



The Future of Lighting Savings in New England

Energy Efficiency Forecast Working Group

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SYSTEM PLANNING



Overview

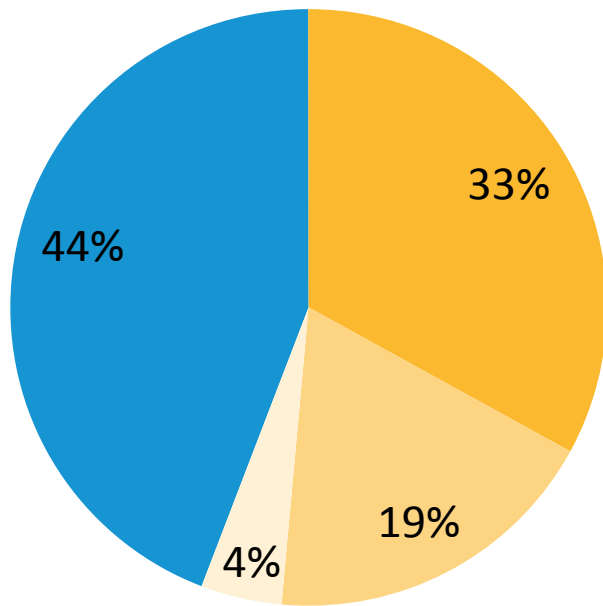
- The Energy Efficiency (EE) forecast utilizes a production cost escalation rate to account for various sources of uncertainty in the forecast
 - State budgets
 - Changing costs of existing measures
 - Evolving measure mix
- To date, claimable lighting savings have made up a significant portion of the region's cost and savings portfolio
 - Low cost
 - Easy to install
- At some time, claimable lighting savings will no longer be available and this will have a significant impact on regional costs and savings
- The purpose of this presentation is to begin the discussion of how to appropriately incorporate this into the forecast by presenting a case study for the state of Connecticut, using program administrator submitted data

INTRODUCTION

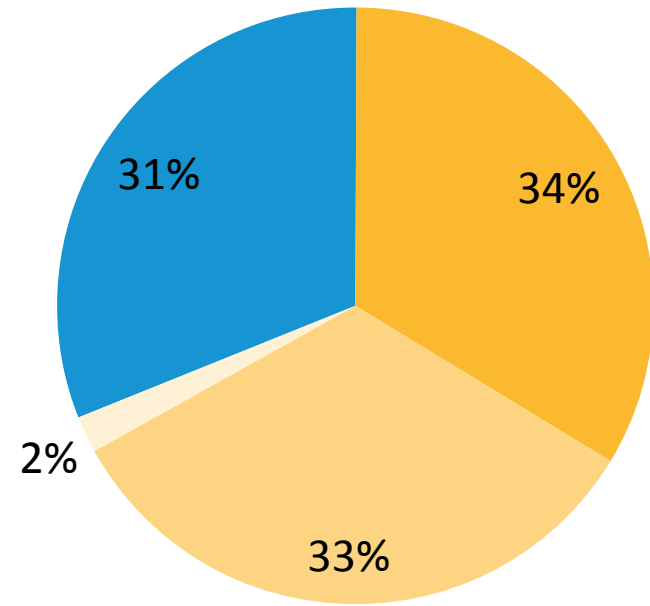
Current Status of Lighting Costs and Savings

New England

Annual Costs (2016)



Annual Energy (2016)



■ All Other Measures ■ Lightng - C&I ■ Lighting - Residential ■ Lighting - Low Income

The Future of Claimable Lighting Savings

- Lighting has dominated EE costs and claimable energy savings in nearly every sector, in every state in New England
 - 56% of regional annual EE spending
 - 69% of regional annual EE energy savings
- Near term production cost expectations used in the EE forecast are heavily influenced by lighting's impact on savings and cost
- At some point claimable savings from lighting will reach negligible levels
 - Market saturation (no more lightbulbs left to convert)
 - Rising baselines (market saturation changes the standard practice)
- When will claimable lighting savings no longer be available?
 - Massachusetts expects to see claimable savings from lighting in the Residential and Low Income sectors to be significantly reduced by the start of the next Three-Year Plan (2019)
 - Massachusetts expects to see claimable savings from lighting in the Commercial and Industrial (C&I) sector to be significantly reduced starting two Three-Year Plans out (2022)
- The timing of lighting's departure significantly influences the degree of uncertainty in the EE forecast, especially in the mid to long-term horizons

The Future of Claimable Lighting Savings

- Lighting is easy to install and relatively low cost
- When lighting leaves the market, the region will have to rely on costlier measures, which often require more time and effort to install
 - Audits
 - Sizing/customization
 - Financing
 - Contractor/Vendor selection
 - Quality control of performed work
- Impacts of the disappearance of claimable lighting savings
 - Higher cost per unit savings
 - More time to achieve savings
 - Less overall savings for similar budgets



THE FUTURE WITHOUT CLAIMABLE LIGHTING SAVINGS

An Analysis of Connecticut

Source Data

- As a part of the Energy Efficiency Forecast process, each year EE program administrators submit detailed information on all of the EE programs administered in their respective service territories
 - Program level savings/costs
 - Measure level savings/costs
- Measure allocation of costs and savings is incomplete in many states
 - Program costs/savings are not fully allocated to measures
 - Is especially true for cost data
- Connecticut has the most complete cost information



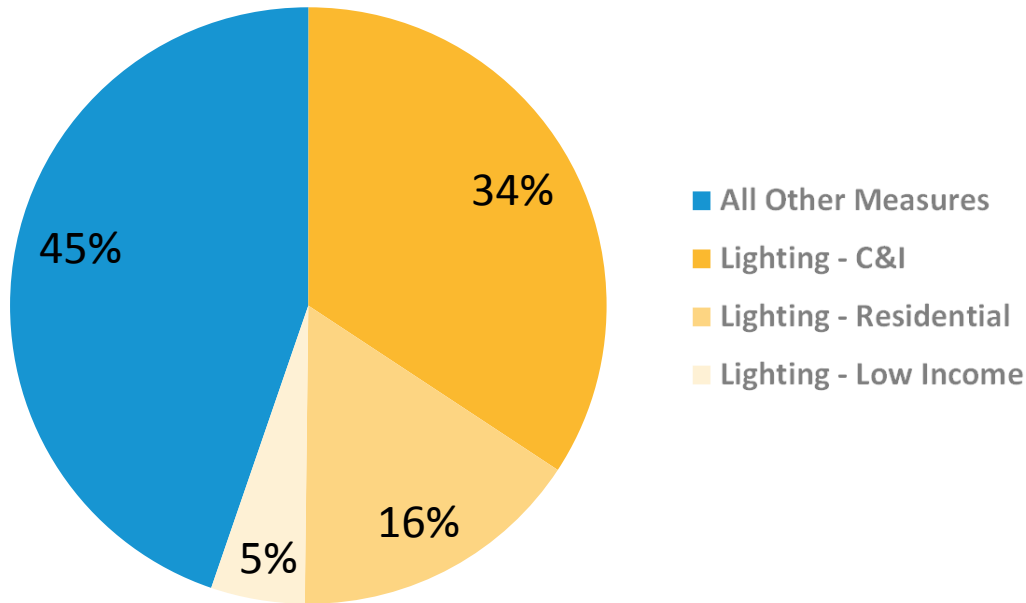
Analysis Assumptions

- Use 2016 program administrator data for the state of CT
- Measure costs remain fixed at 2016 values
 - No inflation
 - No accounting for changing costs to implement specific measures/technologies
- Measure achievable savings remain fixed at 2016 values
 - No accounting for rising baselines
- Assumes 100% of lighting costs translate directly to other measures
 - Assumes a comparable technical potential for savings in non-lighting measures
 - Assumes the ability to operationalize increased funding to non-lighting measures
 - Ignores increased implementation time often required for non-lighting measures
- It should be noted that many of these assumptions constitute a very optimistic expectation of future impacts
 - Minimizes impact on cost increases
 - Minimizes impact on savings decreases

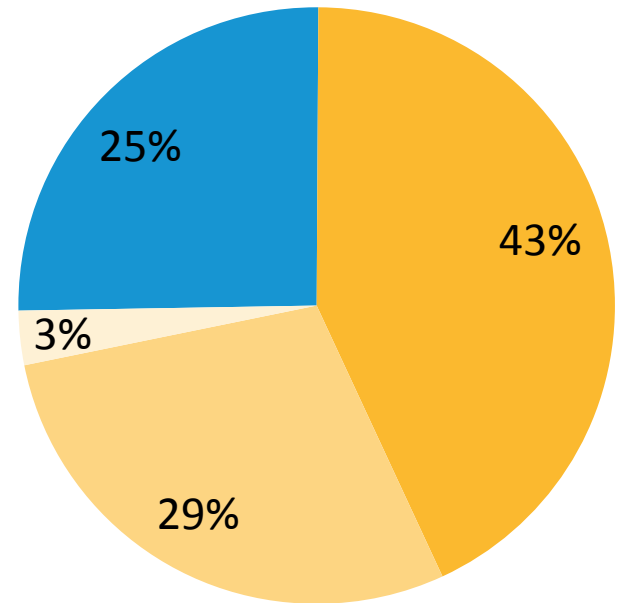
Current Status of Lighting Costs and Savings

Connecticut

Annual Costs (2016)



Annual Energy (2016)



State Summary (2016)

Annual Costs (\$1,000's)	199,188
Annual Energy (MWh)	427,036
Production Cost (\$/MWh)	466
Annual Demand (MW)	59
Annual Peak to Energy Ratio (MW/GWh)	0.137

Removal of Lighting

- Massachusetts expects claimable savings from lighting to diminish in the coming years
 - Lighting in the Residential and Low Income sectors is expected to be significantly reduced in the next few years
 - Steep declines of lighting in the Commercial and Industrial (C&I) sector are expected in later years
- Other states will eventually face the same issue, although the timing may vary
- How do we explore what happens if lighting is removed from the measure mix?
 - Keep total costs fixed within each sector
 - Proportionally reallocate lighting costs to other measures within the same sector

Removal of Lighting

Methodology

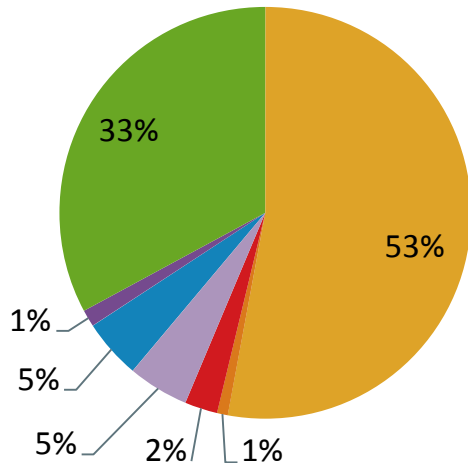
- For each measure/sector (e.g. HVAC in the Low Income sector), compute the following quantities from the 2016 program administrator data:
 - Annual Cost (\$)
 - Production Cost (\$/MWh)
 - Peak-to-Energy Ratio (MW/GWh)
- Lighting costs within each sector are reallocated to the remaining measures in that sector based on cost weights
 - 2016 measure annual costs are used to calculate weights of non-lighting measures within each sector
- 2016 measure production costs are used to calculate new energy savings
- 2016 measure peak-to-energy ratios are used to calculate new demand savings

Removal of Residential Lighting in CT

(16% of CT Annual Costs)

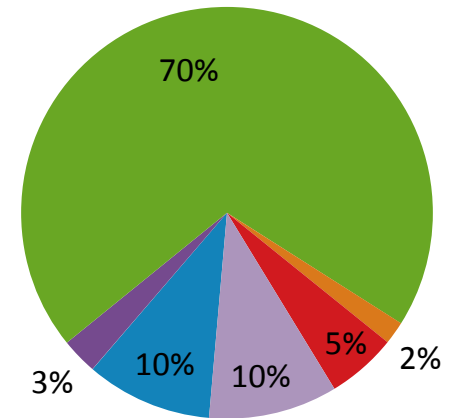
Measure	Production Cost (\$/MWh)	Peak to Energy (MW/GWh)	% of Annual Costs (2016)	% of Annual Costs (Reallocated Lighting \$\$)
Lighting	258	0.123	53%	0%
HVAC	1,377	0.241	33%	70%
Other	219	0.228	5%	10%
Building Envelope	7,708	0.672	5%	10%
Hot Water	353	0.080	3%	5%
Custom	1,928	0.147	1%	3%
Heating	363	-	1%	2%
Refrigeration	-	-	-	-

Annual Costs (2016)



- Building Envelope
- Custom
- HVAC
- Lighting
- Heating
- Hot Water
- Other
- Refrigeration

Annual Costs (Reallocated Lighting)

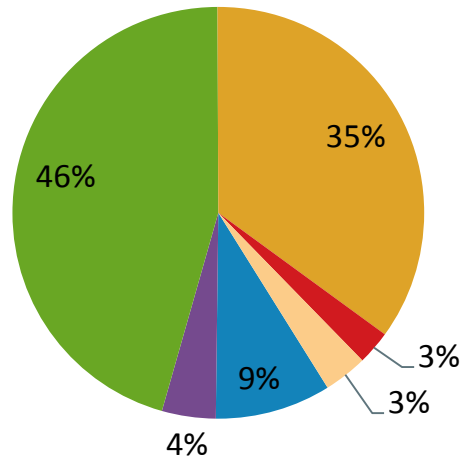


Removal of Low Income Lighting in CT

(5% of CT Annual Costs)

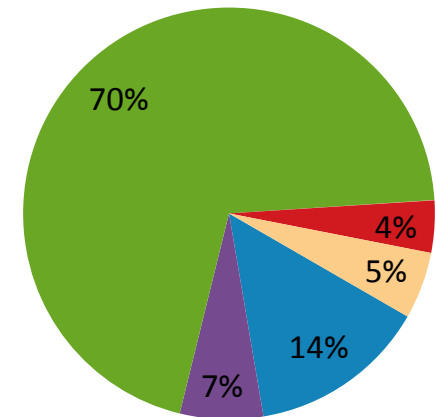
Measure	Production Cost (\$/MWh)	Peak to Energy (MW/GWh)	% of Annual Costs (2016)	% of Annual Costs (Reallocated Lighting \$\$)
Lighting	813	0.116	35%	0%
HVAC	5,352	0.134	46%	70%
Other	-	-	-	-
Building Envelope	3,099	0.025	9%	14%
Hot Water	620	0.031	3%	4%
Custom	720	0.106	4%	7%
Heating	-	-	-	-
Refrigeration	615	0.177	3%	5%

Annual Costs (2016)



- Building Envelope
- Custom
- HVAC
- Lighting
- Heating
- Hot Water
- Other
- Refrigeration

Annual Costs (Reallocated Lighting)



Removal of Residential and Low Income Lighting

CT State Level Impacts

Quantity	2016	Reallocated Lighting \$\$	% Change
Annual Costs (\$1,000's)	199,188	199,188	0%
Annual Energy (MWh)	427,036	334,167	-22%
Production Cost (\$/MWh)	466	596	28%
Annual Demand (MW)	59	51	-14%
Annual Peak to Energy Ratio (MW/GWh)	0.137	0.151	10%

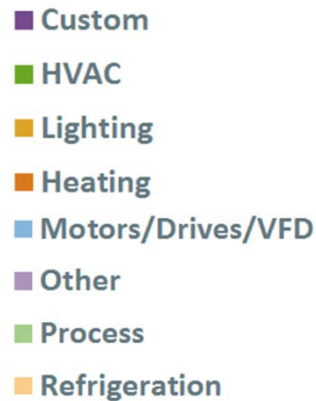
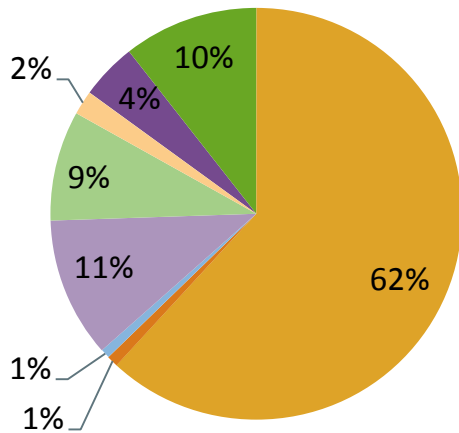
- Annual costs remain fixed
- Annual ***energy decreases*** by 22%
 - Money is shifted to more costly measures
- Production ***cost increases*** by 28%
 - Same amount of money divided by less energy savings
- Annual demand decreases
 - Energy savings are shifted to measures with higher peak-to-energy ratios, but there are less savings over all
- Peak-to-energy ratio increases
 - Weighted peak-to-energy ratio of all measures

Removal of C&I Lighting in CT

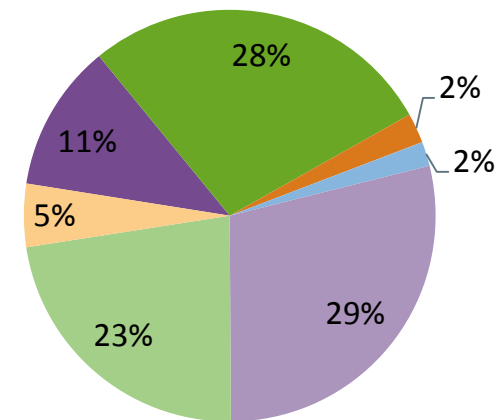
(34% of CT Annual Costs)

Measure	Production Cost (\$/MWh)	Peak to Energy (MW/GWh)	% of Annual Costs (2016)	% of Annual Costs (Reallocated Lighting \$\$)
Lighting	372	0.136	62%	0%
HVAC	700	0.208	11%	28%
Other	3,867	0.135	11%	29%
Custom	1,461	0.184	4%	12%
Heating	22,090	0.014	1%	2%
Refrigeration	158	0.063	2%	5%
Process	340	0.128	9%	23%
Motors/Drives/VFD	371	0.113	1%	2%

Annual Costs (2016)



Annual Costs (Reallocated Lighting)



Removal of All Lighting

CT State Level Impacts

Quantity	2016	Reallocated Lighting \$\$	% Change
Annual Costs (\$1,000's)	199,188	199,188	0%
Annual Energy (MWh)	427,036	258,568	-39%
Production Cost (\$/MWh)	466	770	65%
Annual Demand (MW)	59	40	-31%
Annual Peak to Energy Ratio (MW/GWh)	0.137	0.157	14%

- Annual costs remain fixed
- Annual ***energy decreases*** by nearly 40%
 - Money is shifted to more costly measures
- Production ***cost increases*** by 65%
 - Same amount of money divided by less energy savings
- Annual demand decreases
 - Energy savings are shifted to measures with higher peak-to-energy ratios, but there are less savings over all
- Peak-to-energy ratio increases
 - Weighted peak-to-energy ratio of all measures

COMPARISON TO 2017 EE FORECAST ASSUMPTIONS

Escalation of Production Costs

2017 EE Forecast Methodology

- In the 2017 EE forecast, production costs were escalated at a graduated rate of 1.25% that begins in the second year of the forecast

Year	Inflation	Graduated Escalation Rate
2018	2.50%	0.00%
2019	2.50%	1.25%
2020	2.50%	2.50%
2021	2.50%	3.75%
2022	2.50%	5.00%
2023	2.50%	6.25%
2024	2.50%	7.50%
2025	2.50%	8.75%
2026	2.50%	10.00%
2027	2.50%	11.25%

Escalation of Production Costs

*Example using 2017 EE Forecast Methodology
(Inflation not Included)*

Cost increase due to removal of Residential and Low Income lighting: 28%

Cost increase due to removal of lighting from all sectors: 65%

Starting Production Cost: \$1/MWh

Year	Production Cost Escalation Rate	Production Cost (\$/MWh)	Cumulative % Increase
2018	100.00%	1.00	0.00%
2019	101.25%	1.01	1.25%
2020	102.50%	1.04	3.78%
2021	103.75%	1.08	7.67%
2022	105.00%	1.13	13.06%
2023	106.25%	1.20	20.12%
2024	107.50%	1.29	29.13%
2025	108.75%	1.40	40.43%
2026	110.00%	1.54	54.47%
2027	111.25%	1.72	71.85%

← Equivalent Breakpoint

← Equivalent Breakpoint

Observations

- This analysis represents an “idealized case” conversion of lighting funds to other measures
 - Ignores rising baselines in other measures
 - Ignores any increased costs associated with new and existing technologies
 - Assumes lighting funds are 100% transferrable to other measures
 - Ignores increased implementation time often required for non-lighting measures
 - Assumes the existence of a high technical potential for savings in non-lighting measures
 - Assumes the ability to operationalize increased funding to non-lighting measures
- The results of this analysis suggest that the removal of lighting will increase the annual production costs for the state of Connecticut
 - 28% increase with the removal of Residential and Low Income lighting
 - 65% increase with the removal of lighting from all sectors

Takeaways

- The current escalation of production costs in the EE forecast may not capture the magnitude and timing of the expected cost increases and savings decreases associated with the disappearance of claimable lighting savings
- The ISO would like to work with stakeholders to understand the impacts of the anticipated departure of lighting to ensure that future forecast assumptions and methodology are appropriate

Questions

