Connecticut Light & Power
The Northeast Utilities System

The Brattle Group

The United Illuminating Company

Overview of Integrated Resource Plan for Connecticut

- Findings and Recommendations -

Presented to the
Connecticut Energy Advisory Board

January 8, 2010

Background

Section 51 of PA 07-242 required CL&P and UI to develop an integrated resource plan

This IRP presents how to meet customers needs for

- Capacity and energy
- Connecticut Renewable Portfolio Standards
- …while minimizing costs and emissions

The Connecticut and New England bulk power supply system was simulated for years 2013, 2015, and 2020

- "Base Case" outlook and alternative scenarios
- Various resource strategies were also explored

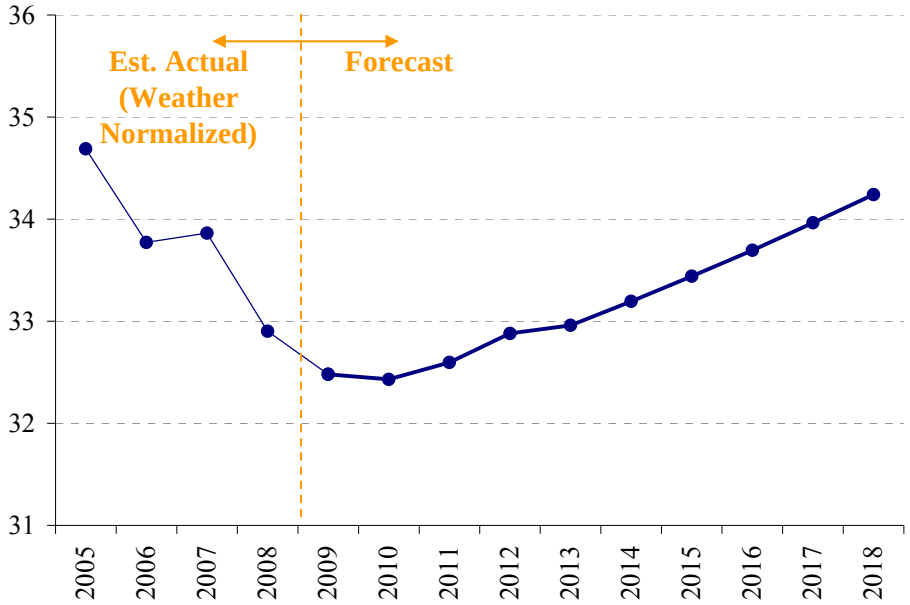
10 subject areas were examined in-depth

1. Resource Adequacy
2. Demand Side Management
3. Renewable Energy
4. Transmission
5. Nuclear Power
6. Combined Heat and Power
7. Environment
8. Energy Security
9. Natural Gas
10. Emerging Technologies

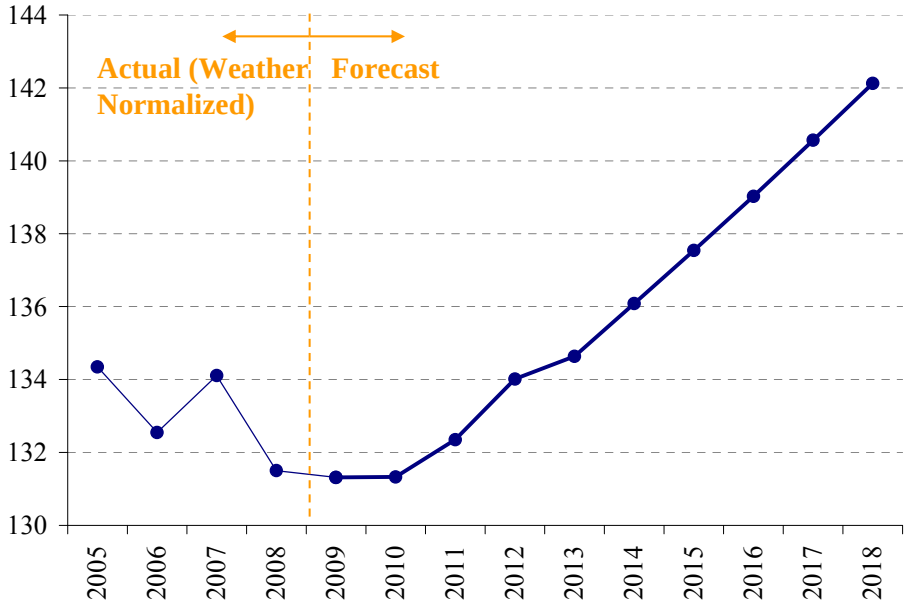
Demand Forecast (Energy)

Started from ISO New England's 2009 CELT 50/50 energy forecast

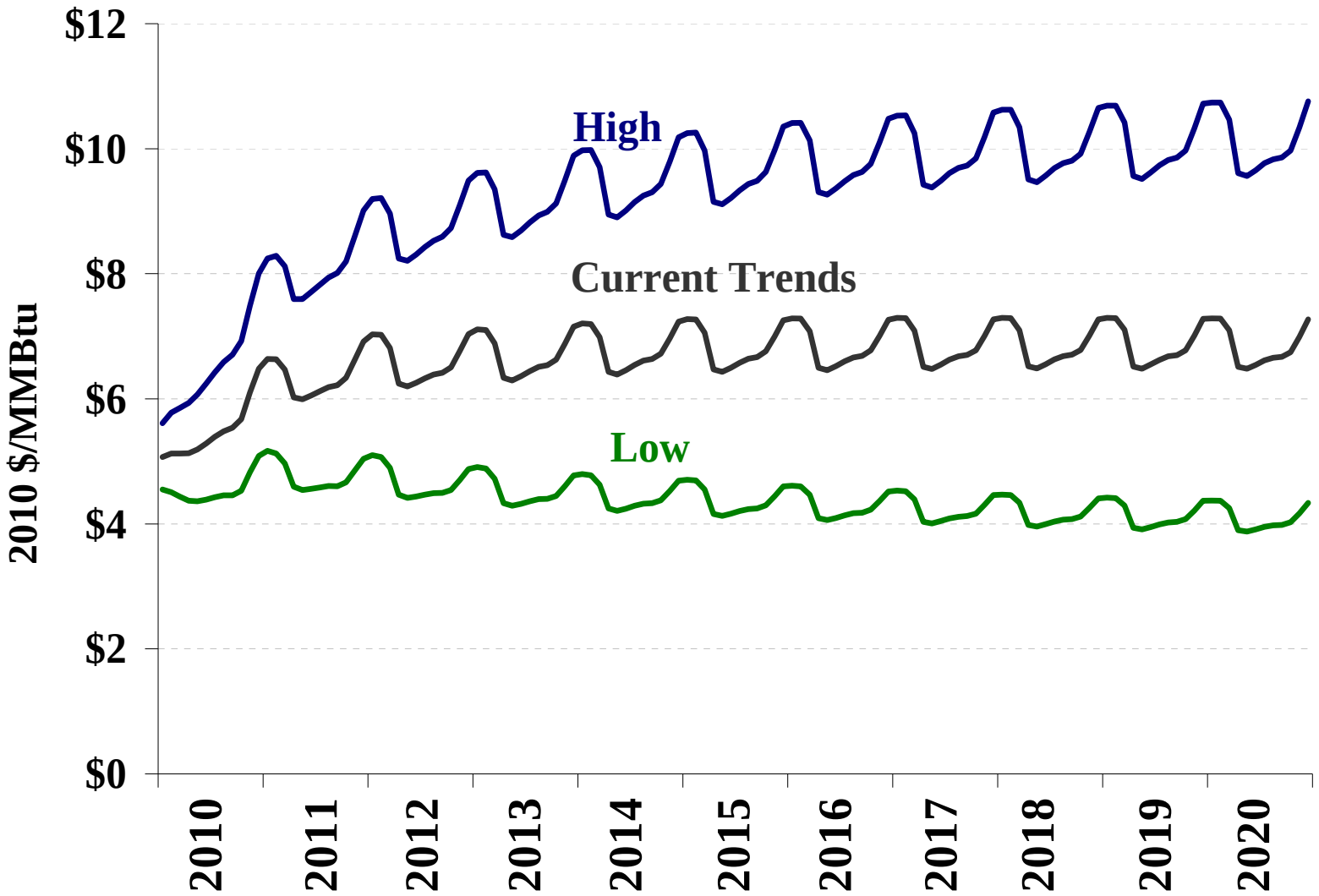
Connecticut (TWh)



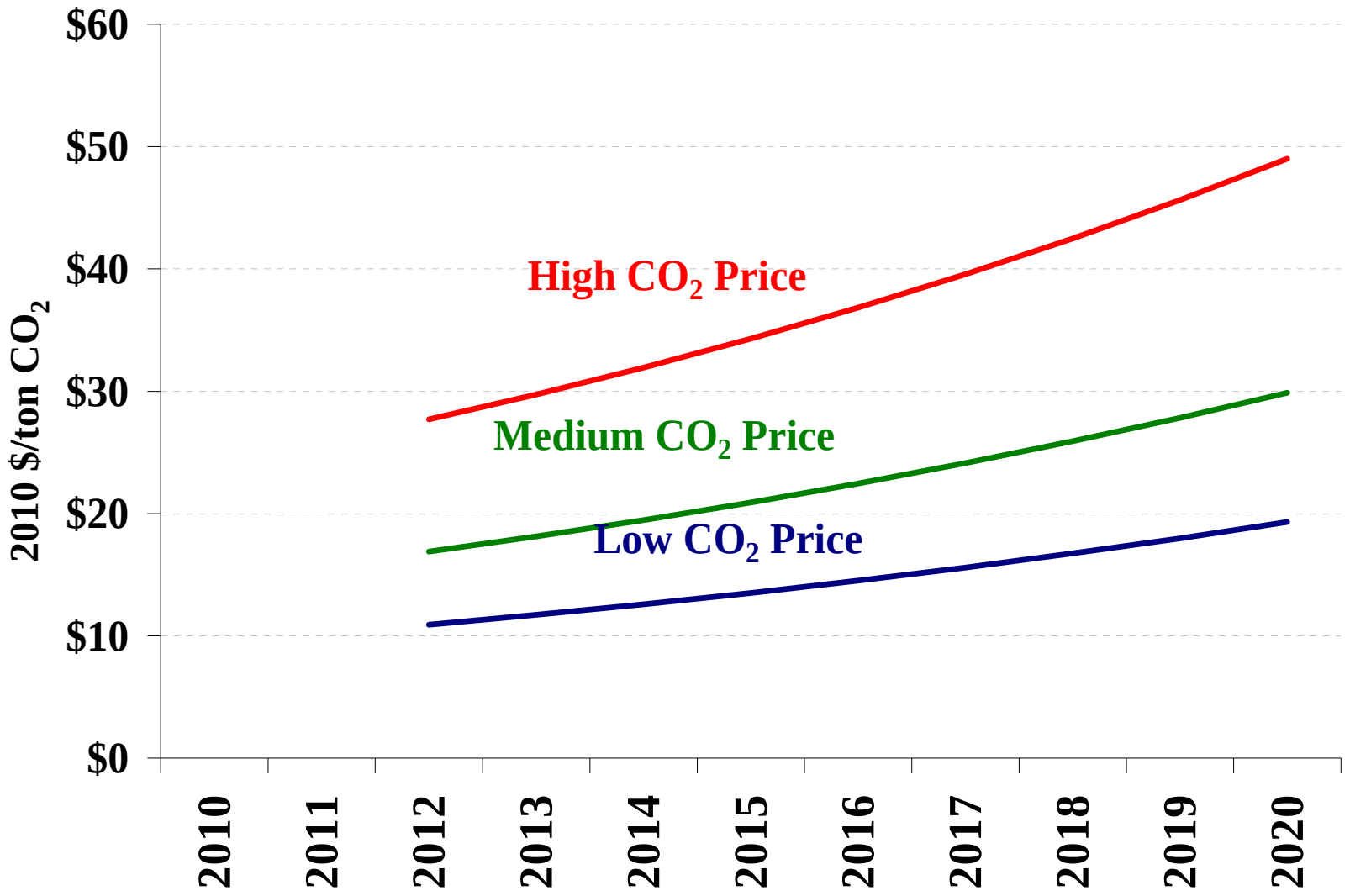
ISO-NE (TWh)



Natural Gas Prices



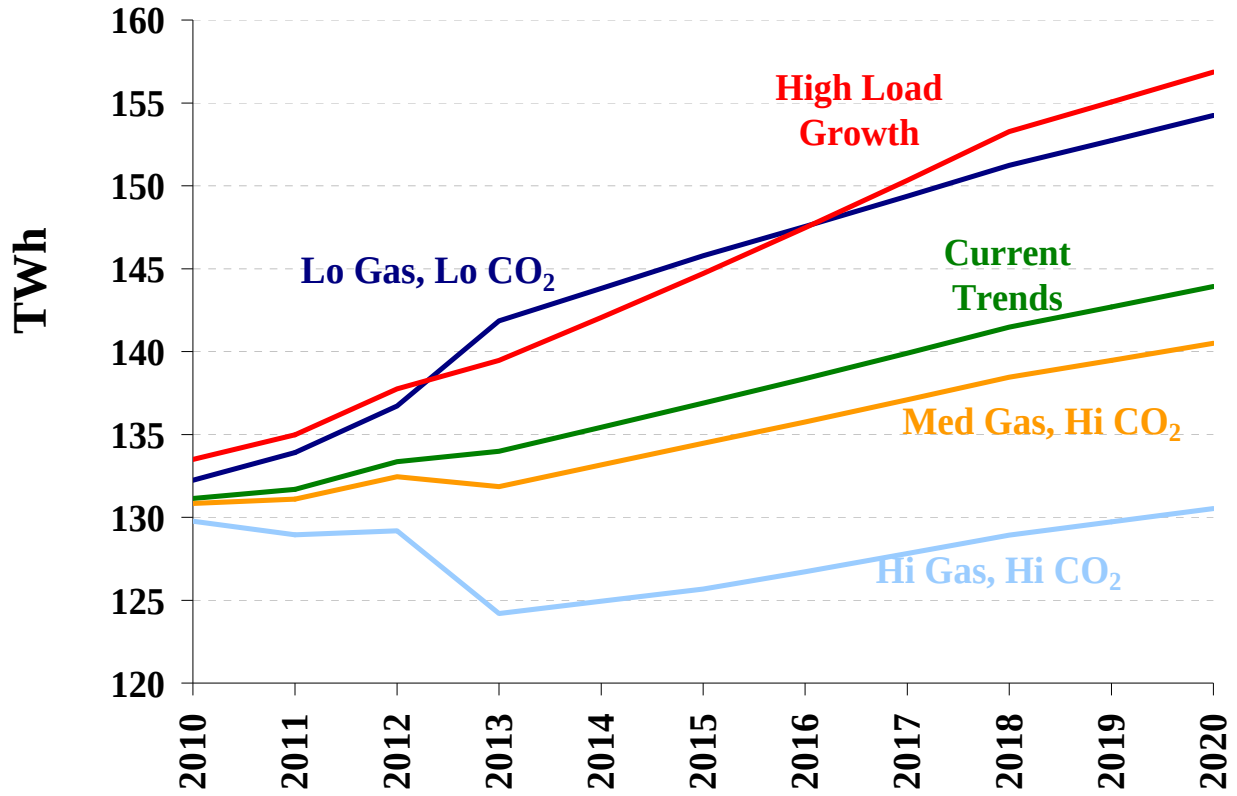
CO_2 Prices


$60
$50
$40
$30
$20
$10
$0
2010 $/ton CO2
High CO2 Price
Medium CO2 Price
Low CO2 Price
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020

Total Energy Demand (ISO-NE)

Energy demand in each scenario starts with ISO-NE's CELT 50/50 forecast, and adjusts for price response to prevailing energy prices

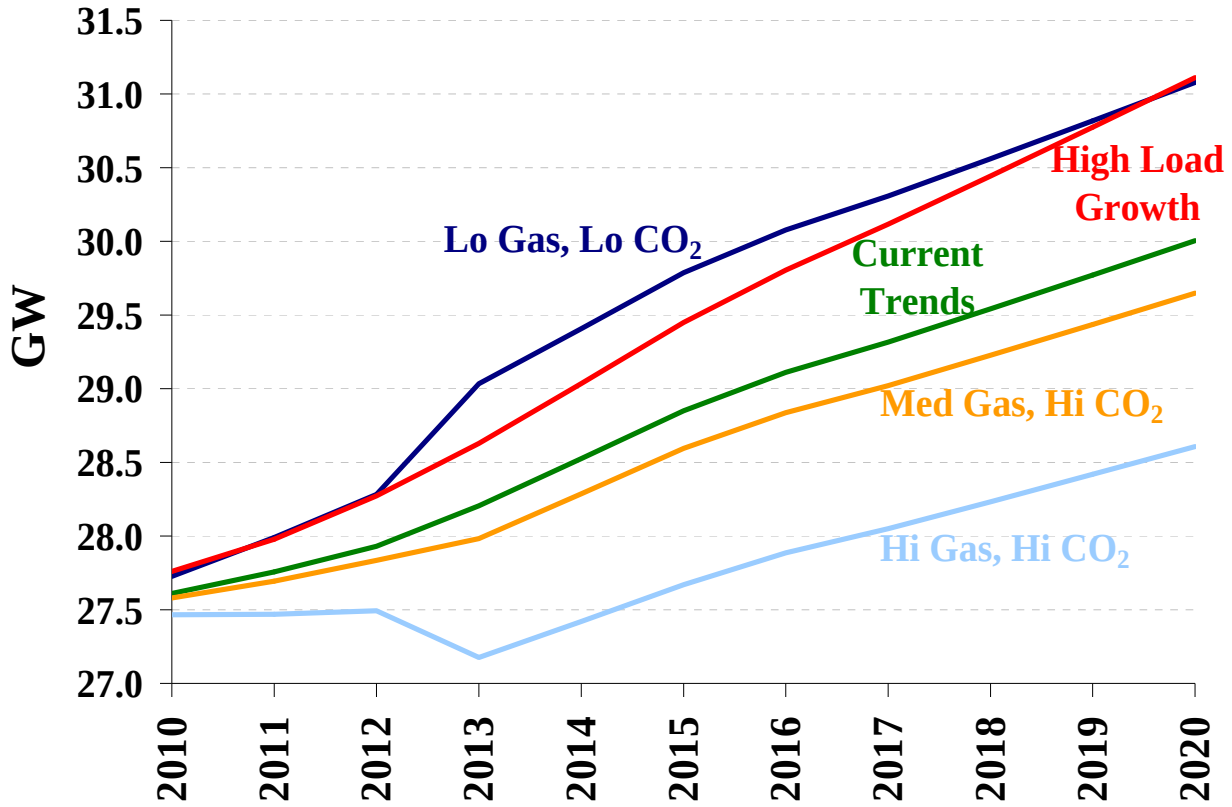
- High Load Growth case reflects ISO-NE's high load case



Peak Demand (ISO-NE)

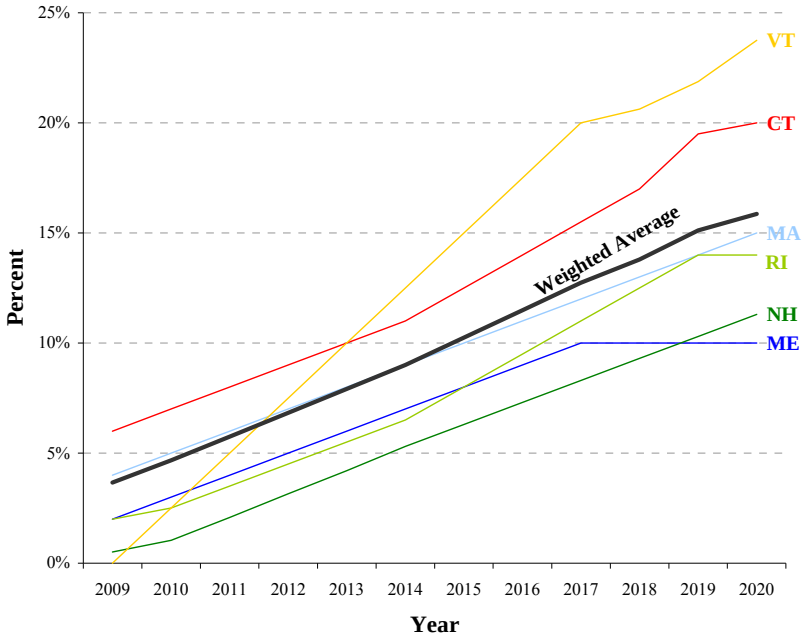
Peak demand in each scenario is also adjusted for price response

- Similar to energy demand, though peak is less price-sensitive

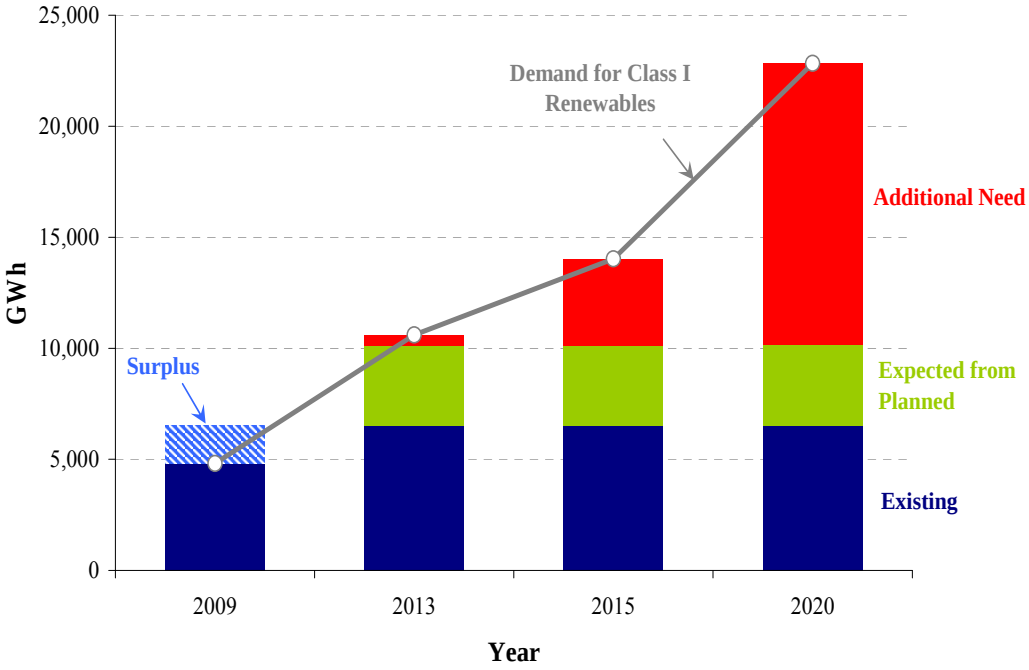


New England Class I Renewable Requirements

New England Class I Renewable Demand as Percentage of Retail Load



New England Class I Renewable Supply Need



Summary of Renewable Buildout for Base Case

Summary of Renewable Buildout
(Current Trends Scenario)

Renewable Technology	Existing Renewable Capacity	New Renewable Capacity Additions Reference Strategy*		
	2009	2013	2015	2020
	(MW)	*(MW)*	*(MW)*	*(MW)*
Connecticut				
Biomass/Biofuels	0	51	55	66
Fuel Cells	3	30	42	66
Landfill Gas	8	20	22	27
Small Hydro	5	0	0	0
Solar PV	13	10	13	21
Wind	0	0	0	0
Offshore Wind	0	0	0	0
CT Total	**31**	**111**	**133**	**180**
ISO New England				
Biomass/Biofuels	457	145	221	382
Fuel Cells	4	30	42	66
Landfill Gas	111	36	38	43
Small Hydro	87	3	12	31
Solar PV	28	103	143	247
Wind	97	239	754	1,939
Offshore Wind	0	367	881	2,066
ISO-NE Total	**785**	**924**	**2,092**	**4,774**

* Includes both planned and unplanned additions to meet demand.

To meet the RPS, New England needs to add about $20B in new renewable generation, and $10B in supporting transmission

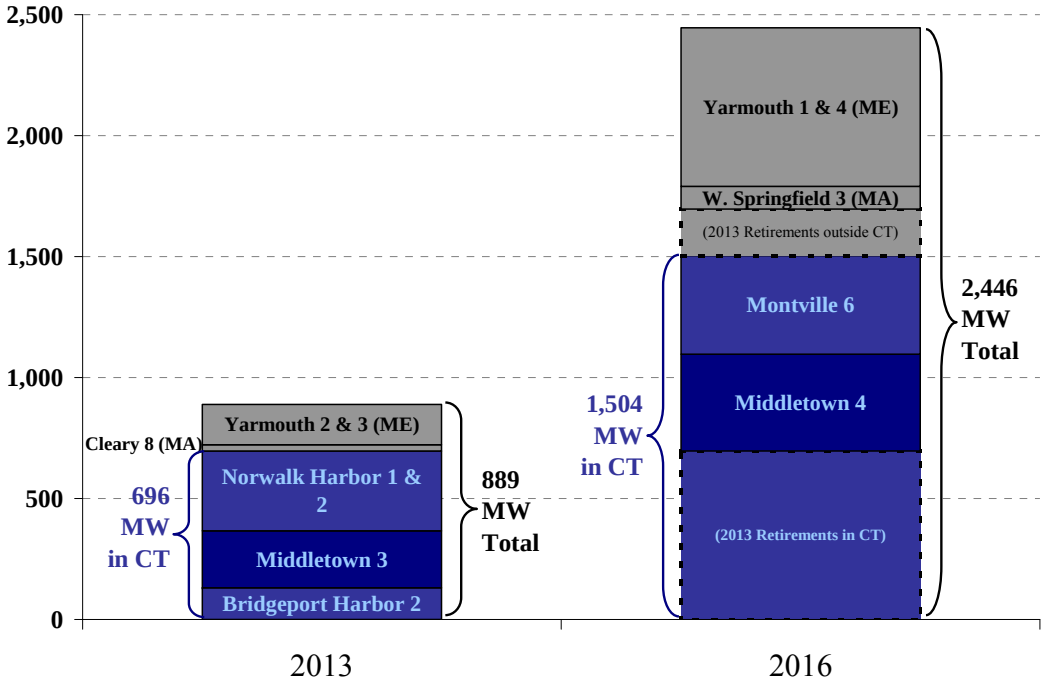
Projected Generation Retirements

CL&P and UI met with the CT DEP to develop realistic assumptions for future NO_X emission regulations to meet National Ambient Air Quality Standards.

As a result of those discussion, NO_X emissions requirements for old, fossil steam oil/gas units are assumed to become more stringent in 2013 and 2017.

- Such plants would have to decide to invest in additional controls, or retire

Based on a long-term economic analysis, the following units had inadequate revenues to cover their going-forward costs, and are assumed to retire.



Note: Generation retirements vary with scenario and strategy

Other Key Assumptions

C&LM programs funded at current level – $3 mills/kWh

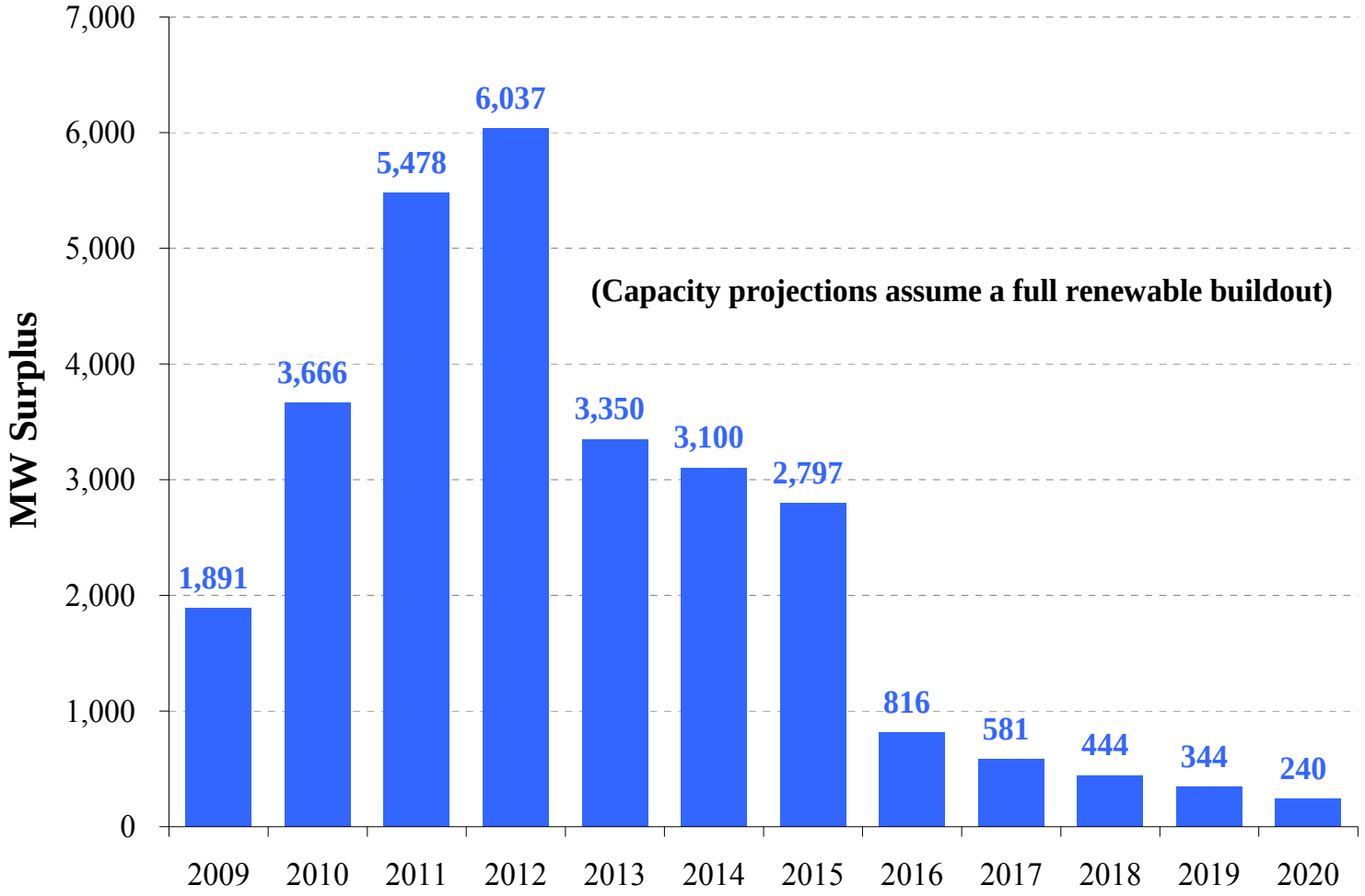
All NEEWS installed by 2015

Project 150 renewable capacity

Kleen Energy (620 MW) completed

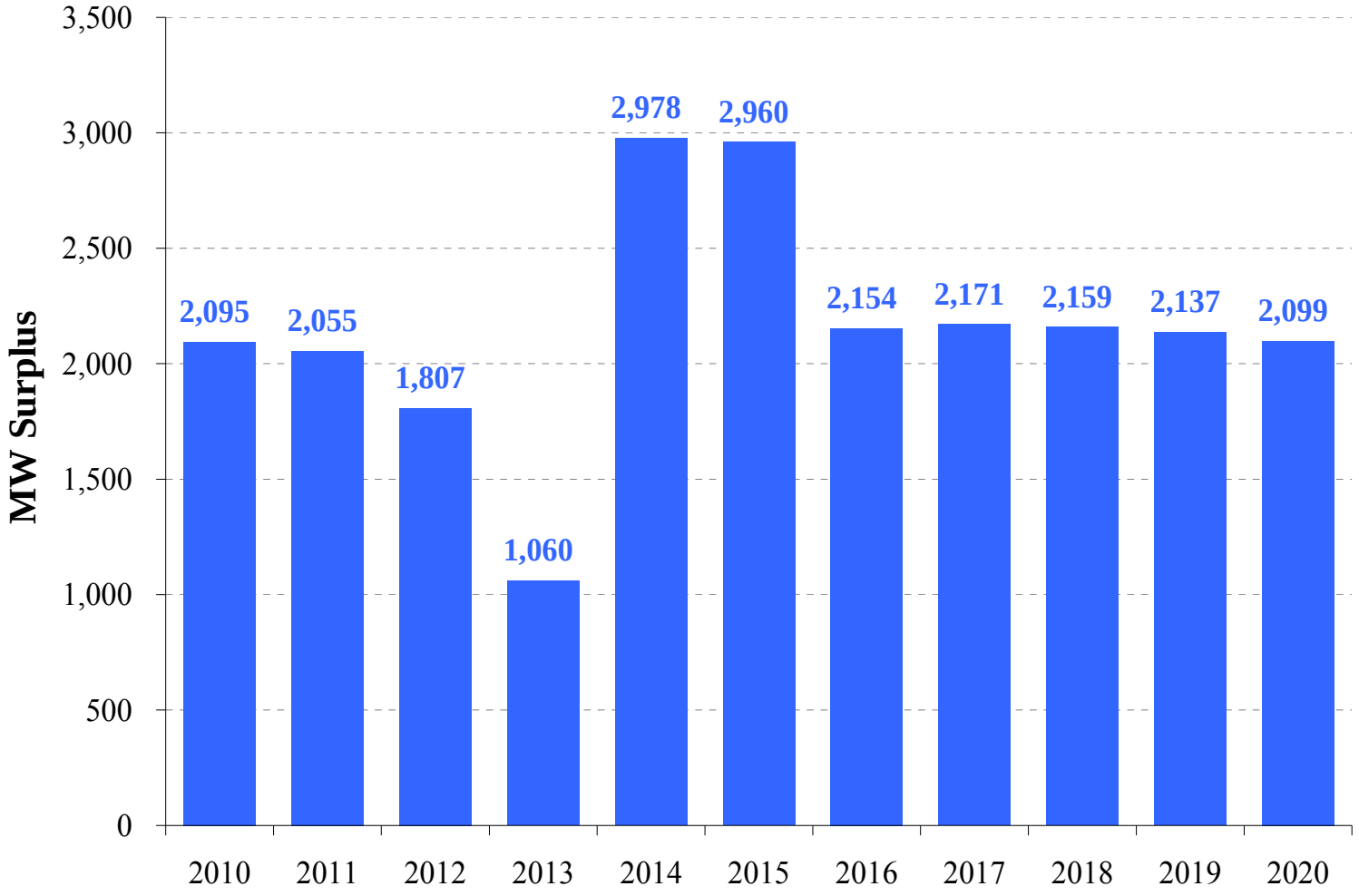
New Connecticut peaking generation (504 MW) completed

ISO-NE Capacity Situation



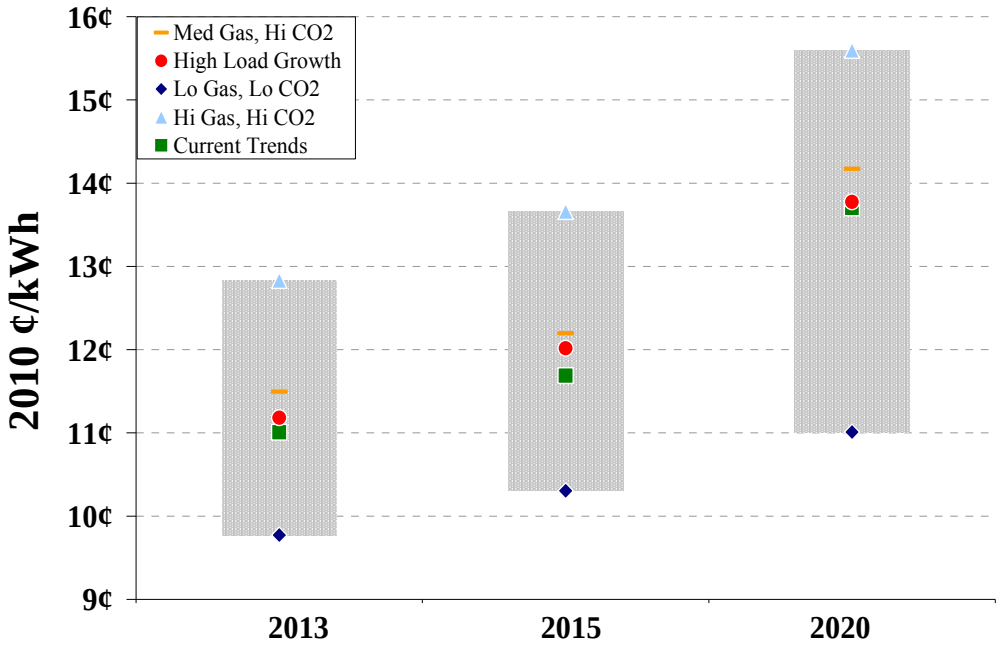
Under Base Case assumptions, ISO-NE has sufficient resources through 2020

Connecticut Capacity Relative to Locational Requirements



Under Base Case assumptions, there are sufficient resources beyond 2020

Average Power Supply-Related Cost in Connecticut



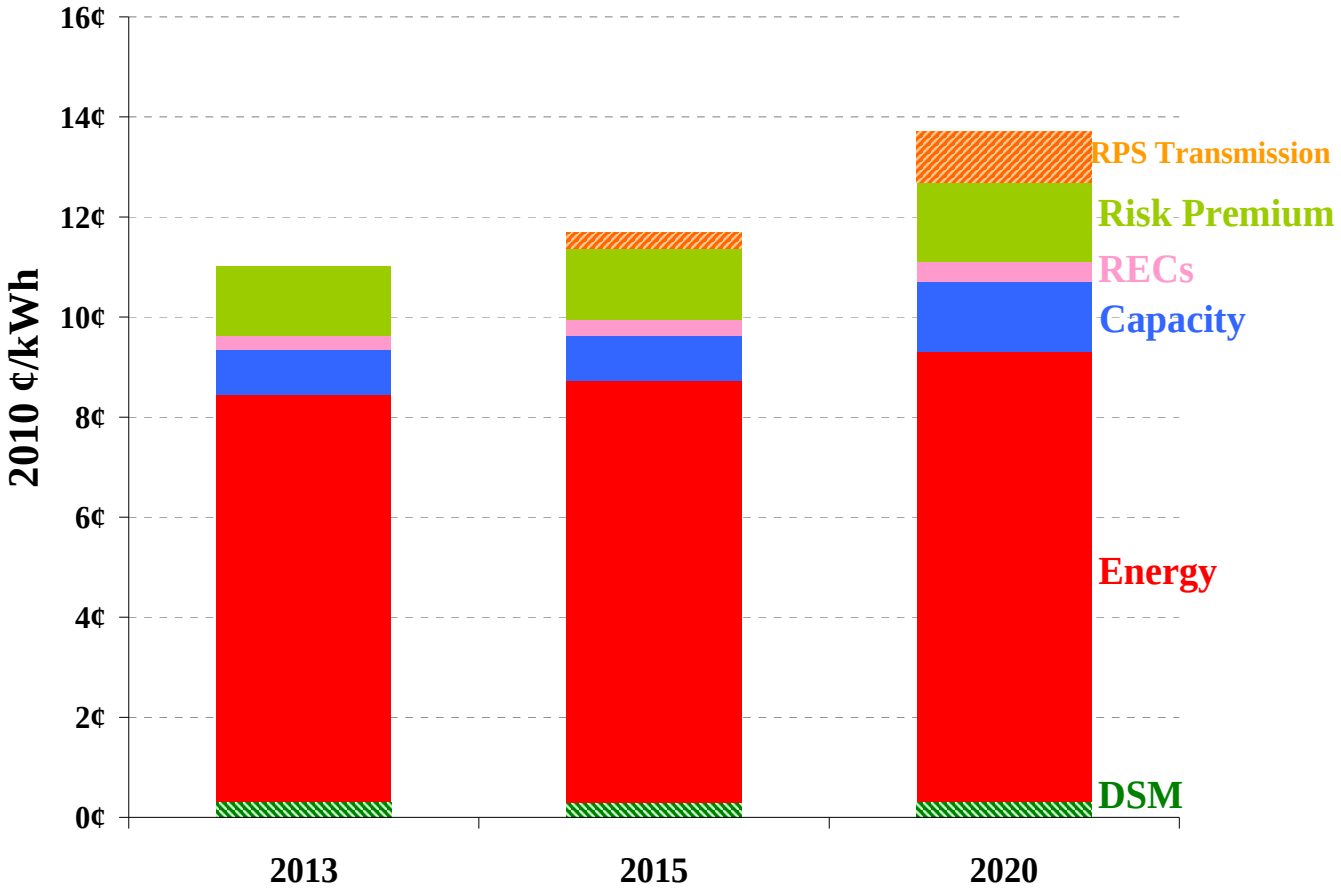
Increasing costs are driven by:

- Renewable generation costs (including transmission expansion)
- Rising CO_2 prices

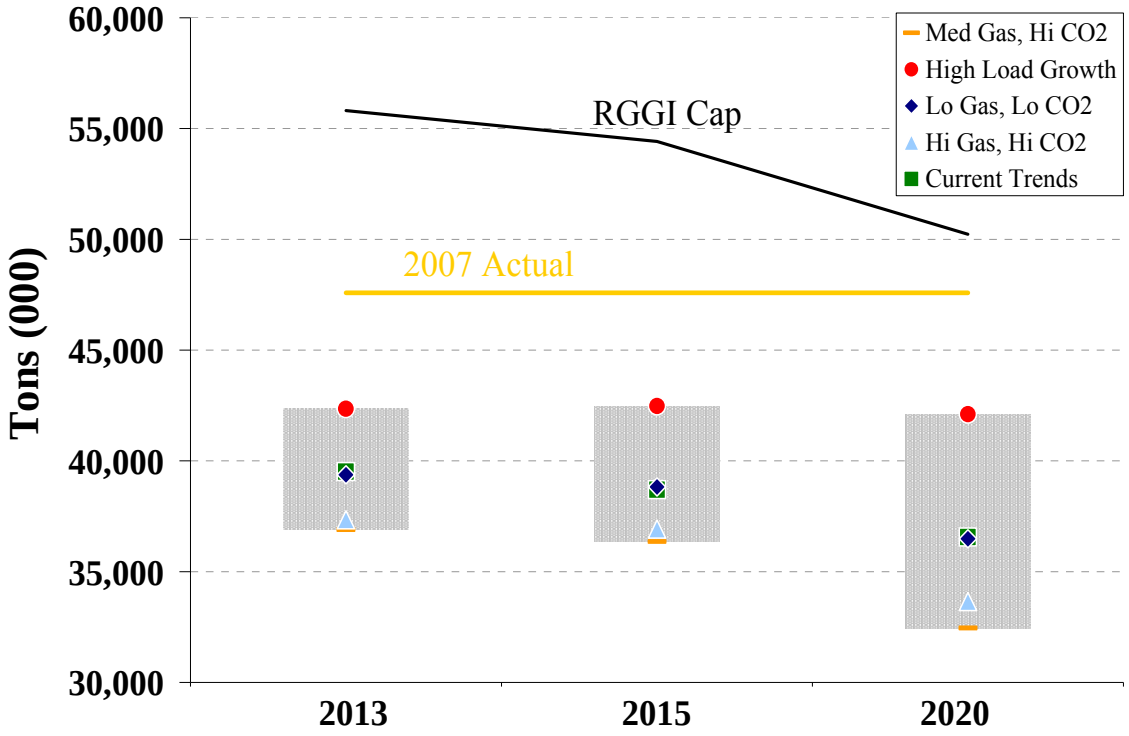
Variability across scenarios is due mostly to gas price

Average Power Supply-Related Cost in Connecticut

Detailed look at Current Trends scenario:



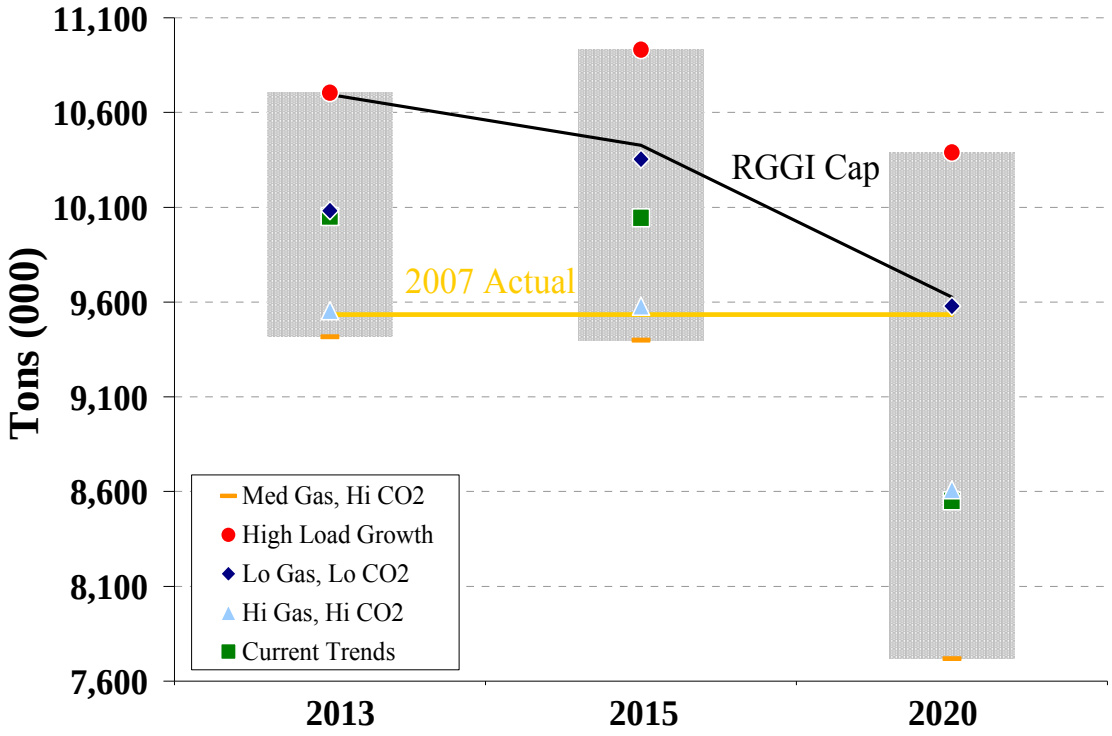
CO_2 Emissions (Annual): ISO-NE



CO_2 emissions are below RGGI cap (and below 2007 levels)

- Large renewable additions, and CO_2 prices well above expected RGGI levels
- Variability across scenarios is due to load as well as CO_2 price

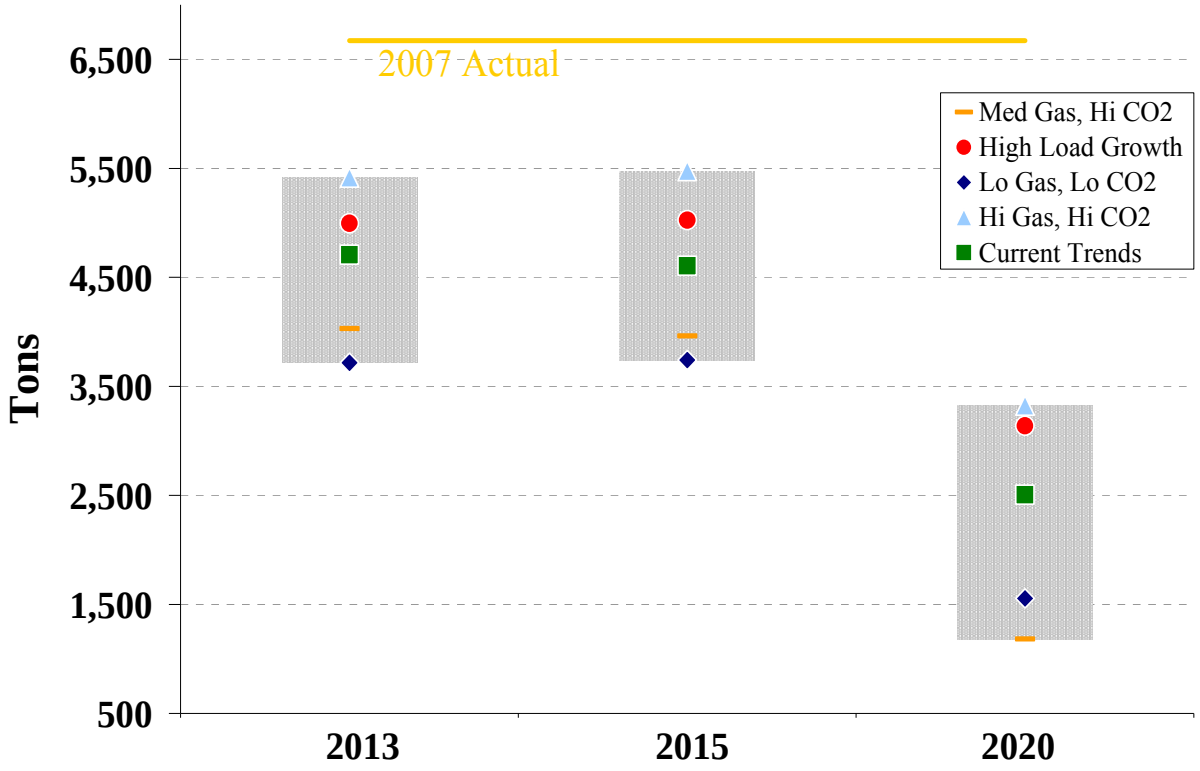
CO_2 Emissions (Annual): Connecticut



Connecticut CO_2 emissions are higher relative to benchmarks

- But this is mostly because more power is generated in-state due to the addition of new Connecticut generation – e.g., Kleen
- Variability due to load, CO_2 price, and exports to other states

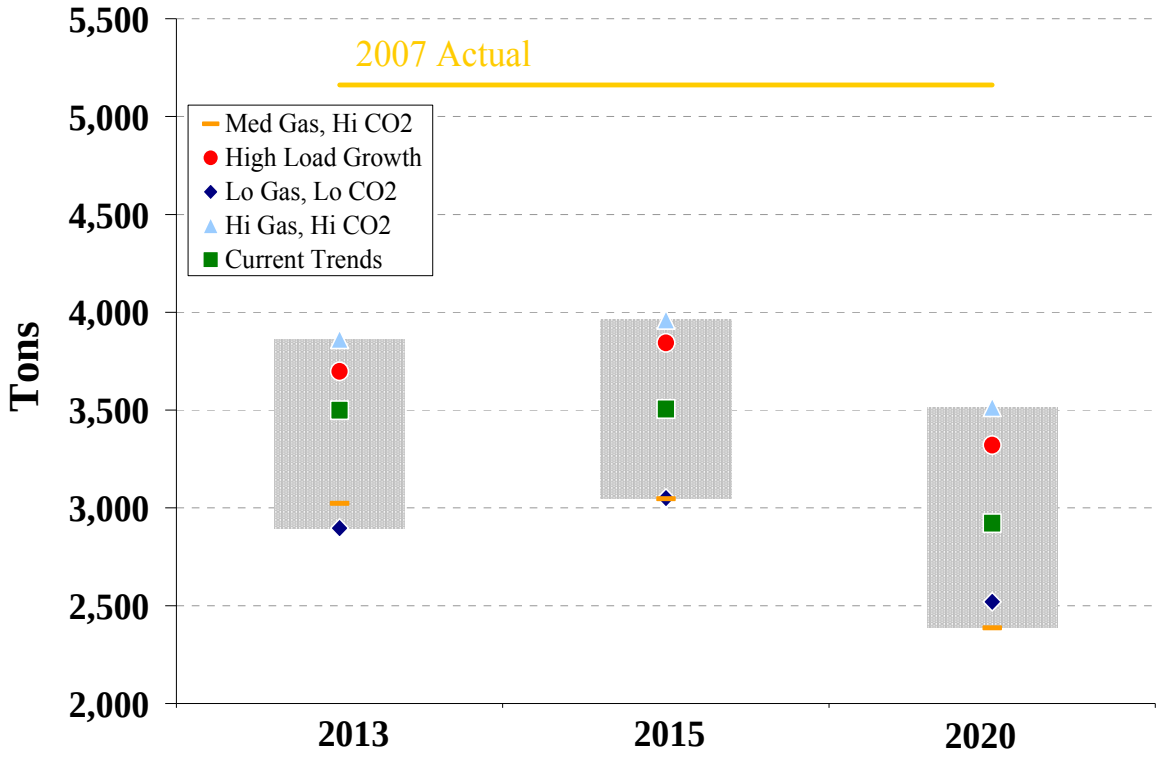
SO_2 Emissions (Annual): Connecticut



Connecticut SO_2 emissions fall relative to 2007

- Retirements of some older fossil steam plants in 2013, more in 2016
- Addition of new clean generation (new gas capacity, renewables) means the remaining fossil steam plants run less

NO_X Emissions (Annual): Connecticut

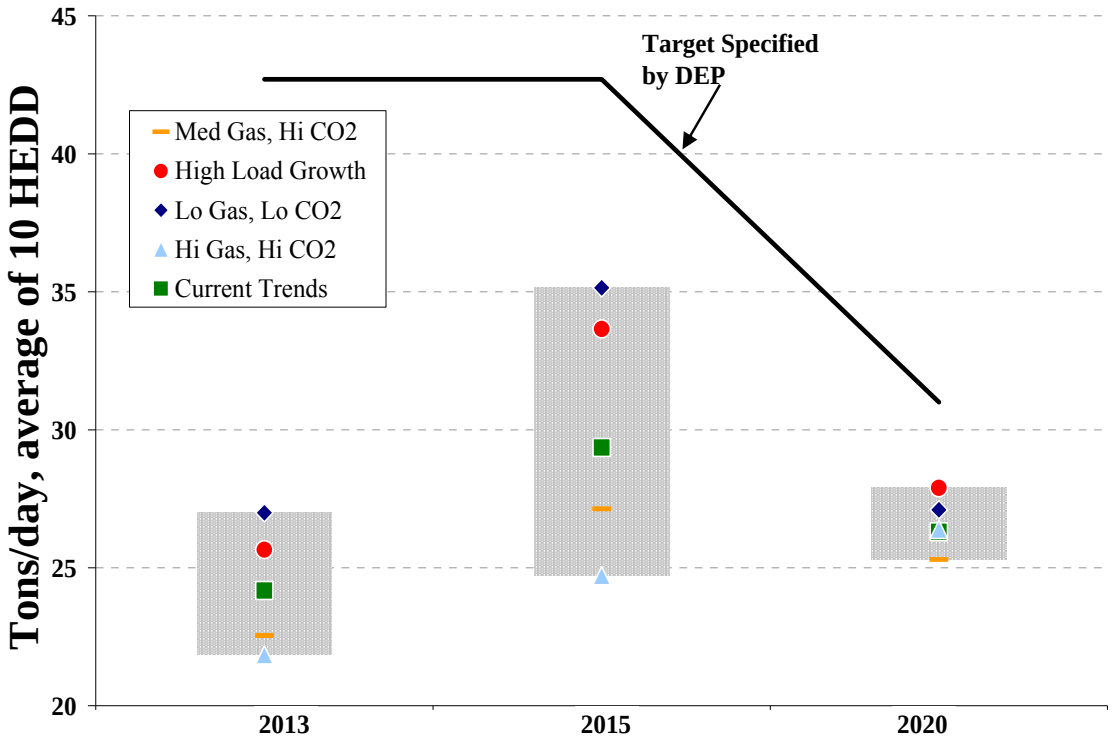


Connecticut NO_x emissions also fall relative to 2007

Reasons are similar to SO_2 effect:

- Retirements of some older fossil steam plants in 2013, more in 2016
- Addition of new clean generation means remaining fossil steam plants run less

NO_X Emissions (HEDD): Connecticut



Connecticut HEDD NO_X emissions are below target (10-day average), though individual highest day(s) may exceed target. Not decreasing over time because:

- Even though older fossil units run less overall, they run more on top 10 days due to increasing peak load and declining reserve margins
- Increase over time is mitigated by 2016 retirements

Alternative Resource Strategies Evaluated: 2020

Reference Strategy: current DSM funding; renewables to meet RPS

Targeted DSM Expansion: four high-potential DSM initiatives not included in current 3 mill/kWh funding

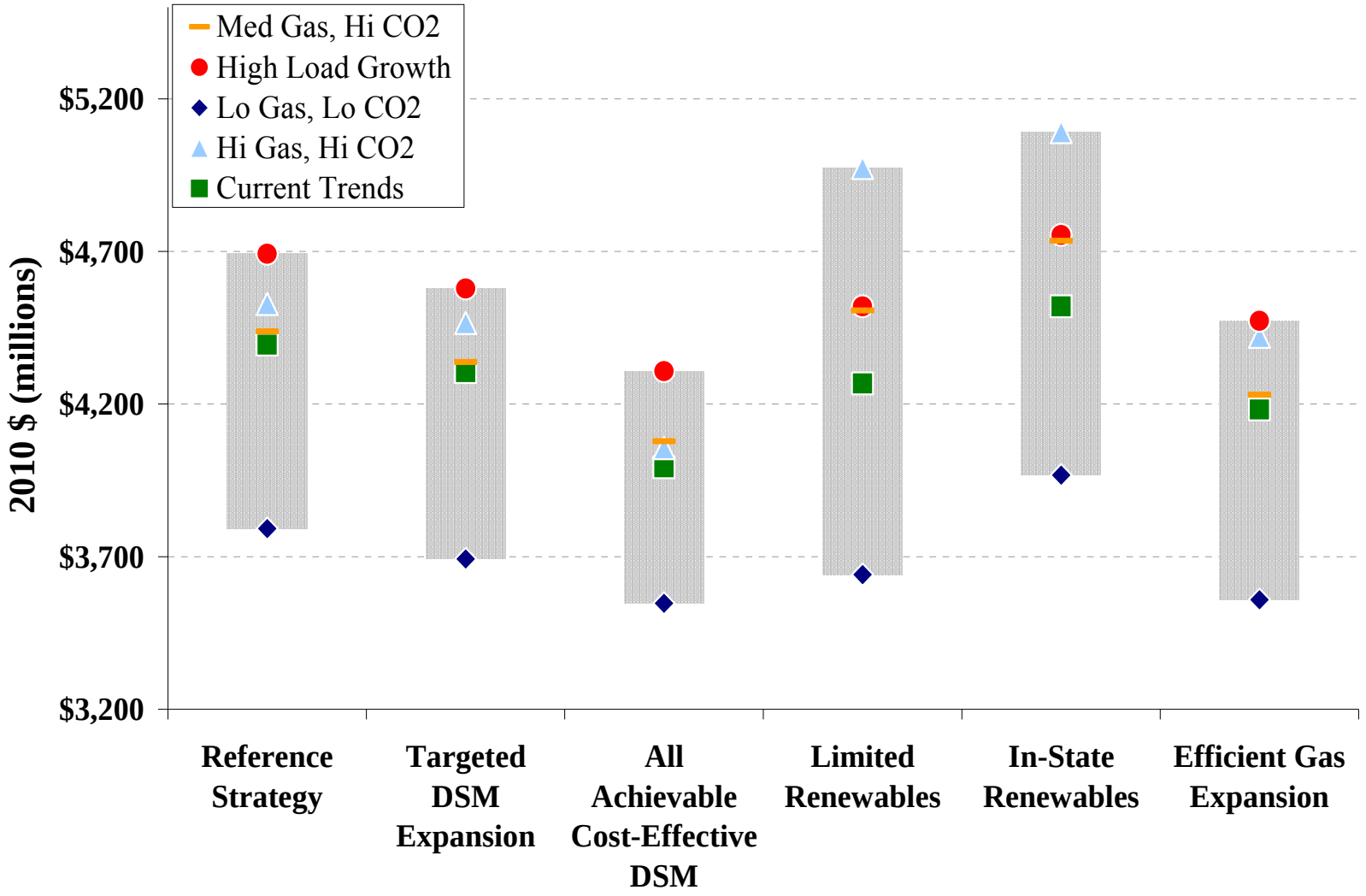
All Achievable Cost-Effective DSM: identified in ECMB "Potential Study"

Limited Renewables: regional renewable build out unsuccessful

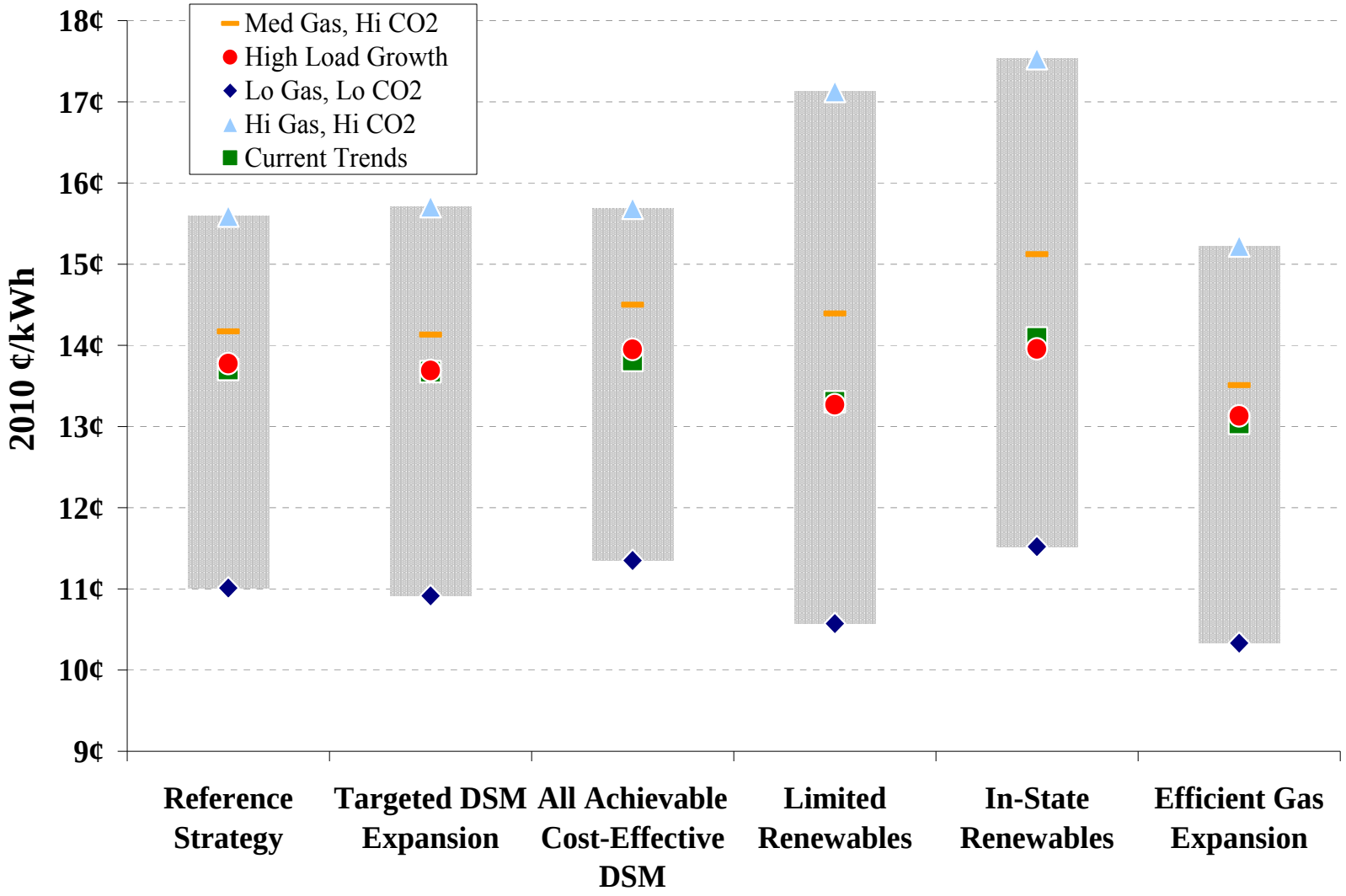
In-State Renewables: renewable build out in CT only to meet CT RPS

Efficient Gas Expansion: efficient gas-fired capacity supported by customers

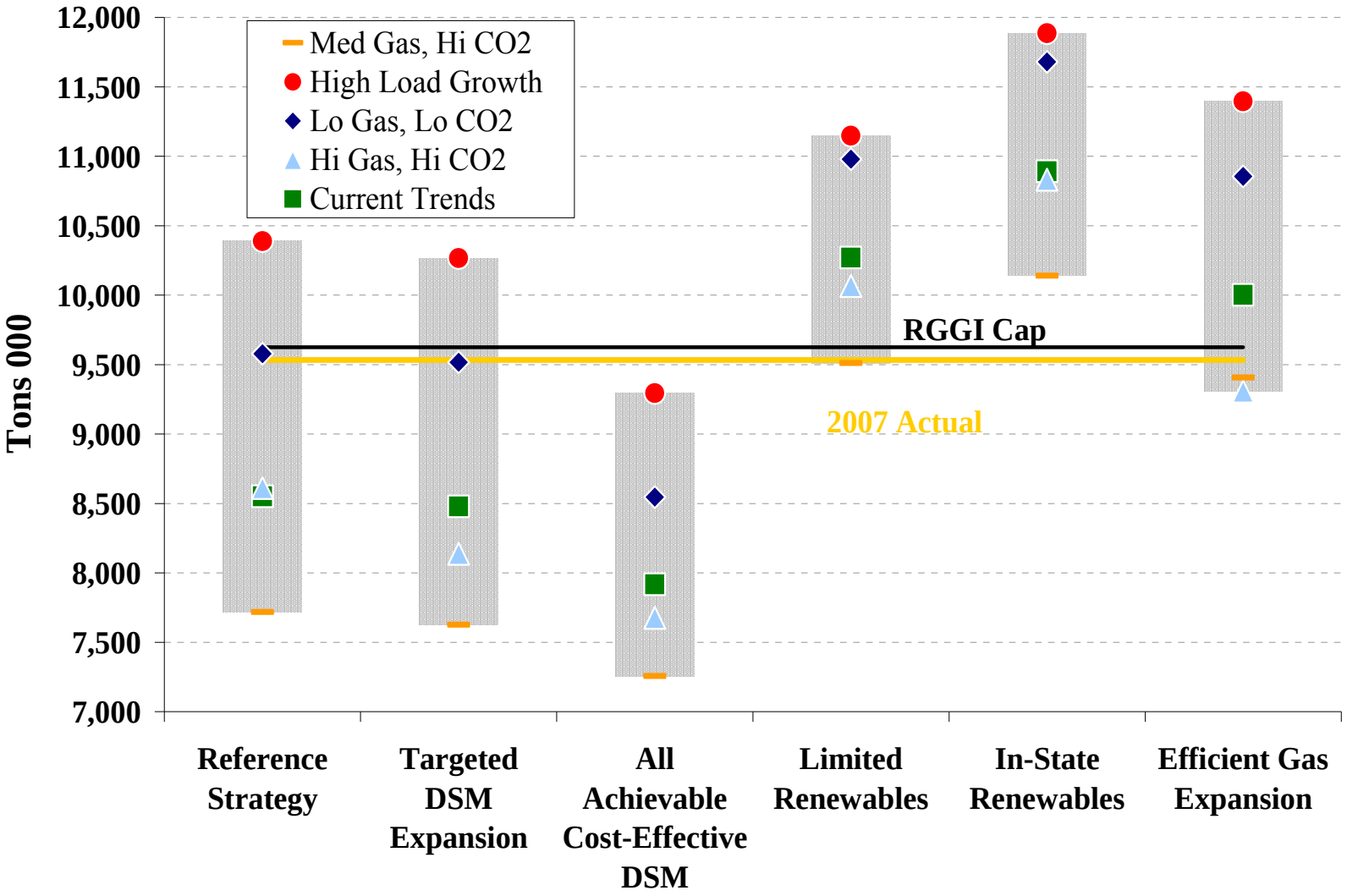
Total Power Supply Cost (Annual) in CT in 2020



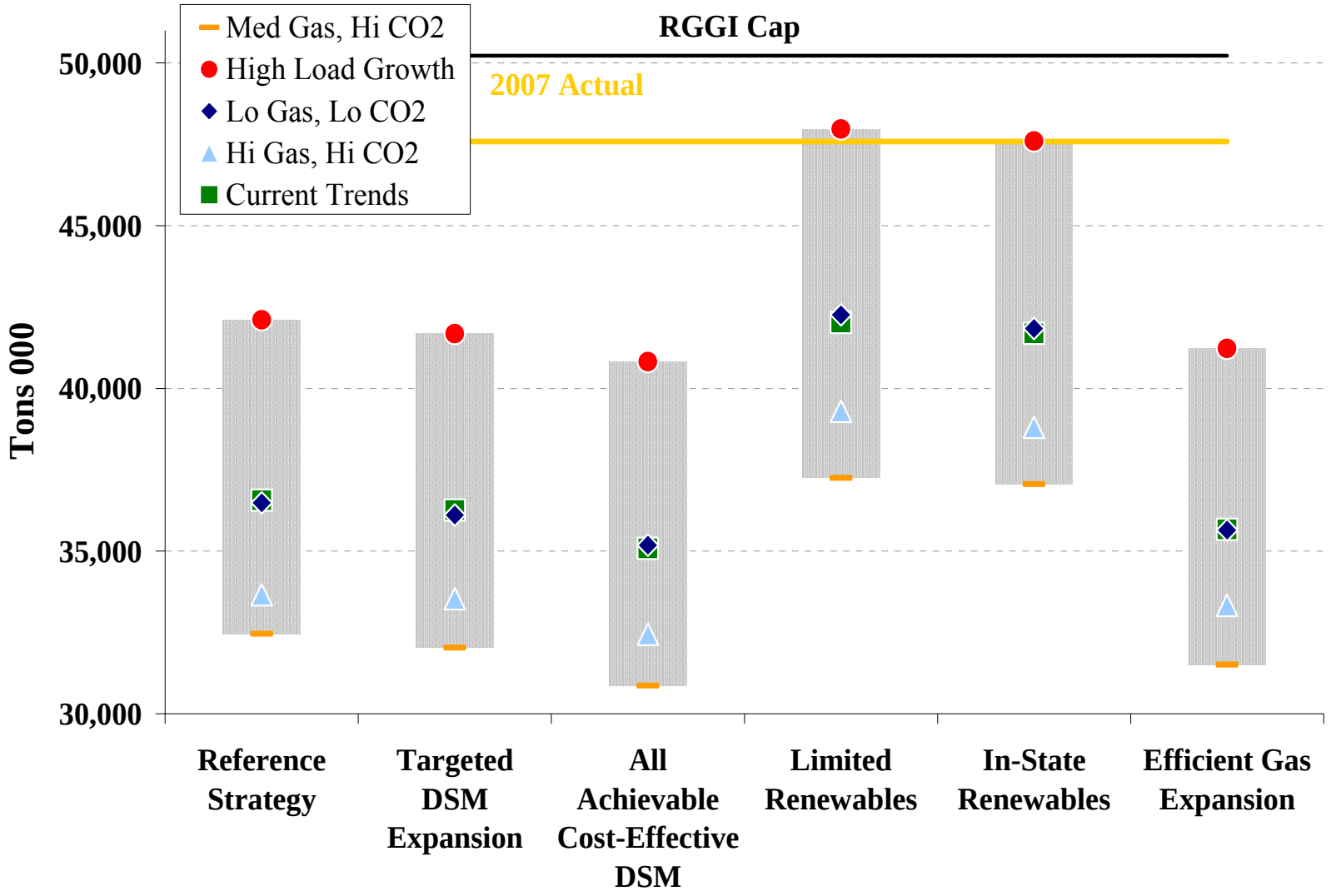
Average Power Supply Cost in CT in 2020



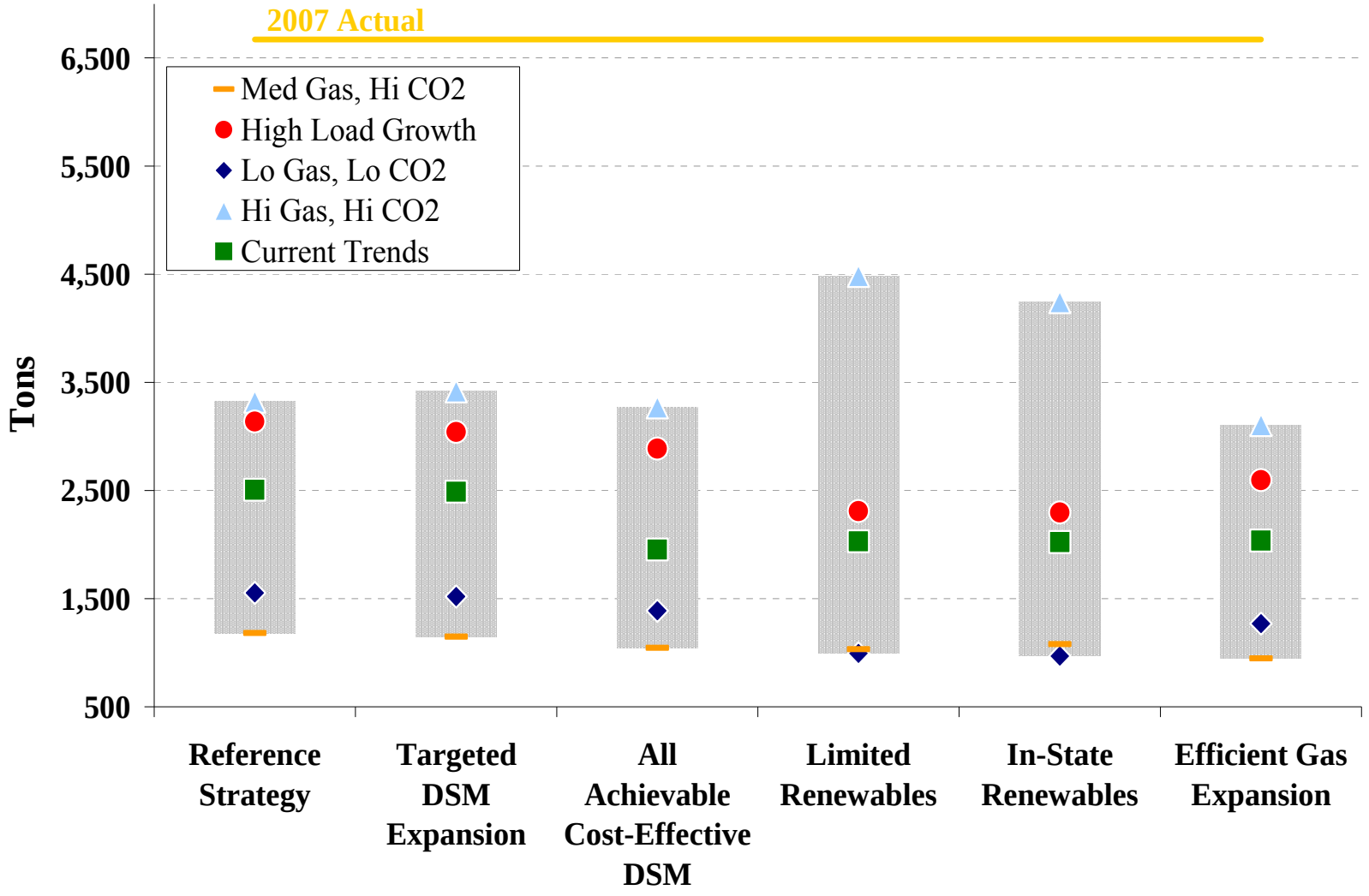
CO_2 Emissions in CT in 2020



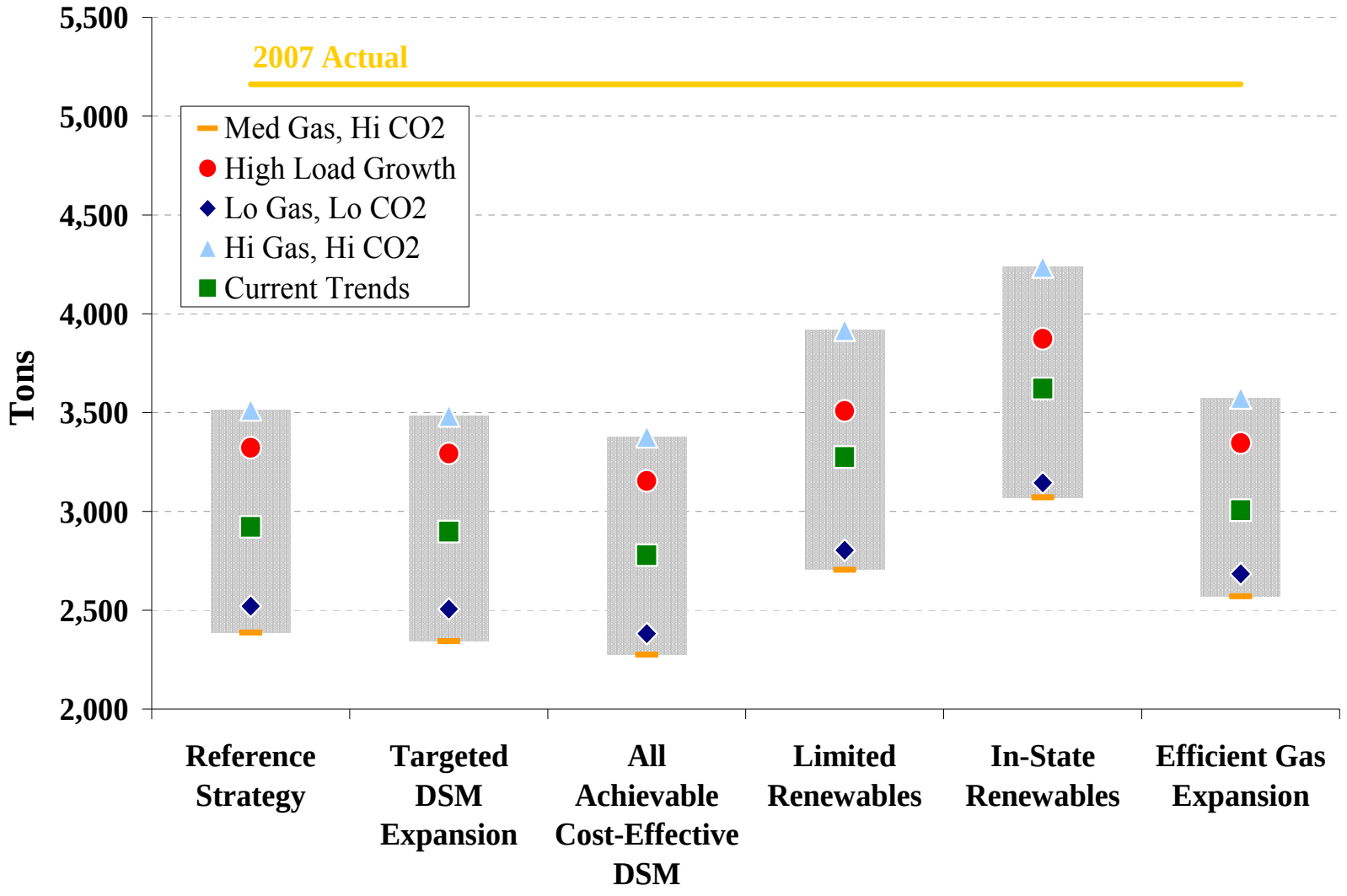
CO_2 Emissions in New England in 2020



SO_2 Emissions in CT in 2020



NO_X Emissions in CT in 2020



Primary Findings

1. Assuming the New England states are successful in building enough new renewable generation and associated transmission to meet RPS requirements, there should be **no need for any additional generating resources** for resource adequacy purposes **over the next ten years** under a wide range of demand uncertainty.

2. Predicated on reasonable assumptions regarding supply and demand and transmission, **Connecticut has sufficient generation** installed or under contract to assure locational resource adequacy requirements **for reliability over the next 10 years**, even if significant uneconomic, high-emissions generating plants retire.

3. Due primarily to the effects of RPS and climate legislation, **power supply-related costs are expected to increase** from 11¢/kWh today and in 2013 to nearly 14¢/kWh in 2020 (in 2010 dollars) under expected supply and demand and moderate fuel and emissions costs.

Primary Findings (continued)

4. A **targeted expansion of DSM programs** beyond those currently planned **can lead to significant reductions in emissions and costs**. It is anticipated that the additional program costs would be more than offset by a reduction in generation service costs and rates.

5. For New England to meet each respective state's 2020 Class 1 renewable portfolio requirements, **New England needs to add about 4,800 MW (nameplate) of new renewable generation**, primarily wind, that will be located in areas distant from load centers that would require investments of approximately **$20 billion in new renewable generation and about $10 billion of investment in transmission** resources to access this new renewable generation.

6. Assuming the Class 1 renewable generation buildout and continuation of the Connecticut DSM measures, **New England's CO_2 emissions, NO_X emissions, and SO_2 emissions in 2020 will be substantially below 2007 actual levels**.

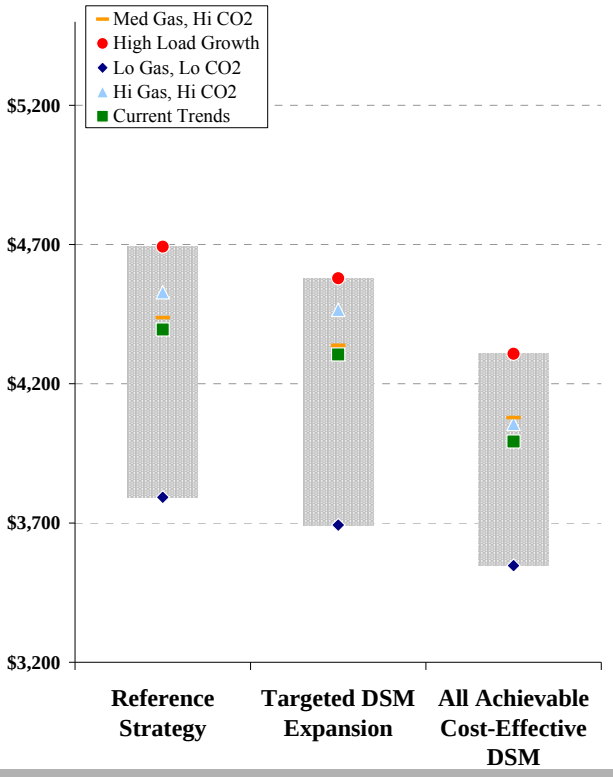
Primary Findings (continued)

7. New England electric energy prices are highly dependent on the price of natural gas. It is expected that the large supply of economically recoverable shale gas, which can be found as close to New England as New York and Pennsylvania, may allow **natural gas prices to remain moderate** and may thereby help to moderate energy prices.

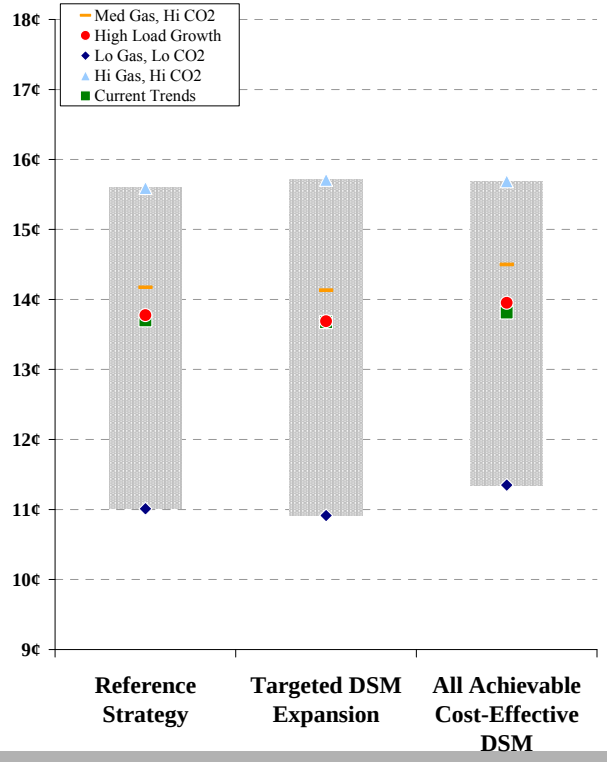
Recommendation 1: Pursue DSM

Given that the Targeted DSM Expansion strategy would reduce customer costs and emissions while even reducing rates for non-participants, the Companies recommend that this strategy be funded.

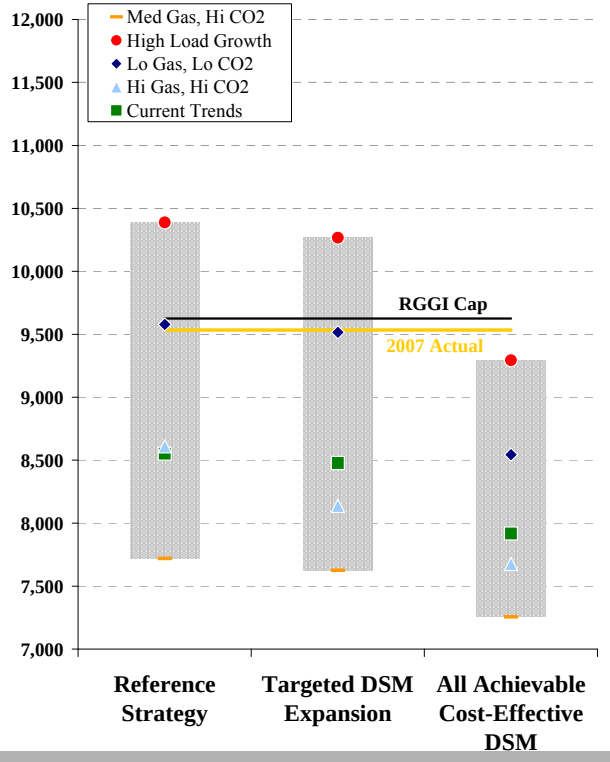
CT Total Power Supply-Related Costs in 2020, 2010 $ (millions)



CT *Average* Power Supply-Related Costs in 2020, 2010 $ (¢/kWh)



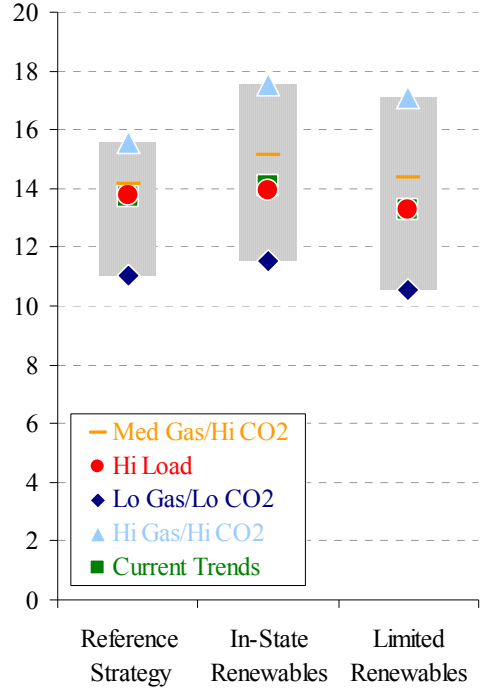
CT CO_2 Emissions in 2020 Tons (000)



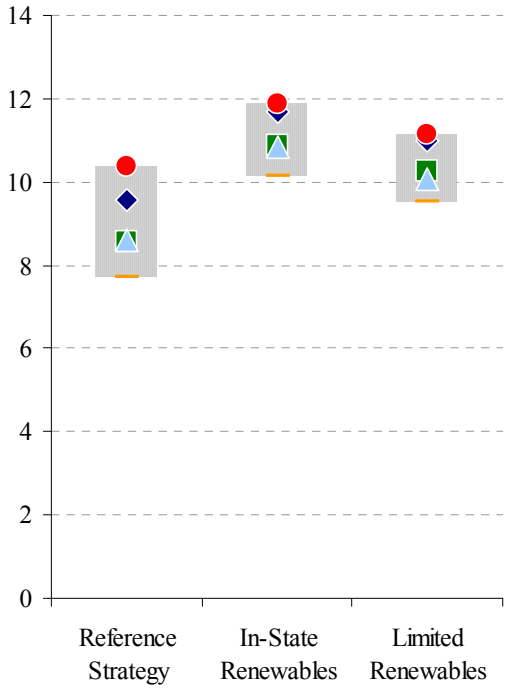
Recommendation 2: Develop Renewable Policy

Connecticut policy makers need to engage with other New England states to develop a comprehensive regional renewable energy policy. The New England states should work to define the best and most cost-effective means to expand renewable energy development in New England and the surrounding regions while meeting environmental goals.

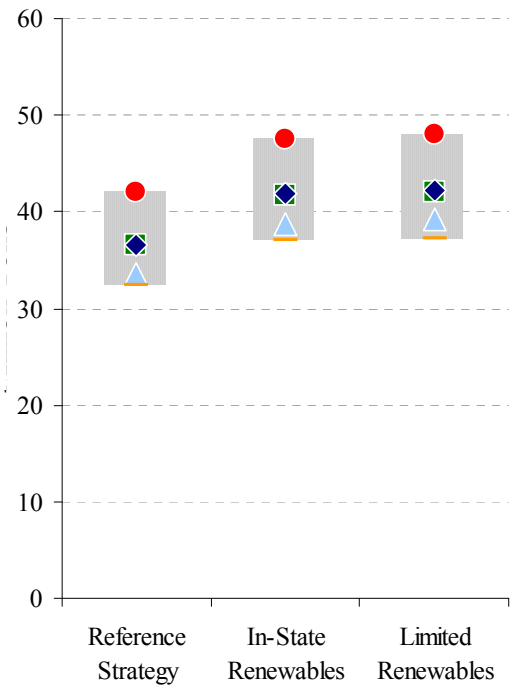
CT Total Power Supply-Related Costs in 2020, 2010 $ (millions)



CT *Average* Power Supply-Related Costs in 2020, 2010 $ (¢/kWh)



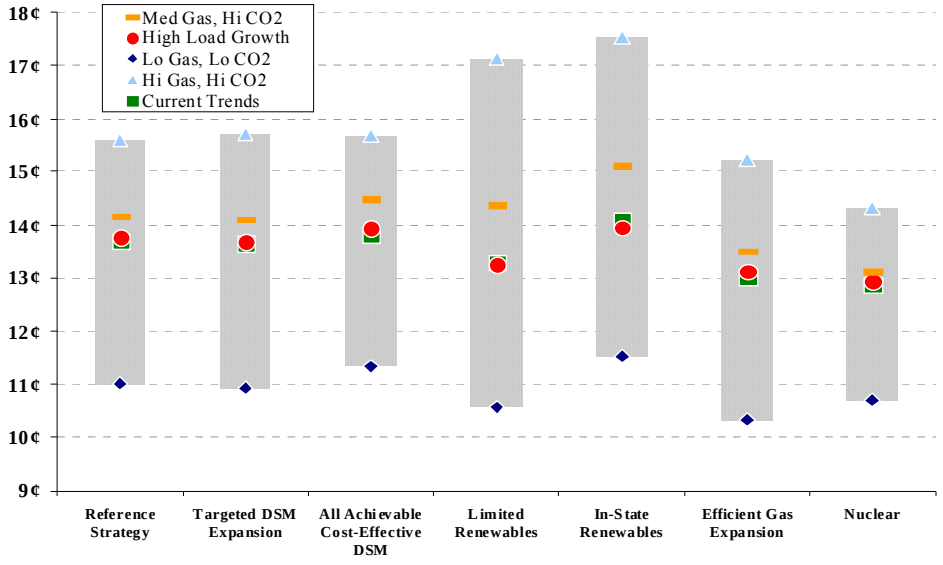
CT CO_2 Emissions in 2020 Tons (millions)



Recommendation 3: Nuclear Study

UI recommends, in light of the potential benefits of a nuclear strategy identified in the analysis, that the CEAB conduct, sponsor, or otherwise support a more detailed study of the potential costs and benefits of nuclear power, with the objective of providing a more complete picture of the tradeoffs encountered with nuclear power as a long-term resource strategy for Connecticut.

CT Average Power Supply-Related Costs in 2020, (2010 ¢/kWh)



CT CO_2 Emissions in 2020 Tons (000)