Town of South Windsor

Municipal, Residential and Business Energy Plan.

July 2019

NorCap South Solar Facility

South Windsor

1540 Sullivan Ave

South Windsor, CT 06074

TABLE OF CONTENTS

1. Executive Summary 4

2. Purpose of Energy Plan 7

2.1. Clean Energy Community Commitment 7

2.2. South Windsor Energy Committee 7

2.3. Sustainable CT 8

2.4. Adoption and Updates of Plan 8

3. Municipal Energy Plan 9

3.1. Municipal Energy Tracking and Management 9

3.1.1. Baseline Energy Use 9

3.1.2. Recent Energy Use 10

3.1.3. Overview of Energy Use Actions – Past and Future 11

3.1.4. Renewable Energy Sourcing 13

3.1.5. Reporting Future Energy Use and Sourcing 14

3.2. Municipal Energy Goals 15

3.2.1. Previously Adopted Goals 15

3.2.2. Municipal Energy Use Goals 15

3.2.3. Municipal Renewable Energy Goals 17

3.3. Energy Management 19

3.3.1. Energy Monitoring 19

3.3.2. Peak Demand Reduction Goals and Actions 19

3.4. Grants and Other Incentives 19

3.4.1. Federal Renewable Energy Tax Incentives 19

3.4.2. State Energy Incentives 20

3.4.3. Energy Savings Performance Contracts 20

3.4.4. Other Grants and Incentives 21

3.5. Fleet Vehicle and Equipment Management 21

4. Residential and Business Energy Plan 22

4.1. Residential and Business Energy Tracking 22

4.2. Residential and Business Renewable Energy Tracking 23

4.2.1. Solar Photovoltaic 23

4.2.2. Air Source and Ground Source Heat Pumps 24

4.2.3. Biofuel 24

4.3. Residential and Business Energy Goals *24*
4.4. Residential Energy Programs *25*
4.4.1. Energize CT 25
4.4.2. Solarize CT 25
4.4.3. Low- and Moderate-Income Energy Assistance 26
4.4.4. Solar for All 26
4.4.5. Residential Energy Education 26
4.5. Business Energy Programs *26*
4.5.1. Commercial Property Assessed Clean Energy (C-PACE) 26
4.5.2. Small Business Energy Advantage and New Construction Program 27
4.5.3. OEEB Business Visits 27
4.5.4. Business Energy Education 27
4.6. Energy Supportive Zoning and Ordinances *27*
4.6.1. Current Zoning Regulations 27
4.6.2. Potential Changes to Zoning Regulations and Ordinances 28
4.7. Grants and Other Incentives *29*
Appendix A Actions Taken and Contemplated 30
Appendix B Clean Energy Communities Pledge 35
Appendix C Connecticut Renewable Portfolio Standard 37
Appendix D Energy Conversion Factors 39
Appendix E Source-Site Ratios for Various Energy Types 41
Appendix F Useful Websites 42

1. Executive Summary

This South Windsor Municipal, Residential and Business Energy Plan outlines the energy goals that the Town will seek for the period ending calendar 2023. During that year, the Town's Plan of Conservation and Development and this plan are required to be updated.

In its June 2, 2014 resolution committing to support the Energize South Windsor Initiative, the Town Council pledged "to reduce [the Town's] municipal building energy consumption 20% by the year 2018 and voluntarily purchase 20% of its municipal building electricity from clean, renewable energy sources by the year 2018" with FY 2010 as the baseline year. (For technical reasons the baseline year has been changed to calendar 2010.)

Both of these goals have been met:

- Between the baseline year and calendar 2018, building energy use intensity decreased from 70.43 kBtu/ft^2 to 51.88 kBtu/ft^2, a 26% reduction. (One kBtu is 1000 British thermal units or the equivalent of 3,412 kilowatt-hours of electric energy.)
- In calendar 2018, the NorCap South solar installation from which the town obtains virtual net metering credits produced 28% of the Town's electricity consumption. Considering that the Town' generation supplier obtains 24% of the remaining electricity from renewable sources, approximately 44% of the Town's electric energy comes from renewable sources.

In addition, the Town has realized energy savings in areas other than buildings.

- By authorizing the conversion of cobra-head streetlights to LED, the Town has reduced streetlight consumption by 35%. The associated Council resolution specified that LED streetlight cost savings be reinvested in energy savings.
- While sewer system energy consumption increased by 9% since 2012 (first year after the sewer plant upgrade), influent increased by 30%. Hence, the sewer system's energy intensity (kBtu/kgal) decreased by 16%.
- Overall, the Town reduced its energy consumption by 17%.

The Town has sponsored two Energize CT programs and two Solarize CT programs for residents in addition to promoting programs such as C-PACE and Small Business Energy Advantage programs for businesses and non-profits. As a result of these programs as well as a general appreciation of the savings to be had by smart energy choices,

- Since 2010, commercial, industrial and residential electricity consumption, per customer, decreased by12%, 6% and 13%, respectively. On the other hand, per-customer use of natural gas increased substantially in the commercial and industrial sector and remained relatively flat in the residential sector. These trends require further study to understand.
- Approximately 400 residential solar PV (photo-voltaic) installations are either complete or in progress, based on building permits.
- Thirteen commercial and industrial solar PV installations are complete or in progress.

As satisfying as these achievements are, this plan establishes new goals shown in Table 1. The new goals are broken down by categories and, as appropriate, accepted by the departments that manage the respective facilities:

Table 1: 2023 Energy Goals

Annual Goal	**2010 Baseline**	**2018**	**2023 Goal**	**Department**
Reduce municipal building energy use intensity (kBtu/ft^2)	53.40	48.75 -8.7%	44 -18%	Public Works
Reduce school building energy use intensity (kBtu/ft^2)	74.65	50.61 -32.2% ***	45 -37%	BOE Facilities
Reduce fire station energy use intensity (kBtu/ft^2)	85.11	89.58 +5.3%	85 -0%	Fire Department
Reduce sewer system energy use intensity (Baseline is 2012) (kBtu/kgal influent)	15.95	13.34 -16.3%	12 -25%	Water Pollution Control
Reduce sewer system influent relative to 2018 by reducing storm and ground water inflow and infiltration (Mgal)		1010	900 -10%	Water Pollution Control
Reduce streetlight energy use (GBtu)	4.87	3.17 -34.8%	2.53 * -48%	Police Department
Increase renewable electricity sourcing (% of electricity use)	20%	46%	81% **	Public Works and BOE Facilities Department
Reduce commercial electricity use MBtu/customer	232.4	205.0 -12%	200 -15%	Energy Committee outreach
Reduce industrial electricity use MBtu/customer	2709.8	2547.0 -6%	2300 -15%	
Reduce residential electricity use MBtu/customer	29.6	25.7 -13%	24 -20%	
Reduce commercial natural gas use relative to 2018 MBtu/customer		598.6	540 -10%	Energy Committee outreach

Annual Goal	2010 Baseline	2018	2023 Goal	Department
Reduce industrial natural gas use relative to 2018 MBtu/customer		5719.7	5150 -10%	
Reduce residential natural gas use relative to 2018 MBtu/customer		81.9	74 -10%	

* This goal requires cooperation of Eversource to convert decorative fixture streetlights to LED.

** This goal depends on the Town receiving cash-flow positive proposals for a Virtual Net Metering project and four school rooftop solar projects.

*** The 2023 goal assumes all elementary schools, including Pleasant Valley which has not yet gone to referendum, match the EUI of the new Orchard Hill School.

In addition, the Energy Committee will:

- Identify new energy saving projects to be funded by reinvesting the savings from previous energy projects.
- Report on progress to these goals in February for the preceding calendar year and September for the preceding fiscal year.
- Run a residential energy efficiency or renewable energy education program every calendar year.
- Give a business energy presentation to a local business organization every calendar year.
- Advise the Town Council and relevant boards and commissions on possible incentives for adopting renewable energy and exceeding building code requirements for energy efficiency and renewable energy in new construction by December 31, 2020.

2. Purpose of Energy Plan

The purpose of the South Windsor Municipal, Residential and Business Energy Plan is to:

- Establish goals and practices to manage municipal energy consumption with the aim of efficiency, economy, environmental responsibility, and resiliency and
- Promote cooperative actions and broad-scale adoption of renewable energy and energy efficiency practices in the municipal, residential and business sectors.
- Provide energy related resources – in some cases in the appendices. Appendix F lists websites with additional resources.

The following major sections of the plan detail these objectives:

- Section 3 provides the Municipal Energy Plan, which applies to municipal, education and fire department facilities.
- Section 4 provides the Residential and Business Energy Plan which describes outreach efforts to these sectors as well as specific programs designed to assist residents and businesses in reducing energy consumption and adopting renewable energy technology.

2.1. Clean Energy Community Commitment

The Clean Energy Communities program is an Energize Connecticut initiative that incentivizes Connecticut cities and towns to improve energy efficiency and promote the use of clean and renewable energy. Under the program, Connecticut cities and towns pledge to reduce municipal building energy consumption by 20% by 2018 and to voluntarily purchase 20% of municipal electrical needs from renewable sources by 2018. As seen below, these goals have been met and this plan establishes new goals. See Appendix B for South Windsor's pledge to the program

2.2. South Windsor Energy Committee

The Town Council established the South Windsor Energy Committee by resolution on May 19, 2014. The committee meets monthly and is an active group consisting of town staff, elected officials and residents.

The Town Council further defined the role of the committee in a resolution dated January 5, 2015:

> The purpose of this committee shall be to
>
> - Investigate appropriate and cost-effective opportunities for implementing energy efficiency measures in all aspects of South Windsor's public buildings, including operational changes and changes in maintenance or capital improvements. These recommendations shall be forwarded to the Town Council or appropriate municipal agency or official as designated by the Town Council.
> - Research and facilitate the use of clean, renewable energy within the Town of South Windsor.

- Educate South Windsor residents about clean energy options, energy efficiency, and energy conservation.
- Identify appropriate Federal and State incentive and grant programs that provide opportunities for clean, renewable energy, energy efficiency or energy conservation.
- Take advantage of unique opportunities and resources within South Windsor for providing clean, renewable energy to help fulfill local energy needs.

Agendas and Minutes of Committee meetings may be accessed at:

http://www.southwindsor.org/energy-committee

2.3. Sustainable CT

South Windsor participates in the Sustainable CT program. This program encourages towns to "to be thriving, resilient, collaborative, and forward-looking. [Sustainable towns] build community and local economy. They equitably promote the health and well-being of current and future residents, and they respect the finite capacity of the natural environment," as described on the program's website: https://sustainablect.org/. Several action areas in the program relate to energy and this Energy Plan reflects the town's energy-related efforts in these areas:

- 1.6 Participate in and Promote the C-PACE Program
- 6.1 Benchmark and Track Energy Use
- 6.2 Reduce Energy Use Across All Municipal Buildings
- 6.3 Achieve High Energy Performance for Individual Buildings
- 6.4 Increase Use of Renewable Energy in Municipal Buildings
- 6.5 Develop a Municipal Energy Plan
- 6.6 Manage Municipal Fleets
- 6.7 Install Efficient Street Lights
- 6.8 Implement a Community Energy Campaign
- 7.1 Hold a Sustainability Event
- 8.3 Benchmark Energy and Water Use for Multifamily Housing
- 9.1 Optimize for Equity

2.4. Adoption and Updates of Plan

The South Windsor Municipal, Residential and Business Energy Plan was adopted by a Town Council Resolution on July 15, 2019. The Energy Plan will also be reviewed annually and can also be revised at any time by Town Council resolution.

This plan will be submitted to the South Windsor Planning and Zoning Commission for incorporation, by reference, in the Plan of Conservation and Development.

3. Municipal Energy Plan

This section of the plan covers municipal facilities including Town government, recreation, Board of Education, Fire Department and sewer system facilities.

3.1. Municipal Energy Tracking and Management

3.1.1. Baseline Energy Use

South Windsor participated in the CT Clean Energy Communities Municipal Benchmarking Initiative beginning in 2015. As part of that initiative, all Eversource electric and gas accounts were entered into the US Department of Energy's Energy Star Portfolio Manager. Consumption of #2 heating oil was manually entered into Portfolio Manager. In later years, the Energy Committee entered sewer plant influent data (gallons per day) to aid in assessing sewer system performance.

This document uses calendar 2010 for the baseline year. However, in the case of the sewer system, the plan uses calendar 2012 as the baseline. Additional pollution control processes substantially increased the energy requirements of the sewer plant in 2010 and 2011 even though more efficient equipment was employed throughout the plant. Hence, use of 2012 more accurately reflects work by the Water Pollution Control Department to continuously improve plant efficiency in the intervening years.

Table 2 summarizes the baseline energy use for various groups of municipal facilities: Note that Energy Use Intensity can only be calculated for buildings with a meaningful floor area, i.e. whose energy consumption is, with the possible exception of some outdoor lighting, entirely within the building envelope.

Table 2: Baseline Energy Use

Facilities	Total Area ft^2	Electrical Use GBtu	Natural Gas Use GBtu	Fuel Oil Use GBtu	Total Site Energy Use GBtu	EUI $kBtu/ft^2$
Town Buildings	**210,097**	**6.46**	**-**	**4.75**	**11.22**	**53.40**
School Buildings	**684,601**	**14.30**	**11.19**	**25.62**	**51.10**	**74.65**
Fire Department	**47,382**	**1.06**	**2.97**	**-**	**4.03**	**85.11**
Sewer System*	**0.776 Ggal***	**10.46**	**-**	**1.92**	**12.38**	**15.95***
Street & Traffic Lights	**-**	**4.87**	**-**	**-**	**4.87**	
Misc. Facilities**	**-**	**0.92**	**0.0310**	**-**	**0.95**	
Totals		**38.07**	**14.19**	**32.29**	**84.55**	
Building Totals	**942,080**	**21.82**	**14.16**	**30.37**	**66.35**	**70.43**

One GBtu = one giga Btu = one billion Btu or one million kBtu.
* Sewer system baseline year is calendar 2012. Sewer system energy use intensity (EUI) is kBtu/kgal influent.
**Miscellaneous facilities include Ayers Road Tennis Courts, Major Donnelly Park, Rotary Baseball Field, Rotary Pavilion, Rye Street Ballfields and Veterans Memorial Park (VMP) – Pool and facilities. VMP is the major user in this group.

3.1.2. Recent Energy Use

Table 3 shows the calendar 2018 energy use for various groups of Town facilities. Table 4 shows the changes. Note that the Town's energy consumption has decreased by 16.8% relative to the baseline. For buildings, the Energy Use Intensity (EUI) has decreased by 26% relative to the baseline.

Sewer system energy consumption is evaluated relative to the system demand, namely the influent flow. This is presented in Table 5. Relative to the influent, sewer system energy intensity has improved by 13.5%. However, it should be noted that this metric does not measure energy savings achieved by reducing influent. Influent can be reduced by reducing storm water inflow and groundwater infiltration throughout the collection system and by encouraging water use reduction by residents and businesses through behavior and equipment changes. The Division of Water Pollution Control conducts regular inspections that, among other things, identify sources of infiltration and inflow.

Actions taken in each facility to achieve these results are listed in Appendix A.

Table 3: 2018 Energy Use

Facilities	Total Area ft^2	Electrical Use GBtu	Natural Gas Use GBtu	Fuel Oil Use GBtu	Total Site Energy Use GBtu	EUI $kBtu/ft^2$
Town Buildings	**214,222**	**5.87**	**2.36**	**2.21**	**10.44**	**48.75**
School Buildings	**756,330**	**17.79**	**10.64**	**9.85**	**38.28**	**50.61*** **
Fire Department	**43,257**	**1.03**	**2.85**	**-**	**3.88**	**89.58**
Sewer System*	**1.0105 Ggal***	**11.67**	**-**	**1.81**	**13.48**	**13.34***
Street & Traffic Lights	**-**	**3.17**			**3.17**	
Misc. Facilities	**-**	**1.10**	**0.02**	**-**	**1.12**	
Totals		**40.63**	**15.87**	**13.88**	**70.37**	
Building Totals	**1,013,809**	**24.69**	**15.85**	**12.07**	**52.60**	**51.88**

* Sewer system energy use intensity (EUI) is kBtu/kgal influent.
*** Because of the ongoing elementary school construction projects and the changing occupancy of old and new schools, calculation of a 2018 EUI ($kBtu/ft^2$) for the school buildings is confusing at best. Nonetheless, the indicated value was used for the schools in the Town's overall building EUI. The 2023 goal discussed later in this document assumes all four elementary schools match the EUI of the new Orchard Hill School.

Table 4: Changes in Energy Use

Facilities	Electrical Use Change	Natural Gas Use Change	Fuel Oil Use Change	Total Site Energy Use Change	EUI Change
Town Buildings	-9.2%	+2.36 GBtu	-53.5%	-6.9%	-8.7%
School Buildings	+24.4%	-4.9%	-61.5%	-25.1%	-32.2%
Fire Department	-2.9%	-4.3%		-3.9%	+5.3%
Sewer System	+11.5%		-5.5%	+8.9%	-16.3%
Street & Traffic Lights	-34.8%			-34.8%	
Misc. Facilities	20.0%	-35.4%		+18.2%	
Totals	6.7%	11.8%	-57.0%	-16.8%	
Building Totals	13.1%	11.9%	-60.3%	-20.7%	-26.3%

Table 5; Sewer System Energy Use

	Year Ending	Influent (Ggal)	Energy Total (GBtu)	Sewer System Energy Intensity (kBtu/kgal)
2010 (before upgrade)	12/31/2010	.645	7.76	12.0
Baseline (after upgrade)	12/31/2012	.776	12.38	15.9
Recent	12/31/2018	1.011	13.48	13.3
Change vs. Baseline		30.1%	+8.9%	-16.3%

3.1.3. Overview of Energy Use Actions – Past and Future

The following actions have reduced the EUI, BTU usage and carbon footprint of Town facilities:

- **T8 Fluorescent Tubes:** Office buildings have been converted from 1½ inch diameter T12 fluorescent tubes with magnetic ballasts to 1 inch T8 tubes. This technology is now obsolete.
- **LED Interior and Parking Lot Lighting:** Interior lighting in existing buildings is being replaced by LED technology in various forms. The new schools have 100% LED lighting. Virtually all parking lot and exterior sports venues (except the baseball fields) have LED lighting.
- **LED Streetlights and Traffic Lights:** With the Town's authorization, Eversource has converted all cobra-head streetlights and all traffic lights to LED. Underground fed decorative fixture lighting has yet to be converted. The associated Council resolution specified that LED streetlight cost savings be reinvested in energy savings.
- **Advanced HVAC Controls:** Modern HVAC (Heating, Ventilation and Air Conditioning) controls sense the need for ventilation by measuring carbon dioxide and

humidity. In addition, adding dampers to HVAC systems with relatively few zones can allow for room by room control where that was not possible before. In the new schools, it is possible to provide cooling, heating or simply ventilation in different rooms at the same time.

  - Demand CO2 controls may be especially useful in gymnasiums where the crowd size varies from no occupants to a gym class to a sports event with full bleachers.

- **Ductless Mini-Split Heat Pumps:** Mounted on the roof, a ductless mini-split heat pump provides refrigerant to one or more rooms where heat and cooling can be controlled individually.

- **Ground Sourced ("Geothermal") Heat Pumps:** Geothermal heat pumps rely on the relatively constant temperature of the ground to draw heat in the winter and dump heat in the summer. They actually move as much as four times as much heat as the electricity they consume. However, the need to drill numerous wells to support a large building's needs may make them cost-prohibitive.

- **VFD Motor Drives:** Alternating Current motors used to turn at fixed rates linked to the 60 cycle AC frequency. The sewer system has numerous AC motor driven pumps, both in the sewer plant and in the collection system. Variable Frequency Drives adjust the frequency of the alternating current that reaches the motors. This allows motor speed to be adjusted based on demand. The laws of physics relate fluid friction to the square of velocity. Thus a pump that runs twice as long at half the speed should consume only half the overall energy as one pumping the same amount of liquid at full speed. Pump stations, in particular, used to wait for a tank to fill before turning on the pumps intermittently. With VFDs, the system not only uses less energy, but by keeping a constant, but low flow rate can minimize fat deposits on pipes and equipment.

  VFDs are applicable to:

  - Sewer Plant
  - Sewer collection system pump stations
  - School cafeteria kitchen exhaust blowers

- **Process sensors:** Blowers forcing air into the Aeration Tanks to reduce Ammonia Nitrogen discharge consume a large fraction of the electricity used in the sewer plant. Aeration is currently controlled by Dissolved Oxygen Sensors. Direct measurement of the Ammonia/Nitrates will reduce energy consumption by causing the blowers to provide additional dissolved oxygen only when necessary.

- **Building Envelope:** New buildings, subject to modern building codes, have significantly better insulation and other features that reduce heat transfer in or out depending on the season. With older buildings, roof, door or window replacements offer an opportunity for energy savings from building envelope improvements. A tapered roof design replacing a flat roof offers increased insulation and better control of drainage.

- **Building replacement or refurbishment:** Replacing or completely refurbishing a building offers the opportunity to employ the latest technology and design a highly effective building envelope. The town is in the process of replacing four elementary

schools and completely refurbished an old post office to become the Emergency Operations Center (EOC) and Town Hall Annex.

- **Vending machine controls:** Cooling of non-perishable items in vending machines can be discontinued when buildings are unoccupied.
- **Local hot water heaters:** Replacing central hot water heating with local hot water, makes sense in restrooms that are the only hot water users in a school wing. This also works for school kitchens.
- **Window air conditioner controls:** Window air conditioners are still present in buildings around town. Until they can be replaced with central or mini-split systems, controls are available to at least ensure they are used as effectively as possible.
- **Piping insulation:** This is simple, but insulating hot water piping where it is accessible can provide savings.
- **Natural gas conversion:** Coupled with new boilers, natural gas conversion decreases carbon releases, energy consumption and operating cost.
- **PC management:** Ensuring that PCs and their monitors are set to shut down when not in use provides savings. This requires attention to settings and user education. Giving students their own laptops reduces the need for PC laboratories and the number of PCs in a school. Regular computer and server equipment upgrades provide savings as manufacturers adopt more energy efficient designs.

3.1.4. Renewable Energy Sourcing

The Town currently obtains its renewable energy from two sources as summarized in Table 6:

- The State of Connecticut requires generation suppliers to obtain a fraction of their electric energy from renewable sources. That fraction increases on an annual basis. (See Appendix C.) For both the municipality and the Board of Education, ENGIE Resources, LLC is the Town's generation service. They did not report their renewable energy fraction, but the regional average was 23.7% in 2018. The region reports 27.1% from nuclear power which is also zero carbon.
- In 2017, the Town contracted to receive energy credits from the NorCap South solar installation in East Windsor, Connecticut. This facility went into service in December, 2017 and supplied 3.36 GWh in the form of Virtual Net Metering (VNM) credits in 2018.

Figure 1: NorCap South Solar Facility

Table 6: Renewable and Zero Carbon Energy Sourcing

	2018 Electricity Use		Percentage Renewable	Percentage Nuclear	Zero Carbon Production
	GWh	**GBtu**			**GWh**
NorCap South	3.36	11.47	100%	0%	3.36
ENGIE	8.41	28.71	23.7	27.1%	4.27
Town Total	11.78	40.18	46%	19.4%	7.64

3.1.5. Reporting Future Energy Use and Sourcing

On behalf of the Town, the Energy Committee will report energy use and sourcing statistics similar to what has been shown herein on a semi-annual basis, i.e. at the end of each calendar year and at the end of each fiscal year. They will report this information to the Town Council, Board of Education and Fire Department.

To produce the reports, the Town will enter and report out data in Portfolio Manager.

- For electric and gas use, Eversource provides automatic updates. Occasionally this system introduces errors in Portfolio Manager such as missing or overlapping entries. In that case Eversource can provide information needed to make the necessary corrections.
- The respective departments will provide #2 Fuel Oil delivery information based on actual purchases.
- The Division of Water Pollution Control will provide sewer plant influent data.
- If any onsite solar PV installations occur, the Energy Committee will download the behind the meter consumption of solar PV energy production for those sites. That is necessary because the "use", as applied for both Portfolio Manager and Sustainable CT, includes all energy used on a site regardless of where it is generated.

3.2. Municipal Energy Goals

3.2.1. Previously Adopted Goals

In its June 2, 2014 resolution committing to Support the Energize South Windsor Initiative, the Town Council pledged "to reduce [the Town's] municipal building energy consumption 20% by the year 2018 and voluntarily purchase 20% of its municipal building electricity from clean, renewable energy sources by the year 2018" with FY 2010 as the baseline year. As it turned out, data for FY 2010 was not readily available, so the Town uses a baseline year of calendar 2010.

For buildings, the Town measures progress toward the municipal building energy consumption goal in Energy Utilization Index (EUI) units of kBtu/ft^2. For the renewable energy goal, the Town uses kBtu. Conversions from billing units of kWh, gallons and ccf (100s of cubic feet) can be found in Appendix D.

For streetlights and facilities where a building area is not applicable, the Town uses kBtu. New or expanded facilities may require individual baseline years that differ from calendar 2010.

3.2.2. Municipal Energy Use Goals

Respective managers have set targets for each category of facilities. For each facility, Appendix A lists actions contemplated to achieve these results.

Table 7 shows the targets for municipal buildings.

For the sewer system, Table 8 provides the Sewer Plant and Collection System EUI target (kBtu/kgal influent). Table 9 provides a separate influent reduction target because of the influent's nearly proportional impact on system energy use.

Table 10 addresses the remaining facilities. The energy savings related to streetlights require cooperation of Eversource to convert decorative fixture streetlights to LED.

It must be recognized that several of these targets are stretch goals. In particular, they may depend on state or federal legislation and regulations, available grants, the ability to win renewable energy credits (RECs) and, in the case of streetlights, scheduling of work by Eversource.

Table 7: Five Year EUI Targets for Municipal Buildings

Facilities	Baseline EUI kBtu/ft^2	2018 EUI kBtu/ft^2	2023 Target EUI kBtu/ft^2	Responsible Department
Town Buildings	53.40	48.75 -8.7%	44 -18%	**Public Works Department**
School Buildings	74.65	50.61 -32.2%	45 -37%	**Facilities Department**
Fire Department	85.11	89.58 +5.3%	85 -0%	**Fire Department**
Buildings Total	**70.43**	**51.88** **-26.3%**	**46.5** **-34%**	

Table 8: Five-year Energy Use Targets for the Sewer System

Facilities	2010 Energy Intensity (kBtu/Kgal)	2012 Energy Intensity (kBtu/Kgal) (Baseline)	2018 Energy Intensity (kBtu/Kgal)	2023 Target Energy Intensity (kBtu/Kgal)	Responsible Department
Sewer Plant	8.07	12.62	10.07 -20.2%		**Division of Water Pollution Control**
Collection System (Pump Stations)	3.95	3.33	3.27 -1.7%		
Sewer System	**12.02**	**15.95**	**13.34** **-16.3%**	**12.0** **-24.8%**	

Table 9: Sewer System Influent Reduction Target

Facilities	2010 Influent (Mgal)	2012 Influent (Mgal) (Baseline)	2018 Influent (Mgal)	2023 Target Influent (Mgal)	Responsible Department
Sewer System	**645.9**	**776.4**	**1010.5**	**900** **-10% vs. 2018**	**Division of Water Pollution Control**

Table 10: Five-year Energy Use Targets for Other Facilities

Facilities	Baseline Energy Use GBtu	Recent Energy Use GBtu	Target Energy Use GBtu	Responsible Department
Street & Traffic Lights GBtu	4.87	3.17 -34.8%	2.53 -48%	**Police Department**
Misc. Facilities GBtu	0.92	1.12 +18.2%	None	**Public Works Department**

3.2.3. Municipal Renewable Energy Goals

Appendix C is a copy of information provided by the Connecticut Department of Energy and Environmental Protection. It defines the accepted forms of renewable energy for various purposes and classes I, II and III of renewable energy. Class I includes all the forms of renewable energy relevant to the Town. Of these, the following are viable for our geography:

- solar power;
- a fuel cell;
- geothermal, a. k. a. ground source heat pumps
- anaerobic digestion or other biogas derived from biological sources including landfills;
- biofuel blended into heating oil and diesel fuel.

Solar

For renewable and carbon-free energy sourcing, it is possible to set goals based on several contemplated near-term projects: four rooftop solar projects and a second virtual net metering solar project. If these can be achieved, as shown in Table 11 approximately 80% of the Town's electricity consumption will come from renewable sources by our five-year point, FY 2023.

Fuel Cell

The Town of South Windsor entered into an agreement with South Energy Investments, LLC ("SEI") to develop and construct a 5MW fuel cell electric generation facility at 515 John Fitch Boulevard. The Town has transferred ownership of the facility to SEI while retaining an interest in the Power Purchase Agreement ("PPA") with Eversource Energy and will receive revenue from the project over a 20-year period.

Geothermal

While the term geothermal can refer to using the temperature gradient caused by the hotter interior of the earth at locations there is a sufficient gradient near the surface, this is not available in Connecticut. Here, geothermal refers to taking advantage of the temperature difference between the relatively constant ground temperature and the seasonal and daily varying air temperature. Heat pumps connected to wells or subsurface piping can very efficiently transfer heat to the ground during air conditioning season and extract heat from the ground in the winter.

In fact, there is an element of energy storage when the heat pumps actually freeze the ground around their pipes in winter and thereby improve the efficiency of air conditioning in summer.

For large facilities such as schools or offices, the drilling of wells and installation of necessary heat transfer piping can make the economics of geothermal unattractive.

The town should evaluate the economics of using geothermal for new construction and when major HVAC equipment replacement is needed for existing buildings.

Anaerobic Digester Biogas

Food waste recycling by anaerobic digestion yields benefits in two main areas. First, the greenhouse gas emissions from organic decay, primarily methane, are captured and burned to produce electricity rather than being released directly into the atmosphere from landfills. When the biogas methane is converted to carbon dioxide, its greenhouse effect is substantially reduced. Second, the remaining solid wastes can be used to improve soil for farming. These facilities can also process sewer plant sludge.

The Town continues to investigate the opportunity to recycle food waste from Town (school and community center) facilities in anaerobic digester facilities. The Town has been exploring the possibility of inducing a commercial company to build an anaerobic digestion facility in town.

Table 11: Five-year Targets for Renewable and Carbon-Free Electricity Sourcing

Project	Renewable and other Carbon Free Annual GWh	Percentage of Town Consumption	Responsible Department
NorCap South VNM (Existing)	3.36	28%	Public Works to monitor
Enfield VNM project (Contemplated)	3.00	25%*	Public Works Department
Rooftop solar on 3 new Elementary Schools and High School (Contemplated)	2.50	21%**	BOE Facilities Department
Generation Service Renewable and Carbon Free (Calculated)	0.75	6%	(No action needed.)
Town Total Consumption (Calendar 2018)	11.9		
Total Town Renewable and Carbon Free	**9.55**	**81%**	

* This goal depends on the Town receiving a cash-flow positive proposal for the Virtual Net Metering project.

** This goal depends on the Town receiving cash-flow positive proposals for the four school rooftop solar projects.

3.3. Energy Management

3.3.1. Energy Monitoring

The Board of Education Facilities Department uses a centralized, district-wide system to monitor all spaces. In newer buildings, the schools have direct digital control (DDC). Older buildings have zone controls. The department can set occupied and unoccupied temperatures and control the hours. All buildings are alarmed for space temperature as well as boiler, freezer and refrigerator temperature. A contractor monitors the system at night.

The Public Works Department also monitors energy related conditions in rooms and spaces throughout the town remotely.

The Energy Committee prepares annual energy consumption reports which are distributed to the various organizations and the Town Council.

3.3.2. Peak Demand Reduction Goals and Actions

Through 2017, the Town participated in a program wherein Eversource notified the Town when our air conditioning loads were likely to increase our peak demand. This can be very expensive, because electric bills throughout the year include a charge for the year's momentary demand peak. When the Town was notified, the Division of Water Pollution Control activated the backup generator at the sewer plant which relies on oil rather than grid power.

Because of our use of virtual net metering (VNM), peak demand notification is no longer available.

3.4. Grants and Other Incentives

The NC Clean Energy Technology Center maintains a database of energy programs available in each state. The list, called DSIRE, includes financial incentives, regulatory policies and technical resources. For South Windsor, this list can be found at:

https://programs.dsireusa.org/system/program?zipcode=06074.

The town, its residents and its businesses benefit directly or indirectly from many of the listed incentives and policies. The following sections describe several key incentives.

3.4.1. Federal Renewable Energy Tax Incentives

The federal Investment Tax Credit (ITC) was originally established by the Energy Policy Act of 2005 and was set to expire at the end of 2007. A series of extensions pushed the expiration date back to the end of 2016, but experts believed that an additional five-year extension would bring the solar industry to its full maturity. Thanks to the spending bill that Congress passed in late December 2015, the tax credit is now available to homeowners in some form through 2021. Here are the specifics:

- **2016 – 2019:** The tax credit remains at **30 percent** of the cost of the system.

- **2020:** Owners of new residential and commercial solar can deduct **26 percent** of the cost of the system from their taxes.
- **2021:** Owners of new residential and commercial solar can deduct **22 percent** of the cost of the system from their taxes.
- **2022 onwards:** Owners of new commercial solar energy systems can deduct **10 percent** of the cost of the system from their taxes. There is no federal credit for residential solar energy systems.

Additionally, in previous years, owners of new solar energy systems could not claim the tax credit unless their system was operational. Now, the legislation allows them to claim it as soon as the construction of the system is complete, as long as it is operational by December 31, 2023.

3.4.2. State Energy Incentives

The Residential Solar Investment Program (RSIP) is a Connecticut Green Bank program that makes it easy and affordable for homeowners to make the leap to a solar-powered home. It offers two types of incentives: The Expected Performance-Based Buydown (EPBB) and the Performance-Based Incentive (PBI). Incentives are available until 300 MW is reached. Eligible properties include one- to four-family owner-occupied residential homes that offer a good location for a solar system and are in the Eversource or UI service territories. Mobile homes are not eligible.

The Expected Performance-Based Buydown (EPBB) incentive provides the homeowner with an upfront cost reduction based on major design characteristics of the system, such as panel type, tilt, shading, and orientation. The incentive is paid directly to the contractor. The incentives vary from $0.40 to $0.463 per kW but may be reduced in circumstances where conditions limit the effectiveness of the panels.

The Performance-Based Incentive (PBI) is designed to allow homeowners to benefit from solar PV systems for little to no upfront cost. Under this model, an Eligible Third-Party PV System Owner owns the system and enters into a contract with the homeowner. The PBI is paid to the System Owner based on actual performance over the course of 6 years, and is used to reduce the homeowner's monthly cost. For qualifying installations, the incentive is $.035 per kWh and is available for systems up to 20 kilowatts.

3.4.3. Energy Savings Performance Contracts

Energy Savings Performance Contracts (ESPCs) help facilities save money, make facilities more comfortable and provide all the benefits of green upgrades. The municipality agrees to implement a set of energy efficiency and renewable energy measures and those measures are guaranteed to save enough money to finance their full cost. Connecticut Green Bank assists the Department of Energy and Environmental Protection (DEEP) in administering the program for Connecticut municipalities and state agencies. They offer pre-qualified contractors, significant technical support and standardized contract documents to help streamline the process.

3.4.4. Other Grants and Incentives

The Energy Committee will work with staff to research available grants and advise town committees and departments of potential projects to reduce energy use in town buildings.

3.5. Fleet Vehicle and Equipment Management

While the Town has not yet invested in alternative fuel vehicles or equipment, Fleet decision-making does consider the technology and its application when replacing and/or purchasing new vehicles and equipment. The town employs a number of other techniques to optimize fuel/energy resources:

1. Rightsizing of the Fleet to conserve fuel and to ensure the appropriate equipment for each job;
2. Use of GPS and route planning to minimize unnecessary trips;
3. Carpooling when appropriate;
4. Evaluating idling of vehicles and equipment;
5. Purchasing of fuel efficient vehicles where possible;
6. Timely replacement of vehicles and equipment to not extend beyond their useful life cycle and fuel efficiency;
7. Maintaining proper preventive maintenance schedules for all vehicles and equipment to ensure they are preforming at peak efficiencies; and
8. Encouraging employees to operate vehicles and equipment within the Manufacturers Guidelines for peak performance and fuel consumption.

4. Residential and Business Energy Plan

4.1. Residential and Business Energy Tracking

The Energy Committee obtains annual electric and natural gas use by customer category from Eversource. Calendar 2010 is the baseline year. All categories have shown substantial reductions in electricity use, though the industrial category, in particular is sensitive to changes in the mix of industrial processes. Electricity use is summarized in Figure 2 and Table 12.

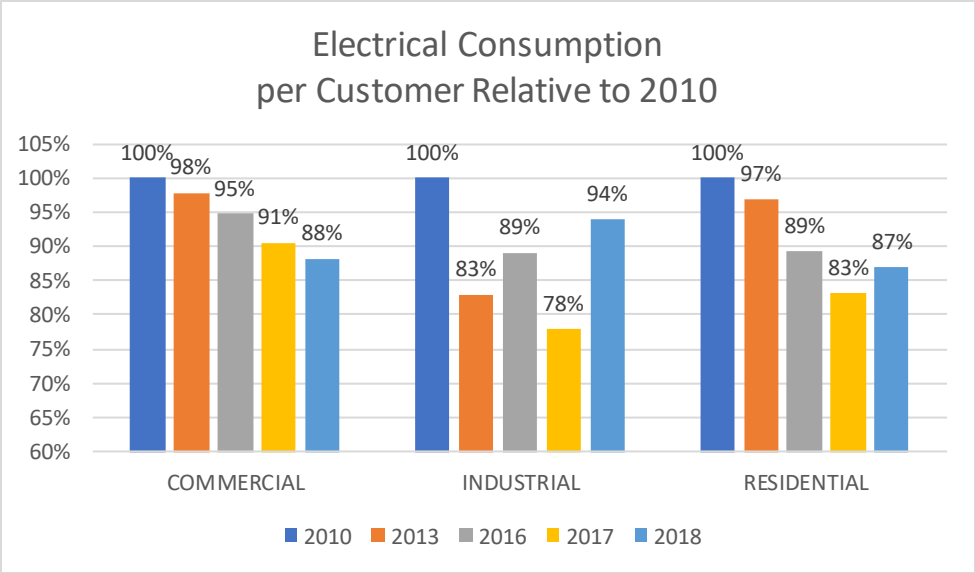

Figure 2: Residential and Business Relative Electrical Consumption

Table 12: Residential and Business Electrical Consumption

Sector		2010	2013	2016	2017	2018
Commercial	Customers	1,328	1,364	1,452	1,474	1,500
	Mbtu/Customer	232.4	227.5	220.2	210.4	205.0
	vs. 2010	100%	98%	95%	91%	88%
Industrial	Customers	64	60	59	67	65
	Mbtu/Customer	2709.8	2248.4	2413.9	2111.1	2547.0
	vs. 2010	100%	83%	89%	78%	94%
Residential	Customers	10,691	10,892	11,221	11,509	11,818
	Mbtu/Customer	29.6	28.6	26.4	24.6	25.7
	vs. 2010	100%	97%	89%	83%	87%

Conversely, the picture for natural gas use per customer shows large increases in the commercial and industrial sectors and fairly flat use in the residential sector. Figure 3 and Table 13 illustrate this result. Understanding these trends will require further investigation.

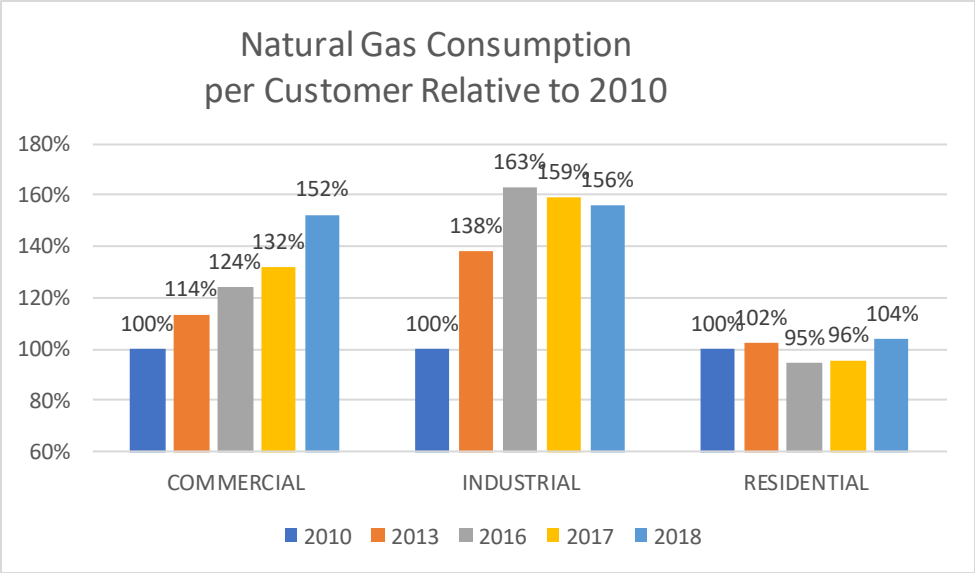

Figure 3: Residential and Business Relative Natural Gas Consumption

Table 13: Residential and Business Natural Gas Consumption

Sector		2010	2013	2016	2017	2018
Commercial	Customers	561	575	631	649	675
	Mbtu/Customer	393.0	446.7	487.5	518.5	598.6
	vs. 2010	100%	114%	124%	132%	152%
Industrial	Customers	78	79	80	86	85
	Mbtu/Customer	3669.5	5072.5	5980.2	5843.6	5719.7
	vs. 2010	100%	138%	163%	159%	156%
Residential	Customers	5,027	5,156	5,384	5,729	5,971
	Mbtu/Customer	78.8	80.5	74.4	75.3	81.9
	vs. 2010	100%	102%	95%	96%	104%

4.2. Residential and Business Renewable Energy Tracking

4.2.1. Solar Photovoltaic

There are two sources of data on solar photovoltaic (PV) installations in town, the Connecticut Green Bank and the Town's Building Department. Each has its limitations. The Green Bank only lists installations sponsored through their programs, while the Building Department reports building permits but has limited data on which projects designated as "Active" have actually gone into service. Regardless, the Building Department data will be used because it is more complete.

Table 14 shows the active or complete building permits for solar PV in South Windsor as of April 2019. Among the active permits, some are known to the Energy Committee to be complete.

Others may have been cancelled but not so reported to the Building Department. Many are undoubtedly in various stages of design, construction and activation.

Table 14: Solar PV Building Permits

Land Use	ACTIVE PROJECTS	COMPLETE PROJECTS	Totals
COMMERCIAL LAND	2	5	7
INDUSTRIAL LAND	3	3	6
RESIDENTIAL CONDOMINIUM	4	1	5
RESIDENTIAL LOT	190	207	397
Totals	**199**	**216**	**415**

4.2.2. Air Source and Ground Source Heat Pumps

The other renewable energy sources suitable for South Windsor are air source and ground source (geothermal) heat pumps. At present we have no data for these installations.

4.2.3. Biofuel

In a life cycle analysis, Argonne National Laboratory found that use of B100 (a pure biodiesel not blended with petroleum fuels) reduces carbon dioxide emissions by 74% compared with petroleum diesel. Heating fuel is essentially the same as diesel, except it is exempt from certain taxes. Biofuel can be blended with petroleum heating fuel.

4.3. Residential and Business Energy Goals

Energy efficiency and renewable energy actions among residents and businesses is largely the responsibility of the owners and occupants.

The Energy Committee's main goal is to keep residents and businesses informed on the latest available technology, incentives and financing options and to encourage adoption when appropriate. Table 15 lists numerical goals for both electricity and natural gas consumption in the commercial, industrial and residential sectors. The natural gas goals will first require understanding the trends shown in Table 13.

Table 15: Business and Residential Energy Use Goals

Annual Goal	Baseline	2018	2023 Goal	Department
Reduce commercial electricity use MBtu/customer	232.4	205.0 -12%	200 -15%	Energy Committee Outreach
Reduce industrial electricity use MBtu/customer	2709.8	2547.0 -6%	2300 -15%	
Reduce residential electricity use MBtu/customer	29.6	25.7 -13%	24 -20%	
Reduce commercial natural gas use MBtu/customer		598.6	540 -10%	Energy Committee Outreach
Reduce industrial natural gas use MBtu/customer		5719.7	5150 -10%	
Reduce residential natural gas use MBtu/customer		81.9	74 -10%	

4.4. Residential Energy Programs

4.4.1. Energize CT

Energize South Windsor program in 2014 and 2018 encouraged residents to take advantage of Home Energy Solutions assessments and services and receive substantial discounts and rebates on insulation, appliances and other energy related home improvements. The Energy Committee continues to find opportunities to promote the underlying Home Energy Solutions (HES) program.

4.4.2. Solarize CT

Solarize South Windsor program in 2014-2015 provided homeowners the opportunity to receive quotes from multiple installers and benefit from favorable financing as well as state and federal incentives. In 2018, a second Solarize South Windsor program offered a pre-selected vendor with essentially the same benefits.

Thanks to the results of the Town's participation in Energize CT and Solarize CT, Energize CT awarded South Windsor two $10,000 Bright Ideas Grants and the Connecticut Green Bank awarded the Town four $4,500 Clean Energy Community awards. The Town used these for a lighting upgrade in the Town Garage.

4.4.3. Low- and Moderate-Income Energy Assistance

The South Windsor Human Services Department assists residents with energy programs including Operation Fuel, the CEAP program (CT Energy Assistance Program) and our private Fuel Bank. Operation Fuel and CEAP are both programs that have an income and asset limit. Caseworkers in Human Services will assist with these applications. If someone does not qualify for either program, or if they have exhausted the benefits, private fuel funds may be available. Caseworkers will meet with staff in the office at the community center or in a person's home if someone is not able to get out due to mobility issues.

4.4.4. Solar for All

The Energy Committee is sponsoring tabling events and seminars to support the Solar for All program run in cooperation with the Connecticut Green Bank and Posigen. While open to all homeowners, the program targets low to moderate income (LMI) homeowners, including any who might have had difficulty obtaining financing during the original Solarize programs.

4.4.5. Residential Energy Education

In an ongoing effort to educate South Windsor residents on energy programs the following activities are in place:

- Monthly Energy Tip: An informative article is posted on the Energy Committee's web page which is linked to the Town of South Windsor website. These monthly articles include a variety of topics including how to cut your personal carbon footprint to the benefits of solar energy to a host of links to government and state programs that residents can take advantage of.
- Information Kiosks: Two information kiosks are located in the South Windsor Public Library and the South Windsor Recreation department providing information to residents on the Home Energy Solutions (HES) service sponsored through EnergizeCT.
- Outreach: In conjunction with the Town of South Windsor Summer Farmer's Market and Summer Concert series, the Energy Committee has hosted an educational booth promoting awareness and program information to area residents.

4.5. Business Energy Programs

4.5.1. Commercial Property Assessed Clean Energy (C-PACE)

The Town Council endorsed the Town's participation in the Commercial Property Assessed Clean Energy program (C-PACE) on June 2, 2014. This program allows businesses and non-profit organizations to obtain favorable financing for a variety of renewable energy and energy efficiency improvements to their facilities. The finance charges are then collected with the Town's tax bill. Information about C-PACE is available at http://www.cpace.com/About-Us.

4.5.2. Small Business Energy Advantage and New Construction Program

Small Business Energy Advantage (SBEA) and New Construction program offerings provide businesses, developers, and other key community groups with access to financing, incentives and technical resources as they pertain to energy efficiency and conservation. The Energy Committee has provided information regarding these programs on the Town website and at meetings with business groups.

4.5.3. OEEB Business Visits

In 2017, the Energy Committee partnered with the Office of Energy Efficient Businesses (OEEB) and the Connecticut Center for Advanced Technology Inc. (CCAT) to support a door-to-door visit to 120 businesses in Town offering energy audits and information on programs such as C-PACE and the Small Business Energy Advantage (SBEA) programs.

In their visits, OEEB examined energy bills to determine whether a business could obtain a more favorable rate for natural gas and/or electric generation service, analyzed fuel switching opportunities, and identified financially attractive energy efficiency and renewable energy choices. Of the businesses visited, 44 received energy education and two received renewable energy evaluations.

4.5.4. Business Energy Education

The Energy Committee seeks repeated opportunities to reach out to the business community.

- Networking Breakfast: In cooperation with the South Windsor Chamber of Commerce, the Energy Committee sponsored a Monthly Networking Breakfast educating local businesses on Energize CT's C-PACE program. The event was held on Friday, February 8, 2019 and 20 local business owners attended. A representative from the Connecticut Green Bank provided the overview. Informational packets were given to each attendee.
- Monthly Energy Tip: An informative article is posted on the Energy Committee's web page, which is linked, to the Town of South Website. The February 2019 article promoted Energize CT's Small Business Energy Advantage audit available to the business community.
- Business Outreach: In cooperation with the South Windsor Chamber of Commerce Annual Business Expo, the Energy Committee hosted an information booth in 2017 and plans to participate in 2019.

4.6. Energy Supportive Zoning and Ordinances

4.6.1. Current Zoning Regulations

In consultation with the Energy Committee, the South Windsor Planning and Zoning Commission (PZC) adopted solar photovoltaic regulations for both small (e.g. rooftop and

ground mounted) solar and large (utility scale) solar installations in 2015. See Zoning Regulations Sections 7.20 Solar Energy Systems and 7.21 Large Scale Solar Energy Systems.

Subsequently, Energy Committee members learned that suppliers of solar installations that track the sun found the 12-foot height limits in the 2015 regulations prevented use of this technology in many instances. The Energy Committee approached the PZC in 2017 with recommendations to amend the height limits to be consistent with other accessory structures. These were adopted in November 2017.

4.6.2. Potential Changes to Zoning Regulations and Ordinances

Incentives: In addition, the Committee will report by December 31, 2020 to Town Officials (encompassing the Town Council, Board of Education, Economic Development Commission and Planning and Zoning Commission) regarding ways to incentivize the use of renewable energy and designs that exceed the energy efficiency requirements of then-current building codes.

Electric Buildings: In recent years, the price of natural gas has decreased. Its lower carbon emissions have led to the view that it is a suitable interim energy source on the road to minimizing carbon pollution. However, it is by no means carbon free and, when production and transport emissions are considered, its environmental benefits are substantially reduced.

Choosing an electric building design requires using electricity for heating, hot water and cooking, in addition to all the other uses. Until recently, there have been three problems with choosing an all-electric building design:

- When electricity is produced from heat, i.e. from burning coal, oil, natural gas or nuclear fission, the laws of physics tell us that approximately 2/3 of the heat energy is lost. This waste heat is either dumped into the atmosphere or a nearby body of water. See Appendix E.
- Electricity generation is not carbon free at the present time. Coal, oil and gas plants release carbon dioxide and other greenhouse gasses in the process of generating electricity. These sources still make up a substantial fraction of New England's electricity generation.
- All-electric buildings used resistance heating (similar to how an electric stove works but in the baseboards of every room), and because of this, they have required special rates and better building envelope insulation to make their use of electric heating cost-effective.

Electric buildings are becoming more and more desirable and economical as time goes on:

- Ground-sourced (a.k.a. geothermal) and air-sourced heat pumps deliver heat and air conditioning, while using substantially less electricity than older systems. In fact they transfer to or from the interior 4.0 or 2.5 times as much heat energy, respectively, as the electric energy they consume. This offsets the wasted heat from fossil or nuclear generation. Furthermore, the capital cost of this technology has fallen to the point where it is an economical choice in many cases.
- As more and more of the electricity taken off the grid comes from renewable or nuclear sources, the greenhouse gas emissions will go down in proportion.

- Modern building codes require insulation that exceeds what was required for older all-electric buildings.

4.7. Grants and Other Incentives

The Energy Committee will advise and educate residents and businesses on existing incentives and rebates available to reduce energy use and participate in renewable energy. See also Section 3.4 for information on the DSIRE database and other programs that may be applicable to residential and business entities.

Appendix A Actions Taken and Contemplated

Facility	Actions
Municipal Facilities	
Town Hall	**Actions Taken:** Chiller, 2010, Boiler Conversion, 2014, Council Chambers LED Lighting, 2015, Exterior LED Lighting, 2018, New Ductless Split Cooling Units for Server Rom, 2011, New LED lighting Second Floor Hallway, 2017, Building Automation Controls installed on Lower Level Meeting Rooms and Lunch Room, 2018, Building Automation Controls Installed on Council Chambers AHU, 2019, ADA Handrails in Stairwells , 2016 **Contemplated Actions:** Contemplated Actions- Upgrade Remainder of LED Lighting Throughout-ADA Upgrades-Elevator Replacement –Window Replacements-A/C Condensing Unit Replacement Lower Level-Variable Air Volume Dampers and VFDs for Main and Return Air handling Units
Police Station	**Actions Taken:** Cooler upgrade 2015, Thermostats 2015 **Contemplated Actions:** Elevator Replacement; Convert boiler to natural gas.
Town Garage	**Actions Taken:** Interior and Exterior LED Lighting 2018, New LED Parking Lot Poles and Fixtures, 2013 **Contemplated Actions:** Replace Wash Bay Boiler
Emergency Operations Center/Town Annex	**Actions Taken:** Old post office essentially rebuilt to modern energy standards. **Contemplated Actions:** None
Library	**Actions Taken:** Building Automation Upgrade, 2011, Boiler Replacement and Convert to NG, 2014, Convert Exterior Lot Lighting to LED, 2017, Convert 24 pendant LED fixtures to LED, 2016, New Cooling Tower, 2018, Modernize Elevator, 2019, New Roof, 2019 **Contemplated Actions:** New Roof, Install VAVs on all AHU's, Interior LED Conversion
T.R.A.C.	**Actions Taken:** **Contemplated Actions:**
Community House	**Actions Taken:** Catalyst on boiler 2014 **Contemplated Actions:**

Community Center	**Actions Taken:** Replace 15 Heat Pumps, Cooling Tower. Replace Boilers and Convert to NG. Convert Make up air unit to NG. Install new Building Automation System. Remove Underground Heating Oil Tank, 2019 **Contemplated Actions:** New Roof
Veterans Memorial Park & Pool	**Actions Taken:** **Contemplated Actions:**
Rotary Baseball Field	**Actions Taken:** **Contemplated Actions:**
Rotary Pavilion	**Actions Taken:** **Contemplated Actions:**
Schools	
High School	**Actions Taken:** High Efficiency Parking Lot Lighting, Occupancy Sensors, Refrigeration Controls (2015) Boiler Rm. "A' Burner Conversion to Natural Gas, M2G Boiler Controls, Partial Roof Replacement (2013-14) **Contemplated Actions:** Boiler Rm. "B" Burner Conversion to Natural Gas, Roof Replacement Section "C", Solar
Middle School	**Actions Taken:** High Efficiency Parking Lot Lighting, Lighting Occupancy Sensors, Refrigeration Controls, Burner Conversion to Natural Gas, M2G Boiler Controls **Contemplated Actions:** Solar
Old Orchard Hill School	**Actions Taken:** Classroom and gym occupancy sensors, M2G Boiler Controls, Roof Replacement (2013) **Contemplated Actions:** Building to go idle, Summer 2020.
New Orchard Hill School	**Actions Taken:** High Efficiency Building (New Fall 2017) **Contemplated Actions:**
Old P. R. Smith School	**Actions Taken:** Classroom and gym occupancy sensors, M2G Boiler Controls 2010 **(Demolished 2019)**
Old Eli Terry School	**Actions Taken:** Classroom and gym occupancy sensors **Contemplated Actions:** Demolition Fall 2020

Old Pleasant Valley School	**Actions Taken:** Classroom and gym occupancy sensors, M2G Boiler Controls, Burner Conversion to Natural Gas, Roof Replacement (2014) **Contemplated Actions:** Pending referendum, Demolition Fall 2023
New Pleasant Valley School	**Contemplated Actions:** Pending referendum, High Efficiency Building (New Fall 2023)
Wapping School/ Parks and Recreation	**Actions Taken:** Classroom and gym occupancy sensors, M2G Boiler Controls, Burner Conversion to Natural Gas, Window Replacement (2006) **Contemplated Actions:** Roof Replacement, Solar
Street Lights and Traffic Lights	
Street Lights	**Actions Taken:** LED conversion of Cobra Head lights 2017 **Contemplated Actions:** LED conversion of Decorative Fixtures
Traffic Signals	**Actions Taken:** LED conversion **Contemplated Actions:**
Fire Department	
Fire House: Company 1	**Actions Taken:** **Contemplated Actions:** LED lighting. Occupancy lighting controls.
Fire House: Company 2	**Actions Taken:** **Contemplated Actions:** LED lighting. Occupancy lighting controls.
Fire House: New Company 3	**Actions Taken:** **Contemplated Actions:** LED lighting. Occupancy lighting controls.
Fire House: Old Company 3	**Actions Taken:** Replaced by new fire house. Converted to TRACS **Contemplated Actions:** N/A
Sewer System	

Sewer Plant	**Actions Taken:** (Upgrade) High Efficiency Pump and Blower Motors, VFDs on Aeration and Grit Blower Motors and Water Pumps, lighting, HVAC 2009-2012, Outside Lighting switched over to LED bulbs, Air Conditioning Program adjusted to Occupied/Unoccupied Settings, Running a thinner sludge on Gravity Belt Thickener for better TWAS pump motor efficiency, **Contemplated Actions:** Advanced UV and Aeration Controls, VFD upgrades, Replacing all Sodium Lighting in Bays and Galleries to LED, Adding Lab AC to Occupied/Unoccupied settings, Making adjustments to heating program, Adding an additional hot water heater and associated components to ADMIN Building. Currently we are undersized and as a result need to run at a higher temperature to keep up with demand.
Avery Street Pump Station	**Actions Taken:** **Contemplated Actions:** Impeller or pump replacement for efficiency and ragging elimination. Heater controls. Smart pump controls. Sizing evaluation.
Barrington Estates Pump Station	**Actions Taken:** **Contemplated Actions:** Impeller or pump replacement for efficiency and ragging elimination. Heater controls. Smart pump controls. Sizing evaluation.
Benedict Drive Pump Station	**Actions Taken:** **Contemplated Actions:** Station is within 14% of its design capacity. Upgrade station and identify & resolve inflow/infiltration (I/I) sources. Replace pumps with higher capacity, efficiency and ragging elimination. Investigate/resolve trapped air.
Clark Street Pump Station	**Actions Taken:** **Contemplated Actions:** Station is within 30% of its design capacity. Upgrade station and identify I/I sources to eliminate and regain capacity. Increase wetwell level to decrease total dynamic head (TDH). Impeller or pump replacement for efficiency and ragging elimination.
Ellington Road Pump Station	**Actions Taken:** **Contemplated Actions:** Impeller or pump replacement for efficiency and ragging elimination. Heater controls. Smart pump controls. Sizing evaluation.
Pleasant Valley Pump Station	**Actions Taken:** **Contemplated Actions:** VFDs, improved heating controls Impeller or pump replacement for efficiency and ragging elimination.

Quarry Brook Pump Station	**Actions Taken:** **Contemplated Actions:** Impeller or pump replacement for efficiency and ragging elimination. Heater controls. Smart pump controls. Sizing evaluation.
Rye Street Pump Station	**Actions Taken:** **Contemplated Actions:** Impeller or pump replacement for efficiency and ragging elimination. Heater controls. Smart pump controls. Sizing evaluation.
Scantic Meadow 1 Pump Station	**Actions Taken:** **Contemplated Actions:** Impeller or pump replacement for efficiency and ragging elimination. Heater controls. Smart pump controls. Sizing evaluation.
Scantic Meadow 2 Pump Station	**Actions Taken:** New higher efficiency HOMA Submersible Pump. **Contemplated Actions:** Impeller or pump replacement for efficiency and ragging elimination. Heater controls. Smart pump controls. Sizing evaluation. Replace old KSB.

Appendix B Clean Energy Communities Pledge

Letter of Commitment
for the
Municipal Bench Marking: Technical Assistance Initiative

The Town/City of SOUTH WINDSOR has agreed to take part in the **Municipal Bench Marking Initiative**, which is a comprehensive energy efficiency and evaluation initiative, and seeks to document its commitment to promote energy efficiency programs and to collaborate with the Clean Energy Communities program administrators, representatives of Eversource, and bench marking consultants ("Consultants"), as further set forth in this Letter of Commitment.

WHEREAS, the Town/City of SOUTH WINDSOR recognizes that the State of Connecticut is a leader in energy efficiency programs and has agreed to lead by example itself in implementing and promoting these programs;

WHEREAS, the Town/City of SOUTH WINDSOR has pledged to become a Clean Energy Community, thereby committing to reduce its municipal building energy consumption 20% by the year 2018 and voluntarily purchase 20% of its municipal building electricity from clean, renewable energy sources by the year 2018;

WHEREAS, the Town/City of SOUTH WINDSOR agrees to establish a committee (hereinafter referred to as a "Green Team") which is the designated municipal entities representative to coordinate with the Consultants for the duration of the **Municipal Bench Marking Initiative**. The Municipal entities should consist of representatives from Office of the Executive Official, Department of Finance, Department of Facilities, Board of Education, and Energy Task Force or Committee;

WHEREAS, the "Green Team" agrees to provide its support to the above-referenced initiative and Consultants by providing information such as:

- Identifying a baseline fiscal year to use for the municipal energy reduction requirement;
- Collecting and requesting historical energy usage for all municipal buildings from utilities representatives or municipal departments (Electricity, Natural Gas, Propane, Oil, Renewable Energy Systems, Co-generations, etc.);
- Create/Update an ENERGY STAR Portfolio Manager® municipal account to include information on all municipal buildings with the exception of utility owned street lights accounts and regional school district facilities;
- Grant "Read Only" access of Portfolio Manager municipal account to Clean Energy Communities program administrators for the use of monitoring energy reduction progress;
- Grant "Editing" access of Portfolio Manager municipal account to designated intern, assigned by the Clean Energy Communities program administrators, to assist with data entry of building information and historical energy usage;
- Researching and documenting municipal building information such as square footage, hours of operations, facility type, number of staff and other facility information specific to each municipal building;
- Attend **Municipal Bench Marking Initiative** in-person training workshops (approximately 2-3 workshops) over the duration of the initiative;
- Schedule and attend weekly or biweekly **Municipal Bench Marking Initiative** progress tracking conference calls with Consultants and Clean Energy Communities program administrators;
- Assist Consultant with monitoring municipal building energy usage and energy performance to identify inefficient buildings to be considered for energy evaluations and upgrades;

- Identify at least one Green Team representative who will attend an in-person onsite energy audit and efficiency evaluation of an energy inefficient municipal building;
- Assist Consultants with creating a customized Municipal Action Plan (MAP) which is a document that describes the progress to date and the subsequent steps which need to be completed in order for the community to meet the energy reduction goals of the Clean Energy Communities Program;
- Provide Consultant with information regarding desired energy efficiency or renewable projects which the Municipality plans to pursue for the purpose of creating the Municipal Action Plan (MAP);
- Identify a representative in the community to update ENERGY STAR Portfolio Manager account monthly or quarterly to monitor municipal energy usage and track energy;
- Present findings from the **Municipal Bench Marking Initiative**, along with the Municipal Action Plan, to municipal executive board for adoption. (Ex. Board of Selectman, City Council, Town Council);

WHEREAS, the Town/City of South Windsor will endeavor to coordinate with Clean Energy Communities program administrators schedule and green team assignments exceptions prior to the start date of the **Municipal Bench Marking Initiative**.

NOW, THEREFORE, BE IT RESOLVED that the Town/City of South Windsor, hereby makes its commitment to support the **Municipal Bench Marking Initiative** and work with all the above-referenced parties to promote energy efficiency and conservation in the community.

Marcia B Gauci
(Name of Town/City Leader)

6/2/15
Date (Deadline May 7th, 2015)

Please complete: Assigned Representatives of Green Team: (Please type or print)

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Appendix C Connecticut Renewable Portfolio Standard

The Connecticut Renewable Portfolio Standard (RPS) is a state policy that requires electric providers to obtain a specified percentage or amount of the energy they generate or sell from renewable sources.

This policy creates a financial incentive for development of renewable energy projects by ensuring a market and steady stream of revenue for renewable generators.

Owners of electricity generation projects that qualify as renewable under one of the three classes of Connecticut's RPS receive one renewable energy certificate (REC) for every megawatt-hour (MWh) of electricity they produce. These RECs are tradable commodities that allow the environmental attribute of the renewable energy to be bought and sold separately from the energy commodity itself. A renewable generator can either contract to sell its energy — "bundled" with the accompanying attribute value directly to an electricity provider (usually at a premium above the wholesale electricity price), or it can "unbundle" the REC and the energy and sell them separately in regional wholesale markets.

Separate portfolio standards are required for energy sources classified as "Class I," "Class II," or "Class III.

Class I renewable energy source, as defined in §16-1(a)(20) of the General Statutes of Connecticut (Conn. Gen. Stat.), means

(A) electricity derived from:

- solar power;
- wind power;
- a fuel cell;
- geothermal;
- landfill methane gas, anaerobic digestion or other biogas derived from biological sources;
- thermal electric direct energy conversion from a certified Class I renewable energy source;
- ocean thermal power;
- wave or tidal power;
- low emission advanced renewable energy conversion technologies […] that use waste heat from an industrial or commercial process that does not generate electricity;
- a run-of-the-river hydropower facility that [meets certain requirements] and,
- a biomass facility that uses sustainable biomass fuel, [and meets certain requirements].

(B) any electrical generation, including distributed generation (DG), generated from a Class I renewable energy source, provided, on and after January 1, 2014, any megawatt hours that are claimed or counted toward compliance in another province or state, other than Connecticut, shall not be eligible.

Class II renewable energy source, as defined in Conn. Gen. Stat §16-1(a)(21), means electricity derived from:

- a trash-to-energy facility that has obtained a permit pursuant to section 22a-208a and section 22a-174-33 of the regulations of Connecticut state agencies.

Class III source, as defined in Conn. Gen. Stat. §16-1(a)(38), means:

- the electricity output from combined heat and power systems with a minimum operating efficiency of 50% that are part of customer-side distributed resources developed at commercial and industrial facilities in Connecticut on or after January 1, 2006;
- a waste heat recovery systems installed on or after April 1, 2007, that produces electrical or thermal energy by capturing preexisting waste heat or pressure from industrial or commercial processes;
- the electricity savings from conservation and load management programs that started on or after January 1, 2006 (on and after January 1, 2014, programs supported by ratepayers are not eligible);
  and,
- any demand-side management project awarded a contract pursuant to §16-243m (eligibility is based on the term of the contract).

Required Annual Renewable Energy Percentages:

Year	Class I	Class II or Class I (add'l)	Class III	Total
2018	17.0%	4.0%	4.0%	25.0%
2019	19.5%	4.0%	4.0%	27.5%
2020	21.0%	4.0%	4.0%	29.0%
2021	22.5%	4.0%	4.0%	30.5%
2022	24%	4.0%	4.0%	32%
2023	26%	4.0%	4.0%	34%
2024	28%	4.0%	4.0%	36%
2025	30%	4.0%	4.0%	38%
2026	32%	4.0%	4.0%	40%
2027	34%	4.0%	4.0%	42%
2028	36%	4.0%	4.0%	44%
2029	38%	4.0%	4.0%	46%
2030	40%	4.0%	4.0%	48%

Appendix D Energy Conversion Factors

Approximate Heating Value of Common Fuels		
Electricity	3412 Btu/kilowatt hour	
Gas		
Natural Gas	1,030 Btu/cu ft	100,000 Btu/therm
Propane	2,500 Btu/cu ft	92,500 Btu/gal
Methane	1,000 Btu/cu ft	
Landfill gas	500 Btu/cu ft	
Butane	3,200 Btu/cu ft	130,000 Btu/gal
Fuel Oil		
Kerosene	135,000 Btu/gal	
#2	138,500 Btu/gal	
#4	145,000 Btu/gal	
#6	153,000 Btu/gal	
Waste oil	125,000 Btu/gal	
Biodiesel – Waste vegetable oil	120,000 Btu/gal	
Gasoline	125,000 Btu/gal	
Methanol	57,000 Btu/gal	
Ethanol	76,000 Btu/gal	
Wood		
Softwood	2-3,000 lb/cord	10–15,000,000 Btu/cord
Hardwood	4-5,000 lb/cord	18–24,000,000 Btu/cord
Sawdust – green	10-13 lb/cu ft	8-10,000,000 Btu/ton

Sawdust – kiln dry	8-10 lb/cu ft	14-18,000,000 Btu/ton
Chips	45% moisture 10-30 lb/cu ft	7,600,000 Btu/ton
Hogged	10-30 lb/cu ft 16	20,000,000 Btu/ton
Bark	10-20 lb/cu ft	9-10,500,000 Btu/ton
Wood pellets	10% moisture 40-50 lb/cu ft	16,000,000 Btu/ton
Coal		
Hard Coal (anthracite)	13,000 Btu/lb	26,000,000 Btu/ton
Soft Coal (bituminous)	12,000 Btu/lb	24,000,000 Btu/ton
Recycling		
Rubber – pelletized	16,000 Btu/lb	32-34,000,000 Btu/ton
Plastic	18-20,000 Btu/lb	
Corn – shelled	7,800-8,500 Btu/lb	15-17,000,000 Btu/ton
cobs	8,000-8,300 Btu/lb	16-17,000,000 Btu/ton

Prepared by:
John W. Bartok, Jr., Agricultural Engineer
University of Connecticut, Storrs CT 06269-4087
December 2004

Appendix E Source-Site Ratios for Various Energy Types

Portfolio Manager provides the following information regarding the concept of Source Energy and Site Energy and how they are related:

> "Commercial buildings all use different mixes of energy including electricity, natural gas, fuel oil, district steam, and many others. In order to evaluate energy performance for these buildings, we have to express all of these different energy types in a single common unit. **Source energy** is the most equitable unit of evaluation, and enables a complete assessment of energy efficiency.
>
> You may be familiar with **site energy**, the amount of heat and electricity consumed by a building as reflected in utility bills. Site energy may be delivered to a facility in one of two forms. **Primary energy** is the raw fuel that is burned to create heat and electricity, such as natural gas or fuel oil. **Secondary energy** is the energy product created from a raw fuel, such as electricity purchased from the grid or heat received from a district steam system. A unit of primary energy and a unit of secondary energy consumed at the site are not directly comparable because one represents a raw fuel while the other represents a converted fuel. Ultimately, buildings require heat and electricity to operate, and there are always losses associated with generating and delivering this heat and electricity. **Source energy** traces the heat and electricity requirements of the building back to the raw fuel input, thereby accounting for any losses and enabling a complete thermodynamic assessment. The table [below] summarizes the ratios used in Portfolio Manager to convert to source energy. We use national average ratios for the conversion …"

The following table represents Source/Site ratios as of 2019. The ratios, especially for grid purchase electricity, change as the mix of renewable vs. fossil and nuclear energy sources change over time.

Energy Type.	U.S Ratio	Canadian Ratio
Electricity (Grid Purchase)	2.80	1.96
Electricity (on-Site Solar or Wind Installation)	1.00	1.00
Natural Gas	1.05	1.01
Fuel Oil (1,2,4,5,6,Diesel, Kerosene)	1.01	1.01
Propane & Liquid Propane	1.01	1.04

Appendix F Useful Websites

South Windsor Energy Committee: http://www.southwindsor.org/energy-committee

South Windsor Human Services Department:

https://www.southwindsor.org/human-services (860) 648-6361

Connecticut Green Bank: https://www.ctgreenbank.com/

Energize Connecticut including Home Energy Solutions (HES) and business solutions:

www.EnergizeCT.com 1-877-WISE USE (877-947-3873)

Solarize Connecticut: https://solarizect.wee.green/

Additional solar information: http://www.gosolarct.com/

Clean Energy Communities Links: www.ctenergydashboard.com

Commercial Property Assessed Clean Energy (C-PACE). http://www.cpace.com/About-Us.

EPA Energy Star Portfolios Manager Links: https://portfoliomanager.energystar.gov/pm/home.html

User name is "SouthWindsorMunicipal". Staff and Energy Committee chair have password.

NC Clean Energy Technology Center DSIRE program listing:

https://programs.dsireusa.org/system/program?zipcode=06074.

Eversource Account Login (follow links to residential or business logins)

https://www.eversource.com/content/ct-c

Eversource Municipal Account login (staff only):

https://www.eversource.com/security/account/login?ReturnUrl=/CG/AcctInfo/AccountInformation

Energize CT Heating pages

Residential Furnaces: https://www.energizect.com/your-home/solutions-list/High-Efficiency-Furnace-Natural-Gas-Boiler-Rebates

Infrared Heaters: https://www.energizect.com/your-business/solutions-list/Natural-Gas-Infrared-Heater-Rebate

Commercial Heating: https://www.energizect.com/your-business/solutions-list/Natural-Gas-Heating-Equipment-Rebate

Consortium for Energy Efficiency, Inc.

Directory: http://www.ceedirectory.org/site/1/Home

Residential Boilers: https://efi.secure.force.com/client/LandingCTMIDV1

Commercial Boilers: https://efi.secure.force.com/client/FormCTDHECIV1

Fourth National Climate Assessment: https://nca2018.globalchange.gov

WHO | COP24 Special report: Health & Climate Change

https://www.who.int/globalchange/publications/COP24-report-health-climate-change/en/