Connecticut Department of Energy and Environmental Protection

Connecticut Department of
ENERGY &
ENVIRONMENTAL
PROTECTION

GC3 Analysis, Data, and Metrics Meeting

July 26, 2016
1:30 — 3:30 p.m.

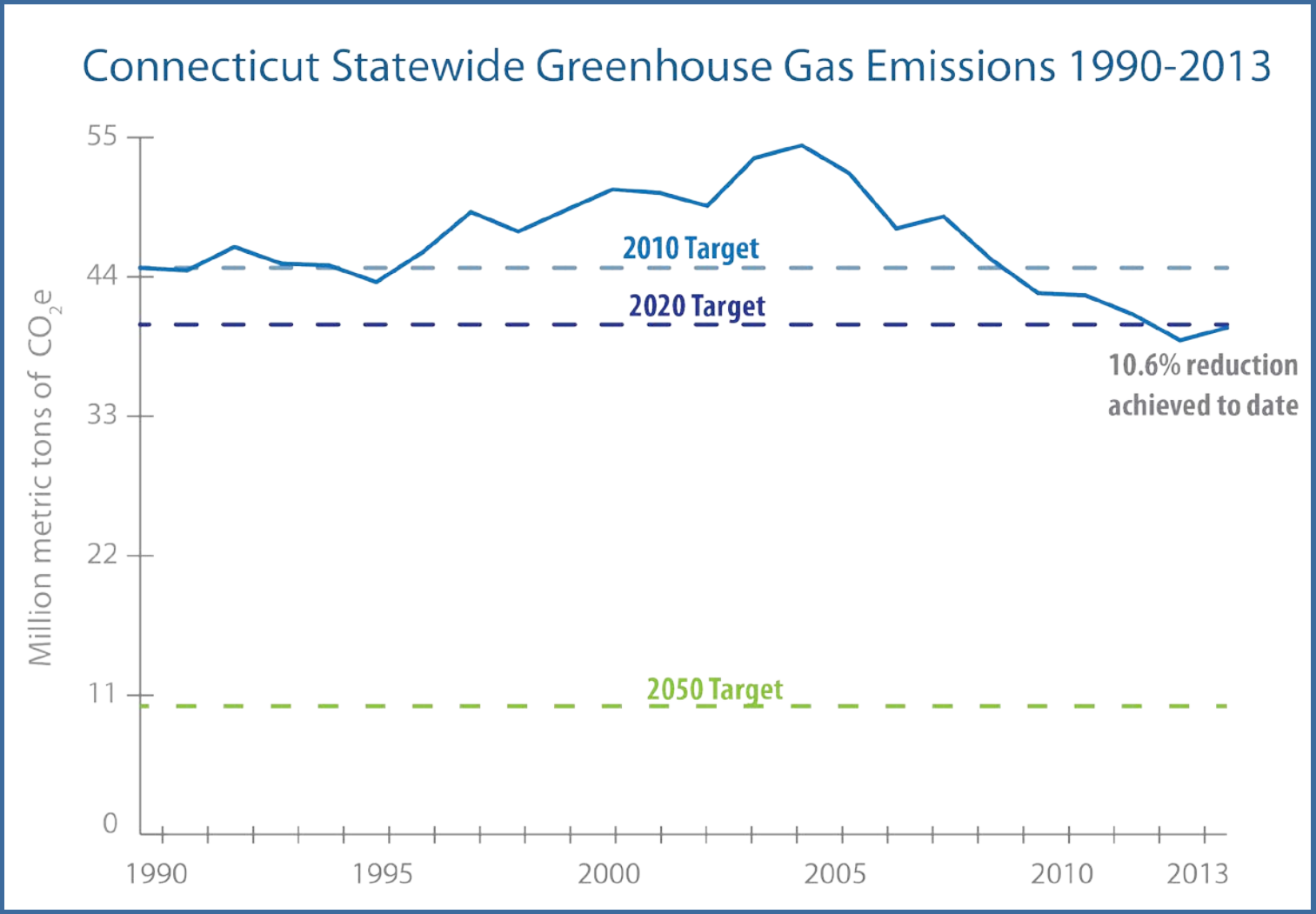
Connecticut Department of Energy and Environmental Protection

Agenda

1:30	Review meeting agenda *DEEP Commissioner Klee*
1:40	Review 2013 GHG Emissions Inventory *Keri Enright-Kato, CT DEEP*
2:00	Review and discuss draft scenarios and setting mid-term targets *Paul Miller and Jason Rudokas, NESCAUM*
3:00	Public Comments

2013 Statewide GHG Emissions Inventory

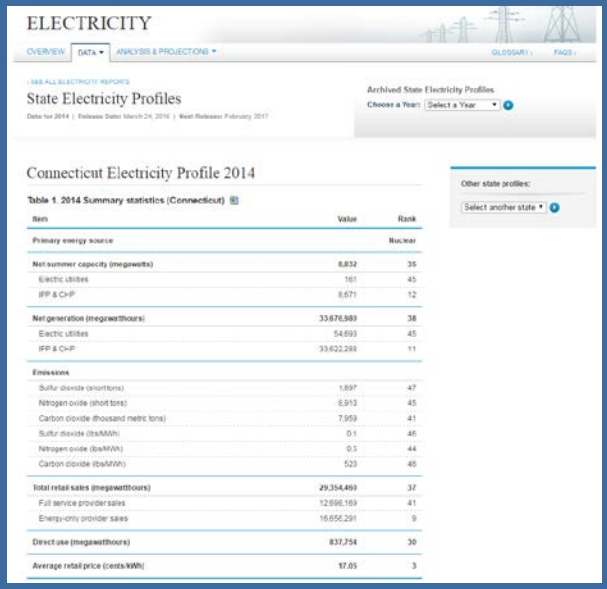
Connecticut Department of Energy and Environmental Protection

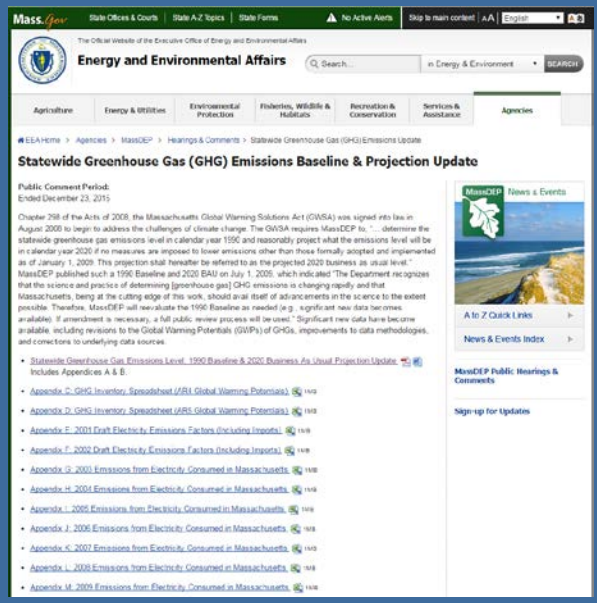


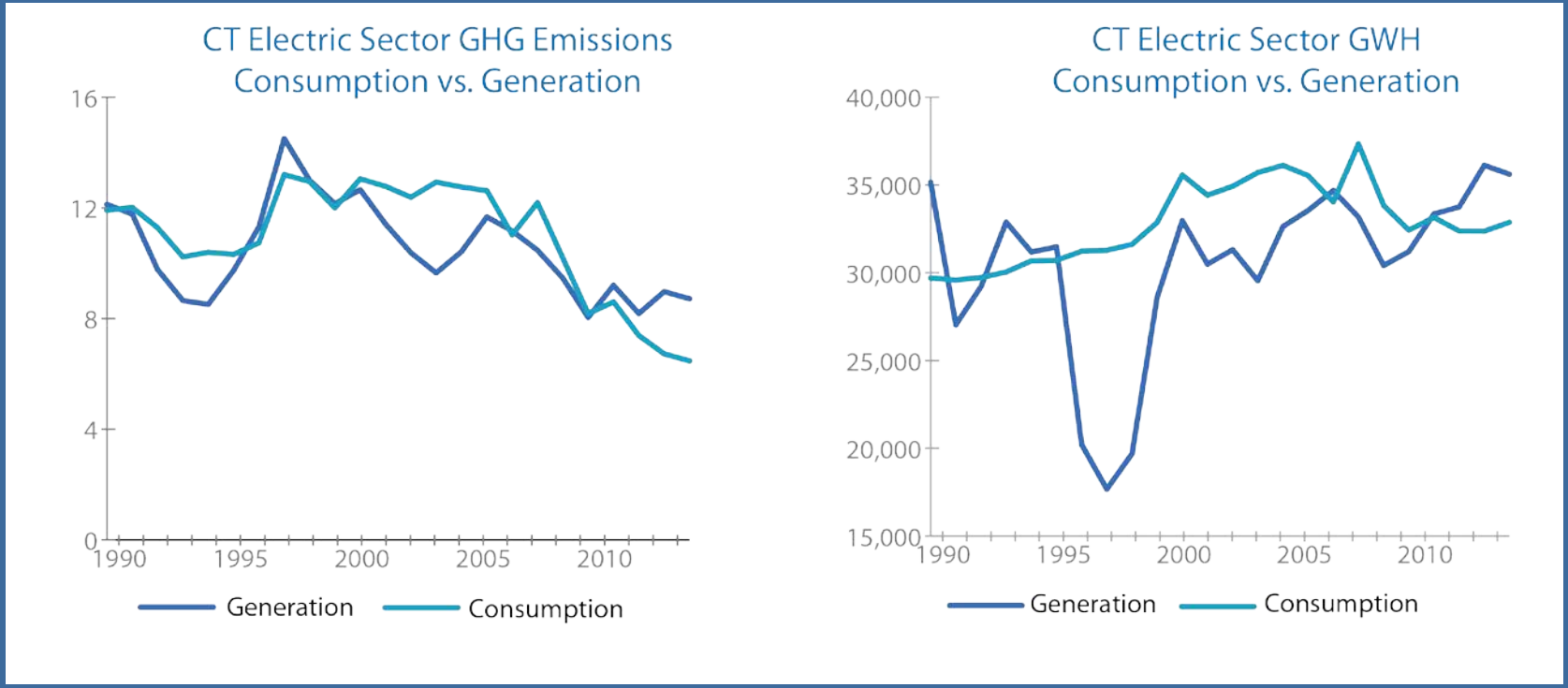
Overall statewide emissions are 10.6% below 1990 levels. This maintains the state's efforts to meet the GWSA goal of 10% below 1990 levels by 2020. There was a slight uptick (2.5%) in emissions from 2012 to 2013.

Inventory Methodology

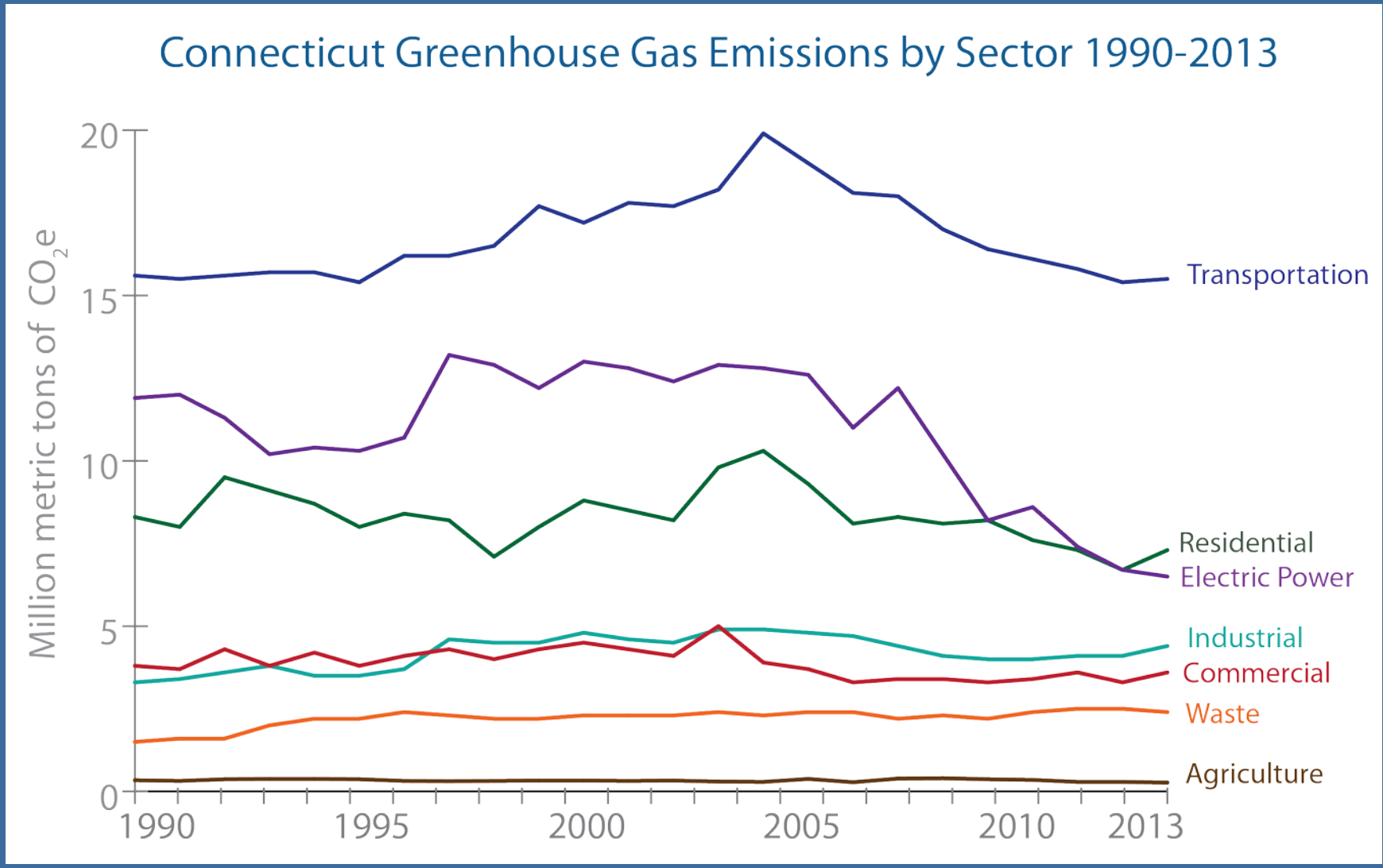
- U.S. Environmental Protection Agency's State Inventory Tool (SIT).
- Solid-waste data collected by the Department of Energy and Environmental Protection's municipal waste program, data that the agency believes to be more accurate than the default SIT data.
- Consumption-based accounting approach for the electric power sector was applied.
- Energy Information Administration data on Connecticut electricity
- Regional-grid carbon intensity data developed by the Massachusetts Department of Environmental Protection which takes into account the carbon intensity of electric generation within the ISO New England grid as well as electricity imported into the region from Canada, New York, and other jurisdictions. This approach more accurately reflects the emission profile of the regional electric grid.







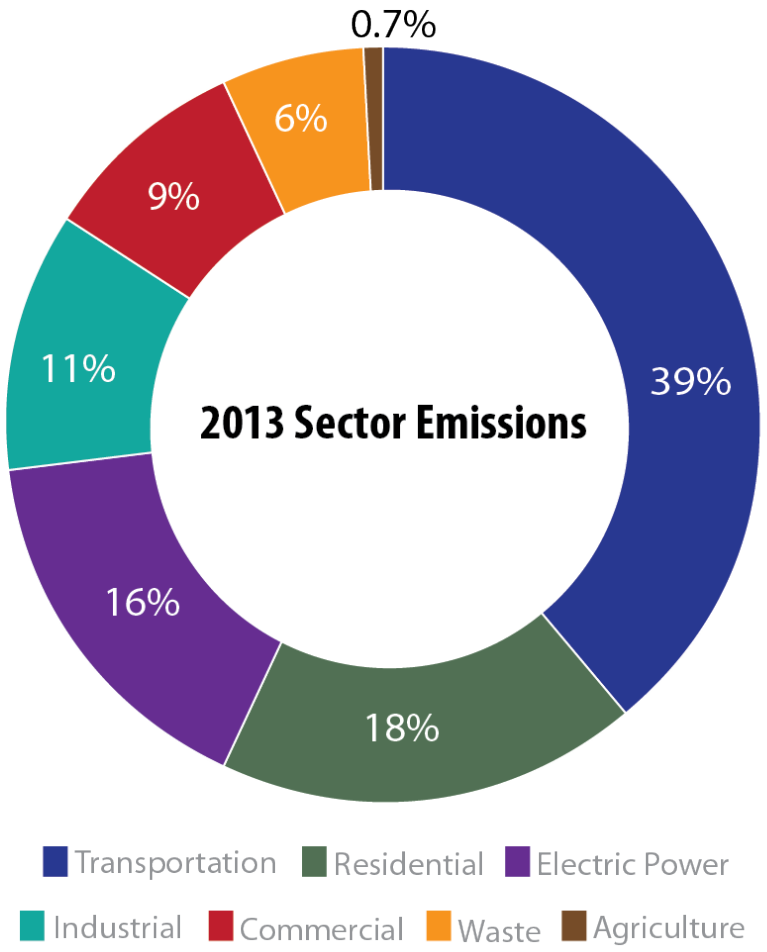
These two graphs represent a comparison of GHG emissions and GWH using a consumption-based and generation-based accounting approaches. While the consumption-based approach will be DEEP's primary method for calculating emissions from the electricity sector, the agency will continue to track emissions associated with in-state electric power generation for the purposes of comparison. The two methods produce roughly parallel estimates across the period 1990-2013: emissions peaking in the mid-1990s and then significantly declining.



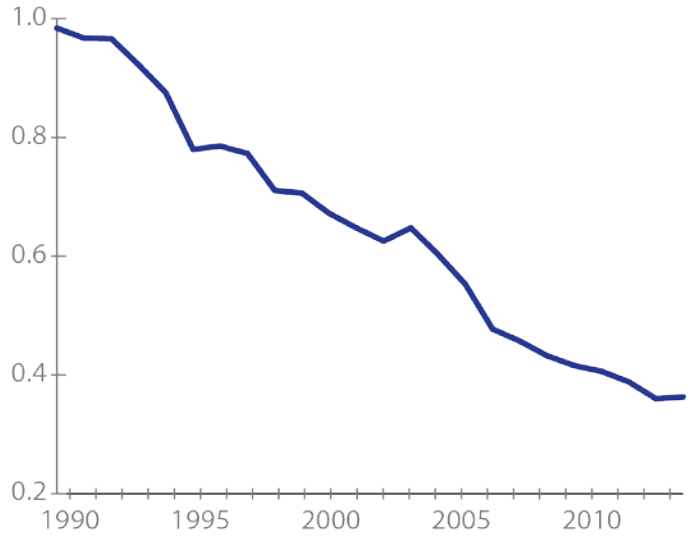
The slight increase in emission from 2012 to 2013 are attributed to increases in the residential (increased from 6.7 MTCO2e in 2012 to 7.3 MTCO2e in 2013), commercial (increased from 3.3 MTCO2e in 2012 to 3.6 MTCO2e in 2013), and industrial (increased from 4.1 MTCO2e in 2012 to 4.4 MTCO2e in 2013) sectors.

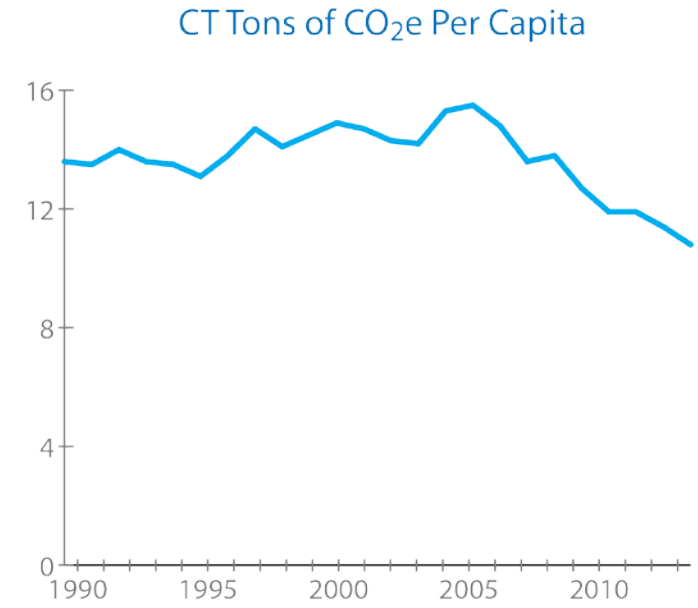
Connecticut Emissions by Sector ($MTCO_2e$)

	1990	2001	2013
Transportation	15.6	17.8	15.5
Residential	8.3	8.5	7.3
Electric Power	11.9	12.8	6.5
Industrial	3.3	4.6	4.4
Commercial	3.8	4.3	3.6
Waste	1.5	2.3	2.4
Agriculture	0.34	0.32	0.27
Total	**44.7**	**50.6**	**40.0**
% change from 1990			-10.6%
% change from 2001			-21%



Emissions from the transportation sector still make up the bulk of the state's emissions, representing 39% in 2013. Residential and the electric power sectors follow next at 18% and 16% respectively.





Overall trends in the inventory demonstrate that the carbon intensity of Connecticut's economy has declined dramatically, from nearly 1 pound of CO_2e per dollar of state gross domestic product in 1990 to less than 0.4 pounds per dollar in 2013. This demonstrates significant decoupling of economic activity and carbon pollution.

Connecticut's 2013 per capita emissions were 10.8 which compares favorably with surrounding northeastern states and is well below the national average of 16.7. Dropping 28 percent since 2000, GHG emissions per person have declined an average of 0.8 percent per year since 1990.

GHG emissions per capita

	2000	2006	2013
Connecticut	14.9	14.8	10.8
Massachusetts	13.0	11.8	9.7
New York	11.2	10.0	8.1
Rhode Island	11.2	9.8	9.5
New Hampshire	14.1	14.7	10.5
Vermont	11.0	10.6	8.9
Maine	17.5	15.9	12.2
California	11.2	10.9	9.2
National Average	20.7	19.6	16.7

Review and discuss scenarios

Paul Miller and Jason Rudokas, NESCAUM

Background

- We are presenting four draft scenarios put together based on the discussion at the June 16 GC3 meeting.

- The purpose of presenting these is to foster further discussion of future mitigation scenarios and of scenario building in general.

Mitigation Building Blocks

- State energy efficiency programs post 2025
- Expanded energy efficiency, e.g., stretch building codes
- Utility-scale renewables
- Behind-the-meter solar PV
- Electric passenger cars and passenger trucks
- Residential renewable thermal
- Commercial renewable thermal
- Short haul heavy-duty electrification
- Clean long haul & rail
- VMT reduction measures

Mitigation Scenarios

Scenario 1:

Pilgrim retires and is replaced with natural gas. Remaining 3 nuclear plants continue to operate through 2050. Grid evolves towards zero-carbon with utility-scale solar the dominant resource.

- **Scenario 1.1 examines greater levels of energy efficiency, e.g., stretch building codes, to significantly reduce load**

Scenario 2:

All nuclear retires at the end of current license and is replaced with natural gas. Grid evolves towards zero-carbon with utility-scale solar the dominant resource.

Scenario 3:

All nuclear retires at the end of current license and is replaced with on-shore wind. Grid evolves towards zero-carbon with roughly even split between utility-scale solar and on-shore wind.

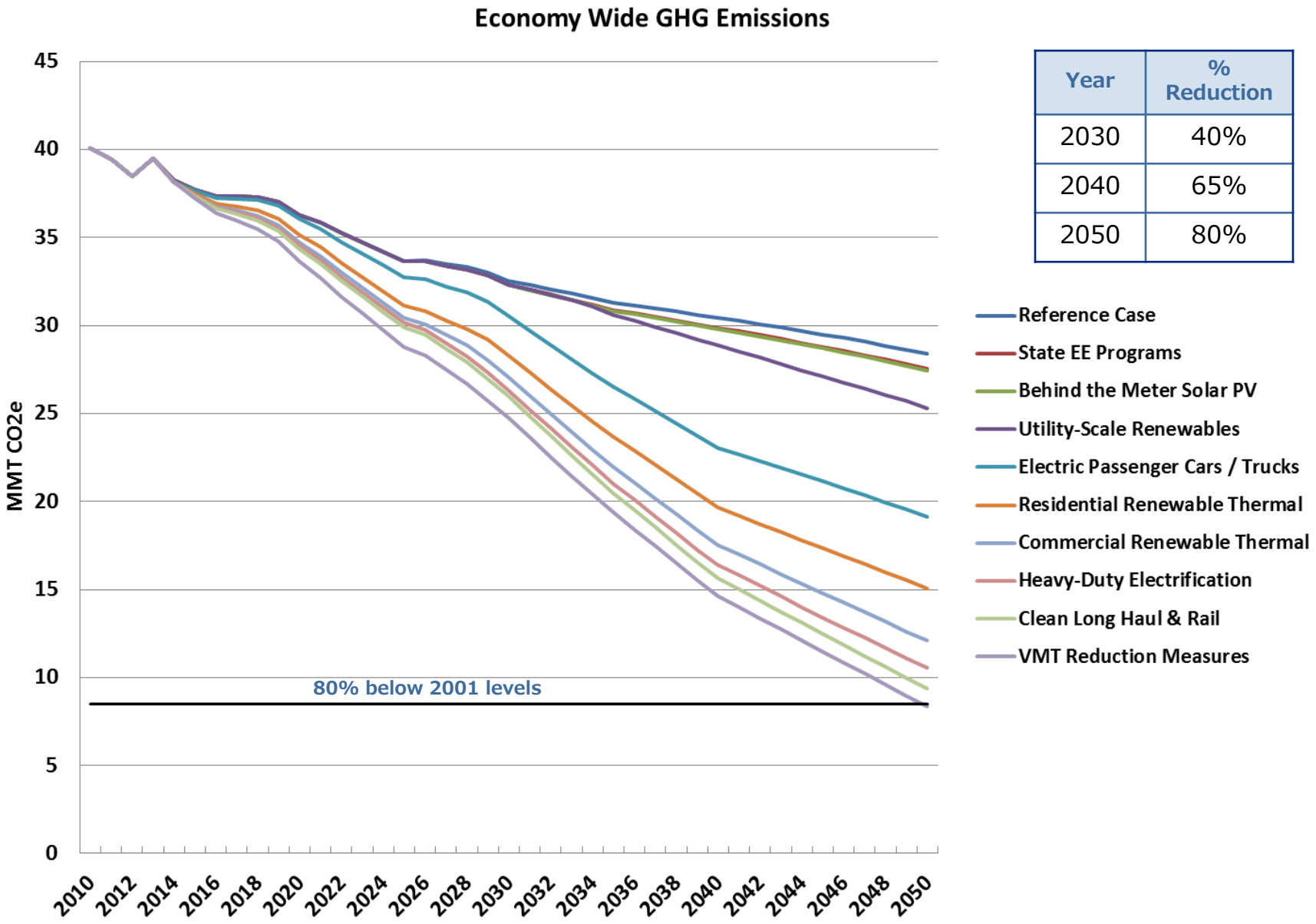
Scenario 4:

Scenario 1 + accelerated early deployment of mitigation technologies and measures.

Scenario 1

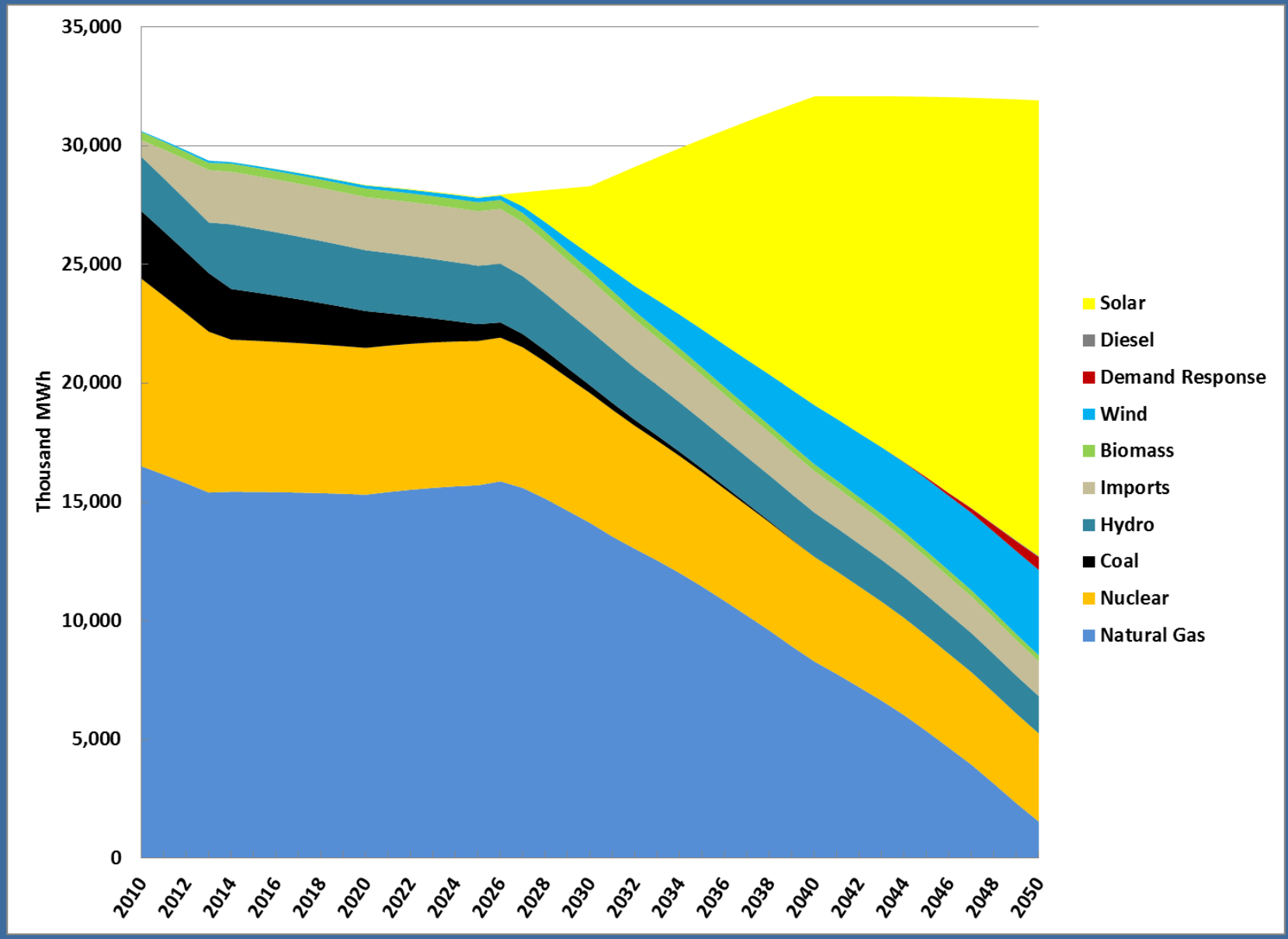
- Pilgrim retires and is replaced with natural gas. Remaining 3 nuclear plants continue to operate through 2050. Grid evolves towards zero-carbon with utility-scale solar the dominant resource.
- Mitigation building block penetration rates were set to achieve 80% reduction by 2050 and mid-range reductions by 2030
- “Reference” scenario for comparison to the other scenarios

Mitigation Wedges – Scenario 1



Year	% Reduction
2030	40%
2040	65%
2050	80%

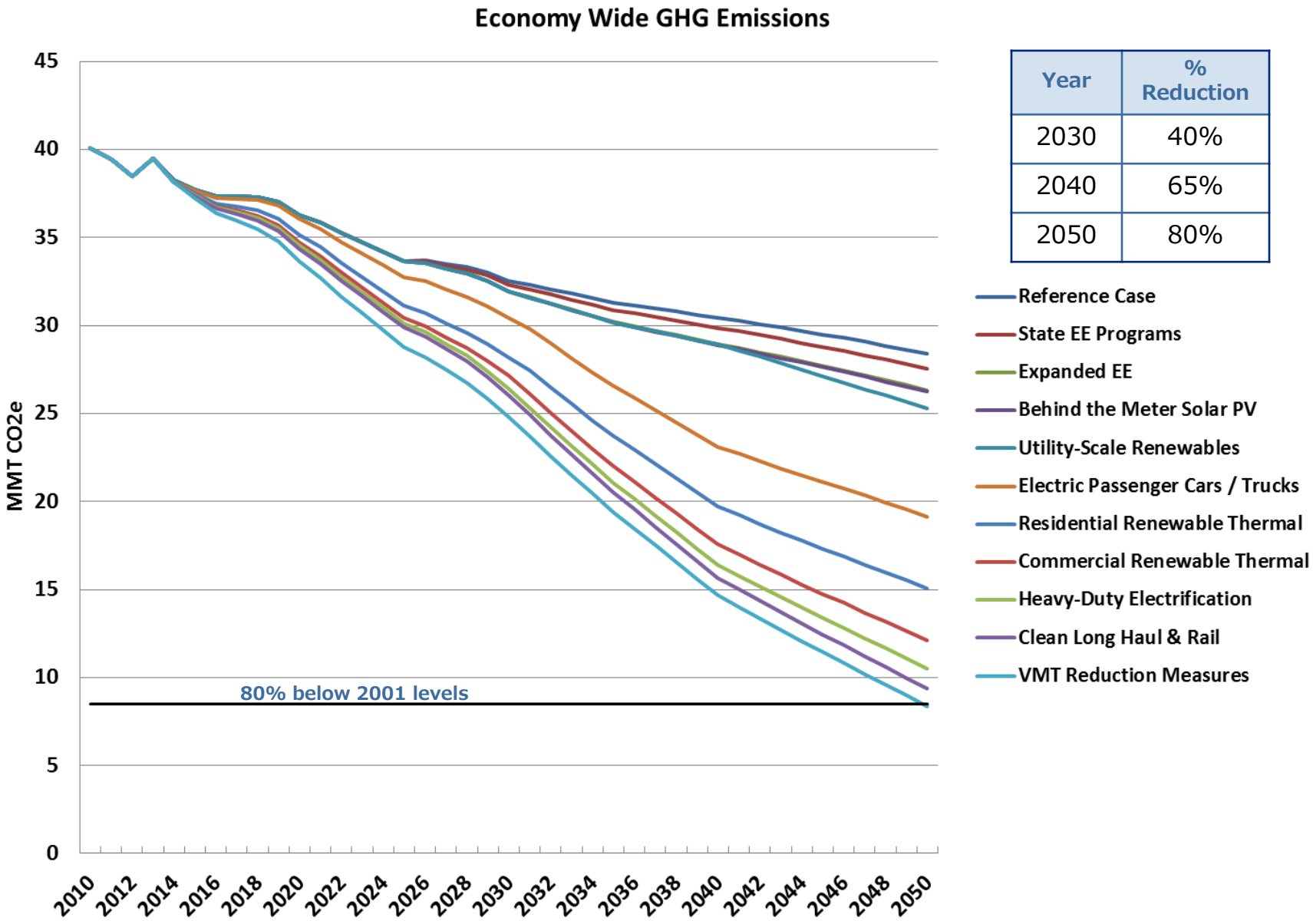
Electricity Generation – Scenario 1



Scenario 1.1

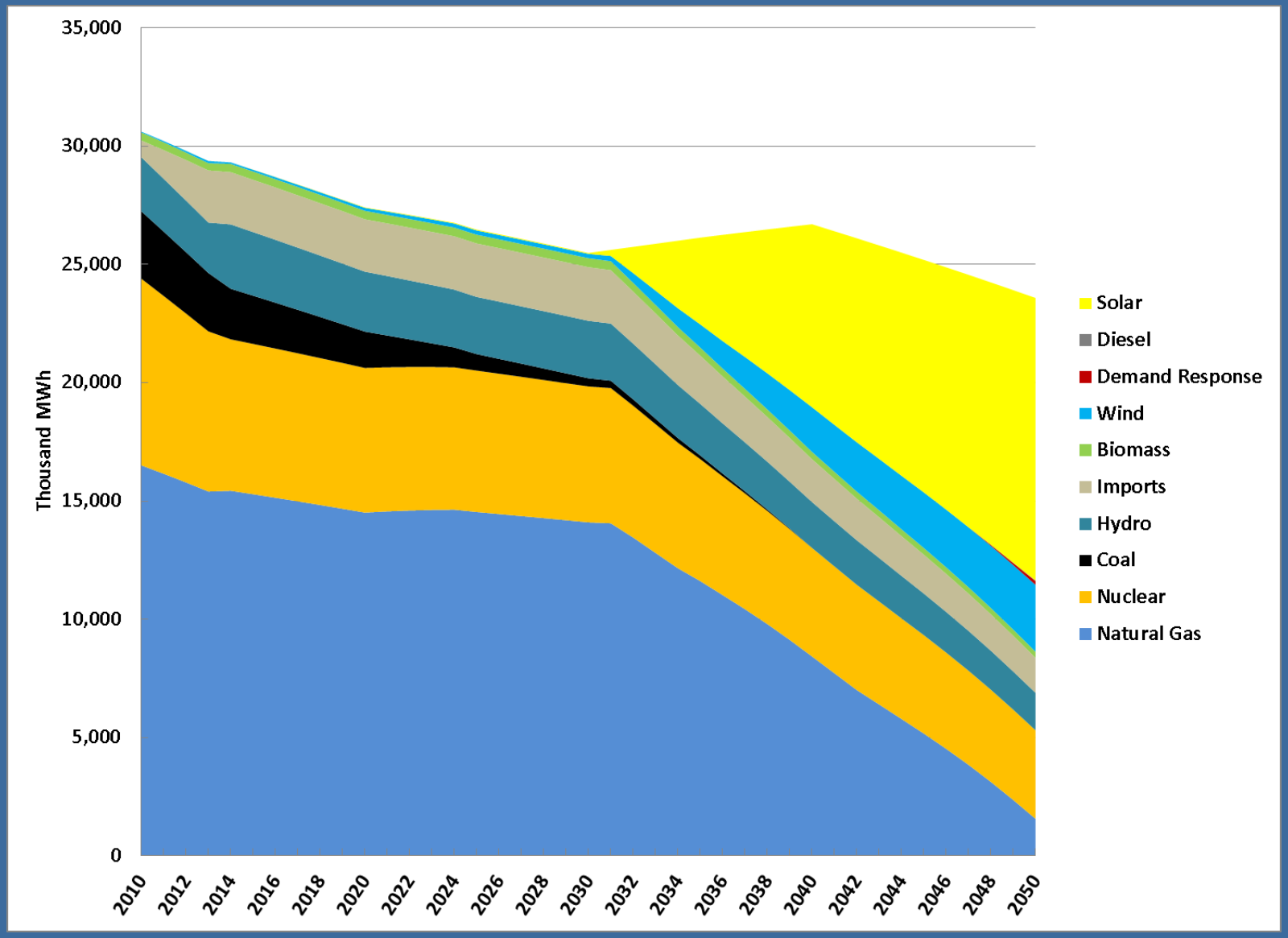
- Pilgrim retires and is replaced with natural gas. Remaining 3 nuclear plants continue to operate through 2050. Grid evolves towards zero-carbon with utility-scale solar the dominant resource.
- Mitigation building block penetration rates were set to achieve 80% reduction by 2050 and mid-range reductions by 2030
- Deep electric energy efficiency significantly reduces load

Mitigation Wedges – Scenario 1.1



Year	% Reduction
2030	40%
2040	65%
2050	80%

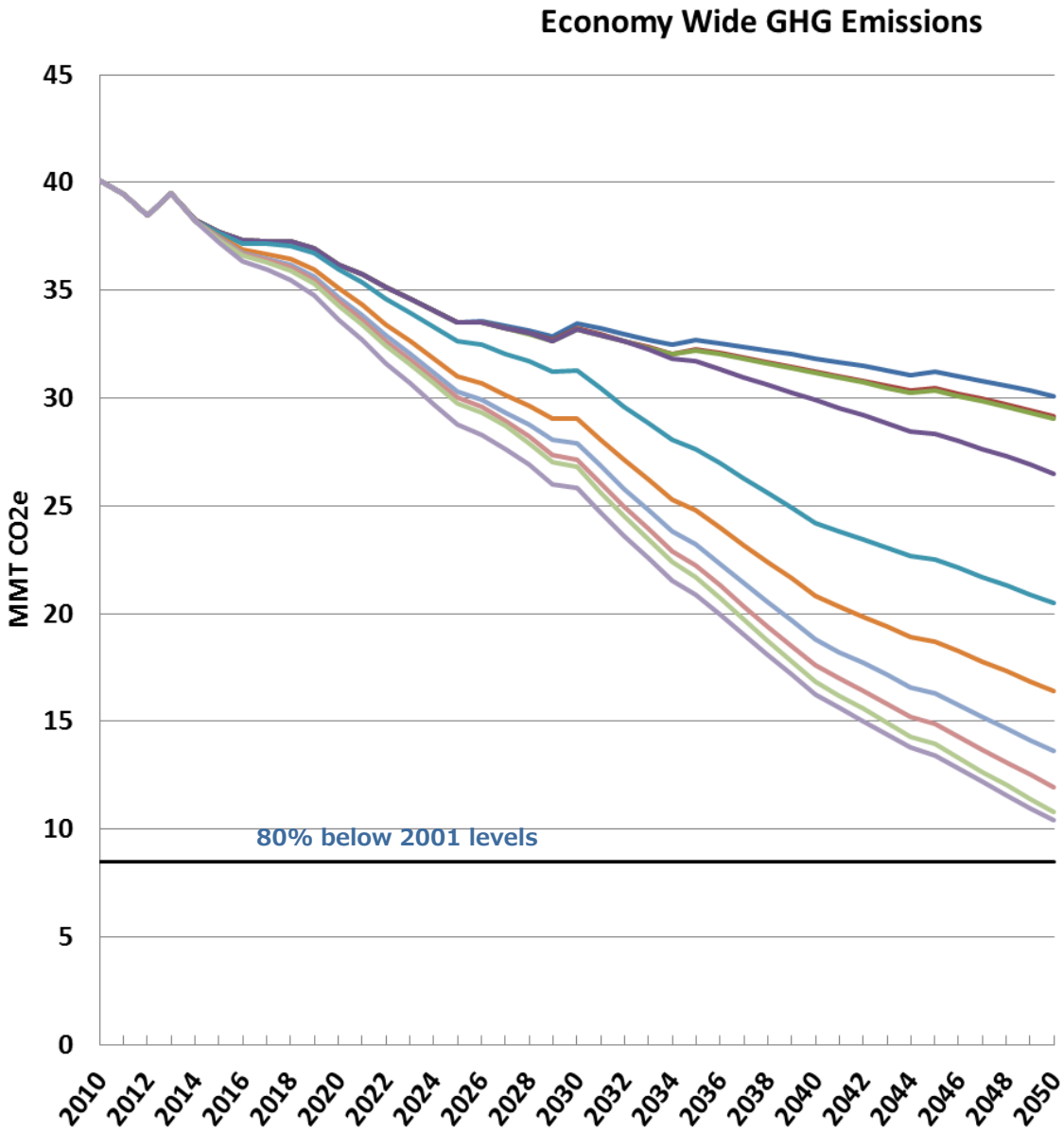
Electricity Generation – Scenario 1.1



Scenario 2

- All nuclear retires at the end of current license and is replaced with natural gas. Grid evolves towards zero-carbon with utility-scale solar the dominant resource.
- Mitigation building block penetration rates were the same as scenario 1.

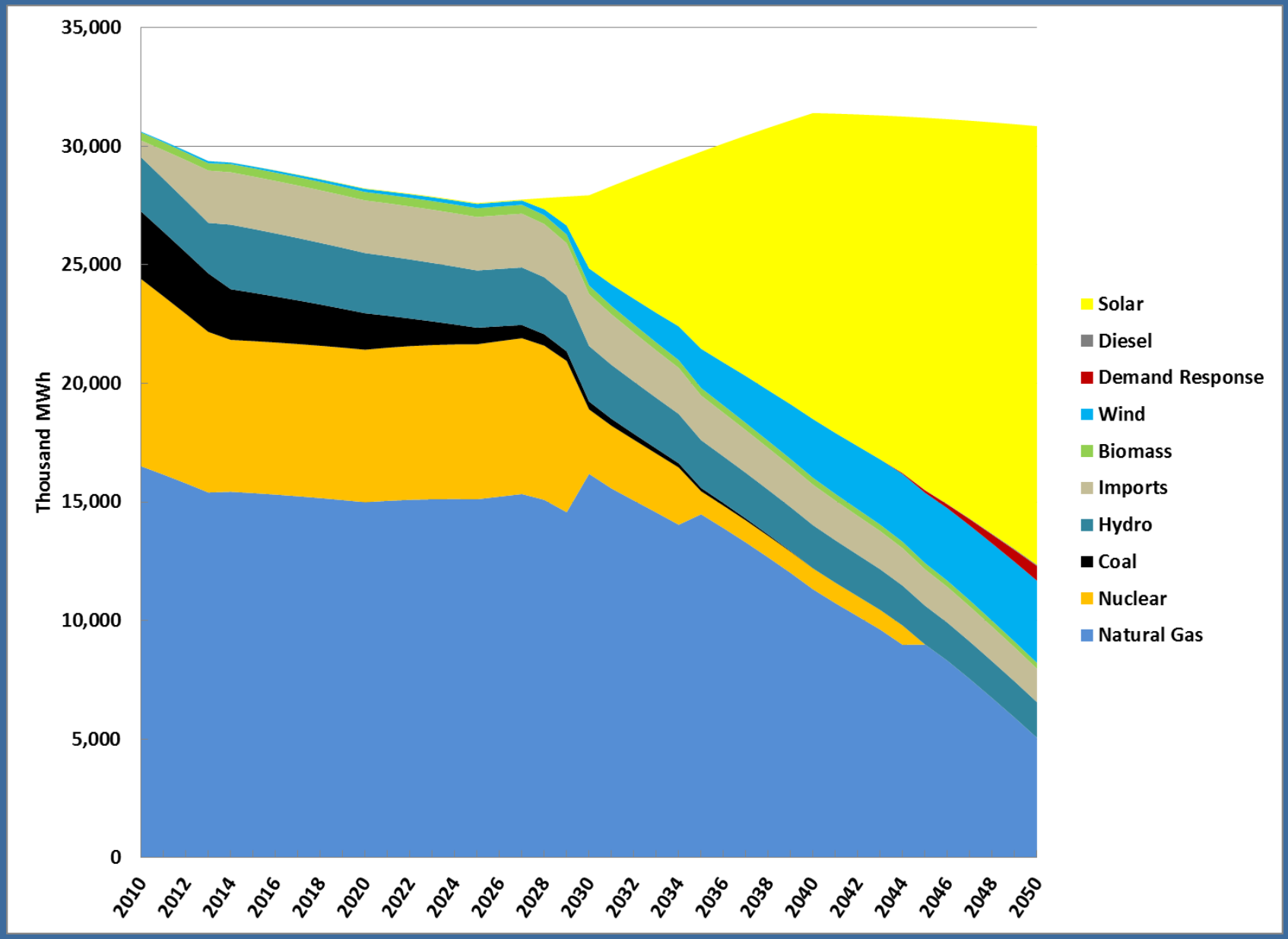
Mitigation Wedges – Scenario 2



Year	% Reduction
2030	38%
2040	61%
2050	75%

- Reference Case
- State EE Programs
- Behind the Meter Solar PV
- Utility-Scale Renewables
- Electric Passenger Cars / Trucks
- Residential Renewable Thermal
- Commercial Renewable Thermal
- Heavy-Duty Electrification
- Clean Long Haul & Rail
- VMT Reduction Measures

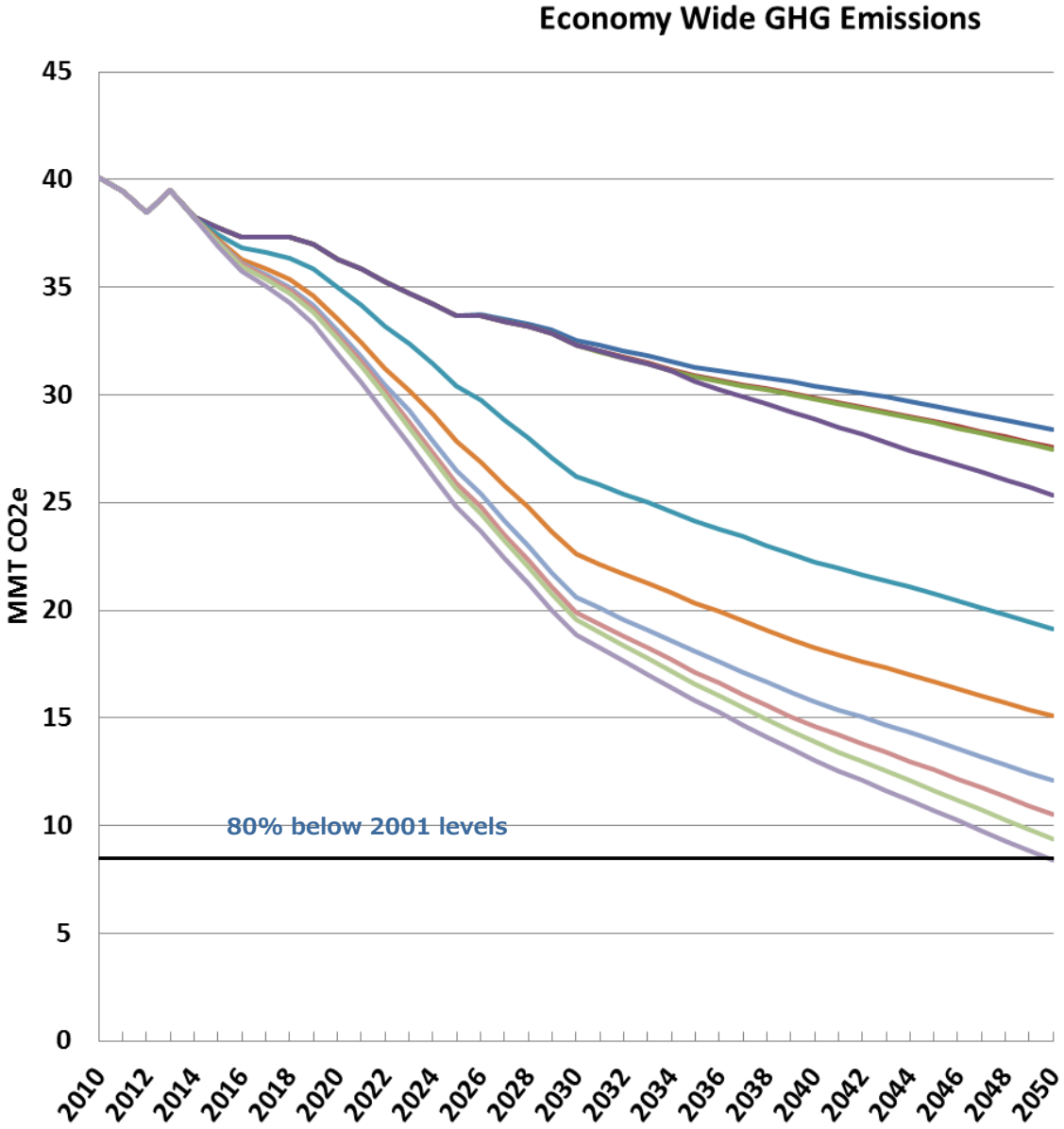
Electricity Generation – Scenario 2



Scenario 3

- All nuclear retires at the end of current license and is replaced with on-shore wind. Grid evolves towards zero-carbon with roughly even split between utility-scale solar and on-shore wind.
- Mitigation building block penetration rates were the same as scenario 1.

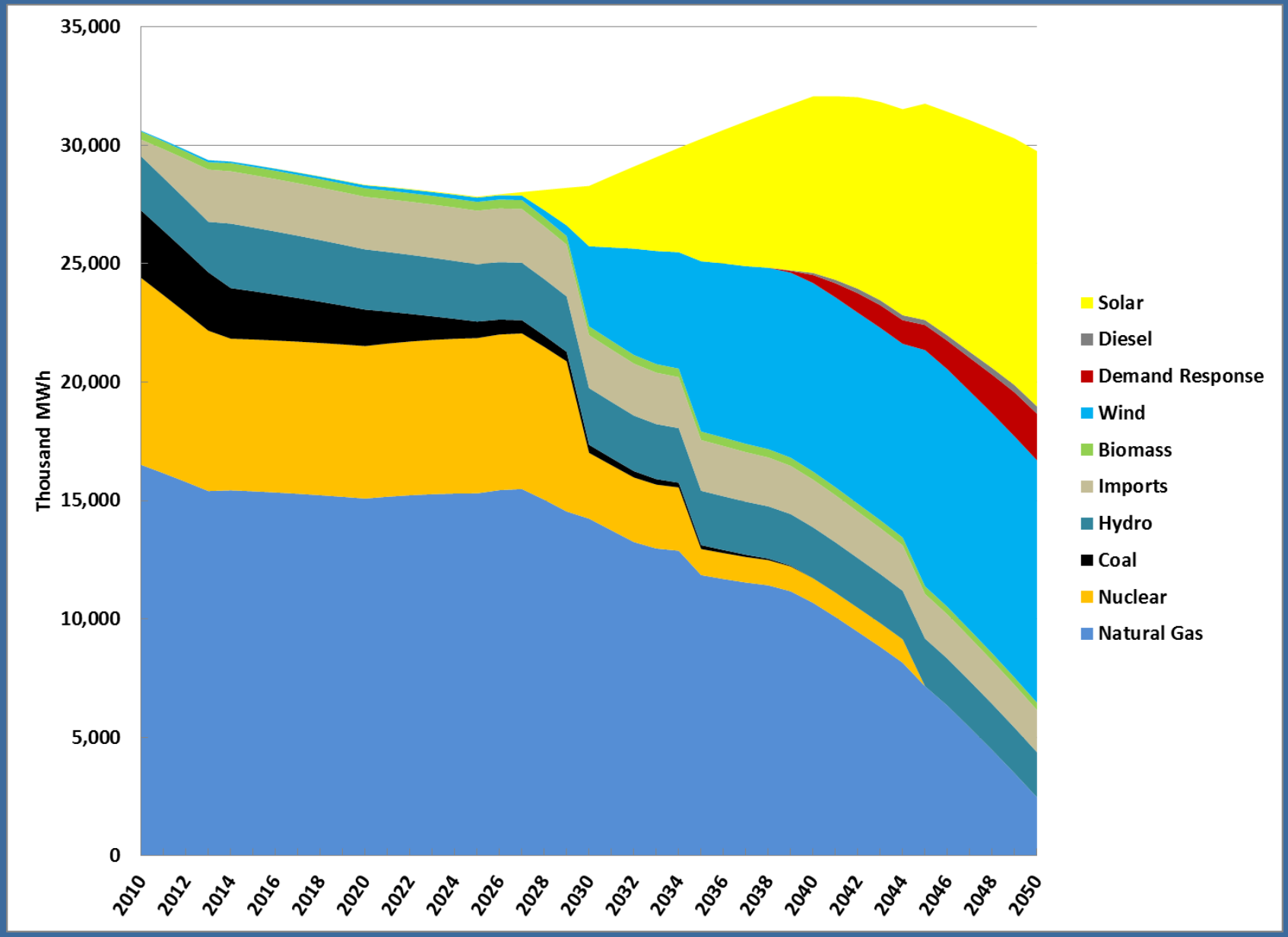
Mitigation Wedges – Scenario 3



Year	% Reduction
2030	40%
2040	63%
2050	80%

- Reference Case
- State EE Programs
- Behind the Meter Solar PV
- Utility-Scale Renewables
- Electric Passenger Cars / Trucks
- Residential Renewable Thermal
- Commercial Renewable Thermal
- Heavy-Duty Electrification
- Clean Long Haul & Rail
- VMT Reduction Measures

Electricity Generation – Scenario 3

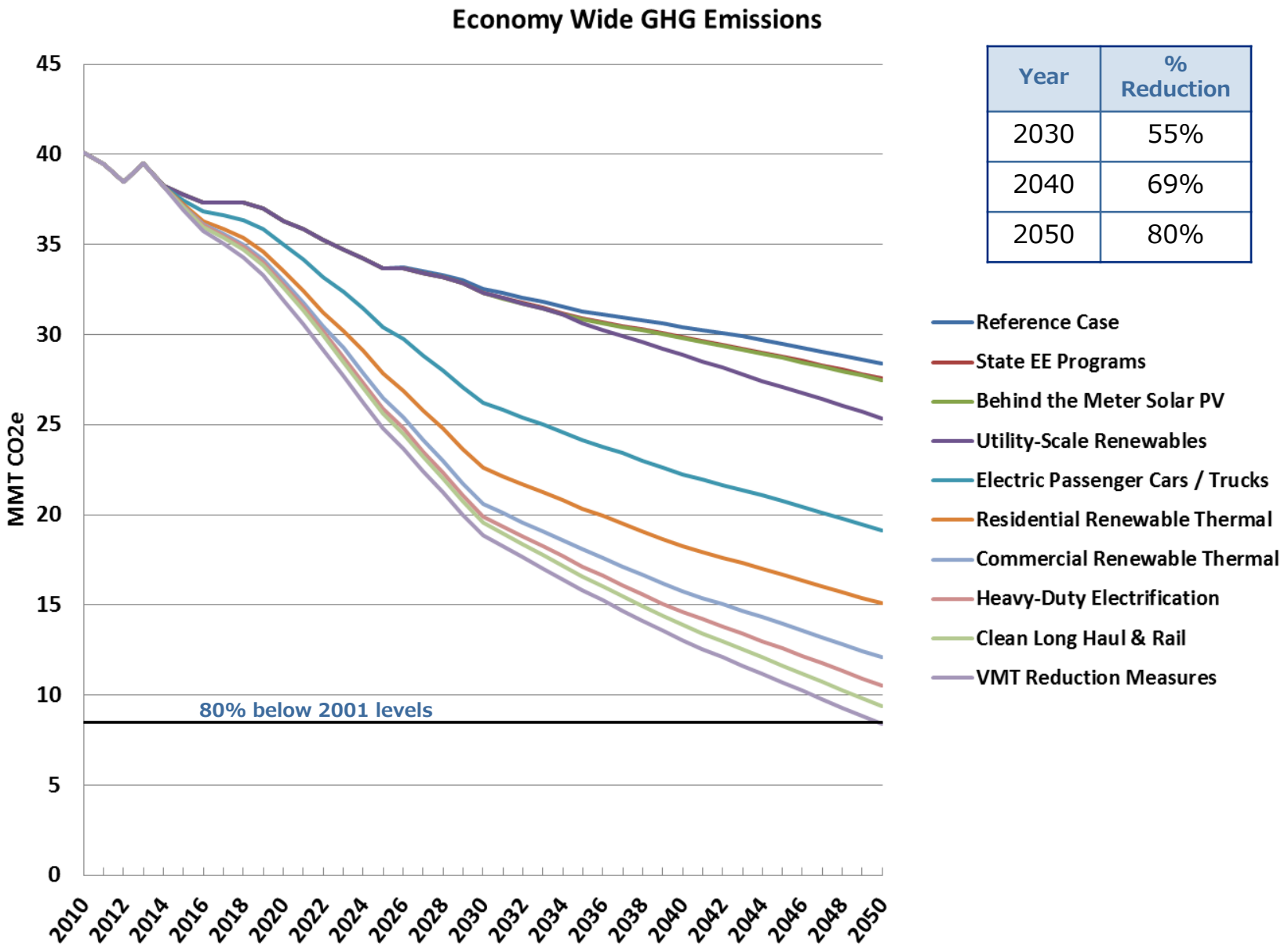


Scenario 4

- Pilgrim retires and is replaced with natural gas. Remaining three nuclear plants continue operating through 2050. Grid evolves towards zero-carbon with utility scale solar the dominant resource.

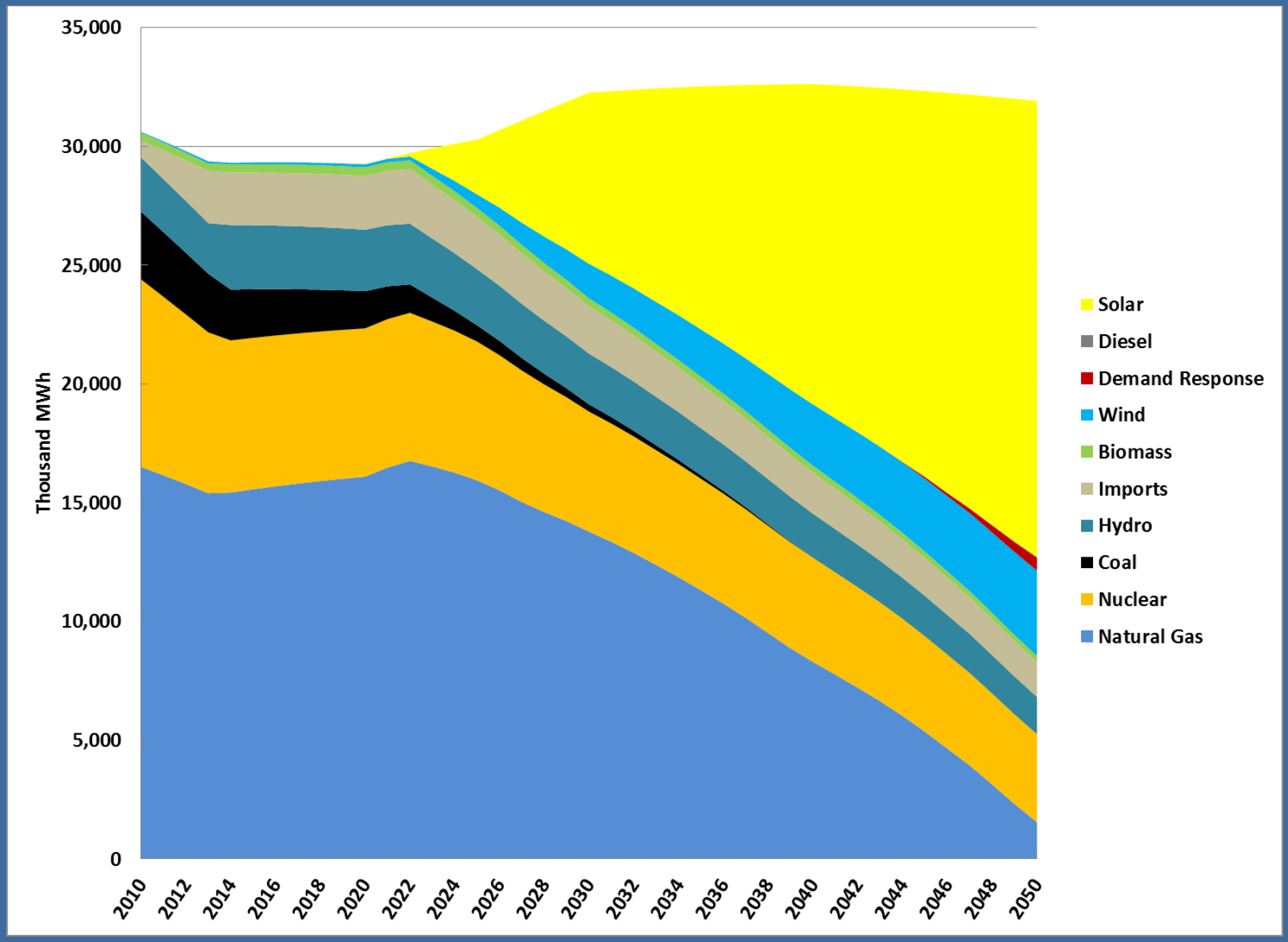
- Mitigation building block penetration rates in 2050 are the same as scenario 1 and adjusted in 2030 to achieve a 55% reduction relative to 2001.

Mitigation Wedges – Scenario 4



Year	% Reduction
2030	55%
2040	69%
2050	80%

Electricity Generation – Scenario 4



Mitigation Wedges – Scenario 4

Electric Vehicles

	2015	2030	2050
Moderate rate of Electrification for Passenger Cars and Passenger Trucks			
# of BEV + PHEV + HEV	2,902	559,443	2,184,529
% of Fleet	0.1%	25%	79%
Accelerated rate of Electrification for Passenger Cars and Passenger Trucks			
# of BEV + PHEV + HEV	2,902	1,532,388	2,184,529
% of Fleet	0.1%	67%	79%

Residential Ground and Air Source Heat Pumps

	2015	2030	2050
Moderate Penetration of Residential ASHP & GSHP			
# of Devices	2,934	289,920	847,293
% of Total Heating Devices	0.3%	30%	87%
Accelerated Penetration of Residential ASHP & GSHP			
# of Devices	2,934	579,840	703,485
% of Total Heating Devices	0.3%	60%	72%

- The accelerated penetration scenario was set up to achieve a 55% reduction by 2030.
- The tables are a way of comparing the difference from a technology deployment point of view between a 40% and 55% reduction by 2030.
- Early and drastic changes in technology choice would be needed for a 55% reduction.

Public Comments