Connecticut Department of Energy and Environmental Protection

GC3 Meeting

November 14, 2016
3:00 — 5:00 p.m.

Connecticut Department of Energy and Environmental Protection

Agenda

3:00 — Welcome & Announcements
DEEP Commissioner Klee

3:05 — Mitigation building blocks discussion
DEEP Commissioner Klee

3:30 — Intro to REMI, Inputs and assumptions for analysis of electric vehicle deployment
Stanley McMillen, Consultant
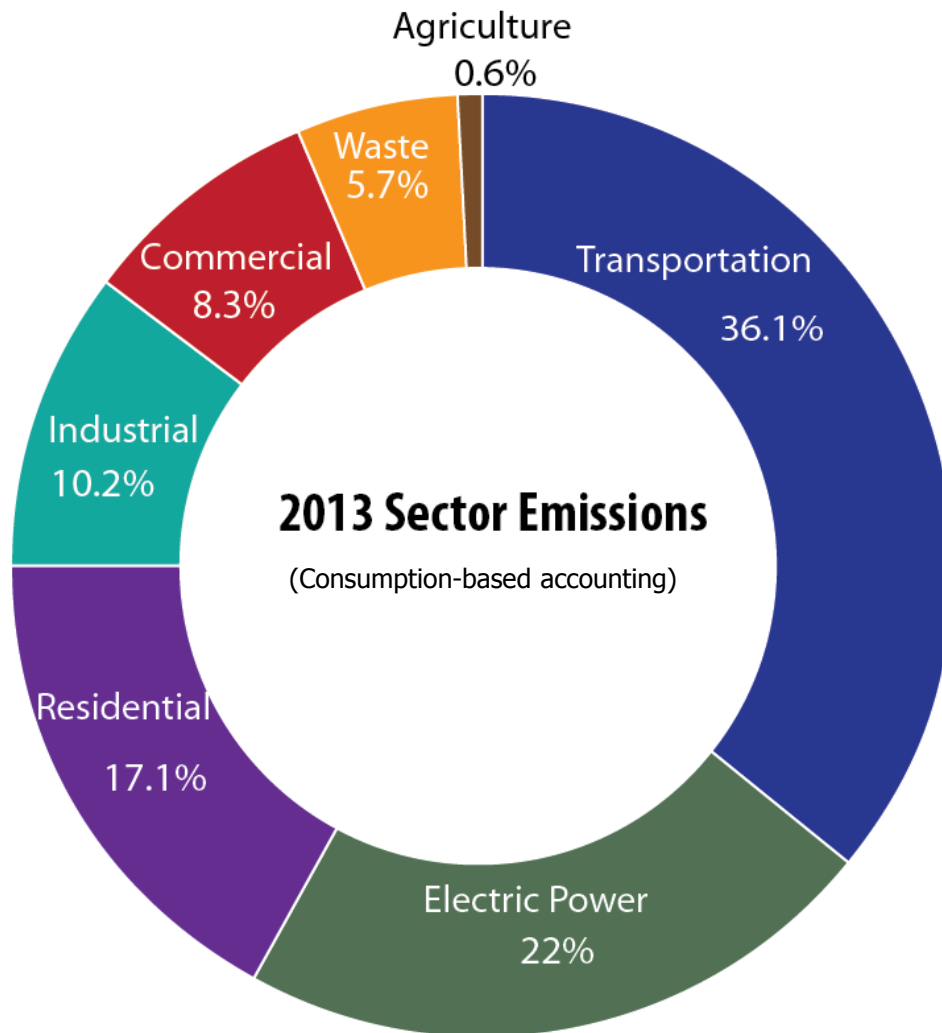
4:00 — Public Comments

Key Mitigation Building Blocks

Paul Miller, NESCAUM

Connecticut Department of Energy and Environmental Protection

Primary GHG Mitigation Wedges

2013 Sector Emissions
(Consumption-based accounting)

- Transportation: 36.1%
- Electric Power: 22%
- Residential: 17.1%
- Industrial: 10.2%
- Commercial: 8.3%
- Waste: 5.7%
- Agriculture: 0.6%

- Transportation 36% of GHG emissions

- Comm./Ind./Res. ("Buildings") 36% of GHG emissions

- Electric Power 22% of GHG emissions

Potential Mitigation Wedges

Economy Wide GHG Emissions
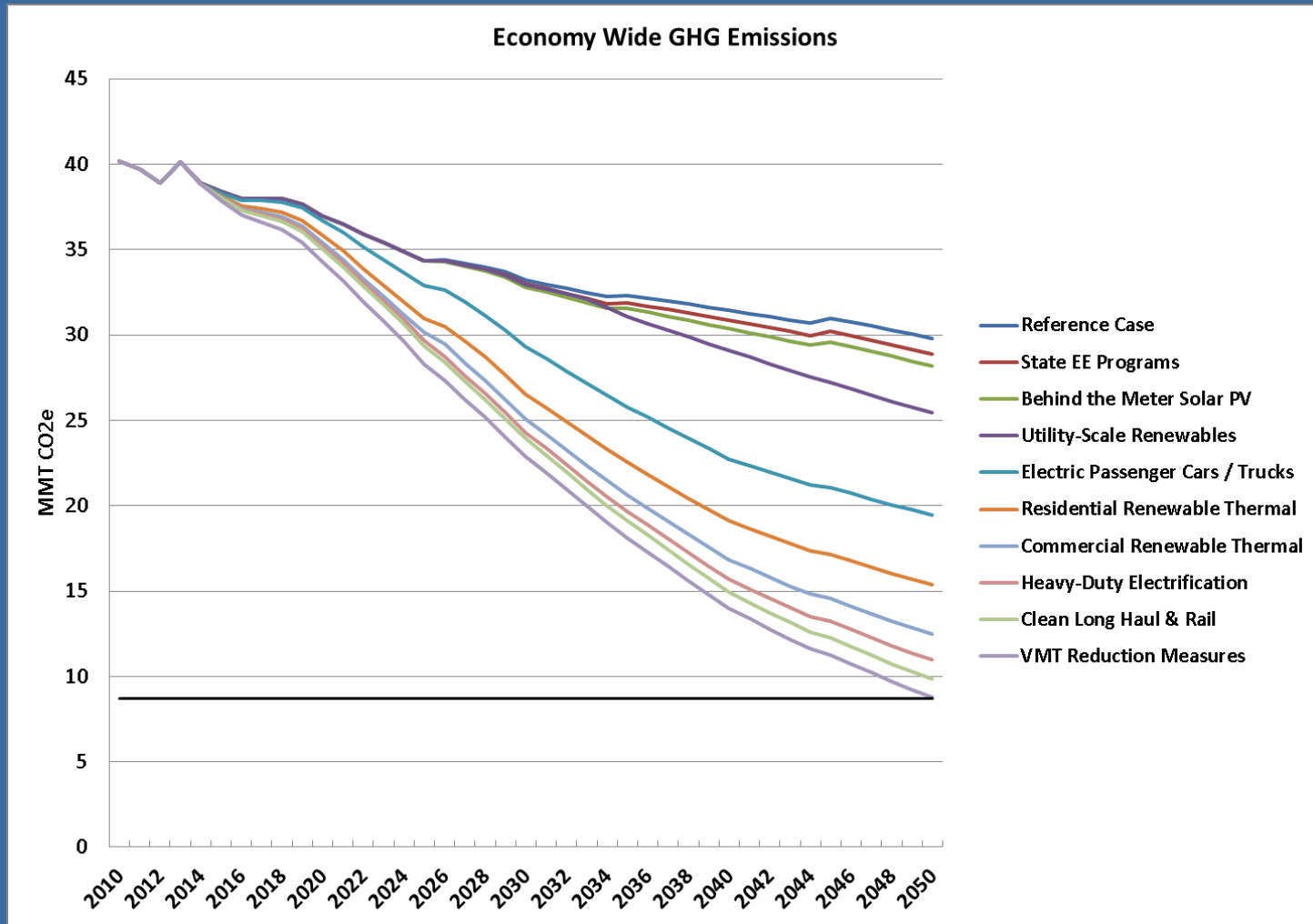
- Results presented at 7/26 and 9/8 GC3 Meetings
- 45% GHG reduction by 2030
- 80% GHG reduction by 2050

Core Building Blocks

- ## Transportation
  - Electrification of passenger cars and passenger trucks
  - Alternative fuels and electrification of heavy-duty vehicles in applicable modes

- ## Buildings
  - Expanded energy efficiency
  - Transition to renewable thermal heating / cooling

- ## Electric Power
  - Transition to a grid powered primarily by zero carbon resources

Total Reduction Potential for Core Building Blocks
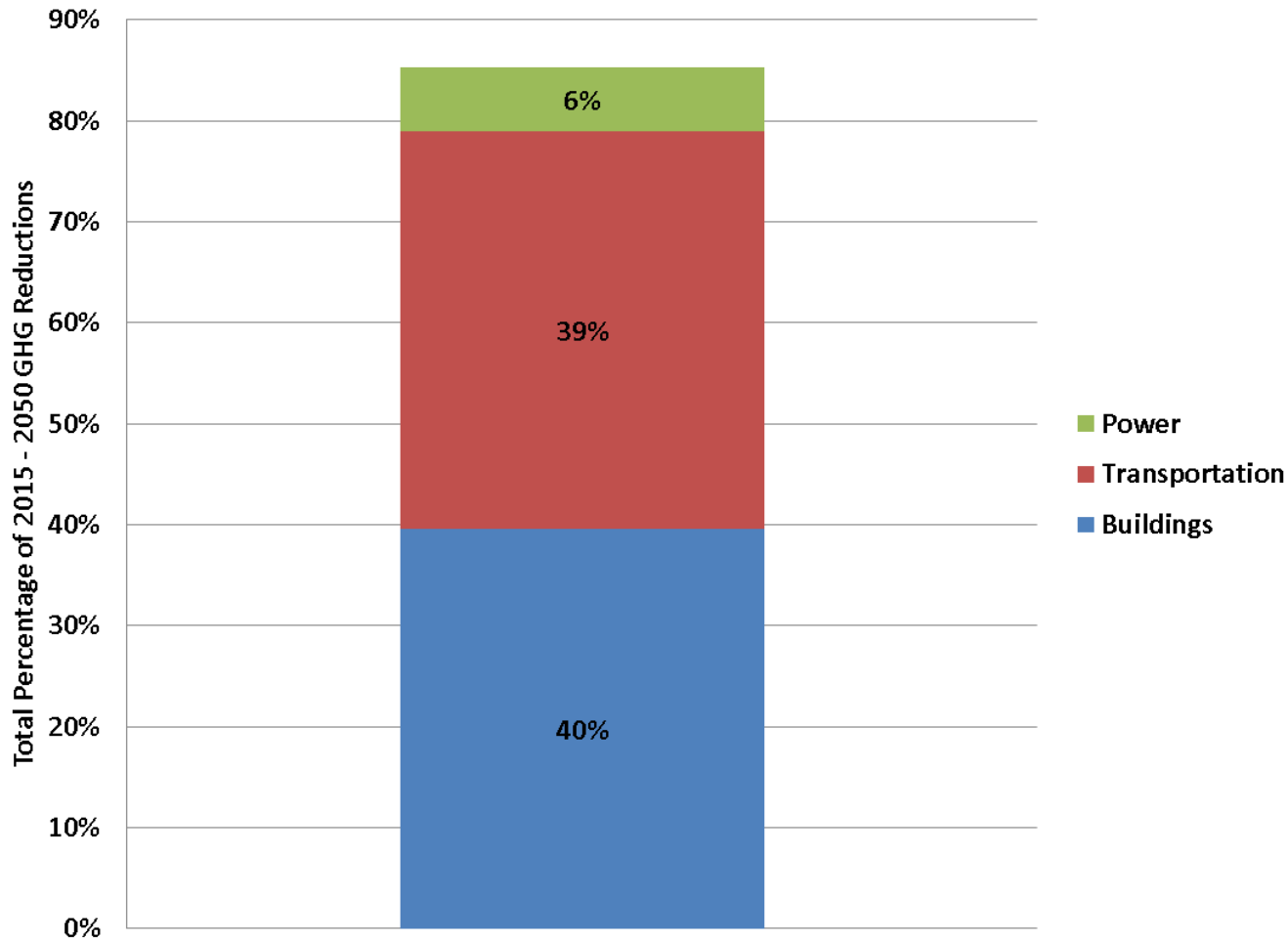
- Key blocks account for 85% of reductions needed to reach 2050 target

- Clean grid enables large reduction potential in transportation and buildings

REMI

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REMI

- ➢ What is it?

- ➢ How does it work?

- ➢ Results

- ➢ Limitations

REMI

- REMI from Regional Economic Models, Inc. of Amherst, MA was created by George Treyz and colleagues at UMASS in the 1980s.

- REMI is a mathematical model of a regional economy (not a statistical model).

- REMI models the effects of changes in the regional economy (usually a collection of counties). These can be changes in employment, taxes, productivity, life expectancy, labor force participation, among many other 'shocks'.

REMI

- The changes are described as the direct impacts of a company expanding, a military base closing, a new or revised tax policy or a change in labor participation, among many other possibilities.

- The results or impacts of the changes ripple through the regional economy and effect imports to and exports from the region to other states and countries.

- This causes trade among the 3000+ U.S. counties and other countries to be rebalanced.
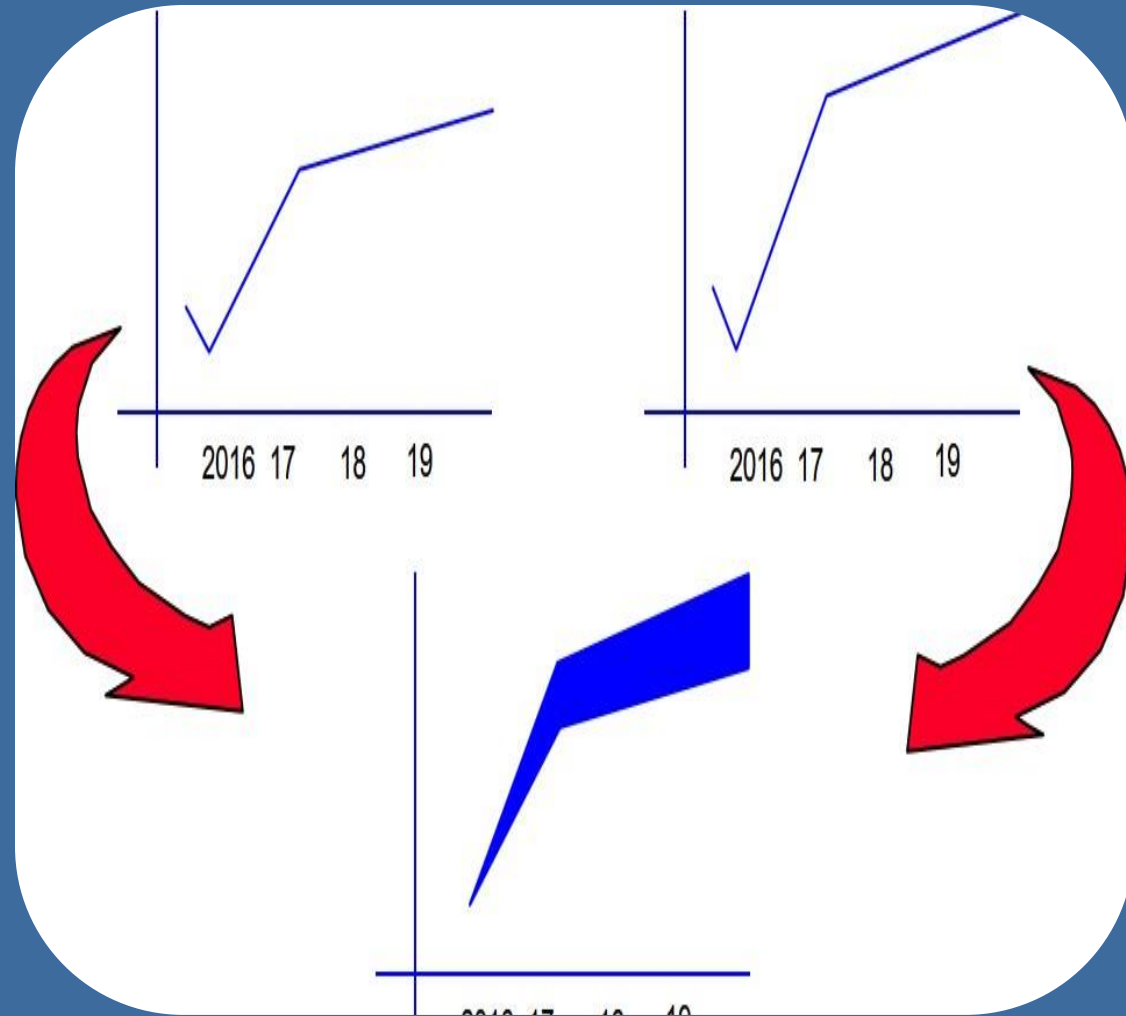
REMI

- REMI contains a baseline forecast of the regional economy (business as usual) based on data from Census, BLS, BEA, among other sources.

- This is typically a small percentage linear growth trajectory of employment by industry, sales by industry, productivity by industry, population by age and gender, labor force participation, among many other economic and demographic variables.

- The user describes the economic and/or fiscal changes in terms of changes in employment, taxes, productivity, investment or sales for example

- Then REMI calculates the changes in the economy due to these direct effects.
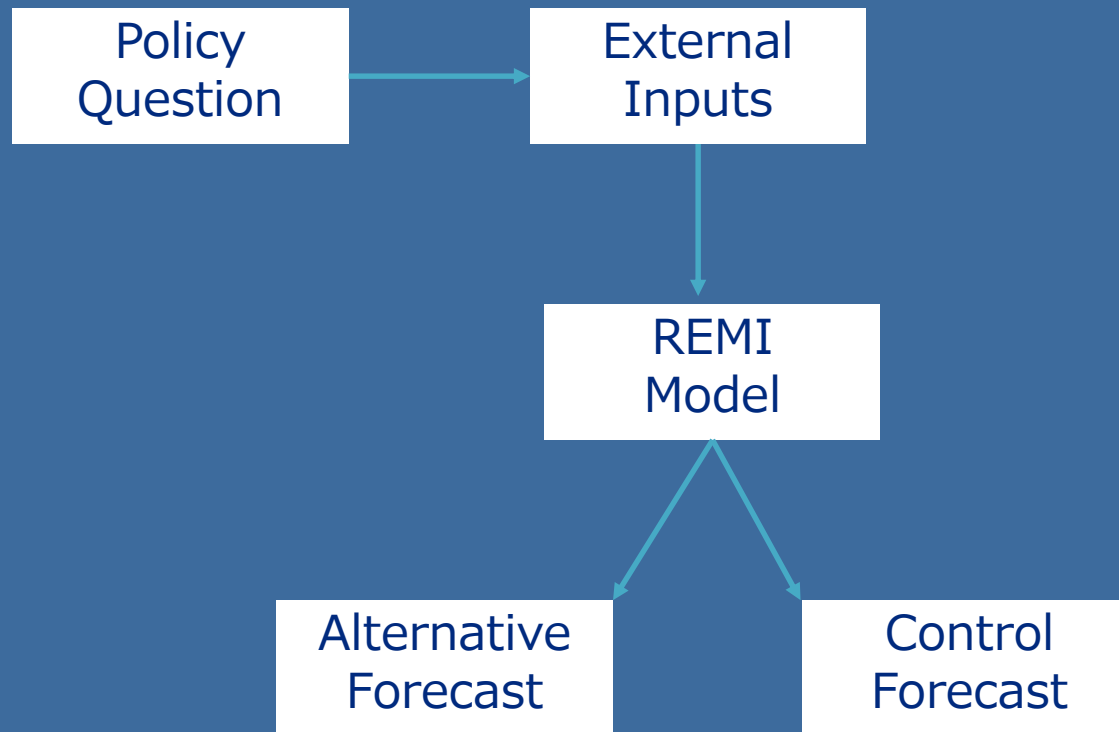
REMI

In the top left graph, is the baseline forecast.

In the top right, graph is the economy's trajectory due to the changes in employment, taxes, etc.

The bottom graph shows the difference between the two trajectories and is what REMI outputs.

REMI

Diagrammatically, one asks a policy question, such as "what are the economic and fiscal impacts of deploying EVs to meet GC3 targets?"
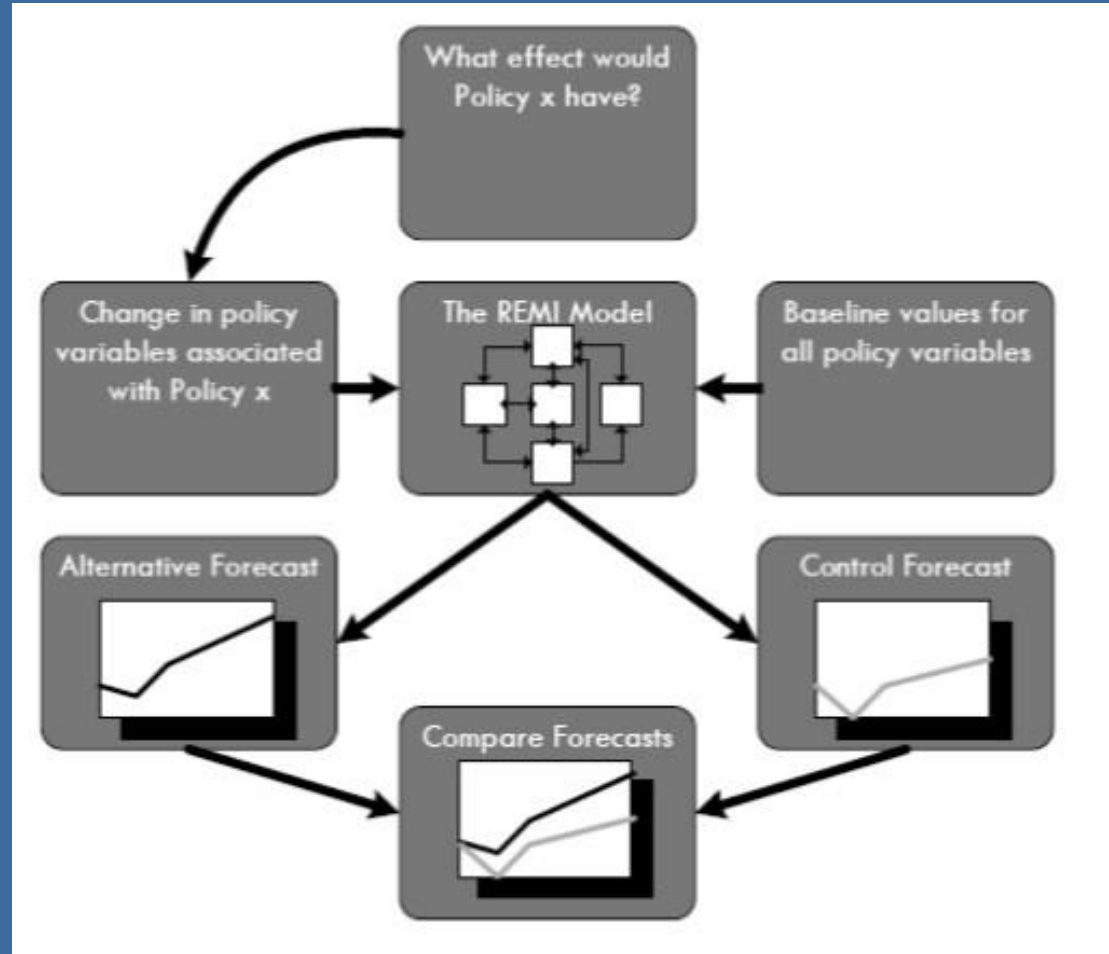
REMI

Then the user imagines the totality of effects the 'policy' may have and collects data to measure these effects.

In lieu of 'good' data, we make reasonable (defensible) assumptions.

Then the user translates the data into REMI 'policy variables' and runs the program (simulations).

To accommodate a range of assumptions, we could run several 'sims'.

REMI

- REMI calculates the total effect of the shock, which is the sum of the direct, indirect and induced effects of the shock.

    – The direct effects are the values of the policy variables input to REMI, such as an employment change, a tax change, a productivity change, or any other change in the economy envisaged in the totality of effects the 'policy' change creates.

    – The indirect effects are the additional business-to-business changes that occur as a result of the direct changes. For example, when Pratt & Whitney hires new engineers, it increases its inputs from and sales of its supply chain. In addition, any other businesses in which the new employees spend their incomes increase their sales and employment.

    – The induced effects are the increased spending the new employees make and the increased spending its supply chain employees make in CT as well as the increased spending of all employees of all industries make that are affected by Pratt & Whitney's new workers, e.g., barbers, restaurants, food stores, housing providers, etc.

    – The total effect that REMI provides is the sum of the three effects.

REMI

REMI

- This output can be pasted into Excel and converted to custom tables, charts and maps.

- The output is quite detailed and can be summarized as the intended audience needs/wants.
  - Demographic changes
  - Industry changes
  - Household changes
  - State and local government fiscal and employment changes

- The analysis is dynamic (shows changes over time), so results can trace the trajectory of the direct 'policy' changes.

REMI

Limitations

- The model results are as good as the data supplied.

- The model focuses on the policy as described by the input data exclusively; no other changes in the economy are taken into account unless specifically modeled.

- There are no error bounds for the results as REMI is not a statistical model.

- The economic assumptions built into the REMI model may not apply in a given case, for example, imperfectly competitive markets or firms with limited substitutability of inputs.

- The geographic granularity is the county; the industry granularity is the NAICS two- or three-digit level. There is no firm-specific or sub-county level of analysis.

- The baseline forecast does not account for possible wars, recessions or other events that would alter the forecast to 2050.

Inputs and Assumptions Used for REMI Analysis of Electric Vehicle Wedge

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Summary of Scenarios Modeled in REMI

- Compare relative costs of 35% and 45% GHG mid-term reduction targets in 2030 on the way to 80% by 2050

- The REMI analysis focused on passenger car and passenger truck electrification

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. What is the average costs for residential, business, parking garages, and on-street charging station applications?

2. What is the loss of retail/wholesale gasoline employment and/or sales?

3. What is the split between increase gas tax revenue (gross receipts and at the pump) and tolling (see above assumptions)?

4. What are the costs to the state of its incentive programs for EVs? How are they implemented (tax credits, rebates, vouchers)?

5. What are the quantitative cost aspects of switching to TOU electricity pricing? On the grid? On suppliers?
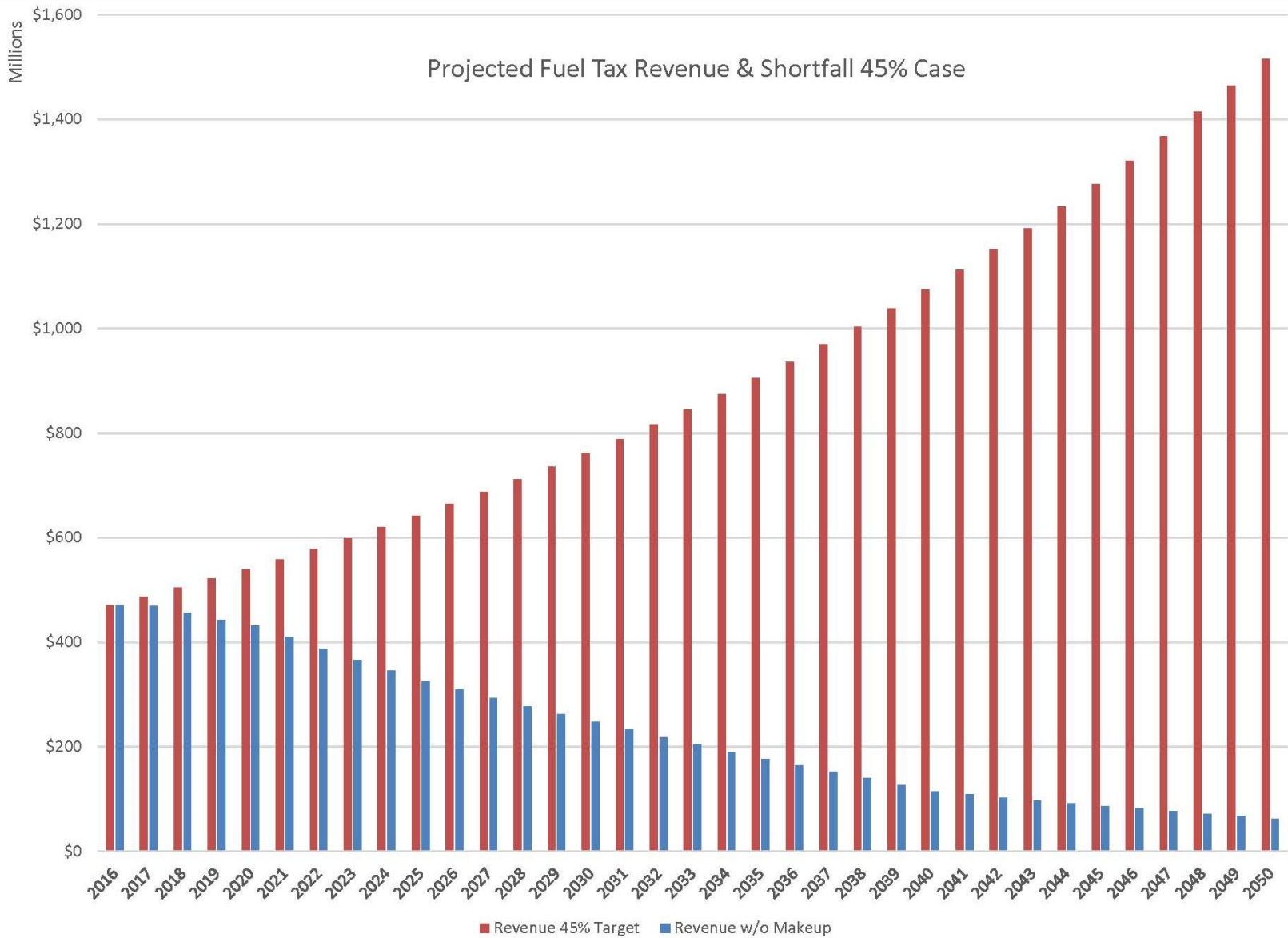
Analysis Assumptions

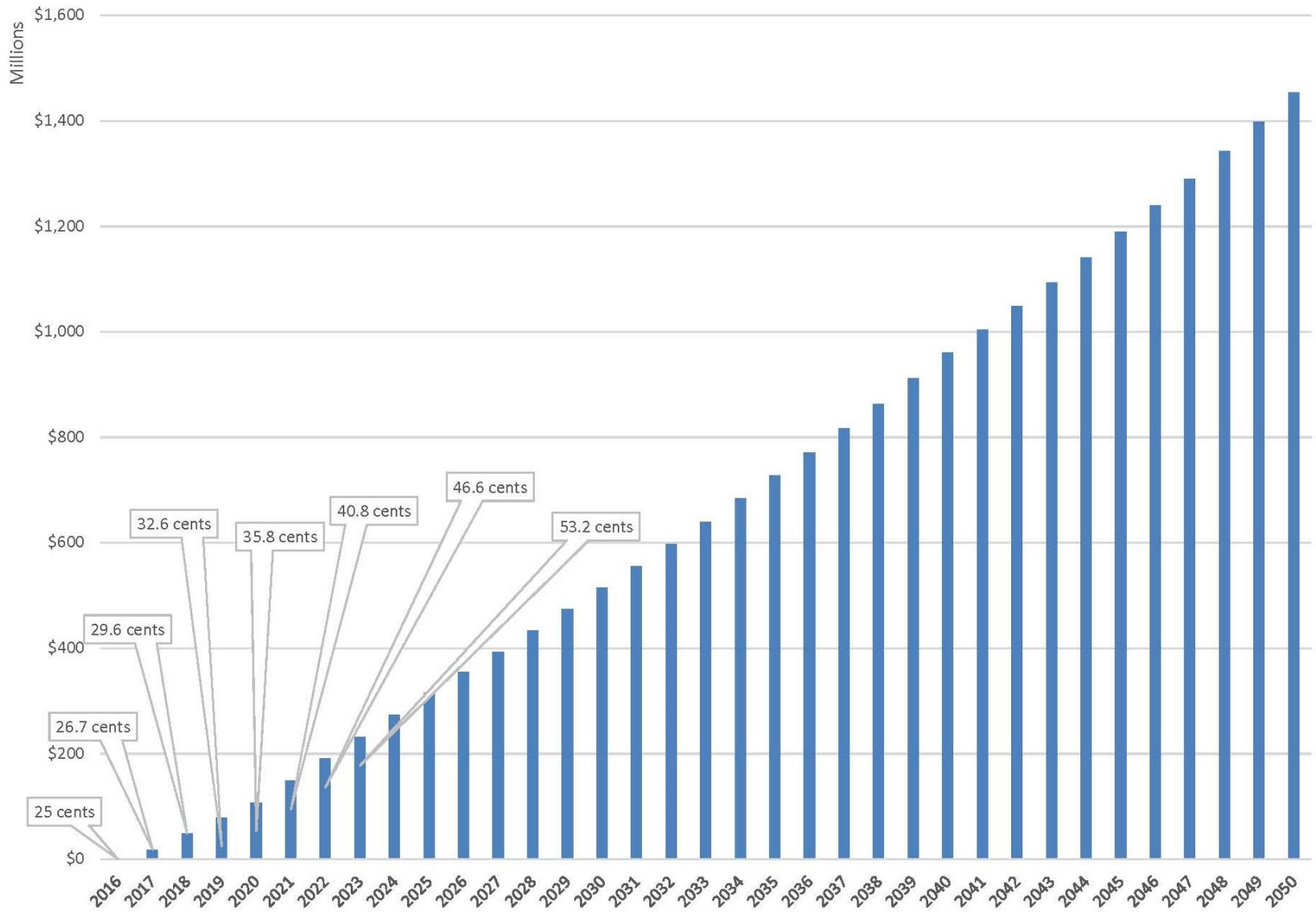| Consideration	Value Description	Description of Rationale
Cost of charging stations and infrastructure	Hardware costs decrease at a rate of 2% through 2032 and 1% onward. Maintenance 3% of hardware annually. **Level 1 Station** Hardware $460 Installation $825 **Level 2 residential** Hardware $650 Installation $1,255 **Level 2 Public** Hardware $3,480 Installation $5,430 **Level 3 DC** Hardware $37,500 Installation $44,100	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. 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. Maintenance costs are based on data reported by C2ES, Clean Cities, and NASEO.

Analysis Assumptions

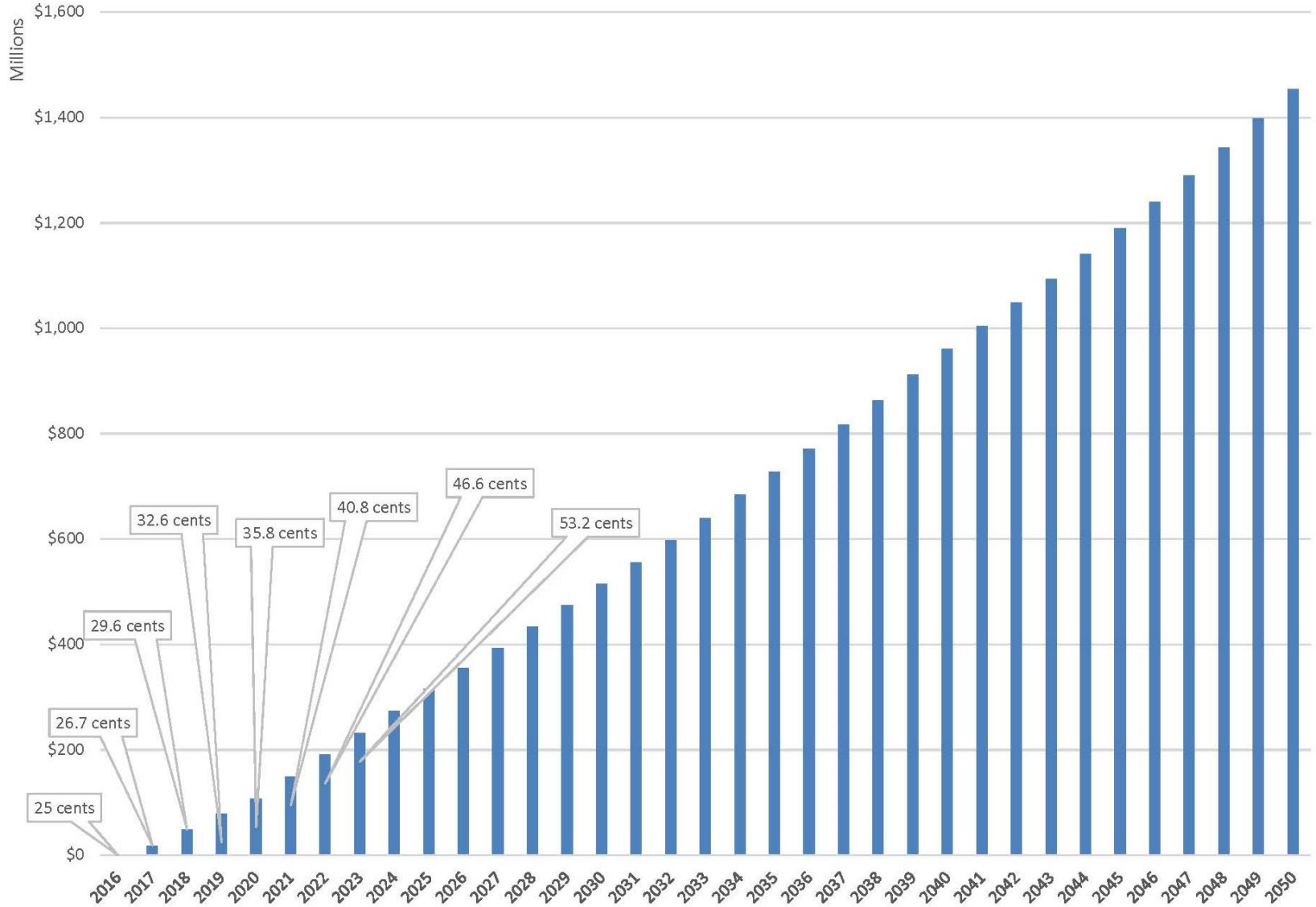| Consideration	Value Description	Description of Rationale
Charging station infrastructure deployment rate	(same as previous slide)	The deployment rate is based on the ratio of different types of charging stations required to support the number of EVs in the reduction scenarios. The ratios are based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

Analysis Assumptions

Consideration	Value Description	Description of Rationale
Impact of declining gasoline/diesel fuel consumption in CT as a result of greater EV deployment.	Annual transportation fuel taxes revenues in reference case fall 41% from 2016 to 2050. In the 35% case cumulative fuel revenues are down 30% from reference case and down 36% in the 45% case. Per gallon fuel tax raised 2017-2023 to offset revenue decline before tolls are instituted and per gallon fuel tax then falls back to 25 cents/gal in 2024. Toll revenue offsets gas tax shortfall 2024-2050. A 75% - 25% split for CT out of state expenditures for tolls.	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. Lost revenue is offset by an increase in the gasoline tax as highway tolls are introduced. Applied CT tax rates (from OPM) to gallons and unit prices to generate annual tax revenues on gasoline, diesel, and ethanol fuels. With guidance from DOT, a 3.5% annual average % change was used to maintain transportation infrastructure spending to be met with fuel taxes & tolls.

Projected Fuel Tax Revenue & Shortfall 45% Case

Legend: Revenue 45% Target, Revenue w/o Makeup

Required Revenue to Makeup Shortfall (45% Case)

29

Required Revenue to Makeup Shortfall (45% Case)

Analysis Assumptions

| Consideration	Value Description	Description of Rationale
Electric Vehicle Purchase Incentive	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. The program has been averaging 600 vehicles and $1.5 million per year. 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.	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.

REMI Analysis of Buildings Wedge Next?

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Buildings
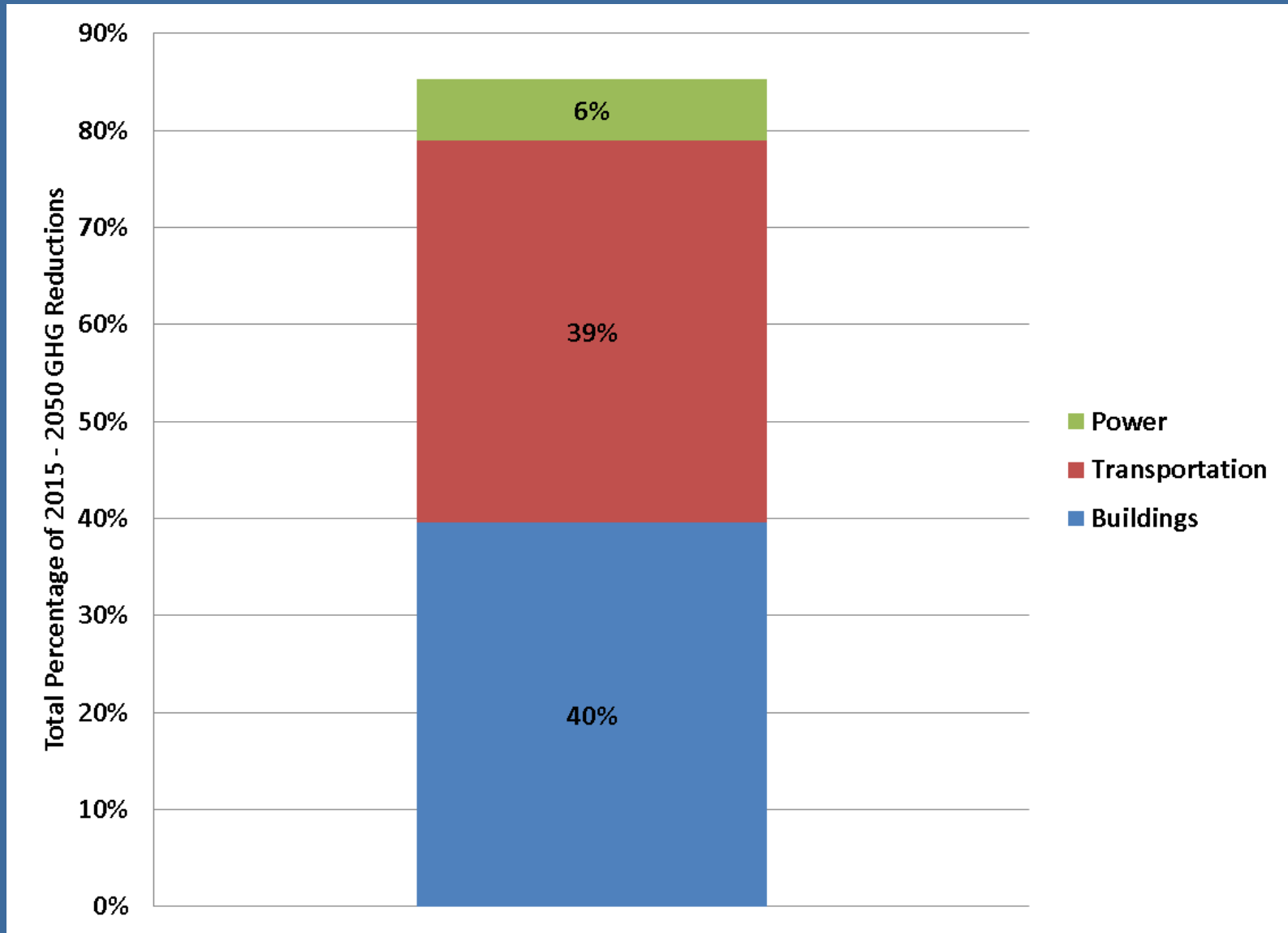
Buildings account for 40% of reductions needed to reach 2050 target

Buildings

Technology/Measure	Description
Deep envelope retrofits for existing buildings	Insulation, window, envelope improvements, building energy management systems in existing and new buildings to make them substantially more efficient. (Could be achieved through advanced building codes e.g. Beyond IECC 2012.)
Expanded high-efficiency lighting	LEDs and advanced control systems.
Expanded advanced energy-efficient appliances	Adoption of state standards for appliance energy efficiency which are more stringent than federal standards.
Expanded high-efficiency water heating	Heat-pumps and other high-efficiency domestic water heaters.
Expanded high-efficiency HVAC	High-efficiency heating, ventilation, and air conditioning equipment.
Expanded renewable thermal technologies	Renewable energy used for heating or cooling (e.g., air/ground source heat pumps, biomass, biofuels).
Increased fuel-switching	Shifting from high-carbon fuel oil to lower-carbon fuel sources.
Expanded district heating/cooling	System for distribution of a heating and/or cooling resource (e.g., chilled water) generated in a centralized location to nearby residential and commercial facilities to satisfy their requirements for space heating, water heating, air conditioning, etc.

Public Comments

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