The RGGI Opportunity 2.0 (March 2016)

RGGI as the Electric Sector Compliance Tool to Achieve 2030 State Climate Targets

Report commissioned by Sierra Club, Pace Energy and Climate Center, and Chesapeake Climate Action Network

RGGI Collaborative Workshop

July 12, 2016

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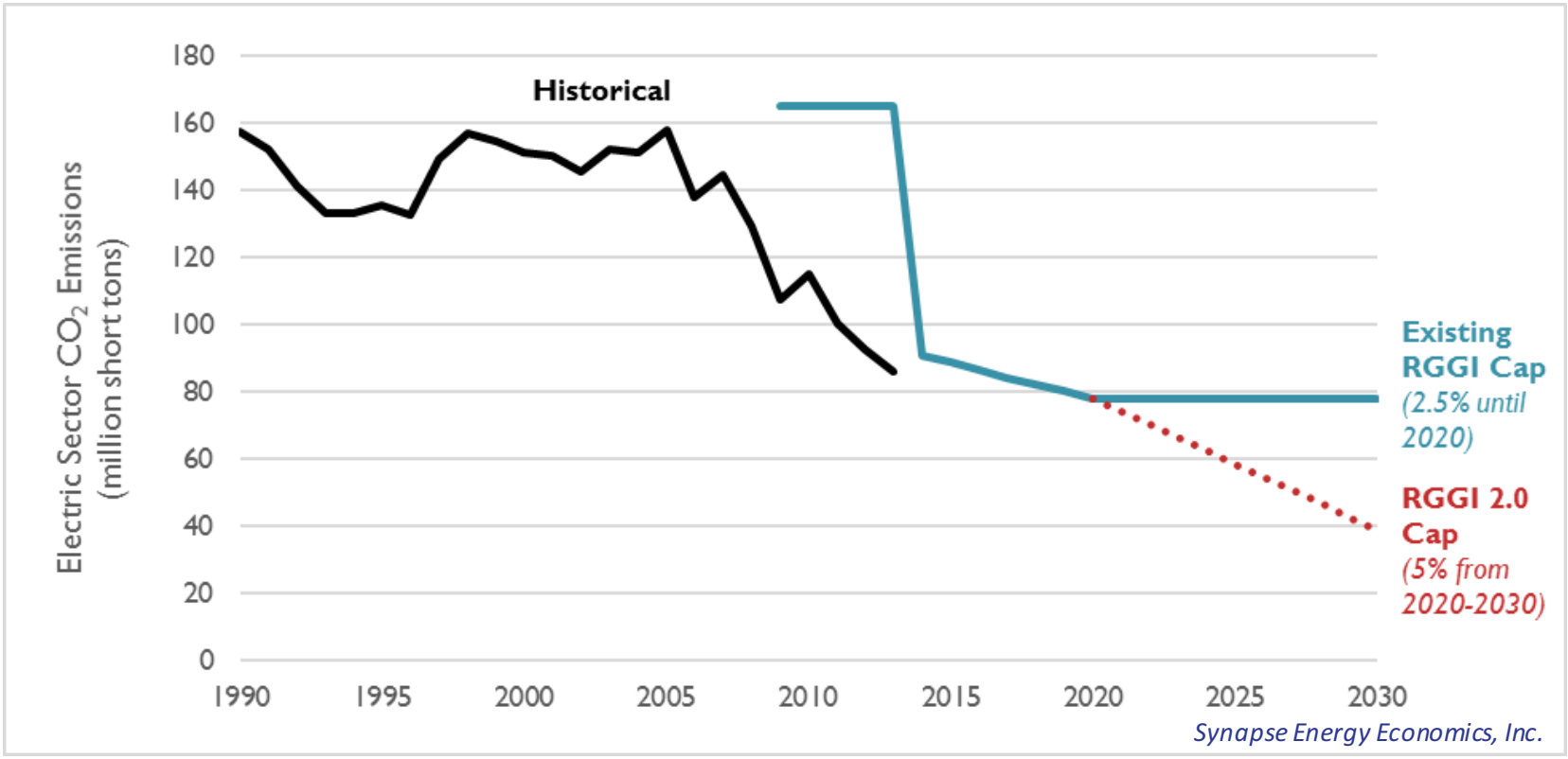
Role of the electric sector

The RGGI Opportunity 2.0:
http://www.synapse-energy.com/sites/default/files/RGGI_Opportunity_2.0.pdf



RGGI states' climate laws require a reduction in electric sector CO_2 emissions of 5 percent each year from 2020 through 2030.

The RGGI Opportunity

What is the RGGI Opportunity?

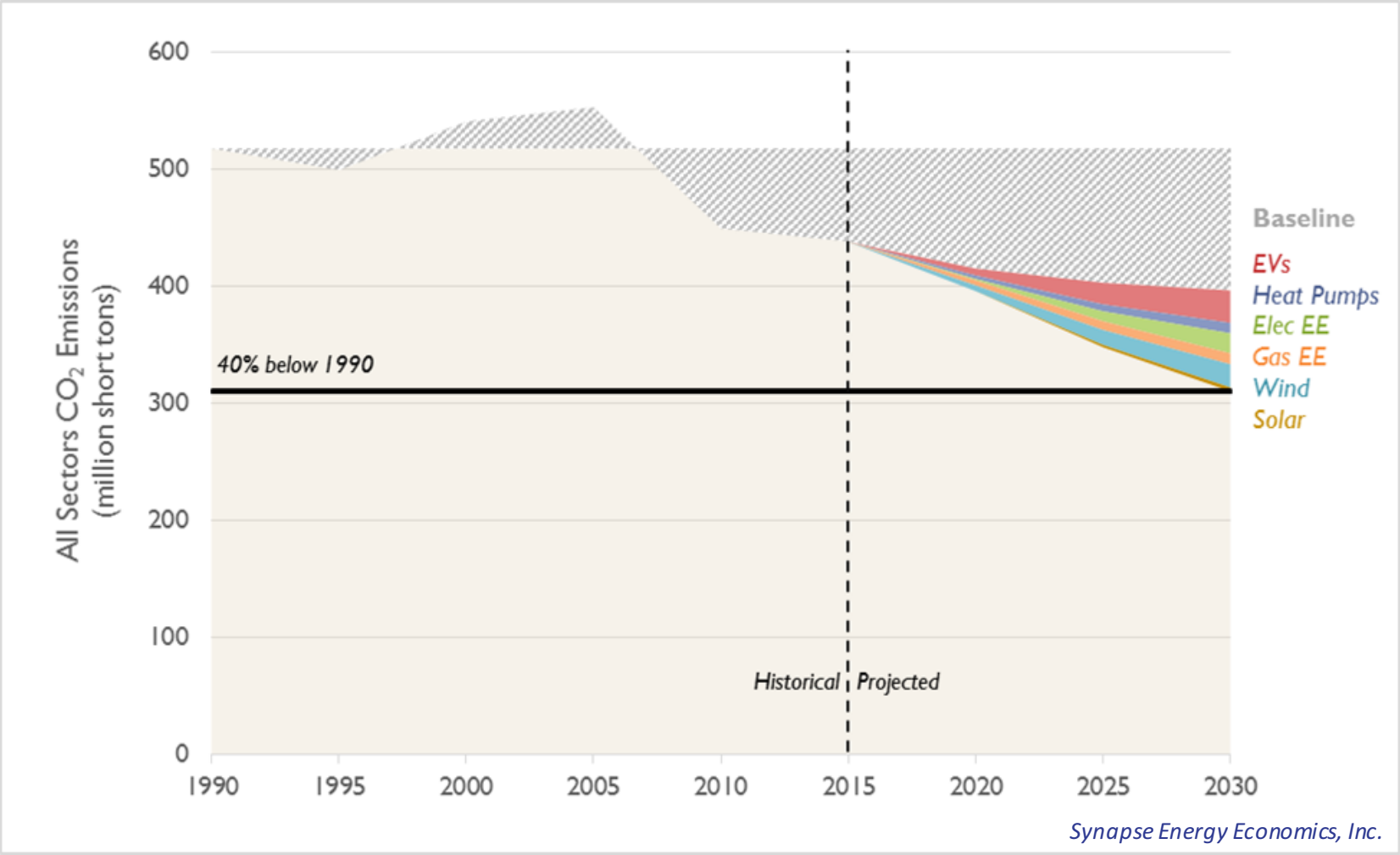
- In the past seven years, states in the Regional Greenhouse Gas Initiative (RGGI) have cut electric-sector CO_2 emissions by 45 percent and economy-wide emissions by 20 percent compared to their 1990 levels
- RGGI's electric-sector carbon cap is complemented by individual state renewable portfolio standards (RPS) and energy efficiency resource standards (EERS)

State	2030 Target	2050 Target
Connecticut	35-45% below 1990	80% below 2001
Delaware	36% below 1990*	No target
Maine	35-45% below 1990	75-80% below 2003
Maryland	35% below 1990**	Up to 90% below 2006
Massachusetts	35-45% below 1990	80% below 1990
New Hampshire	35-45% below 1990	80% below 1990
New York	40% below 1990	80% below 1990
Rhode Island	35-45% below 1990	80% below 1990
Vermont	35-45% below 1990	75% below 1990

** Delaware's 2030 target is a non-binding goal recommended in the state's Climate Framework of 30 percent below 2008.*
*** Maryland's 2030 target is framed as 40 percent below 2006.*

- The nine RGGI states have also established longer-term economy-wide climate goals, clustering around a 40 percent reduction from 1990 levels by 2030 and an 80 percent reduction by 2050

How do we get from here to there?



We evaluated cost-effective approaches for states to meet their 2030 climate goals of a 40 percent CO_2 emission reduction in the nine states.

Key findings

1. Achieving a 40 percent CO_2 emission reduction requires reductions in multiple sectors

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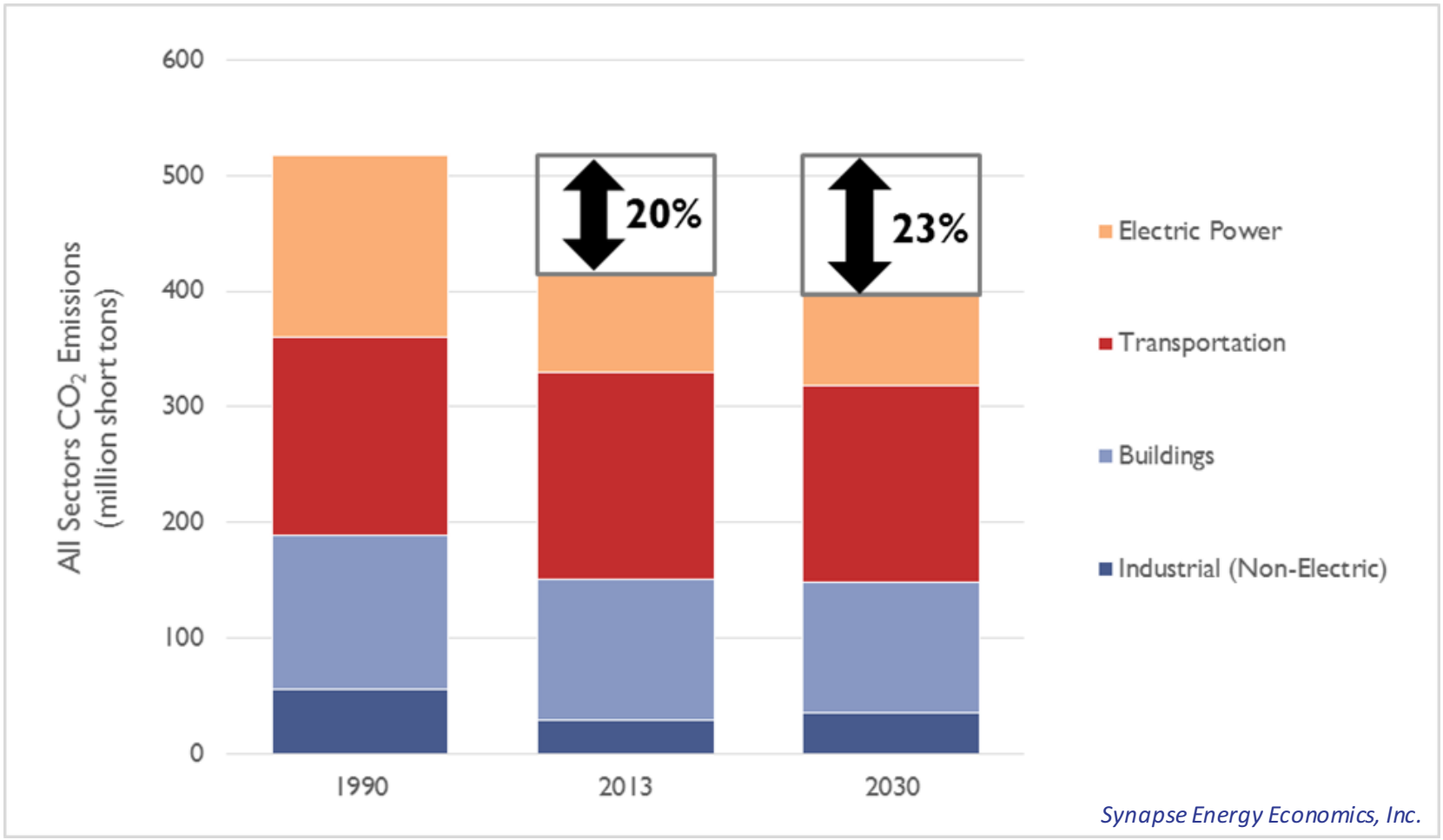
2. Emission reductions measures save money for customers:
   - adoption of electric vehicles
   - converting aging oil heaters to efficient heat pumps
   - modernizing outdated gas furnaces to more efficient units
   - adding better insulation to homes reduces both gas utility bills and emissions
   - robust investment in energy efficiency lowers total system costs
   - expanding the use of renewable energy

Key findings

1. Achieving a 40 percent CO_2 emission reduction requires reductions in multiple sectors
2. Emission reductions measures save money for customers
3. With these measures in place:
   - overall electric sales fall despite a significant increase in electric vehicles and heat pumps
   - renewables supply one-half of the RGGI region's electric generation in 2030
   - employment increases by nearly 60,000 jobs per year
   - savings amount to $25.7 billion in present value, even when not including the social cost of carbon

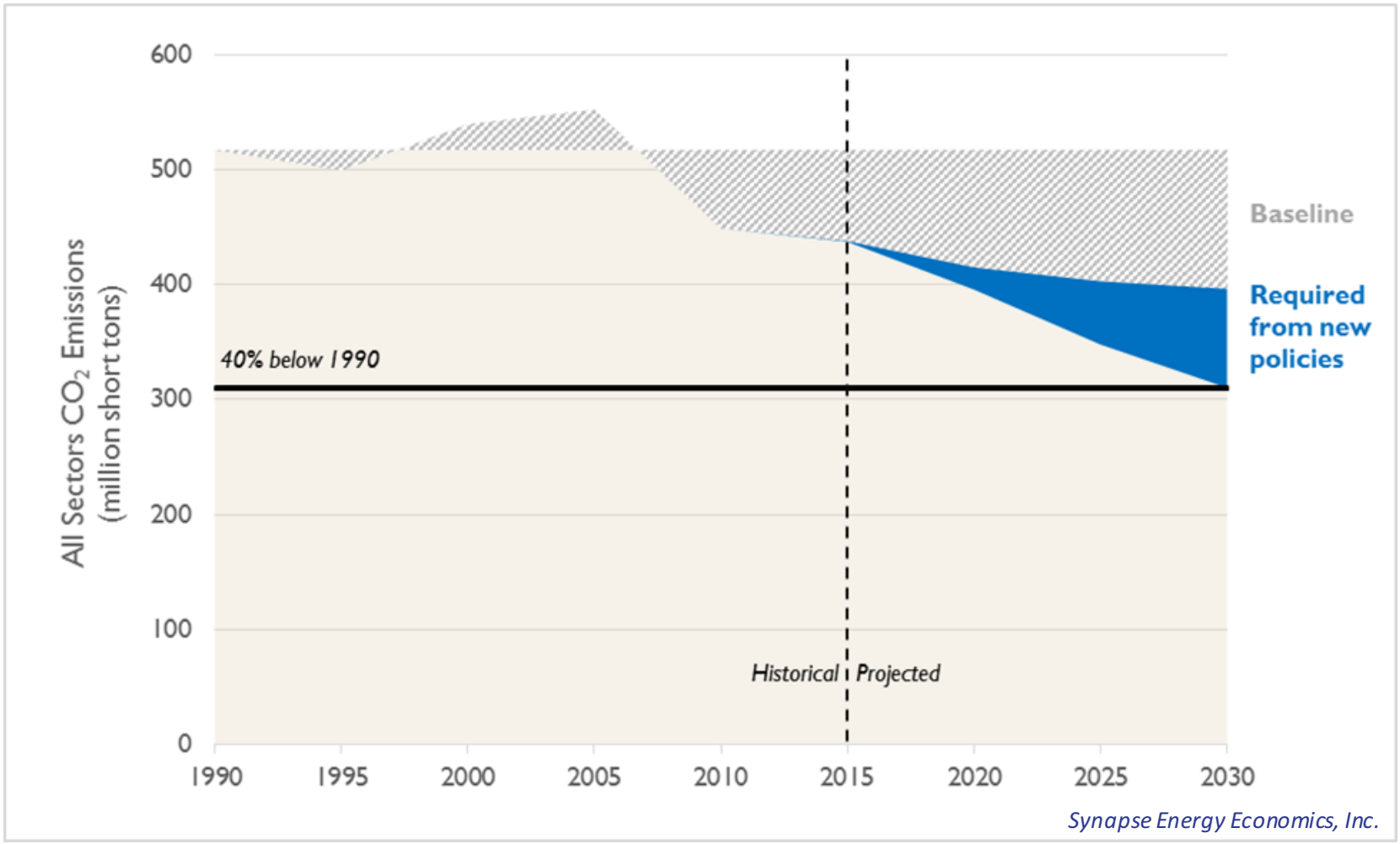
The RGGI Opportunity: Modeling Case Study

Step 1: Develop a baseline scenario



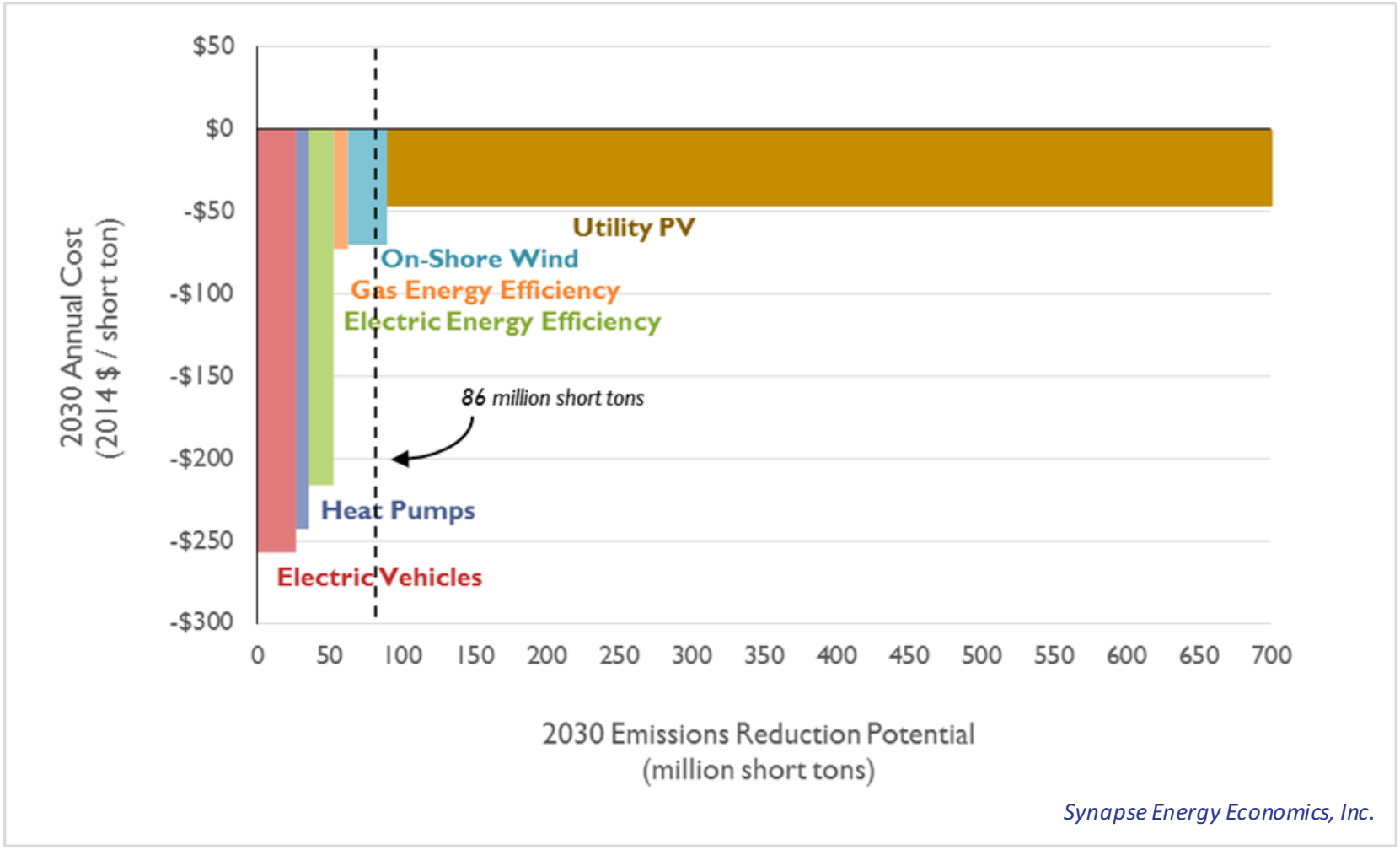
Tools used: M-SEM

Step 2: Establish an emission reduction target



Tools used: M-SEM

Step 3: Develop a Marginal Abatement Cost Curve



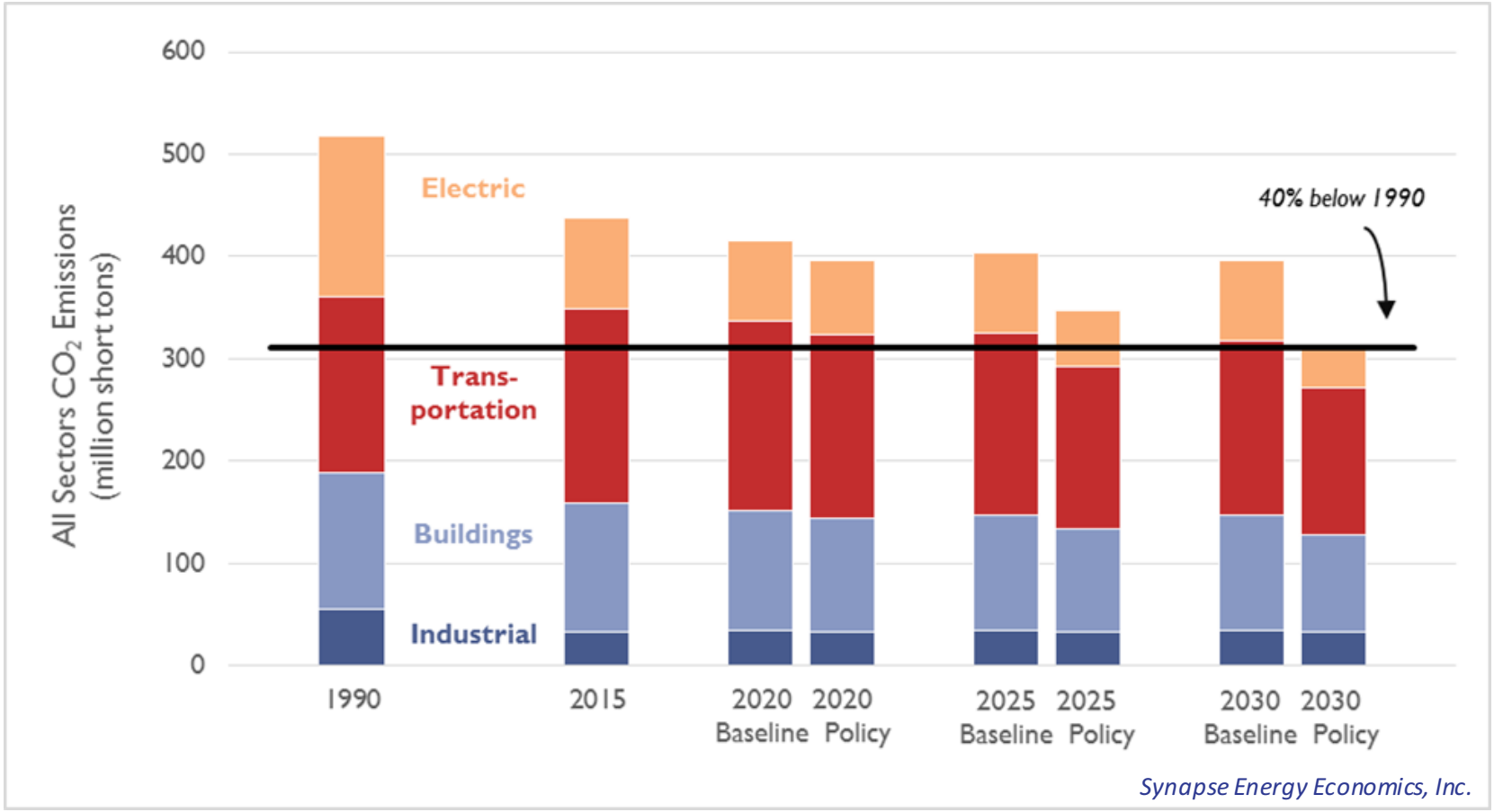
Tools used: EE Savings Tool, M-SEM, Synapse research

Step 3 (continued): Marginal Abatement Cost Curve

- **Electric vehicles:** By 2030, 35 percent of existing light-duty vehicle trips under 100 miles are assumed to be replaced with trips taken in plug-in battery electric vehicles
- **Heat pumps:** By 2030, 44 percent of residential consumption of petroleum is assumed to be replaced with ductless minisplit heat pump systems
- **Electric energy efficiency:** Electric energy efficiency savings reach the savings level assumed for Massachusetts in the RGGI baseline (3 percent annual incremental)
- **Gas energy efficiency:** Gas energy efficiency spending equals potential outlined in a 2013 LBNL report (1.9 percent annual incremental)
- **Onshore wind:** Economically achievable onshore wind in the Northeast
- **Utility PV:** Economically achievable utility PV in the Northeast

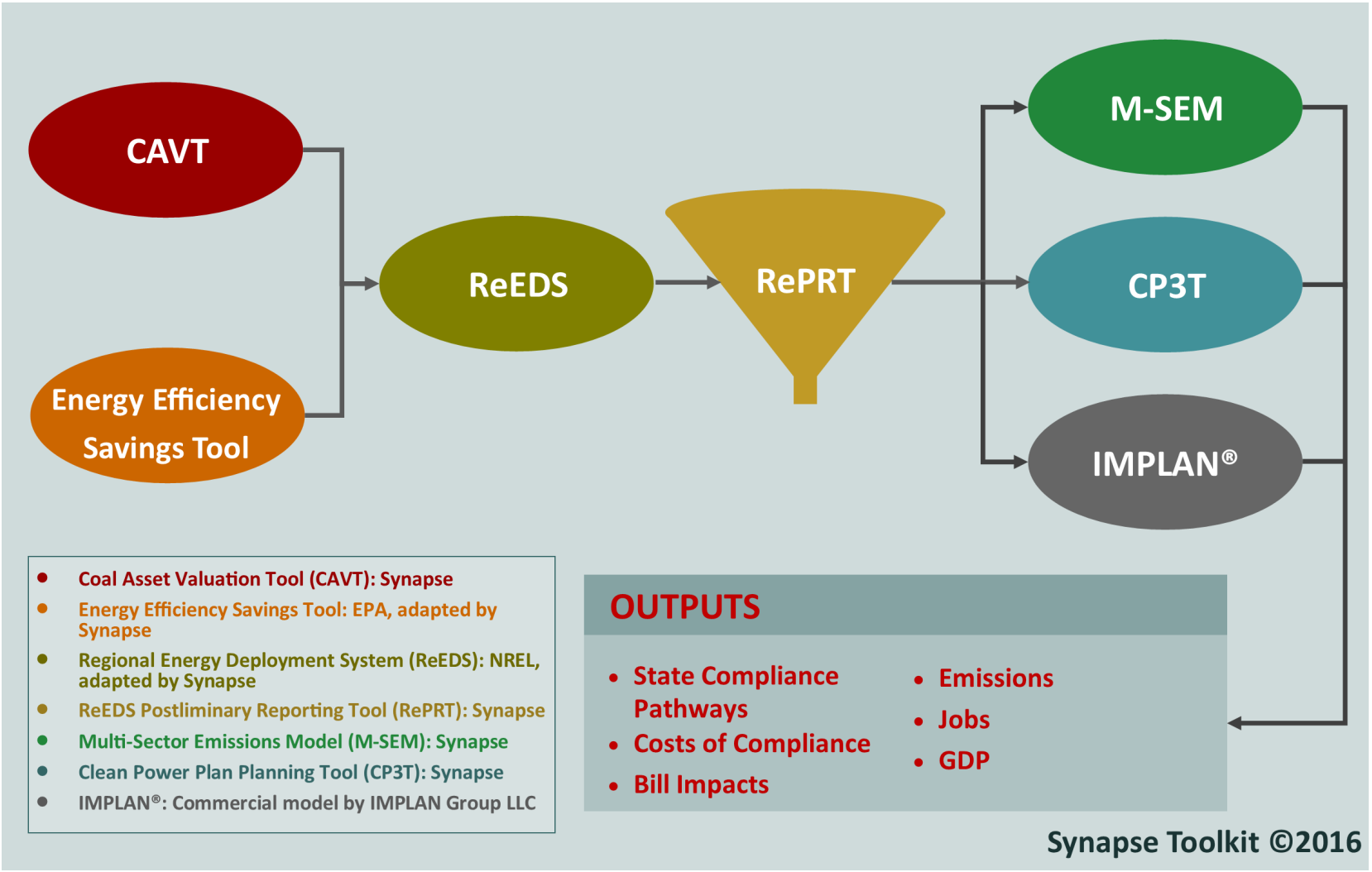
All the measures to the left of (cheaper than) the emission reduction target are selected as "shifts" to be applied in modeling.

Step 4: Apply the emission reduction shifts



Tools used: EE Savings Tool, CAVT, CP3T, ReEDS, RePRT, M-SEM

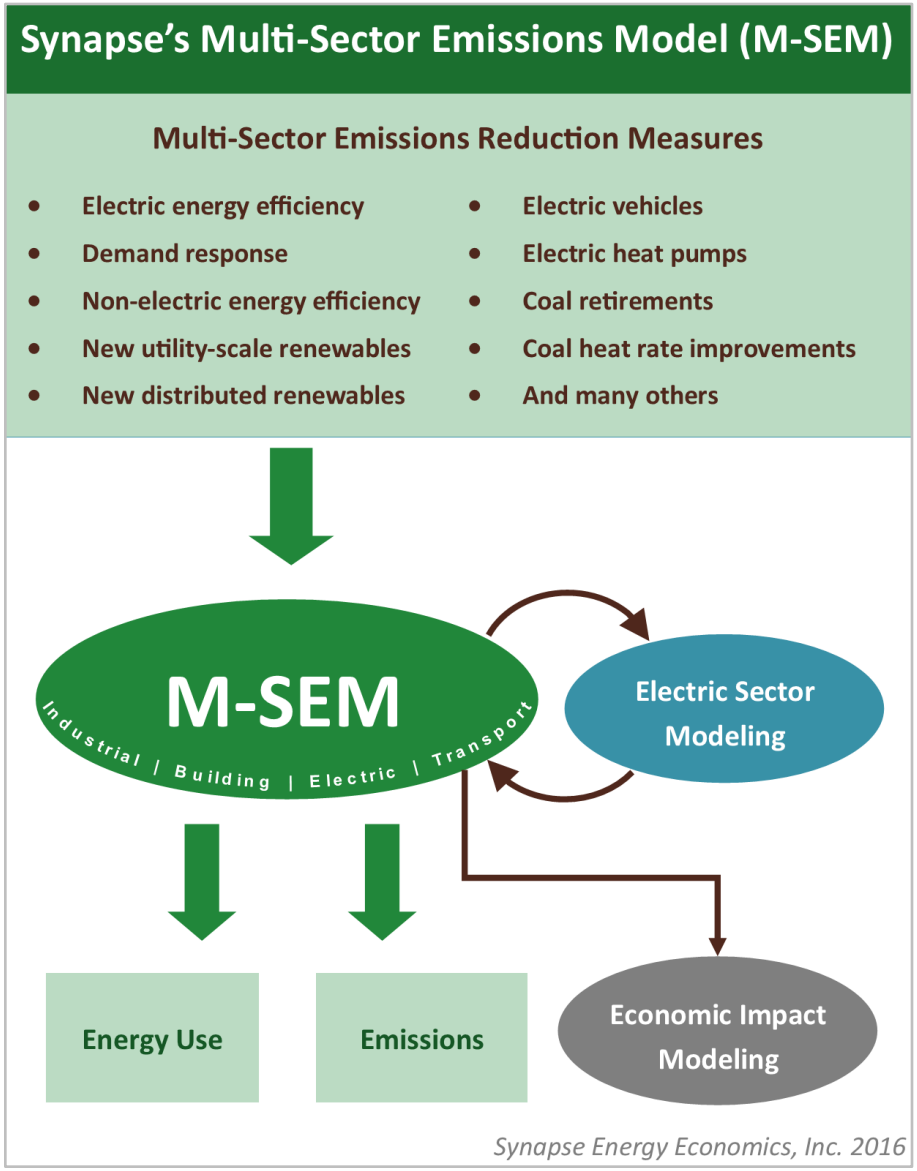
The Synapse Multi-Sector Toolkit



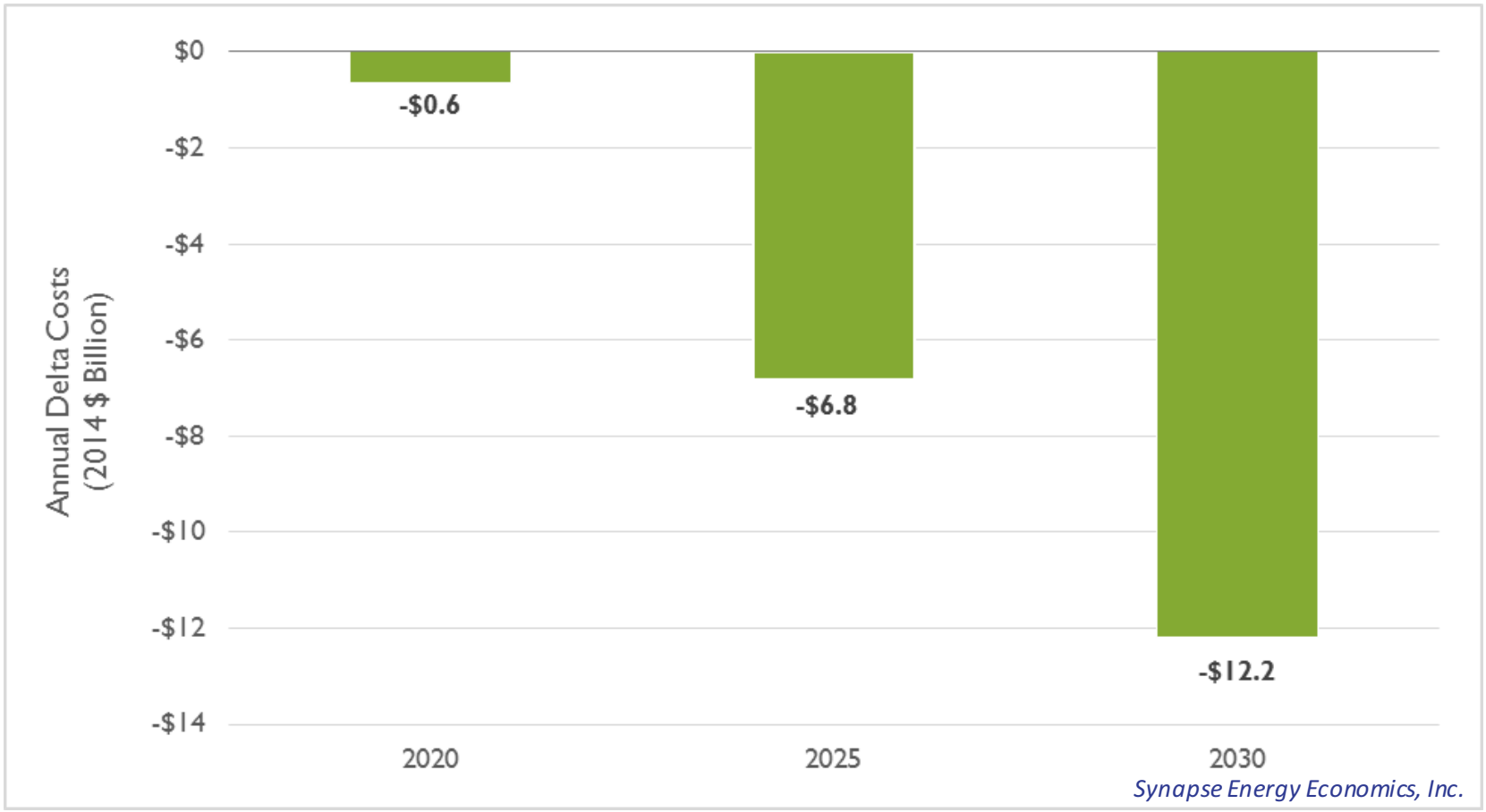
In-House Tools: Multi-Sector Emissions Model (M-SEM)

Synapse's new M-SEM tool provides a comprehensive picture of future emissions and enables economy-wide screening of a wide variety of emissions reduction options.

- Based on publicly available data and integrated with Synapse's other modeling tools
- Synthesizes data by sector, by state, and by fuel type for reference and policy cases
- Can be used for:
  - State and regional emissions reduction planning
  - Enhanced electric-sector modeling
  - Energy and environmental stakeholder engagement
  - Projecting clean-tech industry impacts

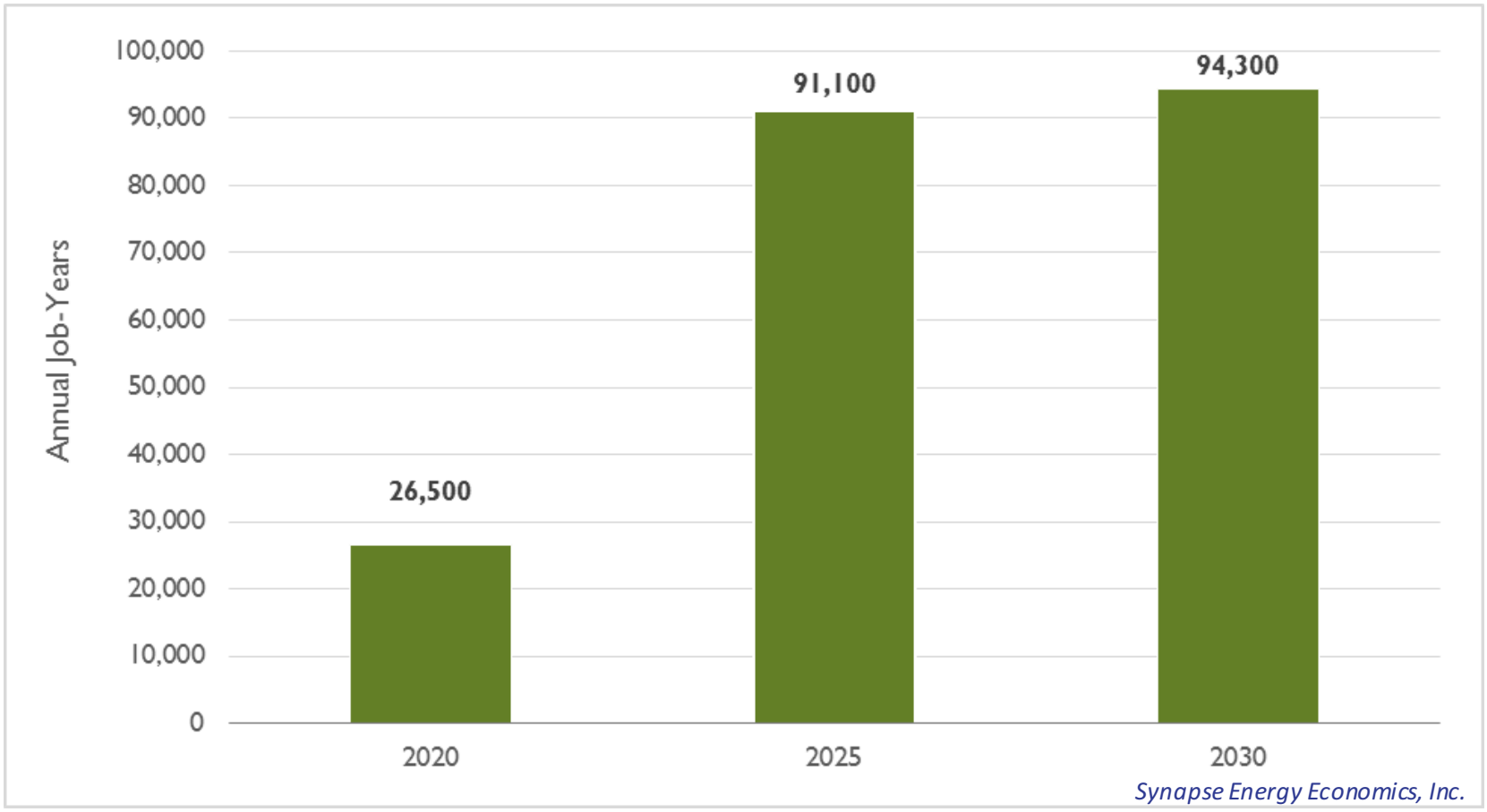


Step 5: Interpret the impact



Tools used: EE Savings Tool, CAVT, CP3T, ReEDS, RePRT, M-SEM, IMPLAN

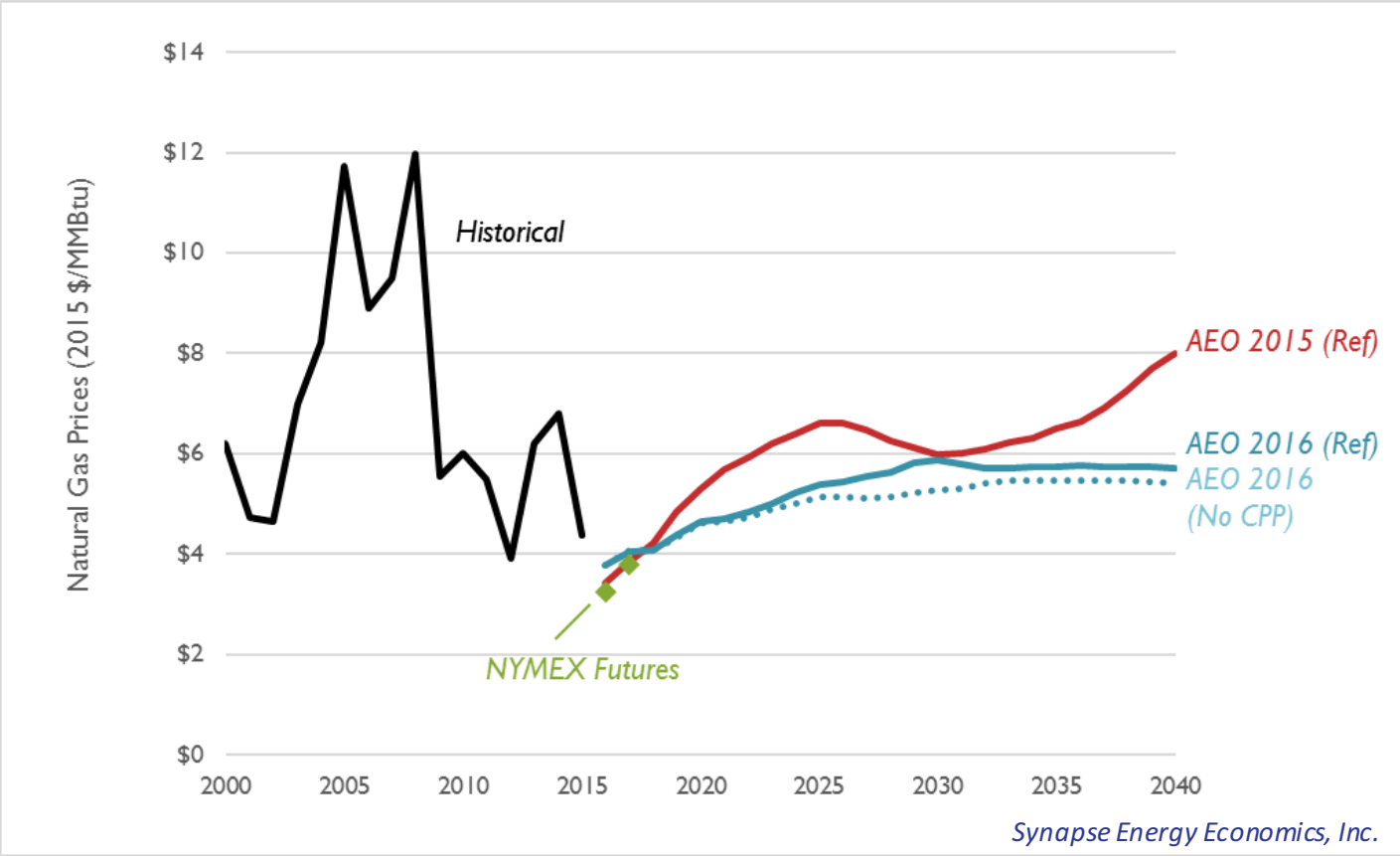
Step 5 (continued): Interpret the impact



Tools used: EE Savings Tool, CAVT, CP3T, ReEDS, RePRT, M-SEM, IMPLAN

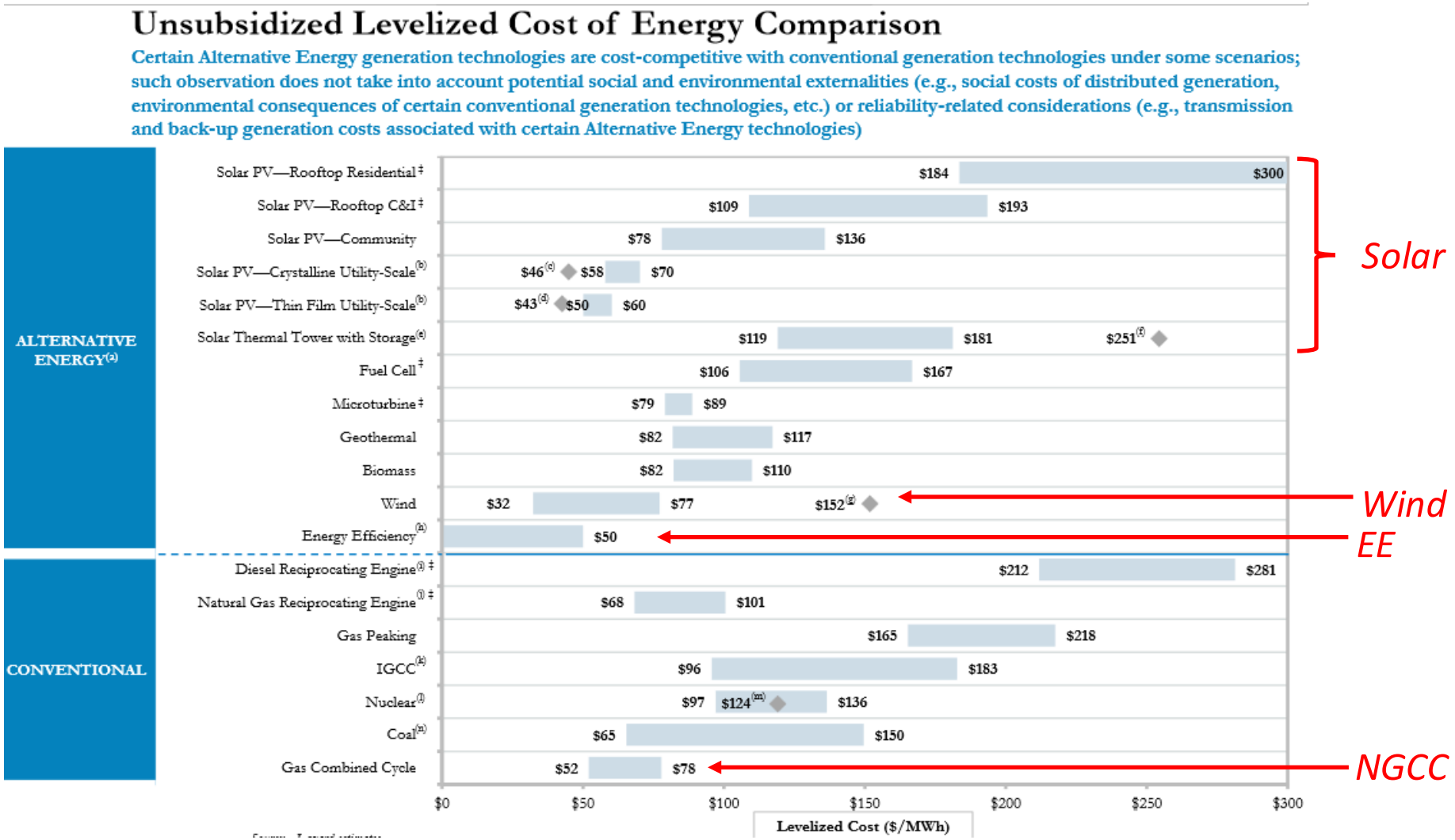
Key Assumptions for Modeling RGGI

Natural gas prices in New England



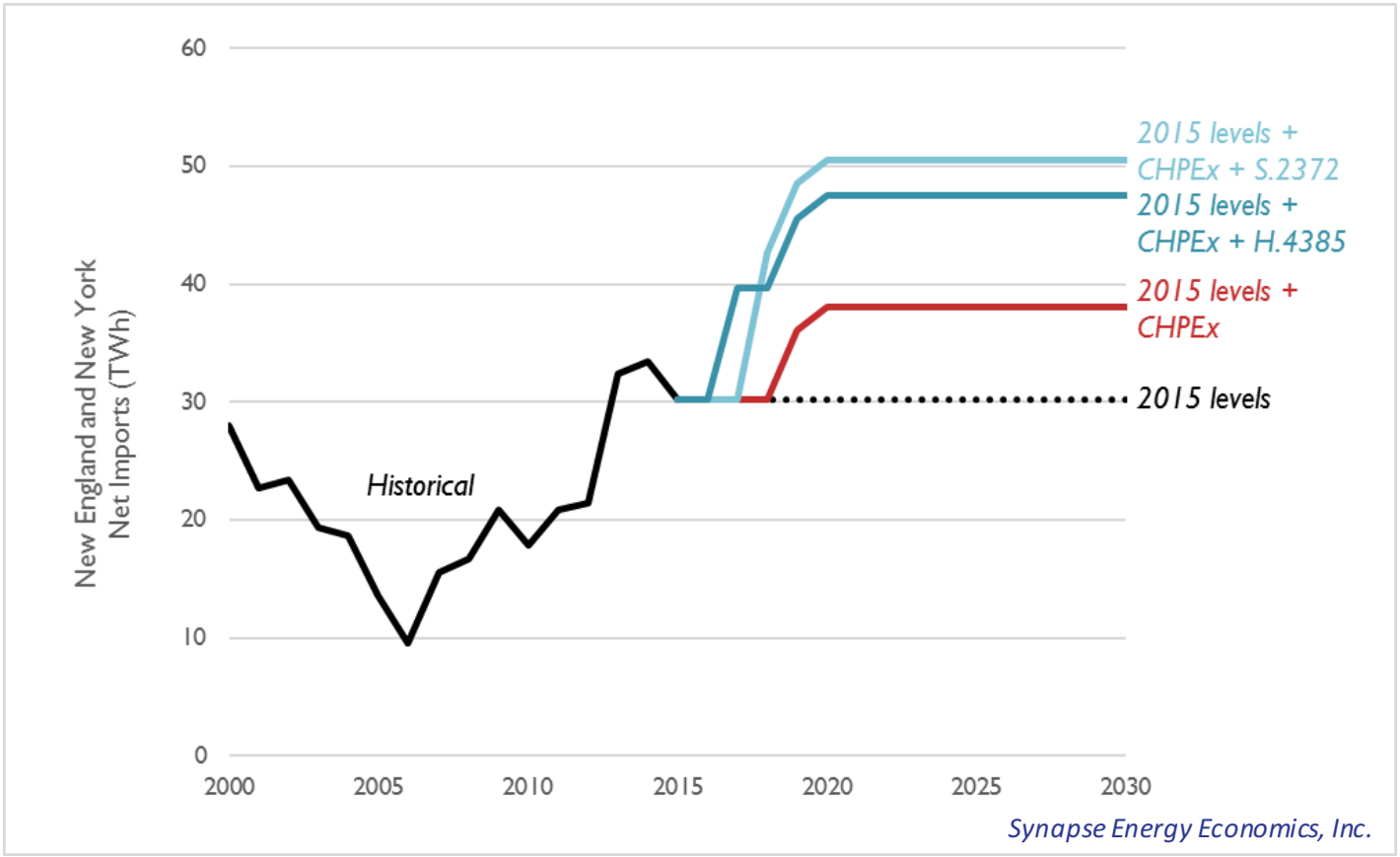
Notes:
"Historical" data is the price of natural gas delivered to electric power generators in Massachusetts, per EIA.
All Annual Energy Outlook (AEO) series reflect the price of natural gas delivered to electric power generators in New England.
"NYMEX Futures" are Henry Hub prices, adjusted to reflect the basis differential reported between Henry Hub and New England power generators in AEO 2016.
All prices adjusted to 2015 dollars using an inflator of 2 percent per year.

Costs of renewables



https://www.lazard.com/media/2390/lazards-levelized-cost-of-energy-analysis-90.pdf

New hydro in New England and New York



Notes:

"Historical" net imports reflects the difference between in-state electric generation and in-state electric sales and losses for the seven states in New England and New York.

"2015 levels" holds e level of net imports calculated in 2015 constant through 2030.

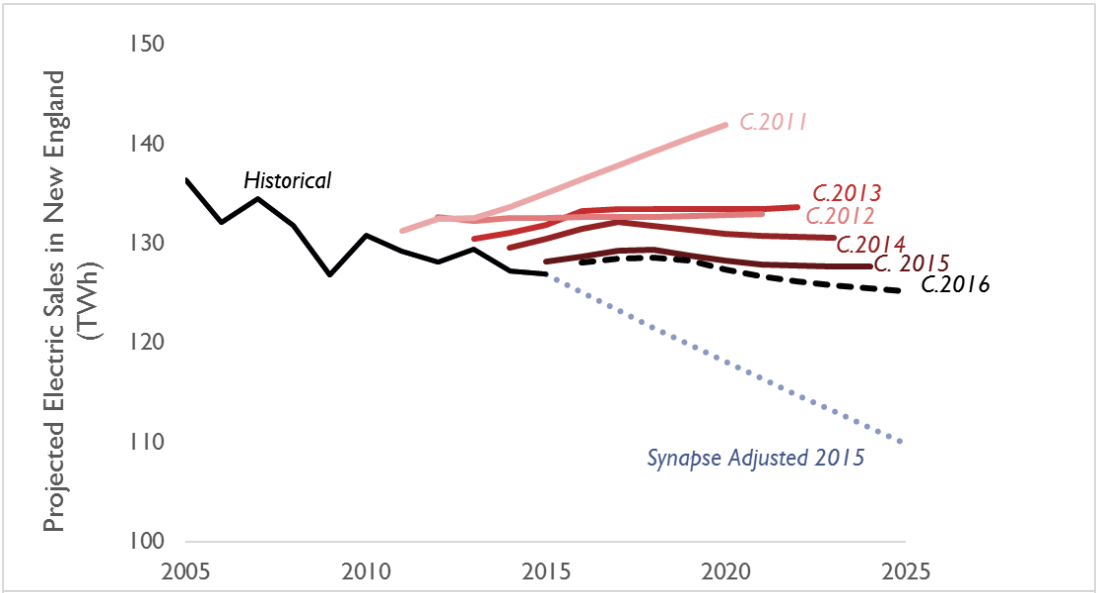
"2015 levels + CHPEx" adds the 1000-MW Champlain-Hudson Express line, estimated to be online in Q2 2019.

"2015 levels + CHPEx + H.4385" adds 9.45 TWh of hydro in 2019, as required by MA House Bill 4385.

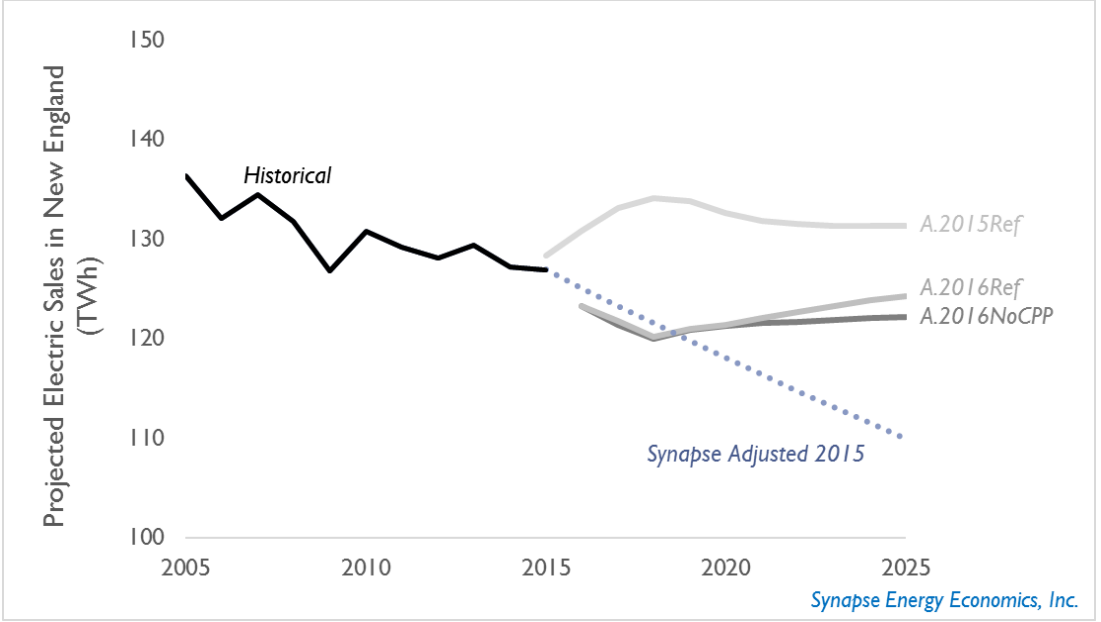
"2015 levels + CHPEx + S.2372" adds the 12.45 TWh of hydro in 2017, as required by MA Senate Bill 2372.

Sales and EE projection for New England

CELT forecasts by ISO-NE



AEO forecasts by EIA



Key assumptions for new RGGI modeling

- Consistent assumptions through 2020 in all cases
- Natural gas price forecast
- New hydro lines (incremental Canadian transmission)
- Incremental efficiency driven by tighter emissions caps
- Consistent assumptions relating to future CCR
- Explicit assumptions regarding cap adjustments to absorb past banking
- Interaction between RGGI and CPP
- CELT 2016 and other up-to-date load assumptions
- Massachusetts GWSA *Kain* decision
- Massachusetts House and Senate energy bills
- Transparent cost assumptions for renewables and energy efficiency
- Explicit nuclear and fossil retirements

Contact Information

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Thanks!

Additional Resources

The Synapse Multi-Sector Toolkit

Customized Tools

- Energy Efficiency Savings Tool
- Regional Energy Deployment System (ReEDS)
- IMPLAN

In-House Tools

- Clean Power Planning Tool (CP3T)
- Coal Asset Valuation Tool (CAVT)
- ReEDS Postliminary Reporting Tool (RePRT)
- Multi-Sector Emissions Model (M-SEM)

Customized Tools: Energy Efficiency Savings Tool

- An EPA tool, adapted and updated by Synapse
- Users can specify an energy efficiency ramp rate, savings level target, measure life distribution, and first-year cost of saved energy for each state.
- Synapse has added sector-specific detail and the latest energy efficiency data from EIA. The Energy Efficiency Savings Tool is fully integrated into CP3T.
- The Energy Efficiency Savings Tool is free and publicly available:
  - As part of CP3T at www.cp3t.com
  - In the Clean Power Plan technical support documents at http://www.epa.gov/sites/production/files/2015-11/df-cpp-demand-side-ee-at3.xlsx

Customized Tools: Regional Energy Deployment System (ReEDS)

- Developed by the National Renewable Energy Laboratory (NREL)
- ReEDS is a long-term capacity expansion and economic dispatch model of the electric power system in the lower 48 states.
- Synapse has adapted its in-house version of the ReEDS model to allow for more detailed outputs by state and sector, and to permit differentiation of energy efficiency expectations by state.
- More information on ReEDS can be found at http://www.nrel.gov/analysis/reeds/.

Customized Tools: IMPLAN

- IMPLAN is a commercial model developed by IMPLAN Group PLC.
- IMPLAN reports data on jobs and GDP based on cost inputs.
- Synapse has adapted IMPLAN to have greater resolution for jobs and GDP impacts from coal, natural gas, wind, solar, energy efficiency, and other electric- and buildings-sector specific expenditures.
- More information on IMPLAN is available at http://www.implan.com/.

In-House Tools: Multi-Sector Emissions Model (M-SEM)

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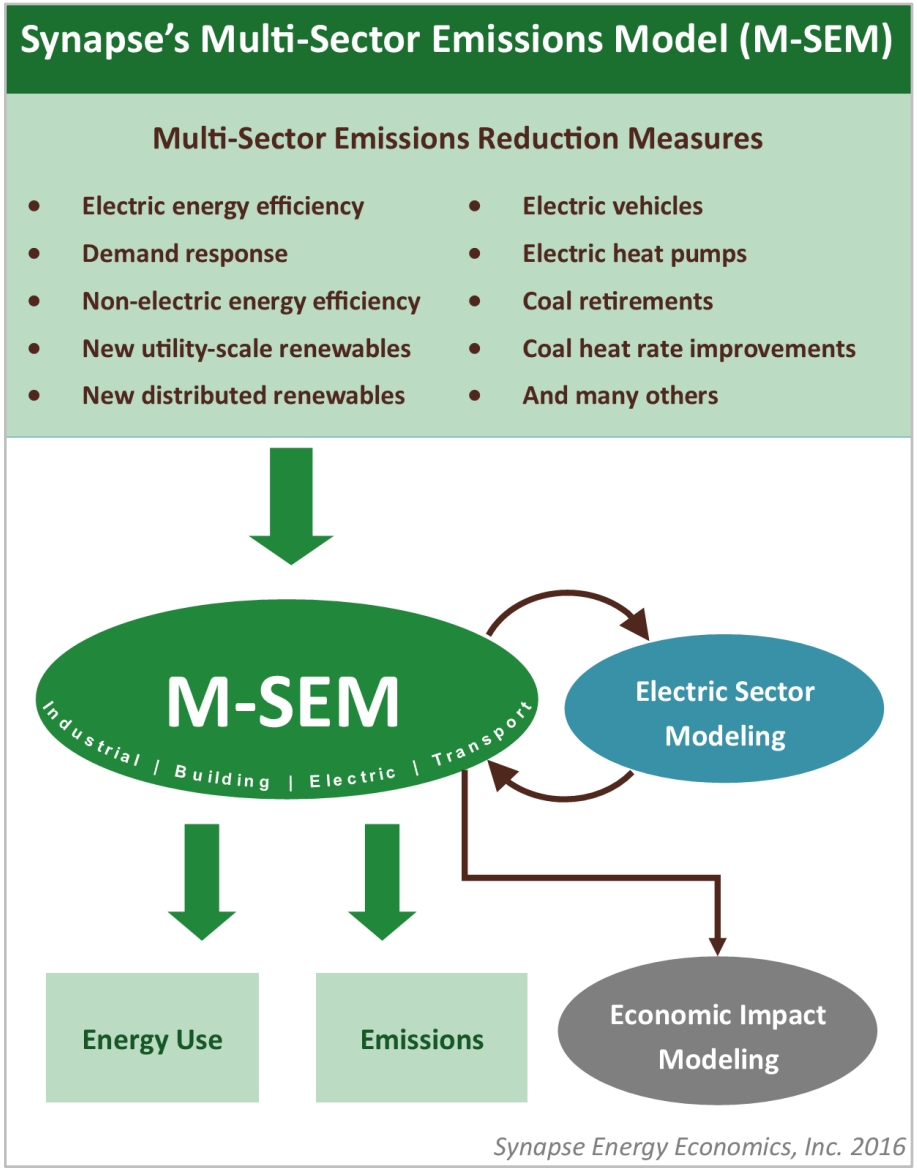

In-House Tools: Clean Power Planning Tool (CP3T)

- CP3T is an Excel-based spreadsheet tool used for performing first-pass planning of statewide compliance with EPA's final Clean Power Plan.
- CP3T integrates unit-specific data and highly customizable user inputs to assess generation, emissions, costs, and compliance with the Clean Power Plan.
- CP3T is free and entirely open source. CP3T can be downloaded at www.cp3t.com.

In-House Tools: Coal Asset Valuation Tool (CAVT)

- CAVT is an Excel-based spreadsheet tool used to estimate the cost of complying with environmental regulations at coal units.
- CAVT integrates unit-specific data, user inputs, and environmental control cost projections to assess future costs of operating individual coal units.
- CAVT is free and entirely open source. CAVT can be downloaded at http://www.synapse-energy.com/tools/coal-asset-valuation-tool-cavt.

In-House Tools: ReEDS Postliminary Reporting Tool (RePRT)

- RePRT is an in-house tool used to quickly synthesize outputs from ReEDS and convert information into data readable by CP3T, IMPLAN, and M-SEM.
- RePRT can also help assess future bill impacts of clean energy futures.
- More information on RePRT can be found at http://www.synapse-energy.com/reeds-postliminary-reporting-tool.