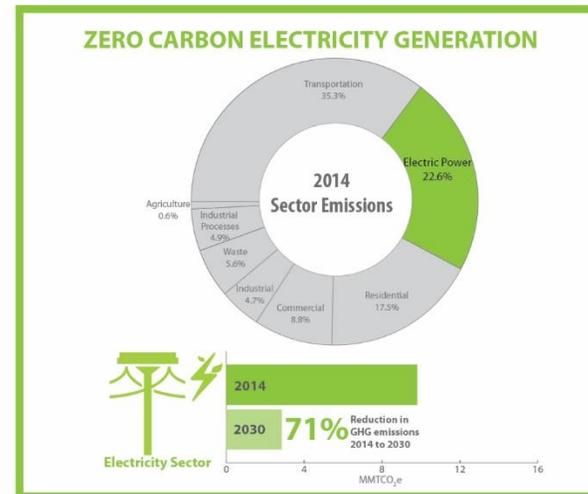
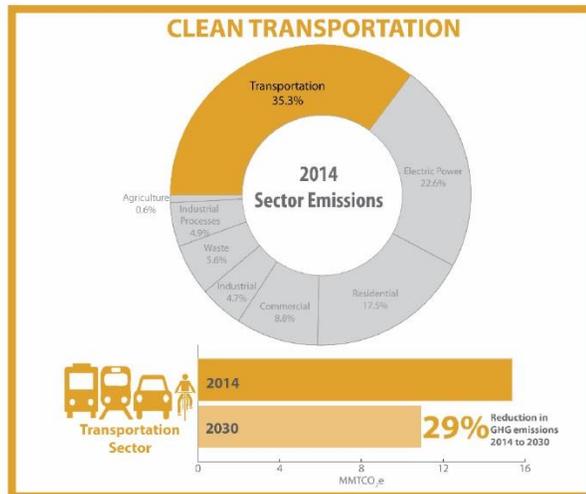
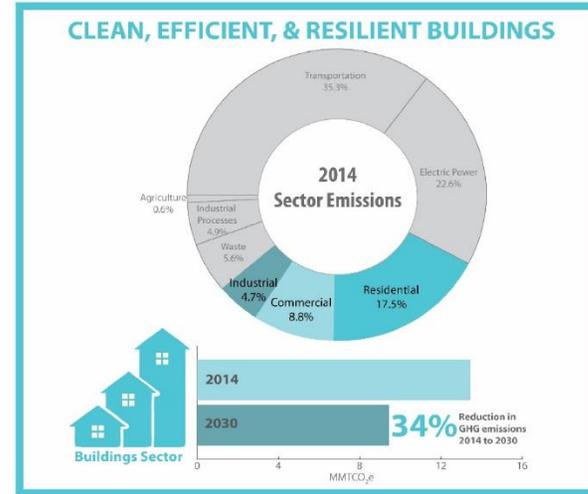
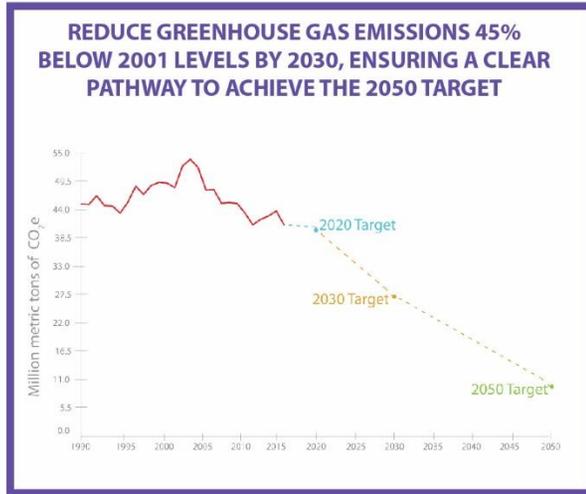


BUILDING A LOW CARBON FUTURE FOR CONNECTICUT

ACHIEVING A 45% GHG REDUCTION BY 2030



RECOMMENDATIONS FROM THE GOVERNOR'S COUNCIL ON CLIMATE CHANGE

DECEMBER 18, 2018

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GOVERNOR’S COUNCIL ON CLIMATE CHANGE

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EXECUTIVE SUMMARY

Carbon dioxide (CO₂) is the greenhouse gas (GHG) that represents the greatest warming potential, due to its atmospheric abundance and long atmospheric lifetime (hundreds to thousands of years).¹ The global CO₂ concentration has surpassed 400 parts per million (ppm), a level higher than at any time in the last 3 million years. Since the start of the 20th century, the Earth has warmed 1°C (1.8°F) since the pre-industrial period²; and the last four years have been the warmest years on record. The Intergovernmental Panel on Climate Change (IPCC) recently released a Special Report on Global Warming of 1.5°C, stating that there is high confidence that “global warming is likely to reach 1.5°C (2.7°F) between 2030 and 2052 if it continues to increase at the current rate.”³ The last time temperatures were 1-2°C (1.8-3.6°F) higher than they are now — some 125,000 years ago — sea levels were 5-6 meters (16-19 feet) higher. A 1.5°C (2.7°F) change in temperature will also have devastating impacts on ecosystems, water supplies, human health, and socioeconomic sectors.

The IPCC Special Report notes that if anthropogenic GHG emissions stopped today, the 1.5°C (2.7°F) limit would not be exceeded, but global emissions to date “will persist for centuries to millennia.” The clear and sober findings of this report deepen our urgency to

accelerate mitigation and adaptation efforts to reduce the risks and impacts associated with a 1.5-2°C (2.7-3.6°F) increase in global temperature from pre-industrial levels.

Moreover, the recently released Fourth National Climate Assessment, Volume II draws a direct connection between the warming atmosphere and the resulting changes that affect lives, communities, and livelihoods. The impacts of observed warming are already being felt in the United States and are projected to intensify in the future. The severity of future impacts will depend largely on actions taken to reduce GHG emissions and our ability to integrate climate adaptation strategies into existing investments, policies, and practices.⁴

With over 600 miles of coastline and 2.2 million people living in shoreline communities in Connecticut, the State’s residents and communities are extremely vulnerable to the impacts of weather and climate events. Connecticut residents are already beginning to experience such effects as climate change ramps up. For instance, in Connecticut alone, Hurricane Irene (2011) caused power outages affecting 754,000 customers and over \$1 billion in damage, and Hurricane Sandy (2012) caused power outages affecting more than

¹ Why does CO₂ get most of the attention when there are so many other heat-trapping gases? Union of Concerned Scientists. August 3, 2017. Retrieved from <https://www.ucsusa.org/global-warming/science-and-impacts/science/CO2-and-global-warming-faq.html#bf-toc-1>

² Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, B. DeAngelo, S. Doherty, K. Hayhoe, R. Horton, J.P. Kossin, P.C. Taylor, A.M. Waple, and C.P. Weaver, 2017: Executive summary. In: *Climate Science Special Report: Fourth National Climate Assessment, Volume I* [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 12-34, doi: [10.7930/J0DJ5CTG](https://doi.org/10.7930/J0DJ5CTG).

³ IPCC, 2018 [In Press]: Summary for Policymakers. In: *Global Warming of 1.5 °C an IPCC special report on the impacts of global warming of 1.5 °C above pre-industrial levels and*

related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.

⁴ Jay, A., D.R. Reidmiller, C.W. Avery, D. Barrie, B.J. DeAngelo, A. Dave, M. Dzaugis, M. Kolian, K.L.M. Lewis, K. Reeves, and D. Winner, 2018: Overview. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA. doi: [10.7930/NCA4.2018.CH1](https://doi.org/10.7930/NCA4.2018.CH1)

600,000 customers and inflicted almost \$2 billion in statewide damages.⁵ The latter forced thousands of Connecticut residents to evacuate, saw thousands apply for FEMA assistance, damaged roads and infrastructure, and took nine days for utilities to restore power.⁶ Many of Connecticut's coastal communities and assets face escalating risk of storm events exacerbated by climate change.

Connecticut's commitment to address climate change is evident in the policies, programs, and voluntary actions it has pursued over the past 15 years. Passage of the 2008 Global Warming Solutions Act, which set forth a statutory requirement to reduce GHG emissions 10 percent below 1990 levels by 2020 and 80 percent below 2001 levels by 2050, establishes a commitment that the State will mitigate harmful GHG emissions. While long-term GHG reduction trends indicate the Connecticut is on a trajectory to meet its targets, the urgency of action cannot be overstated. Beyond 2020, far deeper cuts are needed to ensure meeting the State's reduction targets.

Anticipating the need to ensure the State maintains a downward trajectory, Governor Malloy issued Executive Order No. 46, creating the Governor's Council on Climate Change (GC3). The GC3 was tasked with 1) "examining the efficacy of existing of existing policies and regulations designed to reduce greenhouse gas emissions and identify new strategies"; 2) "establish[ing] interim goals that, if met, will ensure that the state will achieve the 2050 target"; 3) "recommend[ing] policies, regulations, or legislative actions that will assist in achieving the interim goals and 2050 target"; and 4) "monitor[ing] greenhouse gas emission levels ... annually to establish whether the state is poised to meet the interim goals and

⁵ NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2018). Retrieved from <https://www.ncdc.noaa.gov/billions/>

the 2050 target." After a thorough review of a variety of scenarios on how the State can drive down GHG emissions in the electric, building, and transportation sectors, the GC3 unanimously recommended an economy-wide GHG emission reduction target of 45 percent below 2001 levels by 2030. As one of the most ambitious mid-term reduction targets in the nation, the target places the State on a linear downward trajectory from today's GHG emissions to the 80 percent reduction by 2050 required by the Global Warming Solutions Act.

The GC3's mid-term reduction target recommendation was adopted by the Connecticut General Assembly when it passed [An Act Concerning Climate Change Planning and Resiliency](#) (Public Act 18-82). The 2030 target of reducing GHG emissions 45 percent below 2001 levels was signed into law by Governor Malloy on June 20, 2018.

Summary of Recommendations

The recommendations in this report build upon the successful policies and measures the State has implemented to date, propose strengthening existing programs, and put forth new strategies to help Connecticut reach its mid- and long-term GHG reduction targets. The recommendations underscore that there is no single solution; instead, they offer a balanced mix of strategies that allow for flexibility and mid-course adjustments as technologies and costs change over time.

The GC3's analysis of a variety of scenarios to determine the best pathway to meet the 2030 and 2050 targets helped establish a long-

⁶ Burgeson, John. Rising Above the Tide: 5 Years Since Sandy. CTPost. October 28, 2017. Retrieved from <https://www.ctpost.com/local/article/Rising-above-the-tide-5-years-since-Sandy-12313727.php>

term vision for decarbonizing Connecticut's economy. Three broad, fundamental objectives emerged from this vision:

1. Zero-carbon electricity generation
2. Clean transportation
3. Clean, efficient, and resilient buildings

The following proposed strategies and suite of recommendations would put Connecticut on track to meet these objectives and help build a strong foundation for achieving a zero-carbon future. Additional actions, beyond those proposed in this report, will need to be regularly evaluated and integrated into state and local planning efforts, and acted upon by public and private entities alike.

Whenever possible, climate change policymaking should assess the multiple added benefits, also known as co-benefits, of policies enacted to reduce GHG emissions. The co-benefits of reduced GHG

emissions include: job growth and local economic benefits; livable and resilient communities; public health benefits; and potential innovation in technology, energy, and resource management practices. These benefits, which depend on the specific nature of the policy enacted, could consist of improved air and water quality, improved soil and ecosystem health, energy cost savings, sustainable land management, and so on. While co-benefits can be difficult to monitor, quantify, and monetize, when properly valued they often help demonstrate that the positive societal impacts of climate policy actions outweigh the costs.

Utilizing existing and proven technologies, the following set of sector-specific recommendations and supporting suite of strategies were developed with the above objectives in mind. We believe they put Connecticut on a sustainable path to meeting its ambitious 2030 target and help position it to meet its transformative 2050 target.

GHG EMISSIONS REDUCTION RECOMMENDATIONS AND SUITE OF STRATEGIES

CROSS SECTOR

IPCC’s recent Special Report on Global Warming of 1.5°C recommended putting a price on carbon (combined with other policy measures) may be the most efficient and effective way to reduce carbon emissions. In the absence of such a policy, the damages resulting from burning carbon-intensive fuels are largely “externalized”—meaning the price of carbon-intensive fuels, goods, and services does not reflect the cost of climate damage. While Connecticut and other jurisdictions have implemented policies that foster adoption of zero-carbon renewable energy technologies and promote energy conservation and load management, economists widely agree that without a price on carbon, we will not be able to transition to a zero-carbon economy at the pace and scale that is necessary to avoid 1.5-2°C warming. Worldwide there is growing attention to using market-based mechanisms that set a fee or price on the carbon content of all fuels, or cap carbon emissions through the sale of emission allowances. Internalizing the cost of carbon can efficiently reduce emissions, change behavior, and transform the market.

Consumer awareness and education on the economic and environmental benefits of low- and zero-carbon technologies is crucial for increasing customer adoption of existing and emerging technologies. Government, non-profit, and private-sector actors can all play a role in educating and informing consumers through outreach campaigns, marketing programs, and formal and informal platforms.

Preparing for the future impacts of climate change is just as important as emissions mitigation. Communities will need to adapt to more extreme weather events, which will likely have severe impacts on Connecticut’s infrastructure. Adopting policies and standards that improve our resiliency and ability to adapt will be critical.

Co-benefits include: Environmental sustainability
Health and well-being
Economic development

Suite of Strategies

1. Implement an economy-wide carbon fee that assesses the carbon content of fossil fuels and sets a price per ton of carbon emitted.

Emissions Reduction Impact	Implementation Entities
HIGH	Governor, General Assembly, DRS, DEEP, OPM

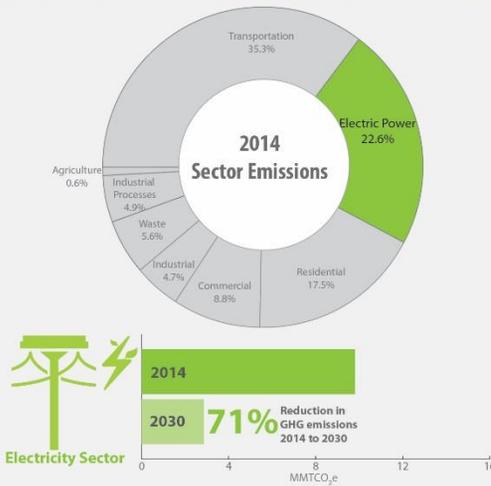
2. Implement an economy-wide cap-and-invest program that sets a limit on carbon emissions and allows the market to determine a carbon price based on least-cost reduction measures.

Emissions Reduction Impact	Implementation Entities
HIGH	Governor, General Assembly, DEEP

Put a price on carbon

<p>Expand consumer education and awareness efforts to increase the uptake of zero- and low-carbon technology and resiliency measures</p>	1. Increase visibility of EnergizeCT resources.	
	Emissions Reduction Impact	Implementation Entities
	LOW	DEEP, CT Green Bank, utilities administering C&LM Plan, CT Energy Efficiency Board
	2. Enhance outreach efforts by using social media campaigns, webinars, case studies, testimonials, and the utilities’ customer-engagement platforms.	
	Emissions Reduction Impact	Implementation Entities
	LOW	DEEP, CT Green Bank, utilities administering C&LM Plan, CT Energy Efficiency Board
	3. Increase training of real-estate industry professionals on integrating U.S. DOE Home Energy Scores and information on energy efficiency, renewables, and resiliency into real-estate transactions processes.	
	Emissions Reduction Impact	Implementation Entities
	LOW	DEEP, CT Green Bank, Multiple Listing Services, Real Estate Trade Organizations, utilities administering C&LM Plan, CT Energy Efficiency Board
<p>Pursuing an integrated approach to GHG mitigation, adaptation, and resiliency</p>	1. Prioritize opportunities for achieving synergies among actions that cut carbon pollution and prepare for the impacts of climate change.	
	Emissions Reduction Impact	Implementation Entities
	HIGH	OPM, DEEP, DOT, DAS, DOI
	2. Ensure that state building codes and performance standards are coordinated to incorporate the Insurance Institute for Business and Home Safety best practices for resiliency.	
	Emissions Reduction Impact	Implementation Entities
HIGH	Governor, General Assembly, DEEP	

ZERO CARBON ELECTRICITY GENERATION



As the second-largest source of emissions, the electricity sector makes up 22.6% of Connecticut's economy-wide GHG emissions. Connecticut has taken numerous actions to accelerate the transition toward cleaner electricity while reducing energy costs, improving system reliability, and minimizing negative environmental impacts. To meet the State's 2030 target, emissions from the electricity sector must be reduced 71% from 2014 levels.

As the building and transportation sectors move towards electrification, zero-carbon electricity generation will play a critical role in achieving a low-carbon future. This first requires retaining zero-carbon nuclear resources in the near-term and developing a comprehensive plan to ensure these resources are replaced with zero-carbon supply or demand reduction in the long-term following the expiration of their licenses. To bring more zero-carbon renewables online, Renewable Portfolio Standards (RPSs) throughout New England have helped provide a clear signal to attract diverse resources. In the coming years Connecticut will need to ensure that its RPS fully reflects the need for a zero-carbon portfolio. Distributed energy resources hosted by residents, businesses, and governments can help alleviate the siting challenges faced by grid-scale projects, and a new compensation design now being developed is expected to make these resources more cost-effective for Connecticut ratepayers. In addition to supply changes, demand-side measures and conservation will also play an important role in reducing emissions. In New England, electricity demand reduction measures can now compete with supply options to meet (or reduce) the total system's need, helping to achieve emission reductions at least cost. Overall, this transition will require a combination of technological innovation, innovative financing, price signals, and further improvements in state, regional, and federal policies.

- Co-benefits include:
- Enhancing energy system security
 - Economic development
 - Environmental sustainability
 - Health and well-being

Commit at least 50 megawatts of demand reduction per year to the ISO New England forward-capacity market

Suite of Strategies

1. Reduce electricity consumption by 1-2 million megawatt hours by replacing existing inefficient electric-resistance space- and water-heating equipment with high-efficiency renewable thermal technology (RTT). This reduction should be implemented through the Conservation and Load Management Plan and other efficiency-procurement strategies.

Emissions Reduction Impact	Implementation Entities
HIGH	DEEP, utilities administering C&LM Plan, CT Energy Efficiency Board, CT Green Bank, installers

2. Invest in electric measures that reduce peak demand such as exterior lighting, retail lighting, lighting in state buildings, and high efficiency refrigeration. These type of reductions should be implemented through the C&LM Plan and other efficiency-procurement strategies.

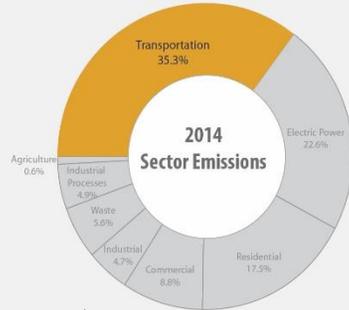
Emissions Reduction Impact	Implementation Entities
HIGH	DEEP, utilities administering C&LM Plan, CT Energy Efficiency Board, CT Green Bank, installers

Achieve at least 66% zero-carbon energy generation by 2030

1. Meet the RPS target of 40% by 2030, with an aim to reduce the carbon intensity of the RPS.	
Emissions Reduction Impact	Implementation Entities
HIGH	DEEP, renewable energy developers, CT Green Bank, PURA
2. Ensure a transparent and predictable compensation framework to maintain at least the historical average deployment of 40-90 megawatts of additional residential behind-the-meter renewable energy resources per year.	
Emissions Reduction Impact	Implementation Entities
HIGH	DEEP, CT Green Bank, PURA, renewable energy developers
3. Deploy at least 50 megawatts per year commercial distributed solar and 10 megawatts per year of fuel cells.	
Emissions Reduction Impact	Implementation Entities
HIGH	EDCs, DEEP, CT Green Bank, PURA, renewable energy developers
4. Implement a shared clean energy program deploying at least 25 megawatts per year, with a focus on low- and moderate-income customers.	
Emissions Reduction Impact	Implementation Entities
HIGH	EDCs, DEEP, CT Green Bank, PURA, advocates, renewable energy developers
5. Maintain in-state zero-carbon nuclear generation and develop a long-term zero-carbon replacement strategy equivalent to 2,100 megawatts.	
Emissions Reduction Impact	Implementation Entities
HIGH	Governor, General Assembly, DEEP
6. Exercise procurement authority for zero-carbon energy through competitive bidding processes that drive down prices.	
Emissions Reduction Impact	Implementation Entities
HIGH	DEEP, PURA

Optimize grid-management strategies to reduce carbon emissions	1. Increase adoption of smart-management technologies to optimize flexibility of distributed energy resources.	
	Emissions Reduction Impact	Implementation Entities
	HIGH	PURA, EDCs
	2. Over the next 2-5 years, research and identify opportunities to integrate battery storage and distributed renewable energy technologies to displace carbon emissions.	
	Emissions Reduction Impact	Implementation Entities
	HIGH	DEEP, PURA, CT Green Bank, EDCs

CLEAN TRANSPORTATION



The transportation sector continues to be the single largest source of emissions in Connecticut, contributing 35%, principally from the use of fossil fuels in passenger cars and light-duty trucks. To meet the economy-wide 2030 target, emissions from the transportation sector must be reduced 29% from 2014 levels.

This will require Connecticut to accelerate its transition toward a modern, clean transportation system — facilitating access to low- and zero-emitting passenger vehicles, public transit, alternative modes of travel, and efficient movement of goods and services.

The primary strategies for this transformation include: retaining stringent fuel-economy and low- and zero-emission standards; creating price signals to accelerate adoption of electric vehicles (EVs); and reducing the vehicle miles traveled (VMT) growth rate through increased use of public transit services and alternatives modes of transportation, supporting transit-oriented development (TOD), and encouraging sustainable land-use planning. Identifying sustainable funding to implement these strategies will be essential.

- Co-benefits include:
- Health and well-being
 - Environmental sustainability
 - Enhancing energy system security
 - Economic development

Maintain increasing fuel economy and low- and zero-emissions standards

Suite of Strategies

1. Maintain adherence to Corporate Average Fuel Economy (CAFE) and GHG emission standards mid-term review 2016 final determination.

Emissions Reduction Impact	Implementation Entities
HIGH	Federal government, California Air Resources Board, DEEP

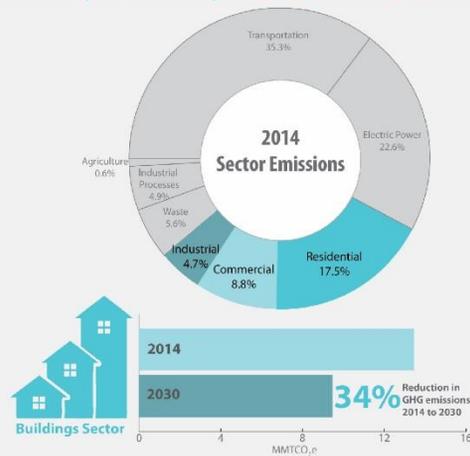
2. Maintain adherence to California low- and zero-emission vehicle requirements.

Emissions Reduction Impact	Implementation Entities
HIGH	Federal government, California Air Resources Board, DEEP

<p>Increase light-duty ZEV penetration rate to at least 20% by 2030</p>	1. Implement price signals to incentivize EV adoption and reduce electric system impacts.	
	Emissions Reduction Impact	Implementation Entities
	HIGH	PURA, EDCs
	2. Expand EV charging network to ensure consumer confidence, reduce range anxiety, and ensure equitable access.	
	Emissions Reduction Impact	Implementation Entities
	MEDIUM	DEEP, PURA, EDCs, private sector
	3. Develop a state fleet transportation Lead by Example program that sets annual emission reduction targets and enables increasing adoption of zero-emission vehicles.	
	Emissions Reduction Impact	Implementation Entities
	MEDIUM	DAS, DEEP, OPM
<p>Advance initiatives that eliminate the rate of annual VMT growth by 2030</p>	1. Implement transit-oriented development projects and adopt state policies and local zoning regulations that support walkable, mixed-use, and sustainable urban and suburban development in areas served by transit.	
	Emissions Reduction Impact	Implementation Entities
	MEDIUM	DOT, OPM, DECD, municipalities
	2. Encourage, incentivize, and support alternative modes and active transportation that reduce single-occupant vehicle driving.	
	Emissions Reduction Impact	Implementation Entities
LOW	DOT, OPM, municipalities	

<p>Develop sustainable funding for transportation electrification and transportation infrastructure</p>	<p>1. Implement a multi-state cap-and-invest program that sets a limit on transportation sector emissions and reinvests program proceeds in measures that drive down emissions, provide benefits to citizens, protect existing transportation funding, generate sufficient additional funding to support transportation infrastructure and operation, and mitigate costs to consumers.</p>	
	<p>Emissions Reduction Impact</p>	<p>Implementation Entities</p>
	<p>HIGH</p>	<p>Governor, General Assembly, DEEP</p>
	<p>2. Implement user-based transportation fees — market mechanisms to reduce traffic congestion and improve efficiency of travel for all drivers.</p>	
	<p>Emissions Reduction Impact</p>	<p>Implementation Entities</p>
	<p>MEDIUM</p>	<p>Governor, General Assembly, DOT, OPM</p>

CLEAN, EFFICIENT, & RESILIENT BUILDINGS



The building sector contributes approximately 31% of total GHG emissions in Connecticut. Heating, ventilation, and air conditioning (HVAC) comprise roughly 60% of all building energy consumption. Over 80% of Connecticut households and commercial and industrial buildings are heated with fossil fuels.

To meet the economy-wide 2030 target, emissions from the building sector must be reduced 34%. In concert with building energy conservation improvements, Connecticut must accelerate decarbonization of building energy end-uses by increasing deployment of renewable thermal technologies (RTTs) such as cold-climate air- and ground-source heat pumps and heat pump water heaters. This will require increased education and training of our HVAC workforce, and the expansion of consumer motivation to adopt building energy efficiency measures and RTTs. Additionally, there must be a commitment to building stronger, more resilient homes and businesses. Enhancing Connecticut's building codes will result in structures that are better able to withstand the natural perils of a coastal state in an era of escalating climate impacts.

- Co-benefits include:
- Social development
 - Health and well-being
 - Environmental sustainability
 - Enhancing energy system security
 - Economic development

Accelerate adoption of building thermal energy conservation improvements such as weatherization, insulation, efficient windows, and efficient HVAC

Suite of Strategies

1. Prioritize building envelope improvements and expand access to thermal energy-efficiency measures through innovative financing options for all income levels.

Emissions Reduction Impact	Implementation Entities
HIGH	DEEP, utilities administering C&LM Plan, CT Energy Efficiency Board, CT Green Bank, Capital for Change, CHFA, DOH, DECD, DAS

2. Ensure building codes are continuously aligned with the most recent International Energy Conservation Code standards.

Emissions Reduction Impact	Implementation Entities
HIGH	DAS, DEEP

3. Track and reduce energy consumption and associated GHG emissions in state and municipal buildings, including setting Lead by Example targets for 2030.

Emissions Reduction Impact	Implementation Entities
MEDIUM	DEEP, utilities administering C&LM Plan, CT Energy Efficiency Board, CT Green Bank, OPM, DAS, Sustainable CT, municipalities

	4. Review consistency of energy efficiency cost-effectiveness testing with public policy goals.	
	Emissions Reduction Impact	Implementation Entities
	MEDIUM	DEEP, CT Energy Efficiency Board, utilities administering C&LM Plan
Transition building fossil fuel thermal loads to efficient renewable thermal technologies	1. Develop sustainable funding mechanisms to incentivize replacement of fossil-fuel space and water heating with efficient RTTs.	
	Emissions Reduction Impact	Implementation Entities
	HIGH	Governor, General Assembly, DEEP, OPM, CT Green Bank
	2. Incentivize installation of RTTs in new construction.	
	Emissions Reduction Impact	Implementation Entities
	MEDIUM	DEEP, utilities administering C&LM Plan, CT Energy Efficiency Board, CT Green Bank, Housing Authorities
Improve training and technical capacity of workforce	1. Expand training programs to include RTT installations and standards.	
	Emissions Reduction Impact	Implementation Entities
	MEDIUM	Industry trade organizations, utilities administering C&LM Plan, state colleges and universities, Department of Education/Technical High School System, manufacturers, NEEP