



2017 COMPREHENSIVE ENERGY STRATEGY

Draft Executive Summary: July 26th, 2017

CT GENERAL STATUTES SECTION 16a-3d

Connecticut Department of Energy and Environmental Protection



EXECUTIVE SUMMARY

The Connecticut Department of Energy and Environmental Protection (DEEP) has prepared this update to Connecticut's Comprehensive Energy Strategy (CES) to advance the State's goal to create a cheaper, cleaner, more reliable energy future for Connecticut's residents and businesses. By statute (see Appendix A), DEEP is required to periodically update the CES to assess and plan for all energy needs in the state, including, but not limited to, electricity, heating, cooling and transportation.

Since the publication of Connecticut's first CES in 2013, the State has advanced policies and programs that have put the State on a path to reduce energy costs, improve system reliability, and minimize environmental impacts for its residents and businesses. Connecticut has achieved significant progress. For example, since 2013 DEEP has:

- Directly procured commitments of renewable energy generation and energy efficiency that equal the generation of a large power plant, at competitive pricing.
 - Specifically, the state has procured over 400 megawatts (MW) of DEEP-solicited small scale renewable energy and energy efficiency resources, and over 400 MW of large-scale renewable energy projects, 90 MW of which will be located in Connecticut.
 - The price of these selected grid scale bids dropped by nearly half compared to procurements in 2012 and 2013.
 - Procurement of energy efficiency as a resource moves the energy efficiency resource standard to a level on par with other generation sources, truly exemplifying the value of efficiency as a resource equivalent to supply.
- Developed a first-in-the-nation statewide microgrid program to build local resiliency for electrical load in critical community operations.
 - Program implementation now includes five operational microgrids and five in development.
- Established a Governor's Council on Climate Change to ensure the State meets its greenhouse gas (GHG) reduction goals.
- Launched a Shared Clean Energy Facility pilot program, with DEEP selecting over 5 MW of solar that will have a dedicated subscription target of low- and moderate-income consumers.

- Advanced development of renewable energy generation and supported lower electricity bills for state, municipal, and agricultural customers through virtual net metering.
- Converted 39,104 residential customers to natural gas for heating, and 12,021 commercial and industrial customers to natural gas for generation or other processes between 2014 and 2016.
- Catalyzed residential and commercial investments in energy efficiency across the state through implementation of Connecticut’s award-winning Conservation and Load Management Plan (C&LM Plan), contributing to Connecticut’s economy, and fueling an energy efficiency industry with 34,000 jobs in Connecticut.
 - These investments have empowered state residents to collectively save more than \$140 million annually, Connecticut’s businesses to save more than \$115 million annually, and Connecticut’s state agencies to save \$6 million annually.
 - Investments are spread across millions of projects statewide, including in more than 20,000 low-income homes annually and at thousands of businesses, large and small.
 - Investments include utilities and others providing low or no interest financing for heating equipment with simplified applications and on-bill repayment, and market-based incentives that transform energy use.
 - Connecticut became the first state to implement the U.S. Department of Energy’s Home Energy Score labeling system on a statewide voluntary basis, producing over 21,000 scores to date.
- Launched the EVConnecticut program to:
 - Provide grants for charging and alternative fueling stations to make Connecticut a range-confident state, and
 - Deploy point-of-sale vehicle rebates through the Connecticut Hydrogen and Electric Automobile Purchase Rebate (CHEAPR) program—supporting the purchase of 1,300 EVs.
- Launched CT *fastrak* bus rapid transit (BRT) service, doubling the ridership in corridor to between 12,000-16,000 weekday trips and helping riders avoid rush-hour congestion.
- Released Let’s Go CT!, Governor Dannel Malloy’s transportation Call to Action representing 30-year vision for Connecticut’s best-in-class transportation system.

The State will continue to build upon this foundation to transform how we produce, distribute, and consume energy to achieve Connecticut’s long-term vision of a zero-carbon economy. This transformation will take many years to implement and requires developing a forward thinking framework with specific plans and recommendations for the near term.

With this in mind, the 2017 update of the CES is guided by the goal of cheaper, cleaner, more reliable energy. Connecticut energy policy must:

- Align with and support the State’s broader environmental policies to meet clean air, clean water, land conservation and development, and waste reduction goals;
- Put the State on a clear path to meet the Global Warming Solutions Act to reduce GHG emissions 10 percent below 1990 levels by 2020 and 80 percent below 2001 levels by 2050;
- Focus on grid modernization, strategic electrification, increasing efficiency, and improving reliability and security;
- Increase energy affordability and economic security to help strengthen the State’s economy now and into the future;
- Maintain equitable access to the benefits of clean and efficient energy generation and transportation options.

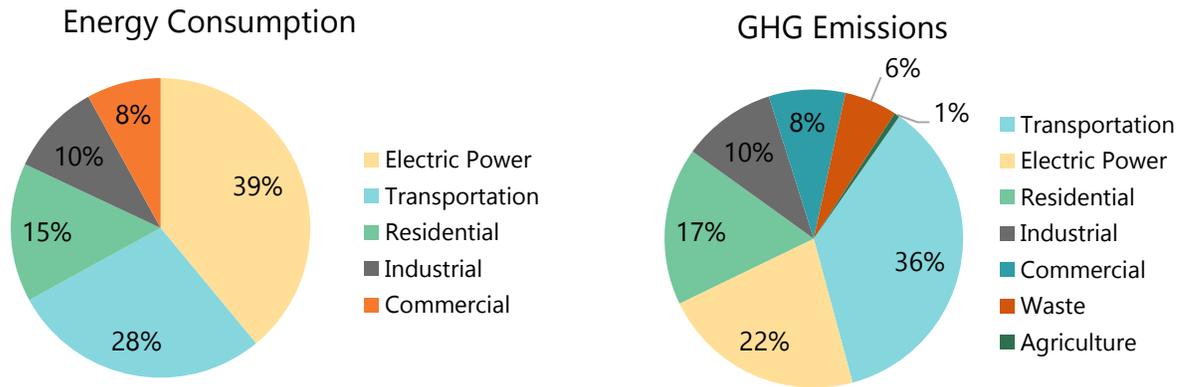
Guided by these principles, this CES offers a series of goals and strategies that reflect lessons learned and respond to new conditions within the three energy end-use sectors; electricity power, buildings, and transportation. These strategies and goals advance the State’s long-term vision by calling for continued investment in clean energy resources, grid-modernization, increasing energy efficiency in buildings and transportation, and accelerating progress to decarbonize the energy sector.

Energy Policy that Advances Climate Goals

Energy consumption across all fuels and sectors accounts for 93 percent of the GHG emissions in Connecticut. Across energy usage sectors, transportation is the largest contributor of emissions, accounting for 36 percent, with the electric power sector following at 22 percent (see Figure ES1). As the State’s single largest source of emissions, Connecticut’s transportation sector emissions are well above the national average where emissions from the transportation sector are 27 percent and the electric power sector makes up 29 percent.¹

¹ U.S. EPA’s inventory of U.S. Greenhouse Gas emissions and Sinks: 1990 -2015, April 2017.
<https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2015>

FIGURE ES1: Connecticut Energy Consumption and GHG Emissions by Sector



Source: United States Energy Information Administration

This difference in emissions contributions for the electric power and transportation sectors can be attributed to Connecticut, and the New England region as a whole, transitioning electric power generation from carbon intensive fuel sources such as coal and oil to less carbon intensive fuel sources such as natural gas and renewables.² The region’s grid operator, ISO New England, attributes this transformation to four primary factors: public policies and programs, economics, innovation, and customer choices.³

DEEP’s most recent GHG inventory analysis shows that the State has reduced emissions 4 percent below 1990 levels and 14 percent below 2001 levels.⁴ Although Connecticut’s progress in reducing GHG emissions has been successful, far deeper cuts are needed in the coming decades to meet the Global Warming Solutions Act’s (GWSA) 2050 target. The State must continue to move swiftly to decarbonize its energy supply across all sectors.

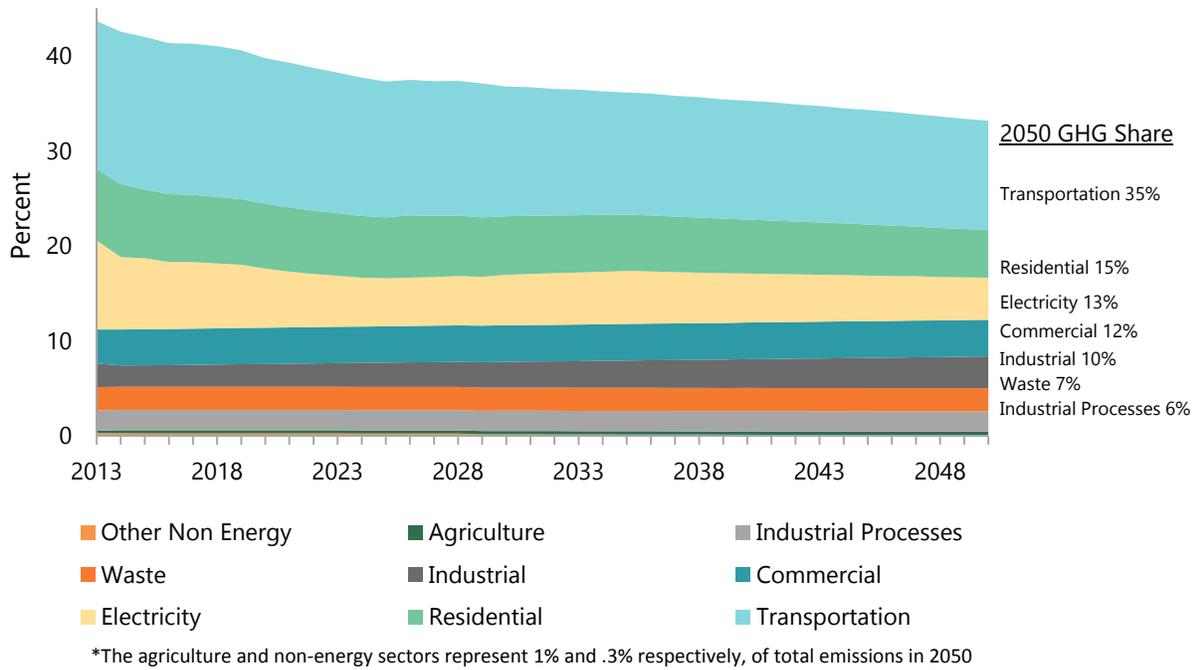
In an analysis completed by the Governor’s Council on Climate Change (GC3), the business-as-usual reference case shows emissions from the electric power sector will continue to decline, while

² New England Power Grid 2016-2017 Profile, ISO New England, https://www.iso-ne.com/static-assets/documents/2017/01/ne_power_grid_2016_2017_regional_profile.pdf

³ Grid in Transition: Opportunities and Challenges, ISO New England Regional Outlook, <https://www.iso-ne.com/about/regional-electricity-outlook/grid-in-transition-opportunities-and-challenges>

⁴ 2013 Connecticut Greenhouse Gas Emissions Inventory, CT DEEP, 2016 http://www.ct.gov/deep/lib/deep/climatechange/2012_ghg_inventory_2015/ct_2013_ghg_inventory.pdf

FIGURE ES2: Economy-wide GHG Emissions Business as Usual Reference Case



emissions from the transportation sector will remain almost constant at 35 percent of economy-wide GHG emissions through 2050.⁵ The residential, electric power, commercial, and industrial sectors follow at 15, 13, 12 and 10 percent respectively by 2050 (Figure ES2).

To achieve the long-term vision of a developing a zero-carbon economy, improving building efficiency, and reducing vehicle miles traveled can help decrease the use of carbon-intensive fuels. But ultimately, widespread electrification of building thermal loads (cooling and heating) and the transportation sector is required. Consequently, by 2050 electricity becomes the dominant source for our energy supply and makes decarbonization of the electric power sector the cornerstone to the success of achieving a carbon-free economy.

It is important to note that Connecticut’s ambitious emissions reduction goals cannot be achieved by government alone. Private actors including businesses, civic and advocacy groups, private citizens, religious organizations, associations, and colleges and universities play a critical role. Collaborative partnerships, private investment, and technology innovation is paramount to achieving the necessary reductions. Climate change solutions that go beyond government action

⁵ Governor Dannel P. Malloy’s Executive Order 46 (4-22-15) established the Governor’s Council on Climate Change to examine the efficacy of existing policies and regulations designed to reduce GHG emissions and identify new strategies to meet the established emission reduction targets.

Governor's Council on Climate Change

On Earth Day 2015, Governor Malloy issued Executive Order 46, creating the Governor's Council on Climate Change (GC3). The Council is composed of 15 members from state agencies, quasi-state agencies, companies, and nonprofits. Governor Malloy tasked the Council with:

- establishing interim goals that will guide the state to the 2050 emission reduction target;
- annually monitoring statewide GHG emissions to determine if the state is poised to meet its 2050 target and any established interim goal(s);
- examining the efficacy of existing policies and regulations designed to reduce GHG emissions; and
- recommending new policies, regulation, or legislative actions that will assist in achieving established emission-reduction targets.

Council members are currently in the process of analyzing greenhouse gas emission reduction scenarios to inform their recommendations on strategies that lead to long-term emissions reductions and to ensure that the state is on a path to meet its Global Warming Solutions Act goal of 80 percent below 2001 levels by 2050.

For more information on GC3 activities: www.ct.gov/deep/GC3

will help stimulate the economy and build strong, vibrant, and resilient communities across the state.

Pathway to Grid Modernization and Decarbonization

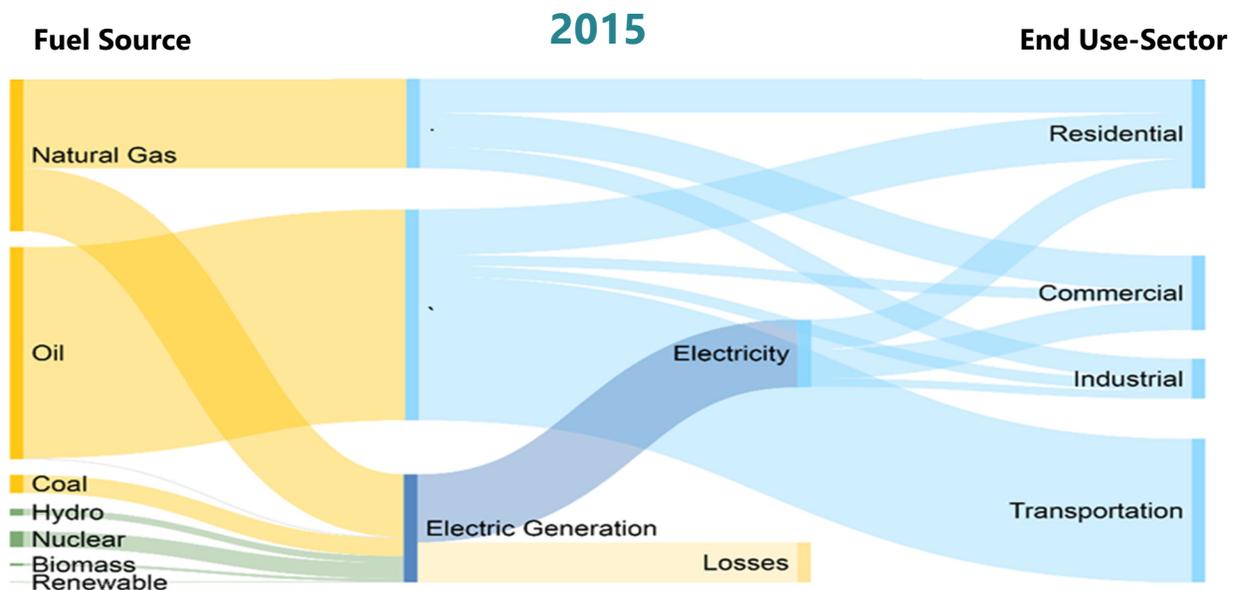
Connecticut's energy vision identifies a pathway for meeting our environmental goals while capturing the benefits of investing in renewable energy sources and minimizing our dependence on commodities subject to price volatility. According to United States Energy Information Administration data for 2015, Connecticut's businesses and residents spend over \$13 billion on energy produced from petroleum and natural gas annually. These costs are spread between the residential sector at 36%, the commercial sector at 22%, the industrial sector at 7% and the transportation sector at 35%. Continued reductions in energy consumption from each sector is essential for Connecticut to reach energy affordability and environmental sustainability goals.

The following figure provides illustrative energy flows for 2015 (Figure ES3) showing Connecticut's energy consumption of the regional mix by fuel type for electricity generation, and also depicts energy losses. The left side of the graphic identifies the primary type of energy supply (natural gas, oil, coal, hydro, nuclear, biomass and renewables). The height of each bar

corresponds to the amount of energy from each source. The figure also depicts portions of the energy flow that is transformed into electricity, while others are used directly in end use sector buildings (residential, commercial, industrial and transportation).

To meet its 2050 greenhouse gas emissions reduction target, transformation of these energy flows is necessary, including increased renewable energy generation and energy storage, deployment of electric vehicles, and energy efficiency. As part of this transformation, fossil fuel use will decline over time and be displaced with renewable generation and electric end use increases. These policies are being evaluated by the Governor’s Council on Climate Change as they provide a recommendation on an interim greenhouse gas emissions reduction target.⁶

FIGURE ES3: Connecticut Energy Flows in 2015



⁶ Connecticut’s Global Warming Solutions Act requires the state to reduce greenhouse gas emissions by 10% from 1990 levels by 2020 and 80% from 2001 levels by 2050. Conn. Gen. Stat. Sec. 22a-200a.

Energy Policy that Advances Grid Modernization Goals

Connecticut's grid of the future must achieve the broad goals of delivering cheaper, cleaner and more reliable energy while addressing increased electricity demand. It will need to integrate distributed generation, and expand energy storage and demand response at the lowest cost for electric ratepayers. The grid must therefore be supported by a secure network that can effectively blend both bulk electric grid operations and highly distributed generation, while remaining resilient to weather and climate events, and resistant to cyber assaults. The system will also need to continue supporting community resiliency and enabling new deployment and interconnection of micro-grid systems. Increased deployment and integration of advanced technologies such as energy storage, will enhance flexibility of grid operations. This will also encourage cost savings, especially during times of peak electrical demand, and increase reliability and customer response.

To ensure steady progress in meeting the state's GHG reduction goals and to put the state on a pathway to decarbonize the electric sector, this Strategy assumes that at a minimum, an extension of the Renewable Portfolio Standard (RPS) to 30 percent by 2030 will be required, along with consideration of the role of other carbon-free resources such as nuclear and large-scale hydroelectric.

Key strategies to modernize the grid include:

- Renew progress, with leadership from the Public Utilities Regulatory Authority (PURA), on smart grid implementation, including variable pricing and advanced meters.
- Continue to promote the development of microgrids and energy storage technologies.
- Work with the utility companies to ensure the continual improvement of cyber-security measures.

As Connecticut continues to increase its level of investment in renewables, it must ensure that investments are made cost-effectively and for the benefit of all ratepayers. This Strategy calls for the majority of RPS obligations to be met using grid-scale resources, which have dramatically reduced in price for all ratepayers, and advocates changes to behind-the meter programs that will maximize the impact of ratepayer dollars on the development of renewables, while improving transparency.

Key strategies to deploy renewables and decarbonize the electricity supply:

- Expand the RPS to achieve 30% Class I by 2030.
- Phase down biomass and landfill gas in Class I of the RPS.
- Evaluate the future of zero-carbon resources as they apply to meeting GHG reduction goals.

- Revise the cost-structure for net energy billing to maximize the impact of ratepayer investment, and ensure that investment is sustainable over the long-term.
- Prioritize grid-scale, DEEP-run procurements for renewables and energy efficiency in order to optimize zero-carbon resource deployment at the lowest cost to consumers, and address siting and land-use pressures through the development of a working group.

Energy Efficiency and Strategic Electrification

Today, over 80 percent of Connecticut households and commercial and industrial buildings are heated using fossil fuels.⁷ Accomplishing Connecticut’s GHG emissions reductions goals will require predictable and sustained investments in reducing energy waste and moving to clean sources of electric power, with substantial electrification of our thermal processes in buildings. Moving our buildings to renewable thermal sources, and to efficient electric thermal technologies will require strategic, phased in deployment.

As electric demand may subsequently increase to meet expanded thermal load needs, the ability to maintain progress in energy efficiency and curb peak energy demand will become increasingly important. Energy efficiency can reduce both consumption and peak demand, avoid transmission and distribution costs (T&D), and mitigate price effects in the wholesale market. Energy savings from efficiency investments are currently being achieved at a cost of about 4.5 cents per kWh of lifetime electric savings.⁸ Therefore, not only is it a low-cost energy resource that delivers savings to ratepayers, but also a critical method for offsetting and neutralizing the increased demand from expanded electrification of home heating and cooling.

Accomplishing this transition will involve significant planning, deployment, and changes to both institutional and regulatory frameworks. Key 2017-2020 strategies for energy efficiency include actions that will:

- Continue to predictably and sustainably invest in energy efficiency and prioritize efficiency as a resource through procurement of efficiency as a supply resource, committed investments in the statewide conservation and load management plan, and through selling efficiency gains to meet the regional grid’s capacity requirements.
- Enhance the performance of built infrastructure and the energy productivity of industrial processes, including through weatherization, efficiency audits, and building codes.

⁷ Gronli et. al. 2017. *Feasibility of Renewable Thermal Technologies in Connecticut: Market Potential*.

⁸ Molina, Maggie, “The Best Value for America’s Energy Dollar: A National Review of the Cost of Utility Energy Efficiency Programs”, Publications, American Council for an Energy-Efficient Economy, 2014, <http://aceee.org/research-report/u1402>.

- Continue to expand active energy demand management through control technologies, pricing signals, and standardized two-way communication, and access to advanced meters.
- Pursue strategic electrification, including encouraging the utility companies to promote the installation of efficient heat pumps, initially focusing on buildings currently heated by electric-resistance heating systems and on new construction, then eventually replacing combustion heating systems as the electric power sector becomes cleaner.

Clean and Accessible Transportation Options

Transportation is an integral part of Connecticut's socioeconomic fabric. Connecticut's transportation system and infrastructure encompass an extensive range of multimodal elements – from roadways and highway facilities, pedestrian and bicycle accommodations, to bus transit systems, passenger and freight railways, airports, deep water ports, and even ferry landings. This infrastructure connects residents and visitors to families, friends, services, jobs and communities. It also enables the movement of retail goods, raw materials, and other commodities in, out, and around the state. The reliability of the state's transportation system and supporting infrastructure, as well as the energy resources necessary to operate that system have a direct impact on Connecticut's economy and the quality of life for its 3.5 million residents and their local communities. To effectively enhance quality of life, minimize environmental impacts, and foster continued economic growth, it is critical that the state provides a safe, reliable and efficient transportation system that can accommodate future growth in population, tourism, business, and recreation.

Transportation energy consumption and emissions are a function of vehicle fuel efficiency, the carbon content of the fuel source and vehicle miles traveled (VMT). A sustainable and low-carbon transportation energy future will require significant refinements in order to provide increased mobility options to citizens and businesses and ensure that the state achieves its GHG emissions reduction targets. As the state's largest contributor to GHG emissions, steep reductions from the transportation sector will be required to ensure Connecticut meets its Global Warming Solutions Act goal of reducing emissions 80 percent below 2001 levels by 2050.

In this 2017 CES, the transportation recommendations put forth embrace solutions that go beyond adding roadway capacity to address population growth and economic expansion, but rather, aim to put Connecticut on a clear path to achieve state emission reduction targets, increase connectivity, user flexibility, and equitable access to efficient and clean transportation options, improve resilience to fuel price volatility, enhance economic growth, and create desirable communities.

Key 2017-2020 strategies for the transportation sector include:

- Develop an Electric Vehicle Roadmap that takes a comprehensive approach to expanding alternative fueling infrastructure and vehicle purchasing, addresses regulatory frameworks needed to support deployment, and enhances current outreach and education efforts.
- Support current state planning efforts that advance smart-growth and transportation-oriented development.
- Embrace technological advances, innovative models, and creative partnerships that improve access to a wider array of clean transportation options.
- Work with regional partners in the public and private sector to advance a clean, efficient, and accessible transportation network.

Process to develop 2017 Strategy

DEEP held a series of scoping meetings, informational meetings and workshops on specific topics to provide inclusive input on the CES.

- May 24, 2016: DEEP held a scoping meeting to receive stakeholder feedback on the major topics to include in the upcoming CES.
- October 27, 2016: DEEP held an informational meeting on demand resource management at the regional and local level
- November 3, 2016: DEEP held an informational meeting on air- and ground-sourced heat pumps, solar water heating, and biodiesel as thermal fuel in the state and region.
- January 10, 2017: DEEP co-convoked with the Department of Agriculture a workshop to discuss state renewable energy programs and their intersection with environmental, agricultural, and land use policies.
- February 15, 2017: DEEP held an informational meeting on implementation of DEEP's strategies to reduce and improve energy use at state buildings.

DEEP received public input on all of these topics and incorporated the feedback into the CES.

OVERVIEW OF RECOMMENDED GOALS & STRATEGIES

The Table below summarizes the recommendations, organized by Chapter and around key goals for each sector and the specific strategies proposed to meet them.

ELECTRIC POWER SECTOR

Goal 1: Align existing programs supporting renewable and zero carbon resources with renewable portfolio standards and global warming solutions act goals.

- E.1.1 Expand the RPS to achieve 30 percent Class I renewables by 2030.
- E.1.2 Phase down biomass and landfill gas RECs in Connecticut's Class I of the RPS.
- E.1.3 Achieve a sustainable balance between behind the meter programs and grid-scale procurements supporting Class I Renewables to expand clean energy at the least cost for ratepayers.
- E.1.4 Increase transparency and certainty in the cost structure for net energy billing by creating renewable energy tariffs.
- E.1.5 Evaluate the conditions around utilizing a diverse zero-carbon generation mix to meet our greenhouse gas emissions reduction goals.
- E.1.6 Pursue goals of the shared clean energy facility program through multiple avenues based on lessons learned from the pilot program.
- E.1.7 Strengthen voluntary renewable product verification in the competitive electric supplier market.
- E.1.8 Convene a working group to implement best practices to optimize siting of renewable facilities on appropriate sites in Connecticut.

Goal 2: Continue to support regional and state reliability and resiliency efforts.

- E.2.1 Support ISO-NE in addressing regional winter natural gas generation reliability issues.
- E.2.2 Continue to deploy community microgrids to support statewide resiliency goals in strategic locations and support the Energy Assurance Plan.
- E.2.3 Ensure coastal resiliency of substations and other critical grid infrastructure to support DEEP's flood management goals.

E.2.4 Continue to identify and explore grid modernization initiatives.

BUILDINGS SECTOR

Goal 1: Prioritize energy savings as both a financial and energy resource.

- B.1.1 Procure energy efficiency as a resource.
- B.1.2 Enhance competitiveness of Connecticut's businesses with customized energy efficiency investments.
- B.1.3 Reduce the energy affordability gap in low-income households.
- B.1.4 Improve financial programs to increase access to clean and efficient energy improvements.
- B.1.5 Maximize consumer demand for energy efficiency by increasing awareness and understanding of its value.
- B.1.6 Evaluate current cost-effectiveness testing methods for accurate reflection of all resource costs and benefits.
- B.1.7 Ensure equitable efficiency investment for delivered heating fuel customers through equitable conservation charges.

Goal 2: Improve the performance and productivity of buildings and industrial processes.

- B.2.1 Ensure application of and compliance with current building energy codes and product efficiency standards.
- B.2.2 Strategically sequence deployment of cleaner thermal fuel choices to transition buildings from fossil fuels.
- B.2.3 Continue increasing the rate of home weatherization and assessment, statewide.
- B.2.4 Address the unique needs of multifamily buildings for implementing cost-effective, clean and efficient upgrades.
- B.2.5 Reduce energy waste by using combined heat and power, where it is cost-effective, in commercial and industrial applications.
- B.2.6 Reduce energy waste at water and wastewater treatment facilities.
- B.2.7 Evaluate applicability of district heating and thermal loops in high density areas.
- B.2.8 Inventory state buildings and their energy usage patterns to identify greatest energy savings opportunities.

B.2.9 Support diversification of the heating oil delivery industry's products and services.

Goal 3: Continue prioritizing grid load management to reduce peak demand.

B.3.1 Target peak demand reductions.

B.3.2 Increase and standardize two-way advanced meter communication.

B.3.3 Optimize economic signals and incentives for demand response to recognize shifts in demand from expanding electrification of heating and transportation.

TRANSPORTATION SECTOR

Goal 1: Put the State on a strategic pathway to decarbonize the transportation sector.

T.1.1 Develop an Electric Vehicle Roadmap to accelerate the adoption of low and zero-emissions vehicles and strengthen alternative fueling infrastructure.

T.1.2 Advocate for the implementation of federal vehicle fuel economy standards and maintaining LEV, ZEV, and GHG programs.

T.1.3 Educate and engage citizens and employers on the benefits of clean and efficient transportation options, including the advantages of transportation demand management measures.

Goal 2: Facilitate state planning to advance smart-growth, transit-oriented development, and mixed-use planning that leads to energy and emissions reductions.

T.2.1 Implement Let's Go CT! initiatives and its long-term vision to create a best-in-class transportation system.

T.2.2 Encourage and support smart-growth, transit-oriented development, mixed-use planning, and development efforts that improve connectivity and accessibility to public transit.

Goal 3: Develop and support strategic partnerships to improve access to a wider array of transportation options.

T.3.1 Embrace technological advances, shared mobility services, and transportation demand partnerships that improve mobility and access to clean modes of transportation.

T.3.2 Participate in regional partnerships and initiatives to advance a clean and efficient transportation network throughout the region.