



Connecticut Department of Energy and Environmental Protection



GC3 Meeting

December 21, 2016
3:00 — 5:00 p.m.



Connecticut Department of Energy and Environmental
Protection

Agenda

3:00

Welcome & Announcements

3:05

REMI inputs and assumptions for electric vehicle deployment

3:40

REMI transportation sector considerations & mitigation building blocks discussion

4:30

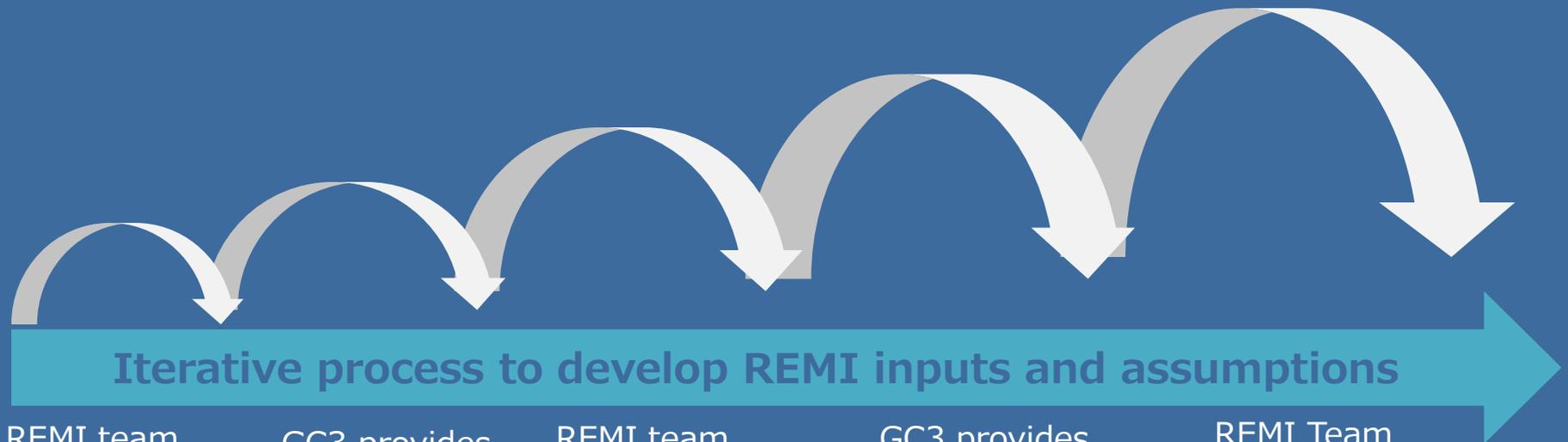
Public Comments

REMI inputs and assumptions for electric vehicle deployment



Connecticut Department of Energy and Environmental
Protection

REMI Team process and GC3 feedback loop



REMI team develops considerations, assumptions and inputs for review

GC3 provides feedback and guidance (data/sources if possible)

REMI team utilizes GC3 feedback to develop/research REMI inputs and assumptions

GC3 provides feedback and assumption on preliminary inputs and assumptions

REMI Team adjusts inputs and assumptions based on GC3 guidance for REMI modeling

LEAP Outputs Used in the REMI Analysis

- Changes in vehicle purchases relative to the reference case
- Changes in transportation fuel consumption relative to the reference case
- Changes in criteria pollutant emissions relative to the reference case
 - Used to monetize the health benefits of improved air quality

Considerations for REMI Analysis

1. Should current EV incentive programs be maintained or altered? How long? And where should the incentive funding come from (tax credits, rebates, vouchers)?
2. What is the average costs for residential, business, parking garages, and on-street charging station applications?
3. Should current charging station incentives be maintained or altered? If so, for how long? And where should the incentive funding come from?

Analysis Assumptions

Consideration	Value Description	Description of Rationale
<p>Electric Vehicle Purchase Incentive</p>	<p>The current Connecticut Hydrogen and Electric Automobile Purchase Rebate (CHEAPR) is maintained through 2021. The current rebate is based on vehicle battery capacity, and range from \$750 to \$5,000 per vehicle.</p> <p>The program has been averaging 600 vehicles and \$1.5 million per year.</p> <p>The Federal tax credit of \$2,500 to \$7,500, depending on the size of the battery in the car is utilized. The incentive begins phasing out after an automaker sells 200,000 vehicles that are eligible for the credit.</p>	<p>To ease the price gap between electric and internal-combustion models the current rebate is extended an additional 5 years. The extension of the program will help increase the overall adoption rate of electric vehicles to a level that will help stabilize the EV market.</p>

Analysis Assumptions

Consideration	Value Description	Description of Rationale
<p>Cost of charging stations and infrastructure</p>	<p>Hardware costs decrease at a rate of 2% through 2032 and 1% onward.</p> <p>Maintenance 3% of hardware annually.</p> <p>Level 1 Station Hardware \$460 Installation \$825</p> <p>Level 2 residential Hardware \$650 Installation \$1,255</p> <p>Level 2 Public Hardware \$3,480 Installation \$5,430</p> <p>Level 3 DC Hardware \$37,500 Installation \$44,100</p>	<p>The decrease in the costs of the hardware is based on declining prices that come with rapid adoption. The costs of installation remains constant as we are assuming new installations and not replacing existing hardware.</p> <p>EVSE and installation costs are calculated by averaging figures obtained from five separate reports. The costs of EVSE hardware and installation vary greatly, thus a high and low cost for each type is utilized.</p> <p>Maintenance costs are based on data reported by C2ES, Clean Cities, and NASEO.</p>

Analysis Assumptions

Consideration	Value Description	Description of Rationale
Charging station infrastructure deployment rate	(same as previous slide)	<p>The deployment rate is based on the ratio of different types of charging stations required to support the number of EVs in the reduction scenarios. The ratios are based on findings from a literature review, current levels of EVSE deployment, and expert industry opinion.</p> <p><u>EVSE per # of EVs:</u> Level 1 Station- 1:500 Level 2 Residential- 1:3 Level 2 Public- 1:8 Level 3 DC- 1:1000</p>

Analysis Assumptions

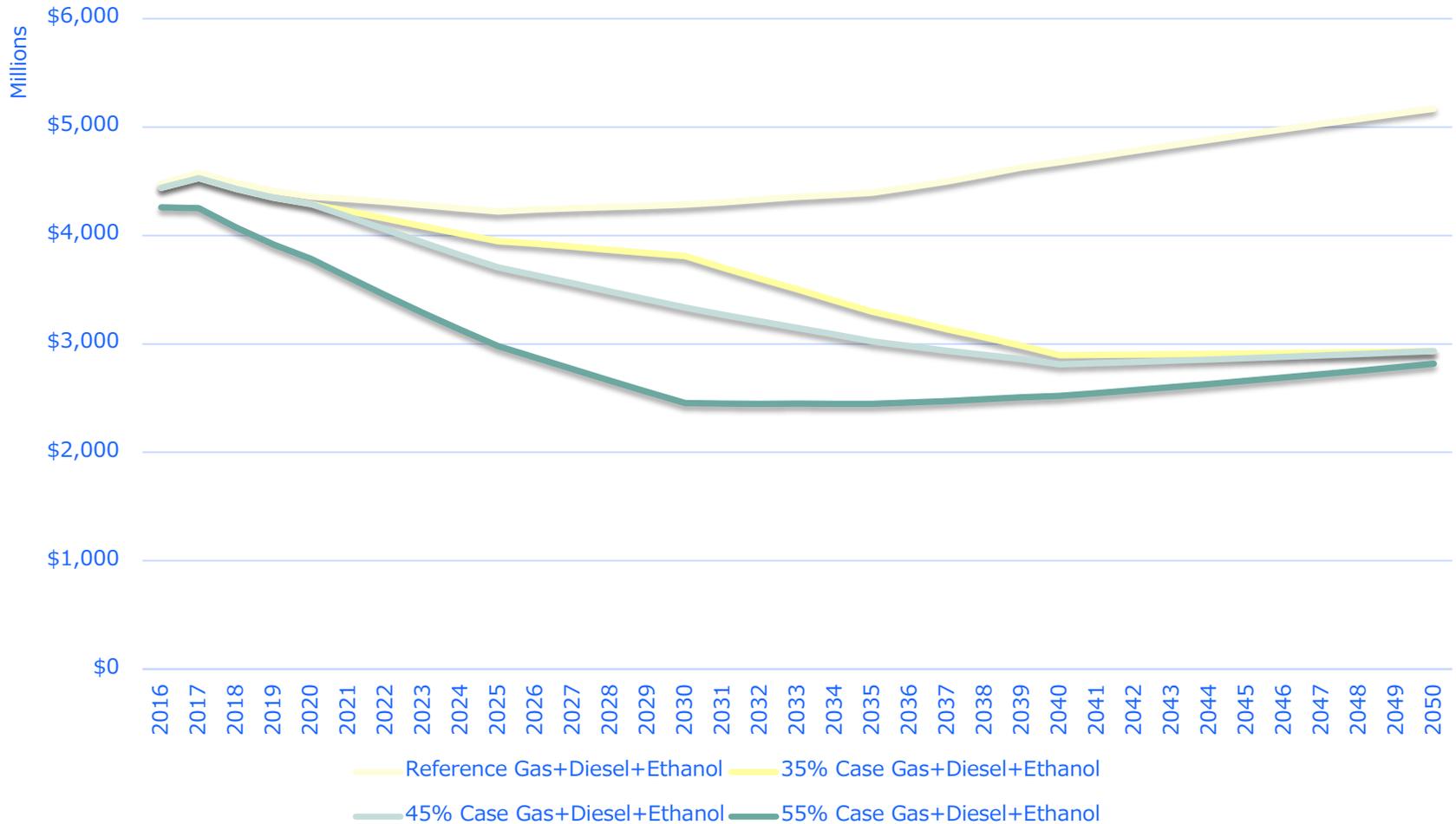
Consideration	Value Description	Description of Rationale
<p>Hydrogen Fuel Cell Electric Vehicles (FCEV) and supporting infrastructure.</p>	<p><u>Vehicle Count</u> 945 FCEVs in Connecticut beginning in 2028. The annual growth rate of Battery Electric Vehicles (BEVs) was applied to FCEVs for this analysis.</p> <p><u>Fueling Stations</u> 1 fueling station for every 160 FCEVs. The cost per fueling station is \$200k.</p>	<p>The vehicle counts are based on projected deployment numbers in CA for 2018, and have been scaled to reflect the difference in population size. The vehicle count begins in 2028 to account for a 10 year lag in deployment of this technology in CT.</p> <p>The ratio of fueling stations to vehicles is based on current and projected deployment rates in CA. The cost of the fueling infrastructure was calculated based on the number of publically funded fueling stations in CA and the level of funding that was required to support their deployment.</p>

Analysis Assumptions

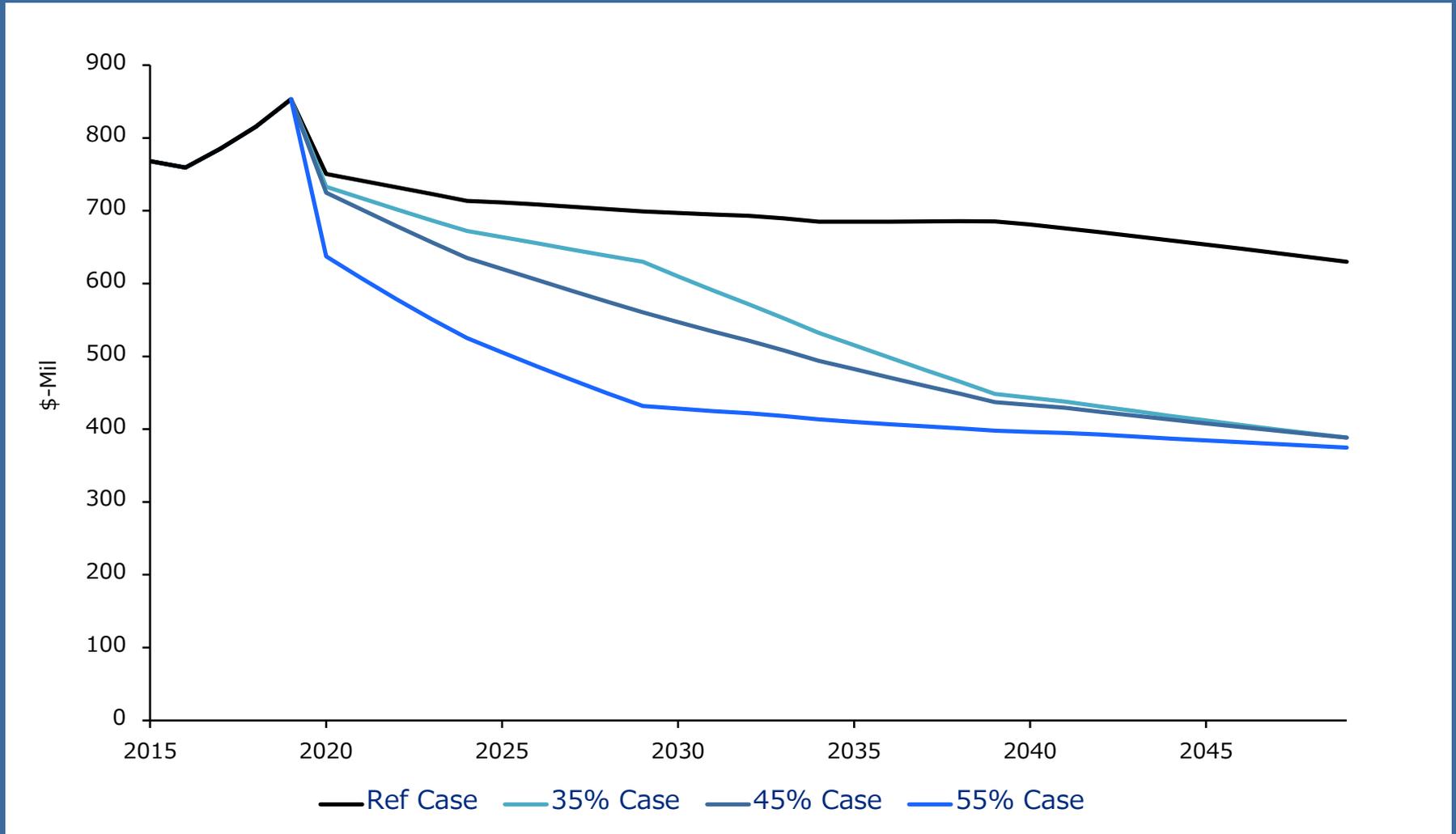
Consideration	Value Description	Description of Rationale
<p>Impact of declining gasoline/diesel fuel consumption in CT as a result of greater EV deployment.</p>	<p>Annual transportation fuel taxes revenues in the reference case fall 18% from 2016 to 2050.</p> <p>From 2016 to 2050, annual fuel tax revenues are:</p> <ul style="list-style-type: none"> • down 49% for the 35% scenario; • down 49% in the 45% scenario; • down 51% in the 55% scenario. <p>From the reference case the cumulative fuel tax revenues are:</p> <ul style="list-style-type: none"> • down 18% for the 35% scenario; • down 21% in the 45% scenario; • down 30% in the 55% scenario. 	<p>As standard passenger vehicles & light duty truck markets transition to electric, a decline in the use of petroleum based fuels decreases. This in turn leads to a fall in fuel tax revenues. No offset is assumed.</p> <p>Applied CT tax rates (from OPM) to gallons and unit prices to generate annual tax revenues on gasoline, diesel, and ethanol fuels.</p> <p>With guidance from DOT, a 3.5% annual average growth rate was assumed to maintain transportation infrastructure and will be used to estimate the revenue shortfall.</p>

Annual Fuel Sales

Fuel Sales



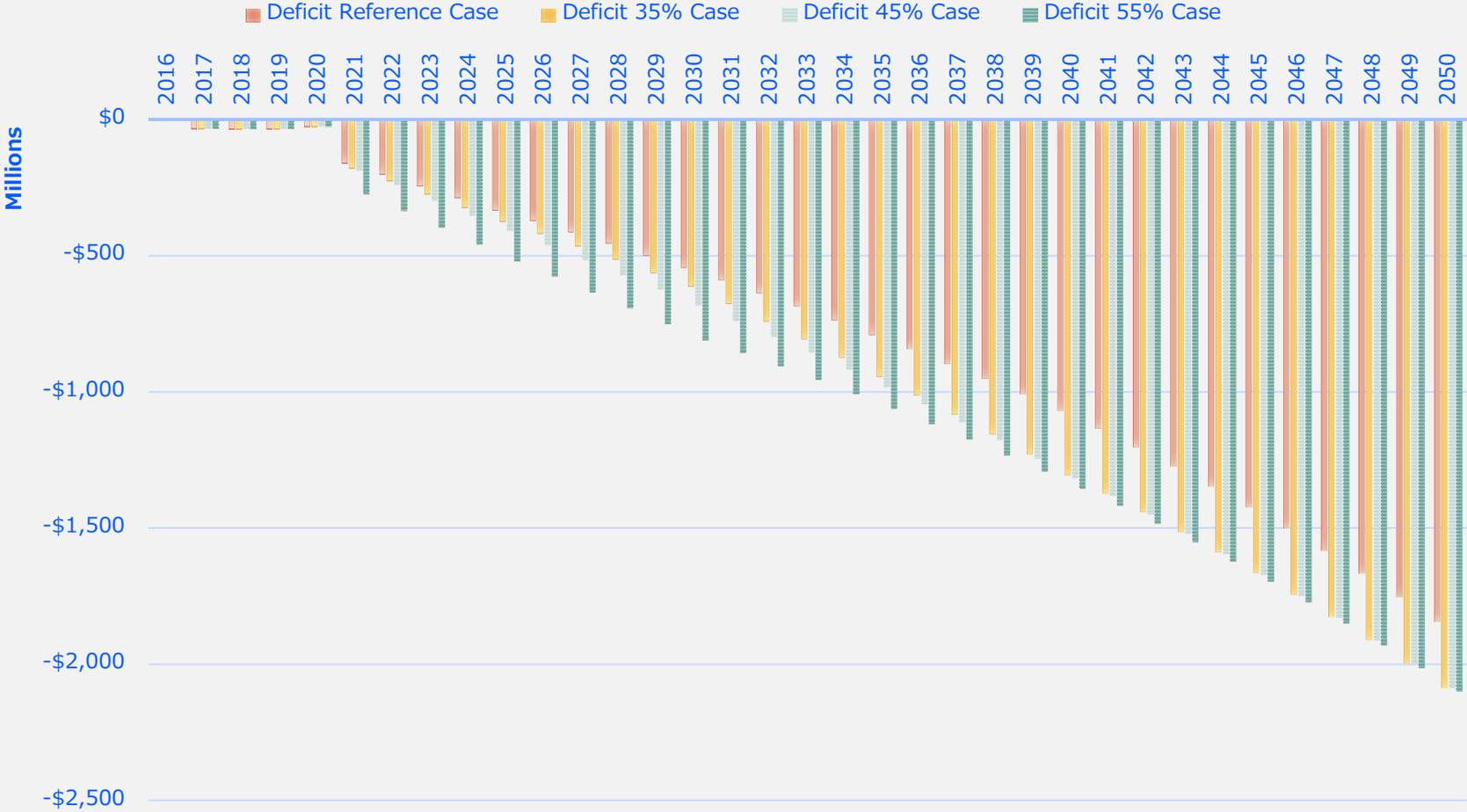
Annual Fuel Tax Revenues



Annual gasoline/diesel tax revenue declines as EV penetration rate increases

Tax Revenue Deficits

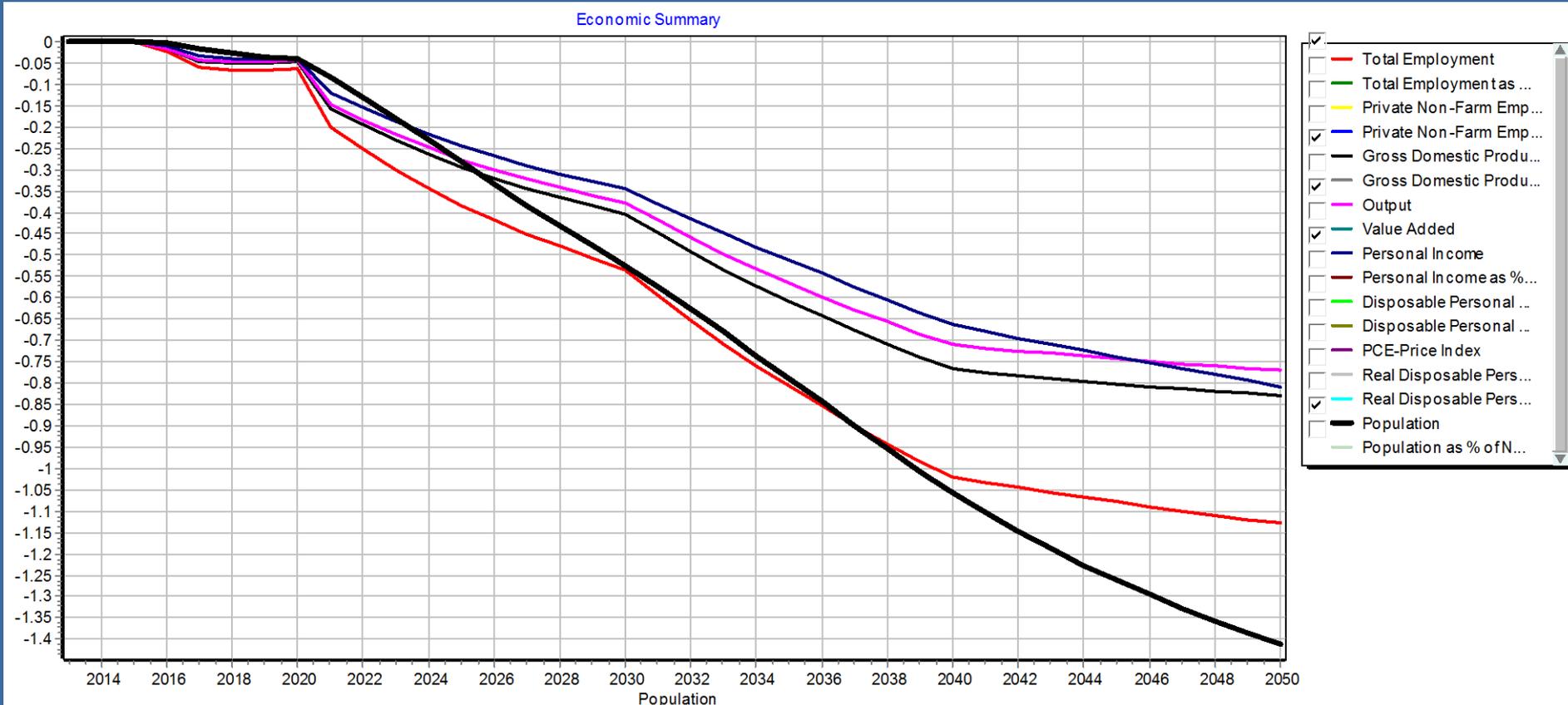
GAS TAX REVENUE DEFICITS



REMI Inputs

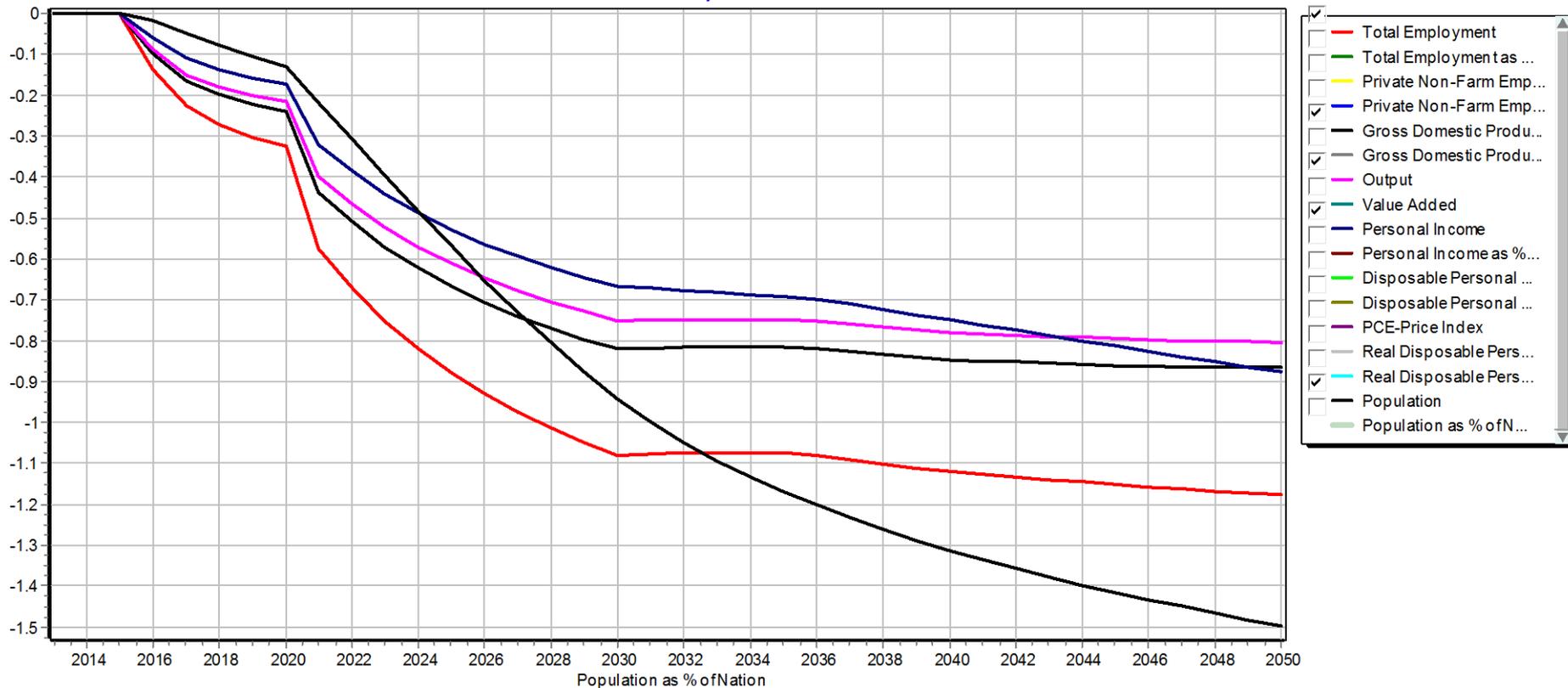
- Included:
 - Fuel sales trajectory.
 - Fuel tax revenue decline
 - EV state incentive (CHEAPR)
- Not Included
 - Increased electricity demand
 - Charging station capital and install expenditure
 - Gas station remediation expenditure
 - Let's Go CT considerations
 - Hydrogen vehicles or potential tax revenue
 - No health benefits
 - No climate change adaptation strategies

REMI Results 35% Case



REMI Results 55% Case

Economic Summary

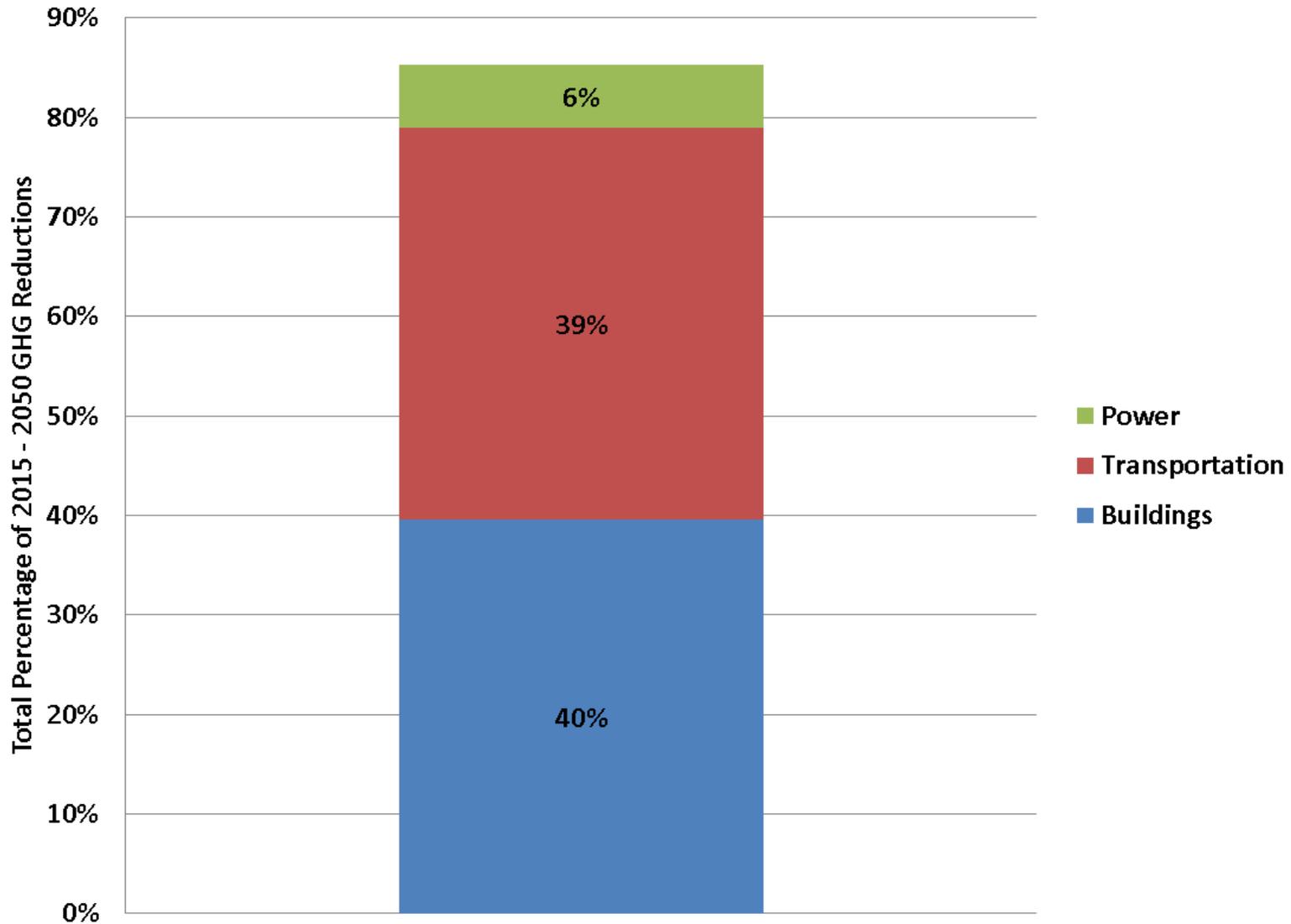


REMI transportation sector considerations & mitigation building blocks discussion

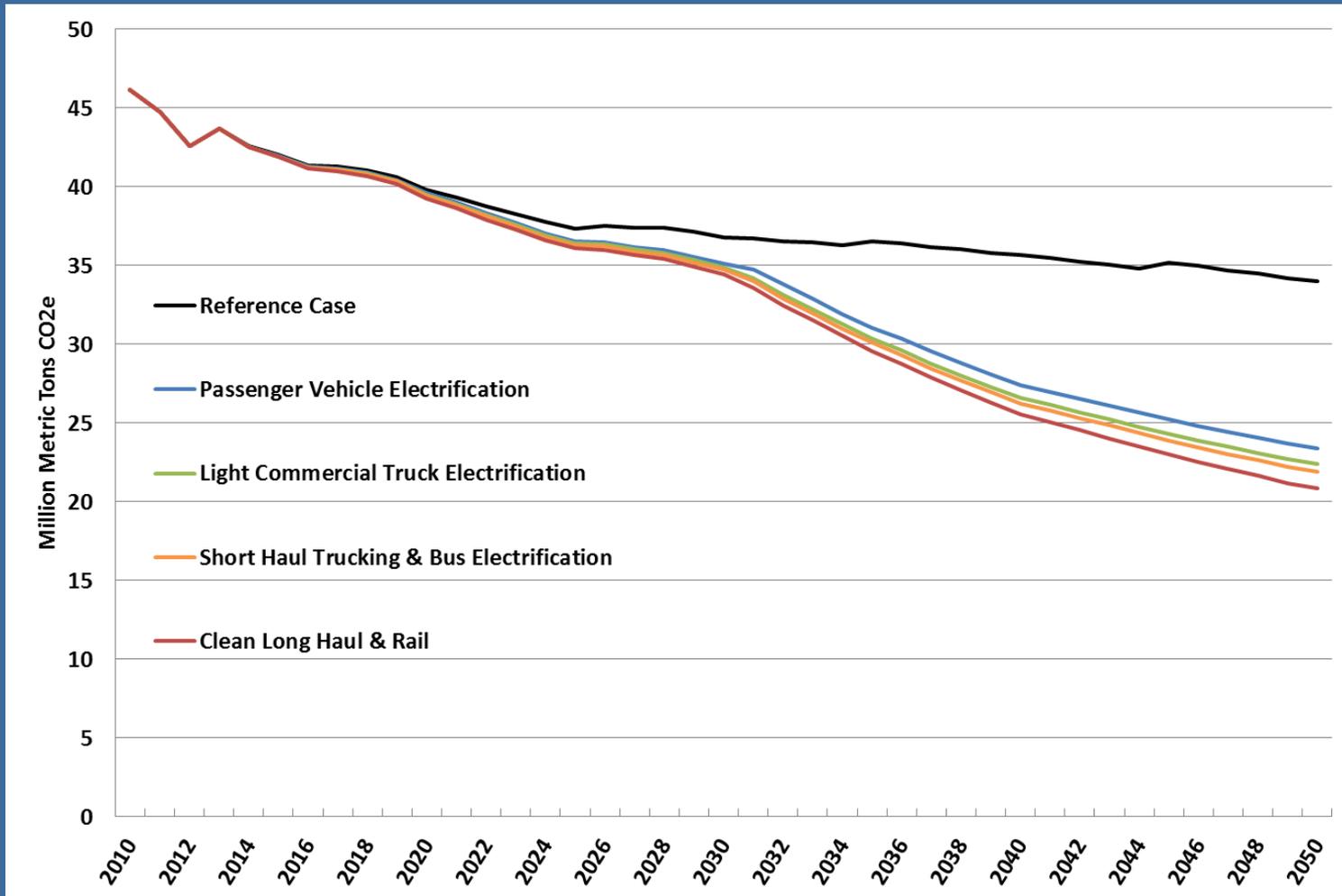


Connecticut Department of Energy and Environmental
Protection

Mitigation Building Blocks



Transportation Sector Mitigation Wedges



- Transportation wedges represent cumulative reductions
- VMT reductions from Let's Go CT are incorporated into the reference case.
- Passenger vehicle electrification represents 80% of transportation GHG reductions by 2050

Considerations for REMI Analysis

Transportation Demand Measures

1. What level of VMT reductions should be assumed from CT's bus system expansion? What are the costs beyond business as usual for this expansion?
2. What level of VMT reductions should be assumed from improvements to bike and pedestrian infrastructure? What are the costs beyond business as usual (bike and infrastructure costs)? Is the expansion and improvement of bicycle and pedestrian infrastructure expected to have a measurable impact on the transportation system (behavior modification), or should it be viewed mainly as increasing accessibility to more CT residents?
3. What level of VMT reductions should be assumed from the expansion of passenger rail service within Connecticut? What are the costs beyond business as usual for this expansion?
4. What level of VMT reductions should be assumed from the completion of transit oriented development projects in Connecticut? What are the costs of TOD projects?

Considerations for REMI Analysis

Technology Measures

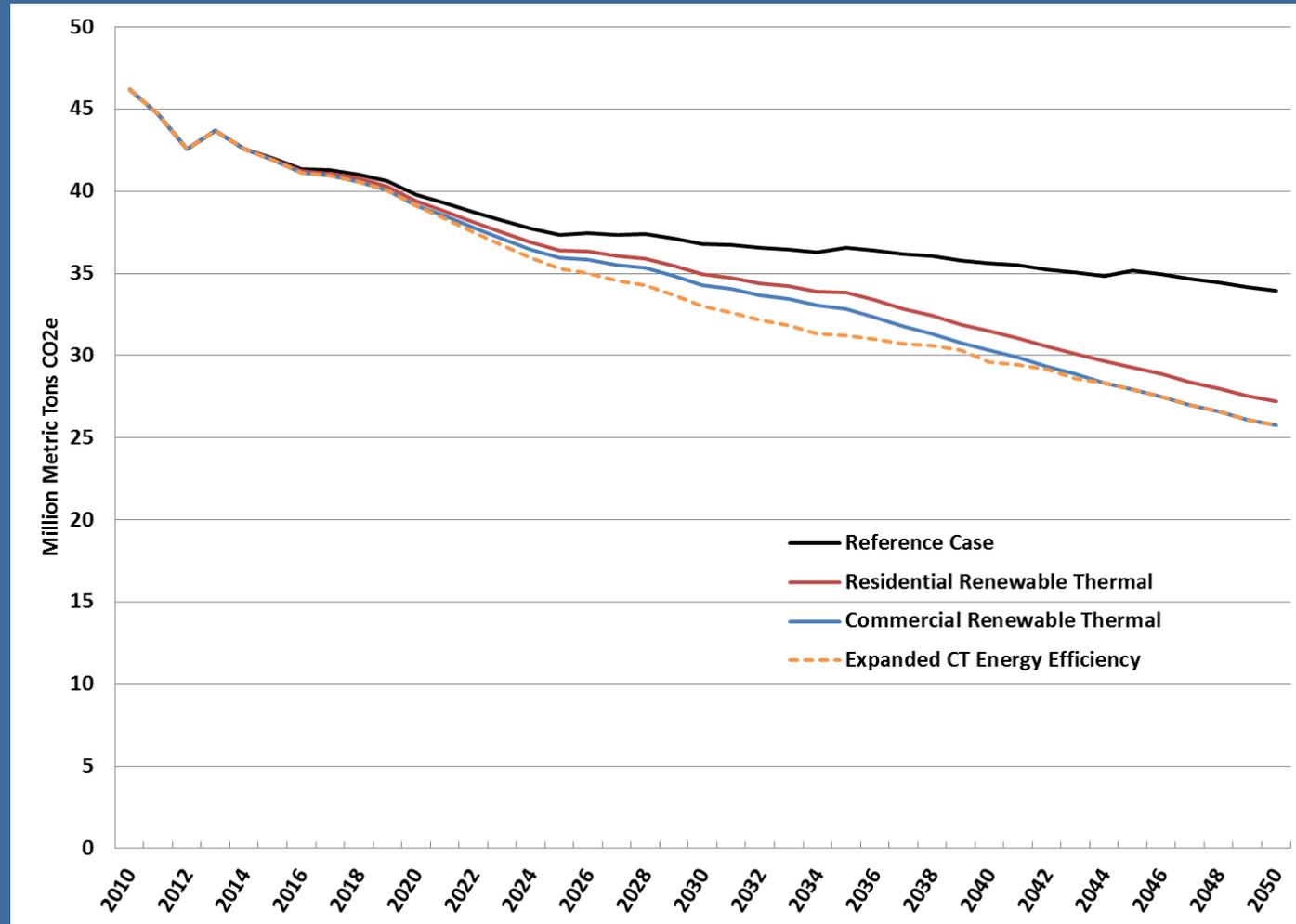
5. What rate of conversion should be assumed for electrification of CT's bus fleet? What are the direct costs of electric buses? What are the costs of the associated infrastructure?
6. What percentage of the rail system should be assumed to be electrified, and what is the timeframe? At what pace will diesel powered locomotives be replaced with electric locomotives? What are the direct costs of rail electrification?
7. What percentage of medium and heavy duty vehicles should be assumed to be electrified? What percentage alternative fuels (propane, CNG, biodiesel, hydrogen)? What are the associated costs of the associated infrastructure?

Considerations for REMI Analysis

Mode Shifting of Freight Movement

8. What level of VMT reductions should be assumed by diverting the movement of freight from tractor trailer to rail?

Building Sector Mitigation Wedges



- Building wedges represent cumulative reductions
- Residential renewable thermal represents 82% of building GHG reductions by 2050
- Energy efficiency investments extended to 2035
- Efficiency measures assumed to have 15 year life

Public Comments



Connecticut Department of Energy and Environmental
Protection