approaches.

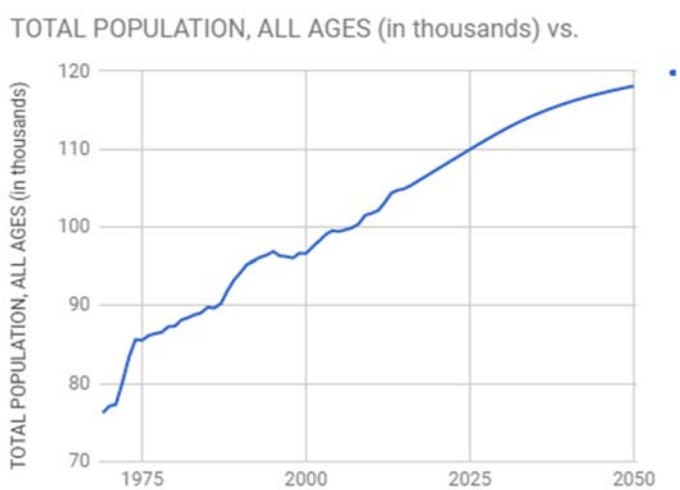


Figure 20. Total Population, Tompkins County, 1975-2050

[2] Woods & Poole Economics, Inc. is a small, independent corporation that specializes in long-term county economic and demographic projections. Source: https://data.sagepub.com/sagestats/html/public/WP%20Methodology%202016.pdf .

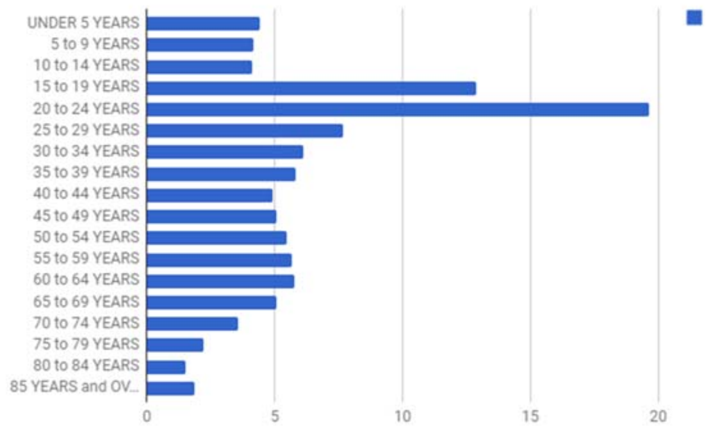


Figure 21. Population Distribution by age, Tompkins County, 2017

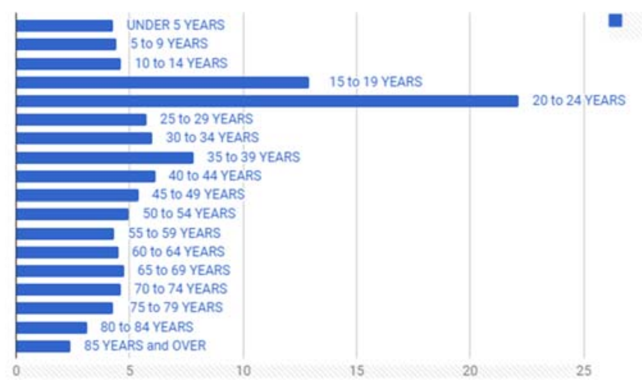


Figure 22. Population Distribution by age, Tompkins County, 2030

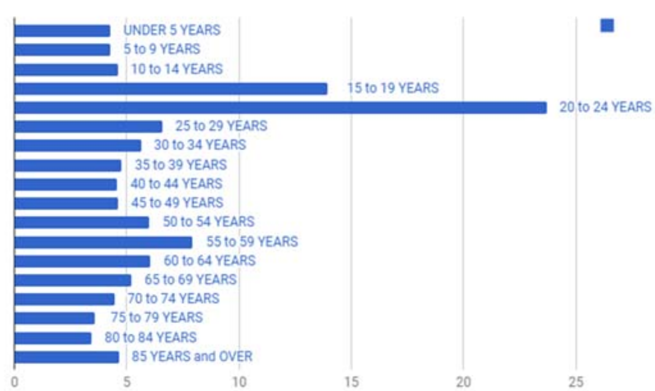


Figure 23. Population Distribution by age, Tompkins County, 2050

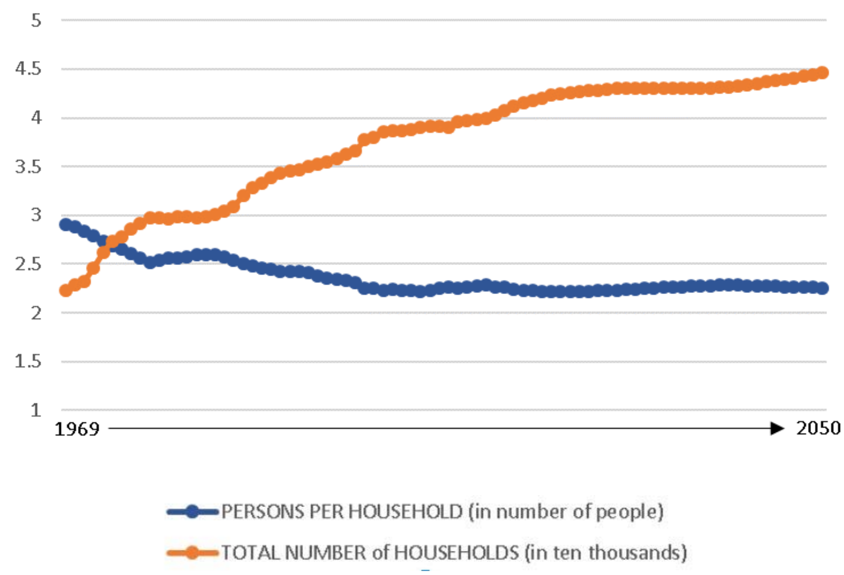


Figure 24. Household number and size change, 1969 to 2050. Source: Woods & Poole Economics, Inc.

We find that the overall population is expected to increase by approximately 10% between 2017 and 2050, resulting in an increased demand for housing, commercial services, water, and energy. The highest proportion of population falls between the age group of 15 to 24 years. The population in this age group is expected to increase by approximately 20% between 2017 and 2050. The 15-24 age group may be a major driver for the residential housing market throughout the region. An increase in the number of households with a decreasing household size indicates an increase in one and two person households. With many individuals in the 15 to 24 years age group as well as seniors living as one and two person households, the expected residential demand for smaller dwelling unit types including studios and apartments is expected to increase relative to large single-family homes.

4.4.2.1 Residential building area

We first calculated the population growth rate between 2015 to 2030, and 2015 to 2050, respectively, for Tompkins County using Woods & Poole time series data. The population growth rates for 2030 and 2050 were then multiplied with the 2015 population of the City and the Town to estimate the population for 2030 and 2050. Residential building area per capita was calculated for 2015. Residential building area per capita was then multiplied by the population estimates for 2030 and 2050 to project the total residential building area for both the City and the Town for 2030 and 2050, respectively.

For the residential building area estimates, we assume that the population growth rate in the City and the Town of Ithaca would remain the same as that of Tompkins County. In recent decades, the population growth in the City of Ithaca has been low despite growth in Tompkins County. In a 2015 interview with Brian Crandall of the Ithaca Voice, Megan Wilson, Senior Planner with the City of Ithaca stated, "In 1950, approximately 50% of Tompkins County residents lived within the city; today (2015), that number has fallen to 30%. At the same time, the city remains an employment center, and more than 13,000 people commute into the community every day." We want to encourage more people to live within the city, closer to jobs and services. Population growth rate similar to Tompkins County serves as a goal to maintain a higher population growth rate in the City of Ithaca. In addition, to better understand the distribution of building area devoted to uses that most people consider to be residential, we have included residential uses considered to be "Commercial" under New York State land use classifications under the *residential building area* in our analysis.[3] To avoid duplication, the area of such property types have been eliminated from the commercial building area analysis.

We also assume that the residential area per person would remain the same in the future as it is now. In reality, the building area per person may increase or decrease in the future. For example, as the number of households in the future increases with a decreasing household size, demand for studio and one bedroom apartments is expected to rise, and the demand for large single-family homes is expected to fall. It may appear that this would decrease the residential building area per person. However, new suburban single-family homes tend to be significantly larger than historic homes in urban neighborhoods, and even apartments are trending toward having an increased number of bathrooms relative to the number of bedrooms (this trend exists in student focused apartments as well as luxury apartment markets). The various Housing Needs Assessments performed by the Danter Company for the Downtown Ithaca Alliance, the City of Ithaca, and Tompkins County identifies additional closet space and additional bathrooms as amenities in high demand. Such trends may outweigh any decrease in average unit size. However, these changes in demand and user behavior are unforeseeable, and have not been accounted for in this study.

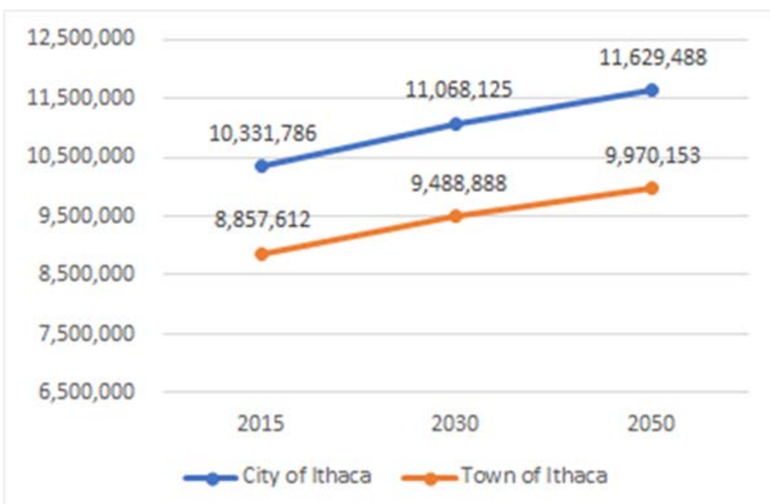


Figure 25. Projected Residential Building Area (in sq. ft)

[3] Apartments (commercial property use type 411 as per the NYS property use codes) have been included in the residential building area. Sixty percent (60%) of building area of detached row type and attached row type (commercial property use types 481 and 482, respectively) has been included in the residential building area, and the remaining 40% in the commercial building area based on a survey of such property types in the City of Ithaca.

The residential building area in the City of Ithaca and the Town of Ithaca is expected to increase by 13% between 2015 and 2050 owing to an increase in the total population of the city and the Town. The rate of employment growth will likely continue to outpace the rates of housing and nonresidential construction.

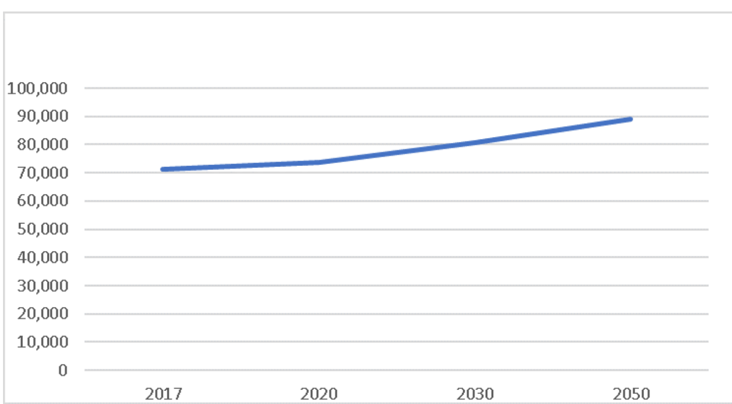
4.4.3 Non-Residential Development and Market Analysis

The development forecasts used in this study are based on projections of economic growth from the New York State Department of Labor Quarterly Census of Employment and Wages (QCEW), the New York Regional Economic Analysis Project (REAP), and the 2017 Complete Economic and Demographic Dataset by Woods & Poole Economics, Inc., a proprietary database containing more than 900 economic and demographic variables for every county in the United States for every year from 1970 to 2050. We first looked at the Woods & Poole employment projections for the different economic sectors in Tompkins County. We then use this data to estimate the building area for commercial, community-service, and industrial land use for 2030 and 2050 in the City and the Town of Ithaca, respectively.

Historically, the data series shows that total employment in the Ithaca Metropolitan statistical area (MSA)[4] took a hit in the 2008-2009 recession, but bounced back to that level in 2016 and is predicted to continue to rise at the rate of approximately 600 new jobs annually through 2050 according to Woods & Poole 2017 projections.

4.4.3.1 Employment growth

We used the Woods & Poole[5] employment projections for 2030 and 2050 for Tompkins County. Woods & Poole follow a standard economic approach for their regional demographic and economic projections called the 'export-base' approach. Given the availability of regional data, 'export-base' approach remains one of the most reliable projection approaches.



[4] A Metropolitan statistical area (MSA) is a geographical region with a relatively high population density at its core. MSAs are defined by the U.S. Office of Management and Budget (OMB) and used by the U.S. Census Bureau and other federal government agencies for statistical purposes.

[5] Woods & Poole Economics, Inc. specializes in long-term county economic and demographic projections. Source: https://data.sagepub.com/sagestats/html/public/WP%20Methodology%202016.pdf .

Figure 26. Total Projected Employment in Tompkins County. Source: Woods & Poole

The total employment is expected to increase by nearly 27% between 2017 and 2050. The increase in employment acts is an indicator for an overall increase in population of Tompkins County. The rate of employment growth will likely continue to outpace the rate of residential construction. Increased employment means an increased requirement of office, retail, industrial and community service building area.

4.4.3.2 Non-residential building-area growth

This section presents the building area estimates for commercial, community service and industrial land use for 2030 and 2050 for the City and the Town of Ithaca. We first calculated the employment growth between 2015 to 2030 and 2015 to 2050 using the Woods & Poole time series data for Tompkins County. Employment growth expectations were calculated by combining projections for each Bureau of Labor Statistics employment sector category to approximate groupings based on the New York State Land Use Codes that identify the use of every parcel in the County Parcel dataset. We calculated the total number of employees for each sector within each Land Use classification in 2015 for the City of Ithaca and the Town of Ithaca, and applied a growth rate in each industry to arrive at an expected number of employees in 2030 and 2050. The expected number of employees in each Land Use Code was multiplied the by the average 2015 building area per employee in that Land Use Code to arrive at an expected building area in 2030 and 2050. For the purposes of these calculations we assumed that each sector's employment growth rate in the City and the Town of Ithaca would be the same as that sector's growth rate in Tompkins County, this is a necessary assumption as employment projections are only available at the County level. This assumption has not always held true historically, for much of Tompkins County's early history job growth was focused in the Village of Ithaca, and then the City after its incorporation in 1888, and in the mid-20th century economic development was largely focused outside of the City of Ithaca, however, it is a stated goal of the City, Town, and County to encourage and increase economic development in areas with the most existing infrastructure and recent trends have shown substantial growth within the transit served areas of the City and Town, we expect development to be spread more evenly across the county in future decades based on the County's nodal development scenarios.

For the commercial, community service and industrial land use, projected employment numbers for each economic sector were classified into the most suitable land use category using the NY state land use codes. For each land use, we calculated the building area per capita for 2015. The building area per capita was then multiplied with the employment estimates of 2030 and 2050 to project the total building area of commercial, community service and industrial land use for the City and the Town of Ithaca.

The Commercial property use was subdivided into office and retail property use as the two types have significantly different energy and water requirements. We eliminated storage space, parking garage, and parking lots from the commercial building area as these property types do not have significant energy (for example heating, electricity etc.), and water requirements compared to other buildings. As previously mentioned, to better understand the distribution of building area devoted to uses that most people consider to be residential, we have removed residential uses considered to be "Commercial" under New York State land use classifications (apartments) and have incorporated those buildings in the residential building area analysis[6].

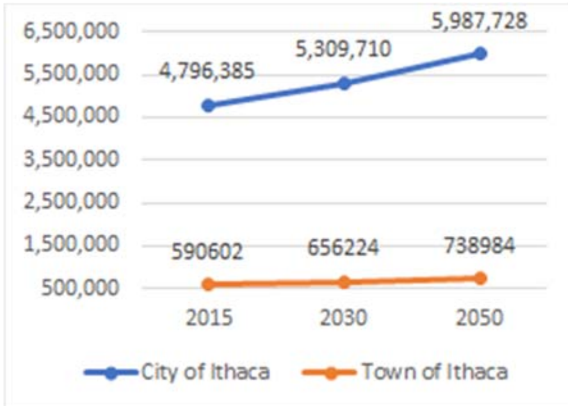


Figure 27. Projected commercial building area (in sq. ft)

Year	2030	2050
City of Ithaca	11%	25%
Town of Ithaca	11%	25%

Table 5. Growth rate of commercial building area

The commercial building area in the City of Ithaca and the Town of Ithaca is expected to increase by 11% by 2030 and 25% by 2050 owing to an increase in employment and demand for office, services, and retail.

[6] Apartments (commercial property use type 411 as per the NYS property use codes) have been included in the residential building area. 60% of building area of detached row type and attached row type (commercial property use type 481 and 482 respectively) has been included in the residential building area, and the remaining 40% in the commercial building area based on the author's experience and survey of such property types in the City of Ithaca.

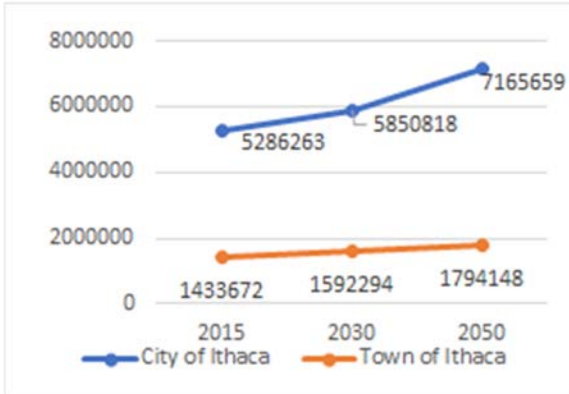


Figure 28. Projected community-service building area (in sq. ft)

Year	2030	2050
City of Ithaca	18%	36%
Town of Ithaca	18%	36%

Table 6. Growth rate of community-service building area

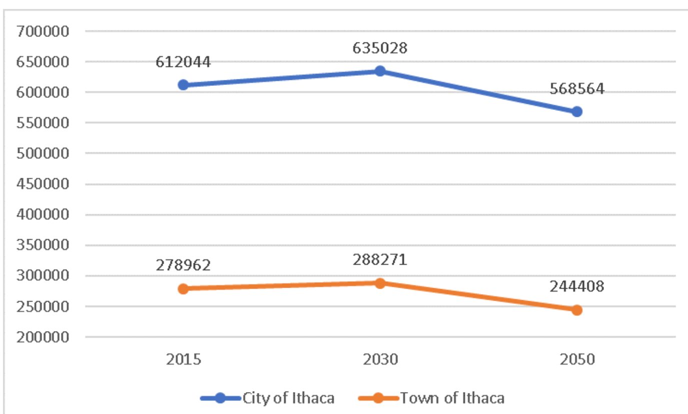


Figure 29. Projected Industrial Building area (in sq. ft)

Year	2030	2050
City of Ithaca	4%	-11%
Town of Ithaca	3%	-12%

Table 7. Growth rate of Industrial building area

The industrial building area is the only sector where we project a reduction in building area. We project a building area decline in the City of Ithaca of 11% from 2015 to 2050, and a decline of 12% for the Town of Ithaca. This projection is consistent with trends of Ithaca's industrial space being converted to other uses including commercial and residential space.

4.5 Energy and Water Usage

4.5.1 Energy

This section of the report presents the analysis of energy demand for 2030 and 2050 for the residential and non-residential uses in the City and Town of Ithaca. To estimate the long-term expected energy requirements of the community, we used the 2015 Residential Energy Consumption Survey (RECS) and Commercial and Business Energy Consumption Survey (CBECS) administered by U.S. Energy Information Administration (EIA) for per foot energy demands of residential, commercial, and community services property types. RECS and CBECS are a nationally representative sample of housing units. For the 2015 survey cycle, EIA used web and mail forms – in addition to in-person interviews – to collect detailed information on household energy characteristics, including the housing unit, usage patterns, and household demographics. This information is combined with data from energy suppliers to estimate energy costs and usage for heating, cooling, appliances, and other end uses for these housing units. We multiplied the building area estimates (from the building area forecast) with the EIA per square foot energy requirement to estimate the total energy requirement for residential, commercial, and community service property use types.

Apart from building area, energy demand also depends on user behavior. There are a range of factors that could impact user behavior: stringent energy codes; changing technology; changing energy costs; increased affordability of renewable energy such as solar panels; personal motivation etc. User behavior is extremely difficult to quantify and is not accounted for in this study. In order to compare apples to apples for our baseline future energy use forecast for a business as usual scenario we assume future energy use per square foot to stay the same. In other words, unknowable factors such as change in energy codes, technology, etc. are not factored into this analysis as an expected baseline. The impact of these factors is difficult to account for, especially at the household or independent business level. In addition, changes in energy use due to unforeseeable future events such as natural disasters, in-migration, etc. have not been considered. Overall, the energy demand forecast calculations are based on the assumption that the energy requirement per square foot in the future remains constant. In future sections of the report possible changes to energy density due to some expected trends will be more fully explored.

4.5.1.1 Residential Energy Demand

This section presents the total energy demand by the residential property type in the City and the Town of Ithaca for 2030 and 2050. We used the residential building area projections for 2015, 2030, and 2050, and multiplied expected building area by the per foot energy usage for residential property type as per RECS.

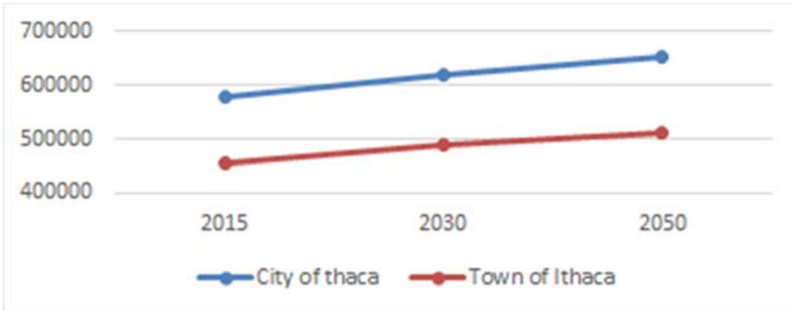


Figure 30. Residential Energy Demand (in million BTUs)

We find that the estimated residential energy demand for the City and the Town of Ithaca in 2015 was approximately 579,000 million BTUs and 456,000 million BTUs respectively. This estimate lines up reasonably with NYSEG's energy consumption data[7] for the City and Town of Ithaca, i.e. approximately 700,000 million BTUs and 430,000 million BTUs respectively. The Cleaner Greener Southern Tier Regional Sustainability Plan report states that residential property use type makes up for 28% of the total energy end use. As per our estimates, residential energy demand makes up approximately 34% of the total residential, commercial and community service energy demand combined together for both the Town and the City. This means that residential demand would make up close to 30% of the total energy demand of the City and the Town (with energy demand of other sectors such as industrial, public services etc. combined). The residential energy demand is expected to increase linearly between 2015 and 2050 for both the City and the Town.

4.5.1.2 Non-Residential Energy Demand

This section presents the total energy demand by the non-residential property types (commercial and community services) in the City and the Town of Ithaca for 2030 and 2050. We used the non-residential building area projections for 2015, 2030, and 2050, and multiplied it with the per foot energy usage for non-residential property types as per CBECS.

As per CBECS, the retail and office commercial spaces have different energy requirements. Thus, we divided the commercial property types into retail and office space depending on the spatial use of the activity. As mentioned earlier, we then multiplied the building area projections with the per foot energy usage for office and retail space as per CBECS.

[7] Community-wide Utility Energy Consumption Report 2010-2015.

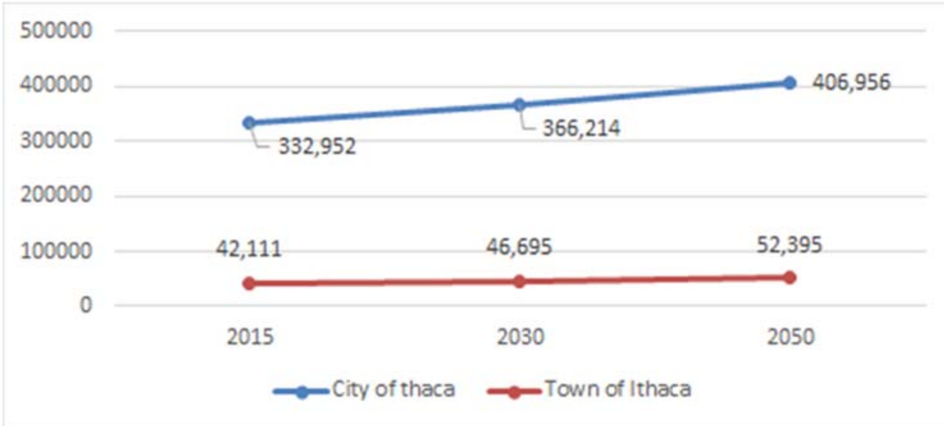


Figure 31. Commercial Energy Demand (in million BTUs)

Commercial Energy Consumption (in million BTUs)				
		2015	2030	2050
	Office	86177	96653	112175
	Retail	246775	269561	294780
City of thaca	Total	332952	366214	406956
	Office	18553	20916	24157
	Retail	23557	25779	28238
Town of Ithaca	Total	42111	46695	52395

Table 8. Commercial Energy Demand by Office and Retail use

We find that the estimated commercial energy demand for the City and the Town of Ithaca in 2015 was approximately 330,000 million BTUs and 42,000 million BTUs respectively. The Cleaner Greener Southern Tier Regional Sustainability Plan report states that commercial property use type makes up for 17% of the total energy end use. As per our estimates, commercial energy demand makes up approximately 20% of the total residential, commercial and community service energy demand combined together. This means that the commercial demand would make up close to 17% of the total energy demand of the City and the Town (with energy demand from other sectors such as industrial, public services etc. combined). In the City, retail energy demand is a substantially larger component of total commercial energy consumption, while in the Town retail uses only slightly more energy than office space, this difference is directly related to the fact that a significantly higher percentage of commercial building area in the city is retail space.

Community services use the third largest building area in the City, and second highest in the Town. As mentioned earlier, we multiplied the building area projections for community services with the per foot energy usage as per CBECS.

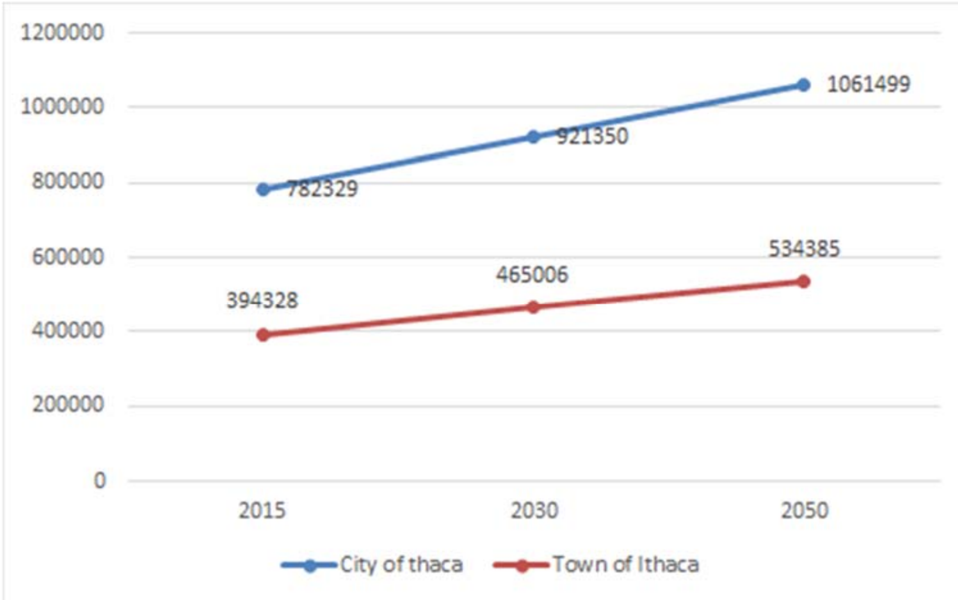


Figure 32. Community Services Energy Demand (in million BTUs)

Projections of energy use if the City of Ithaca and Town of Ithaca adopt the proposed green building policy are provided in Section 1.5.

4.5.2 Water

This section of the report presents the analysis of water demand for 2030 and 2050 for the residential and non-residential uses in the City and Town of Ithaca. To estimate the long-term expected water requirements of the community, we used the 2015 parcel-wise quarterly water consumption data provided by the City of Ithaca. A major limitation faced with estimating the water demand were incomplete datasets. Water consumption data for many parcels was missing in the quarterly datasets. Keeping this limitation in mind, we were able to estimate the water demand by using annual average water-use per-foot for each property use type. To do this, we considered those parcels that have a built area, and whose water consumption data was complete within a quarterly dataset. We eliminated parcels with -0- building area, negative or -0- water consumption,[8] as well as outliers where there was a huge variance from the building type's average use (such outliers are likely the result in changes in meter technology or other errors). We calculated the total water usage for residential, commercial and community services in each quarter. We then divided the water use for each use type by their building area (given in the dataset) to get the average quarterly water-use per-square-foot for each property type. Because of issues in the dataset and the way water use data is collected there was not consistent data for every building for every quarter so calculating average use per square foot separately for each

[8] A building cannot have negative water use over a quarter. A -0- or negative water reading may imply an empty building or parcel, or an issue with the water meter.

quarter was the most accurate method. The average water-use from the four quarters was combined to deduce the annual average water-use per-foot for each building type.

A similar process was applied to water consumption data provided by the Town of Ithaca with consumption for 2017, however the town water data was extremely inconsistent with other tested data. For the residential parcels that water consumption data was available for, the average per square foot consumption was about 26 gallons/sq ft, while the City of Ithaca's average was just over 50 and national averages are in the upper 50 gallons/sq ft. This may be the case for a number of reasons, the average home size per person in the Town is significantly higher than the average home size per person in the city, however none of the tested reasons fully account for the discrepancy. We expect that the majority of future development in the Town, based on the Town's Comprehensive Plan, will be more similar to development in the City than it is to existing development in the Town so we have decided to apply City water consumption rates (that are more in line with regional and national datasets) to the expected future development in the Town.

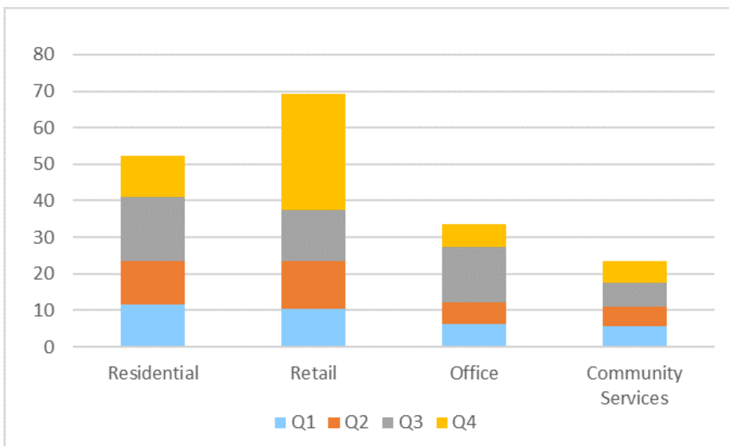


Figure 33. Quarterly water-use per-foot in the City of Ithaca, 2015

The water demand projections assume that the rate of use relative to building area will be constant, in reality, water usage demand is based more on per capita (per person) consumption than per foot usage. Water demand per foot may change in a number of scenarios; for example, we project that the number of households in the City and the Town are likely to increase with a decreasing household size leading to a higher demand for apartments instead of single-family homes. In such a scenario, if the water use per person remains the same, the water usage per foot would increase if the residential area per person decreased and vice versa. With that said, consumption per square foot of building at the municipal scale is not likely to change substantially and for the use as a simple baseline for scenario comparison this tradeoff is reasonable.

4.5.2.1 Residential Water Demand

This section presents the estimated water demand for residential buildings in the City and the Town of Ithaca. We multiplied the residential annual water use per foot use with the estimated residential building area for 2015, 2030, and 2050.

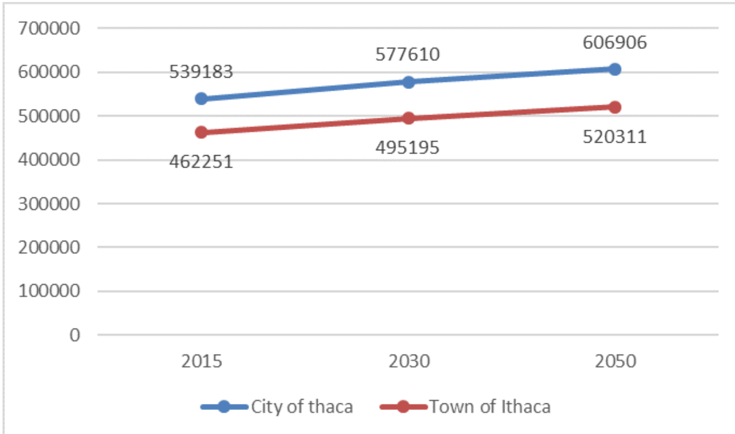


Figure 34. Residential water demand (in thousand gallons)

We find that the residential water demand in the City and the Town is expected to increase linearly for the City and the Town between 2015 and 2050.

4.5.2.2 Non- Residential Water Demand

In this section, we present the estimated water demand for commercial buildings in the City and the Town of Ithaca. The water requirements for retail and office spaces are different. We calculated the annual water use per foot for retail and office spaces separately for 2015, 2030, and 2050 based on each uses average water consumption per square foot.

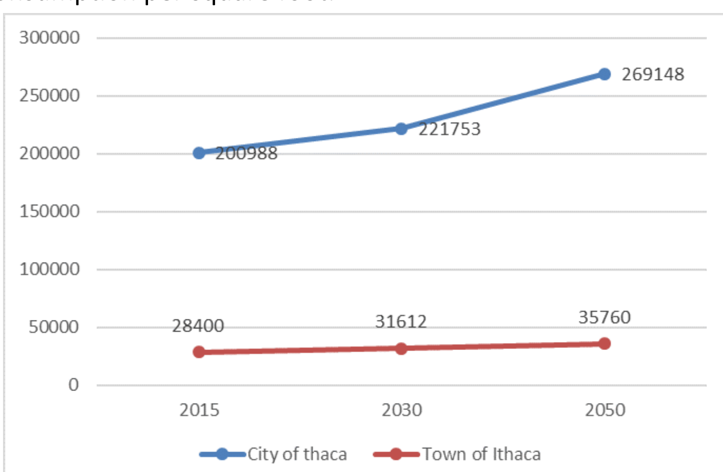


Figure 35. Commercial water demand (in thousand gallons)

Commercial Water Consumption (in thousand gallons)				
		2015	2030	2050
City of thaca	Office	76887	86207	109449
	Retail	124101	135546	159699
	Total	200988	221753	269148
Town of Ithaca	Office	16553	18652	21558
	Retail	11847	12960	14201
	Total	28400	31612	35760

Table 9. Commercial Water Demand by Office and Retail use

We find that the water demand for the City increases at a higher rate than the Town between 2015 and 2050. The water demand in both the City and the Town is driven largely by the increasing retail water demand.

For the community services water demand projections, we multiplied the annual water use per foot for community services with its estimated building area for 2015, 2030, and 2050.

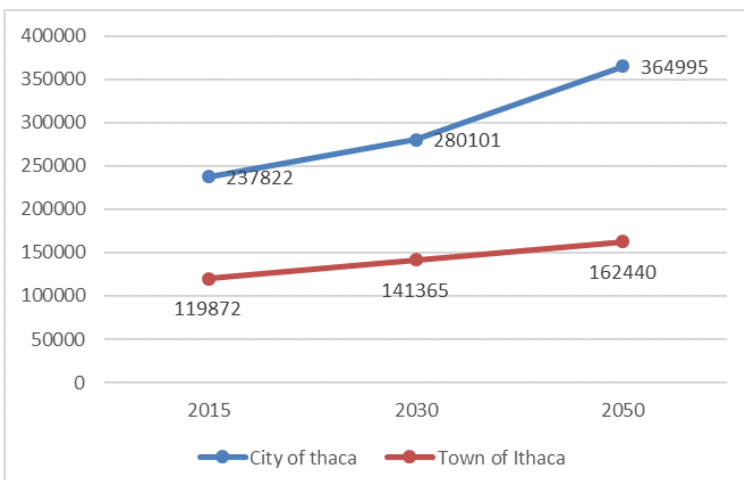


Figure 36. Community Services water demand (in thousand gallons)

We find that the water demand for community services buildings in the City increases at a higher rate than that of the Town.

4.6 Benchmarking and Data Limitations

While there is adequate information to move forward with a Green Building Policy in the City of Ithaca and Town of Ithaca now, to be most efficient such policy will require ongoing monitoring and evaluation with more complete data than is currently available. Data collection should be improved in the areas of building characteristics and individual building energy use benchmarking, particularly the latter, as it is a foundational element of energy management strategy.

The City's FileMaker Pro building permitting system has capacity for inventorying basic building characteristic information, including siding materials, foundation, roof, heat type / BTU, water heaters / BTU, and electrical system but these values were generally missing in the data, indicating an opportunity area for establishing a protocol for filling in data gaps. The Town of Ithaca uses Municity, an advanced database for processing building permits that has significant capacity for monitoring the size and performance of new and existing buildings but that would require better record keeping and data input for all projects to be as useful as possible for the evaluation of green building related policies.

The distributed nature of buildings in addition to perceived and real permitting costs and time requirements for developers make it an especially hard sector to regulate. However, robust and accurate data collection is critical to achieving optimal energy use in the City and Town. Without it, it is difficult to estimate the impact of a proposed green building policy and to assure that the incentives offered by the City and Town, respectively, lead to the optimized energy use and public benefits that are desired.

4.7 Projections in the Context of Local Plans

To understand the range of variation between this report's projections for growth and other local long range estimates it is useful to compare the various published expectations. While none of the existing local plans fully describe buildout scenarios in the way that this report attempts to quantify, the context is helpful to understand.

The City of Ithaca published Ithaca Planning Influences report[9] in 2012 as part of their Comprehensive Plan process. The Planning Influences report references Cornell's Program on Applied Demographics (PAD) projections for Tompkins County. According to this source the population of Tompkins County was expected to grow very slowly from 2011-2020 and then to decrease by 0.8% and 2.3% by 2030 and 2050 respectively. The PAD projections predict the total population of Tompkins County to be 100,893 in 2030, and 98,606 in 2050. The Woods & Poole projections used our baseline expectations of buildings in Ithaca suggest that the population of the County would increase to approximately 112,000 in 2030, and to 118,000 by 2050. The reason for a difference in the projected population for the County are likely a difference in methodology, with Tompkins County's strong economic performance in recent years and the expected growth of major employers we believe planning for more development, rather than less, is the most prudent approach for the Green Building Policy. The Planning Influences Report informed the Comprehensive Plan, however, the Comprehensive Plan does not include any specific targets for construction, or expected development within any specified timeline. The Planning Influences Report also includes an analysis of infill building potential based on then existing zoning and an extremely conservative metric of assuming buildings would only be torn down for redevelopment if the land under

[9] https://www.cityofithaca.org/DocumentCenter/Home/View/170

the building was worth more than the improvements, however, with the average building in Ithaca being worth five or six times more than the land it sits on and the recent history of variances and zoning changes, in addition to the significant areas of character change called for in the City of Ithaca and Town of Ithaca comprehensive Plans, we believe that looking at demand for building either housing or space for expected business growth is a stronger predictor of future building expectations.

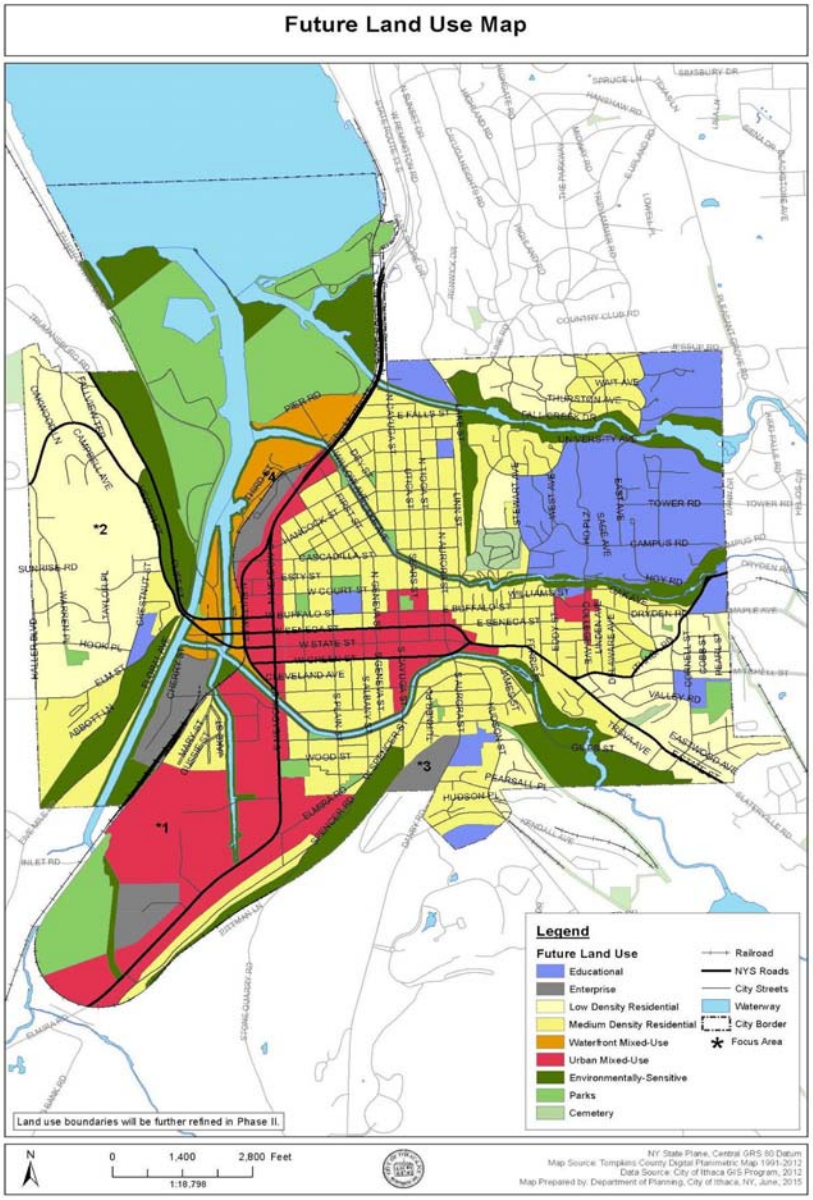


Figure 37. City of Ithaca Future Land Use Map

The Town of Ithaca's comprehensive plan includes an appendix with some population growth calculations. The Town projected a 2030 population of 22,605, this reports methodology projects a 2030 population of 21,697. The Town of Ithaca projected a 24% increase in housing units every 10 years with an expectation of 1,029 new housing units by 2030. While our projections are slightly smaller than the Town's internal projection, within the Town of Ithaca's Comprehensive Plan Appendix E Population and housing projections the analyst demonstrates that applying the methodology that they used for the 2030 projection to 2000 census numbers would result in an expected population of 17,972 in 2010 while the census actually found a population of 16,201.

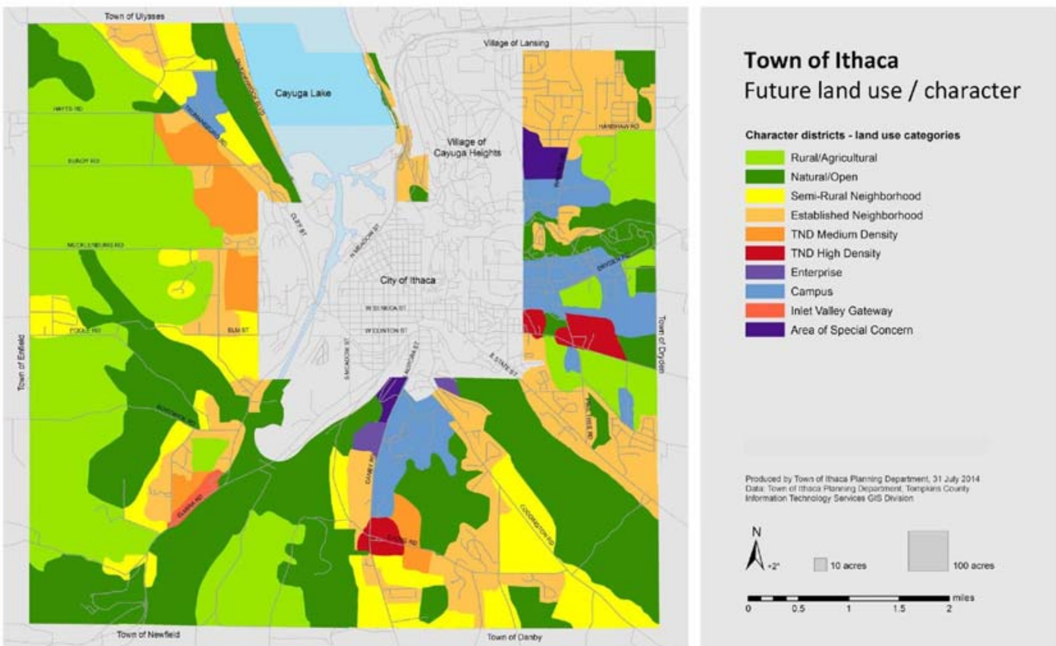


Figure 38. Town of Ithaca Comprehensive Plan Future Land Use Map

According to the 2017 Tompkins County Housing Strategy, there is currently a desire for an additional 1-200 subsidized senior apartments, 200 new rental units per year through 2025, 300 new single family homes in the $150k and up price range per year through 2025, 80 new condominiums per year, and an existing deficit of 1,400-1,500 purpose built student housing beds, and that does not include the demand for new luxury units. The Downtown Housing Strategy, prepared for the Downtown Ithaca Alliance in 2011, projects that over the next 5 years there is overall housing demand for up to 1,350 units in the Downtown area (consisting of up to 350 for-sale units and up to 1,000 rental units). This equates to an annual demand of as many as 70 for-sale units and 200 rental units per year. As per this report, it is estimated that there will be new 2000 jobs in Tompkins County by 2020, 5000 by 2030, and 10,000 new jobs in the County by 2050, an annual increase of just under 300. The Ithaca Planning Influences report of 2012, estimated a more aggressive 558 new jobs per year from 2012-2022.

Discrepancies in the various long range projections available should be expected, there are no crystal balls and communities and economies are more complex than any mathematical model can hope to capture. Compared to the various long range plans available for the City, Town, and County, we believe this report's projections to be conservative in terms of not significantly over or under estimating the potential impacts of the proposed Green Building Policy.

5 Conclusion

This report represents the culmination of work performed to date as part of the Ithaca Green Building Policy project. The final policy recommendations are based on the other elements of this report. The survey of Ithaca's existing building stock and the projections of future development provided a "business as usual" baseline. The study of green building standards provided insight into potential economic, social and environmental impacts of policies. A robust public outreach process ensured that stakeholder input was captured and incorporated into the final policy recommendations. The resulting Ithaca Green Building Policy, which is proposed to go into effect as soon as possible, and to ramp down to net-zero buildings by 2030, aims to maintain affordability and flexibility for the developer while dramatically reducing carbon emissions from new construction.

Additional work, such as research and stakeholder outreach, is needed to provide a level of detail sufficient to develop code language for a green building policy that can be considered for adoption by Ithaca's City Council and Town Board. However, it is important to stress that the need for careful vetting of any proposed legislation must be balanced with the need to act quickly to address climate change amidst a local building boom. A thorough but swift codification and adoption process will give the Town and the City the best chance of meeting their ambitious climate goals and securing Ithaca's reputation as a leader in climate action.

5 Glossary

Biomass - “different types of organic material that can be processed and burned to produce energy…. Biomass is considered a renewable resource…. Biomass, however, is not necessarily a carbon-neutral resource. A determination of carbon neutrality requires an assessment of the particular conditions under which a type of biomass (e.g., feedstock) is grown and consumed.” EPA

EnergyStar - an energy efficiency program of the U.S. EPA, including certification for energy products, like lighting and appliances, as well as whole-building energy ratings.

EUI - Energy Use Index. A measure of the total energy used by a building in a year, per square foot of floor area. All energy uses (including electricity) are converted into units of kBtu/SF/year.

Fossil fuels - Fuels derived from fossilized carbon-based sources. For green buildings, these are used primarily for heating. For buildings, fossil fuels most prominently include fuel oil, natural gas, and propane.

GBCI - Green Business Certification Inc. is an American organization that provides third-party credentialing and verification for several rating systems relating to the built environment, including most prominently LEED.

Heat pumps - An electrically-driven heating and cooling system that most typically extracts heat from the outdoor air or from the ground in order to heat buildings.

HERS - Home Energy Rating System. A scoring index for residential energy efficiency, developed and adminstered by RESNET.

IECC - International Energy Conservation Code.

LEED - Leadership in Energy and Environmental Design. A green building rating/certification system, developed by the U.S. Green Building Council (USGBC) and administered by Green Business Certification Inc (GBCI).

RESNET - Residential Energy Services Network. Developer and administrator of the HERS index residential energy rating system.

Renewable energy - Energy that is produced from sources regarded as renewable, including most prominently solar photovoltaic systems, solar thermal systems (typically hot water), wind-generated electricity, and biomass for heating.

Social Impact - "A significant, positive change that addresses a pressing social challenge. Having a social impact is the result of a deliberate set of activities with a goal around this definition." University of Michigan, Center for Social Impact, http://socialimpact.umich.edu/about/what-is-social-impact/

Stretch Energy Code - An energy code recently developed by NYSERDA that can be used by local municipalities to reduce energy use below what is required by the New York State Energy Conservation Code. The 2015 Stretch Energy Code targets 10% lower energy use. A 2018 version is in development that targets 20% lower energy use. The stretch energy code has a set of mandatory requirements, separate core requirements, and a set of additional energy efficiency options from which one must be chosen. The core requirements are met through either “prescriptive” compliance (for example, additional insulation) or “performance” compliance (meeting specific performance goals on a whole-building basis).

USGBC - U.S. Green Building Council. Developer of the LEED green building rating system.

Ventless heat pump clothes dryer - A type of electric clothes dryer that efficiently removes heat from clothes by condensation, and so does not require a vent.

WaterSense - A water conservation program of the U.S. EPA.

WELL - A green building wellness certification system, developed and administered by the International Well Building Institute.