Synapse's New Multi-Sector Toolkit

A Case Study on Deep Emission Cuts in RGGI

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Synapse Energy Economics

- Research and consulting firm specializing in energy, economic, and environmental topics
- Leader for public interest and government clients in providing rigorous analysis of the electric power sector
- Services include economic and technical analyses, regulatory support, research and report writing, policy analysis and development, representation in stakeholder committees, facilitation, trainings, and expert witness services
- Develops resources such as the Synapse Clean Power Plan Toolkit to promote transparent decision-making
- All non-confidential publications and open-source tools available for free at www.synapse-energy.com

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Agenda

The RGGI Opportunity: 40% Economy-Wide CO_2 Reductions by 2030

- What is the RGGI Opportunity?
- Methodology and study findings

An In-depth Look at the Synapse Multi-Sector Toolkit

- Toolkit overview
- Customization of outside tools
- In-house tools

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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

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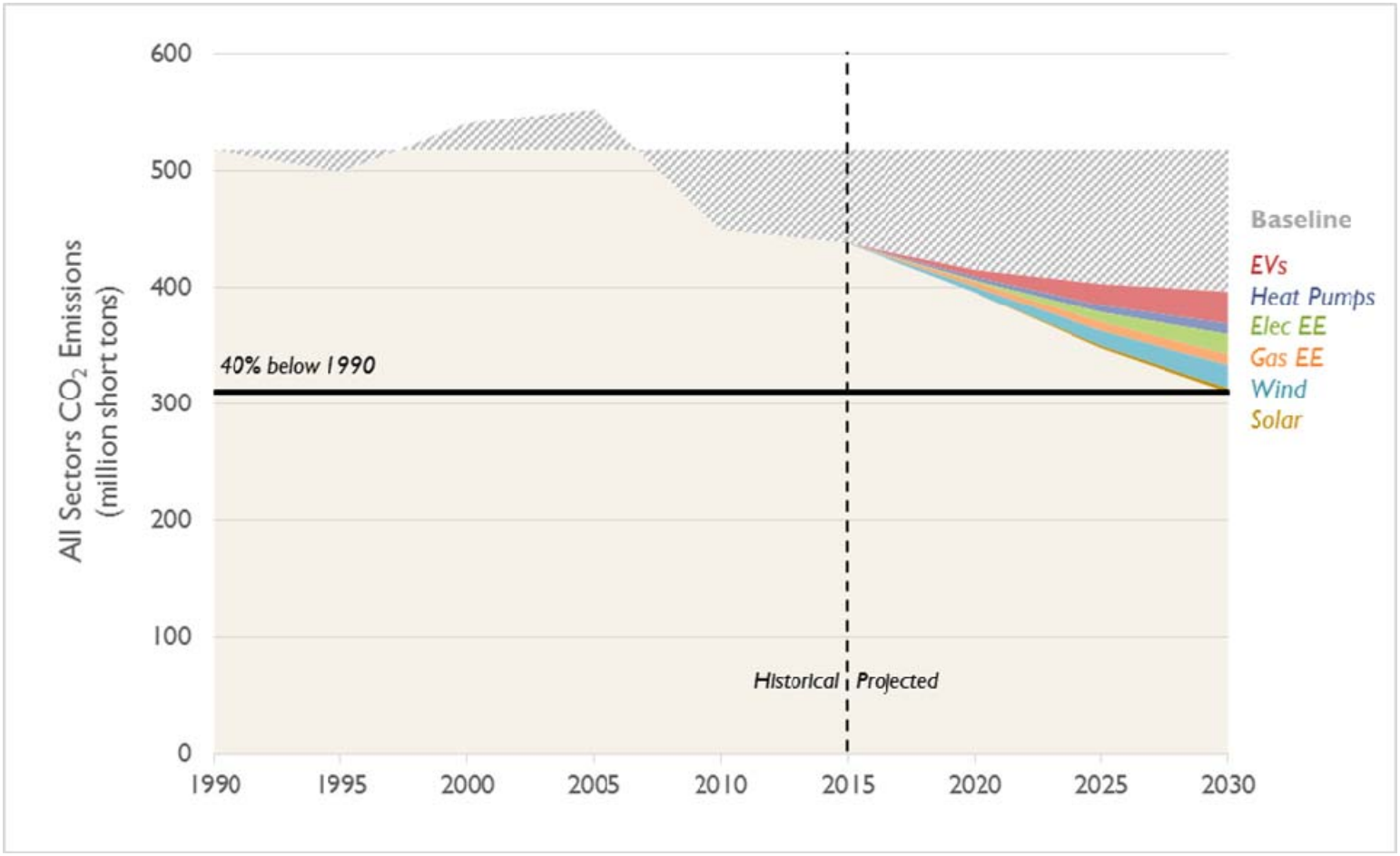
How do we get from here to there?



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
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
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

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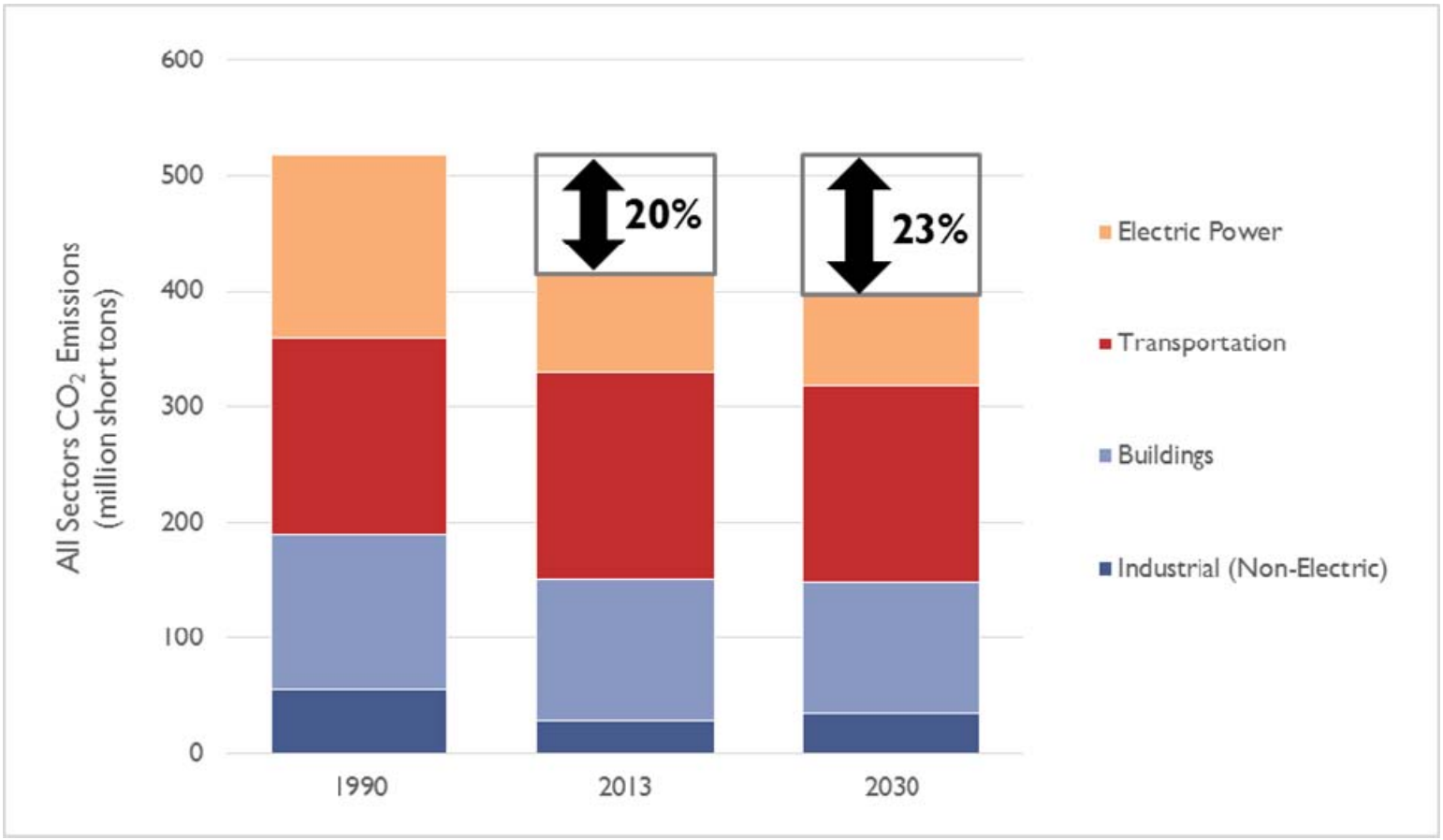
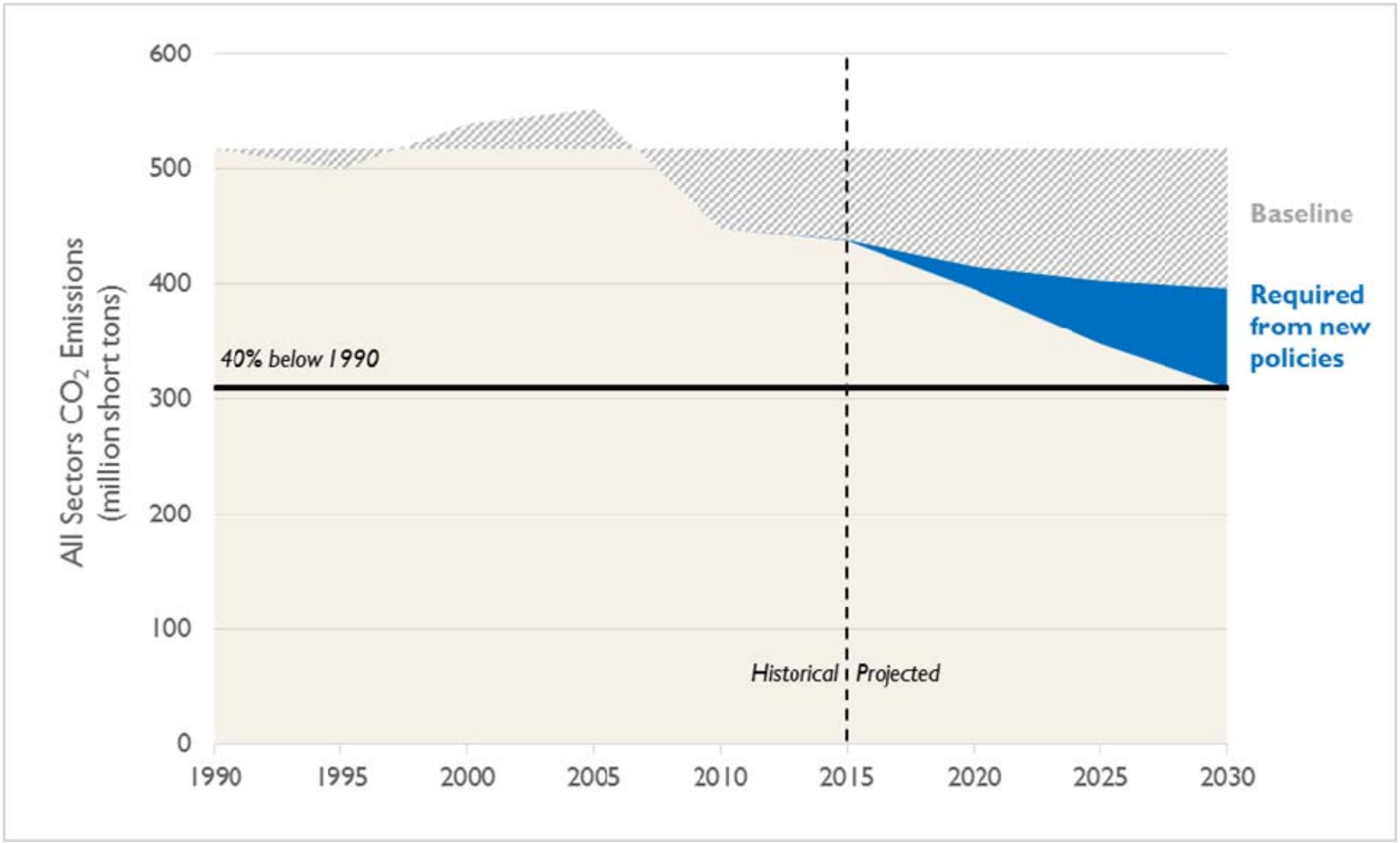
The RGGI Opportunity: Modeling Case Study

Step 1: Develop a baseline scenario



Tools used: M-SEM

Step 2: Establish an emission reduction target



Tools used: M-SEM

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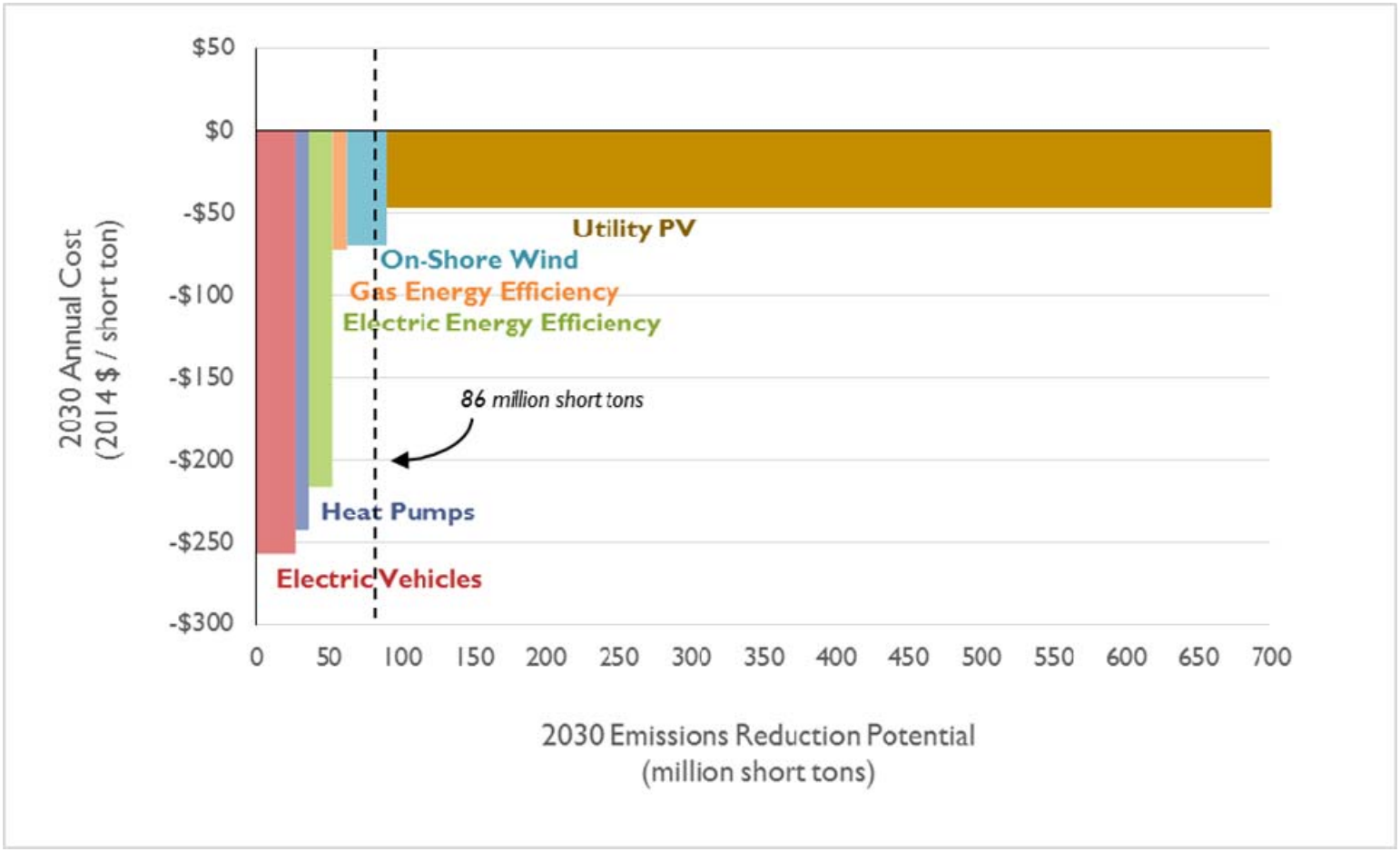
Step 3: Develop a Marginal Abatement Cost (MAC) Curve



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

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Step 3 (continued): Develop a Marginal Abatement Cost (MAC) 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.

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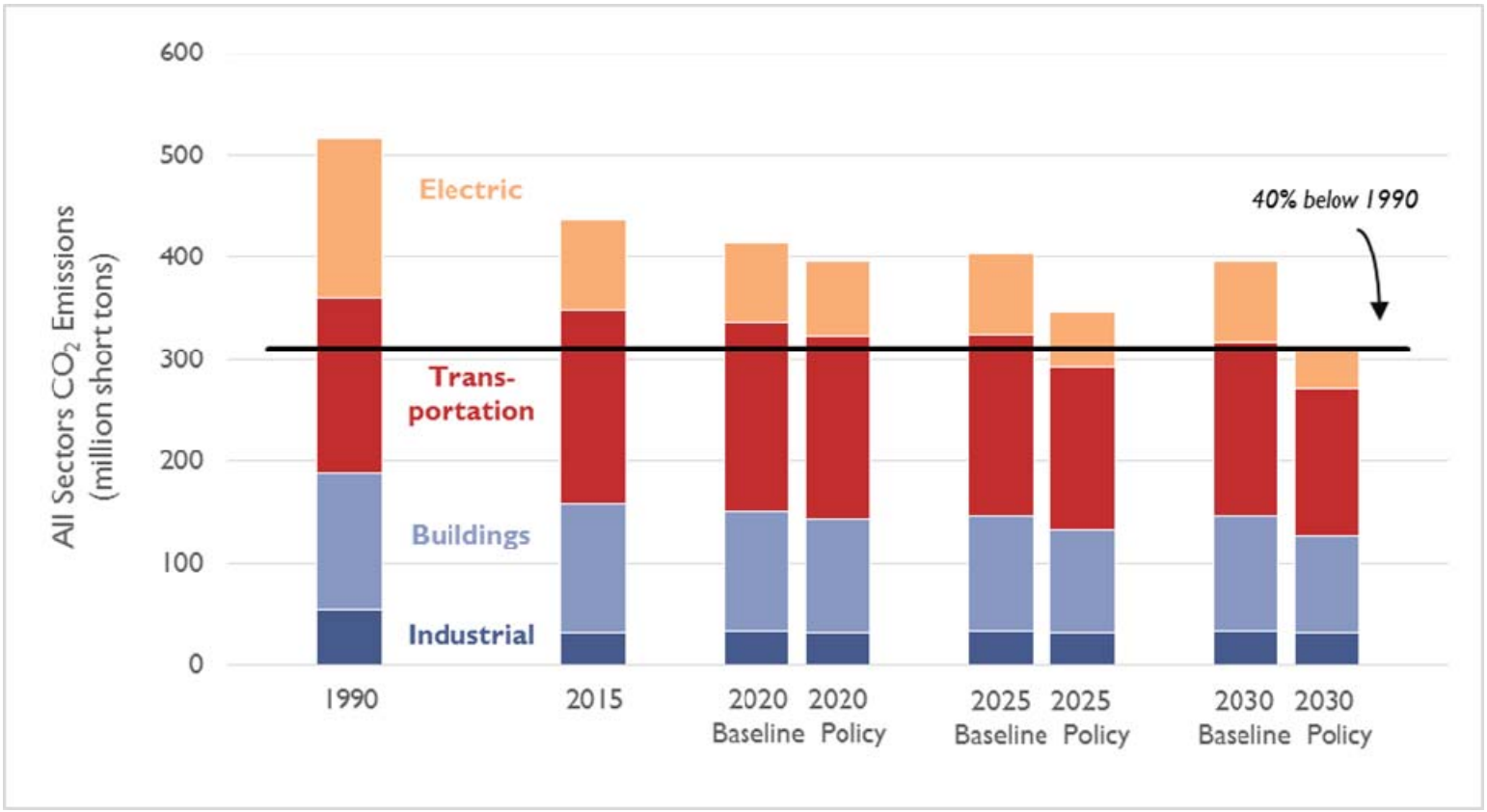
Step 4: Apply the emission reduction shifts



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

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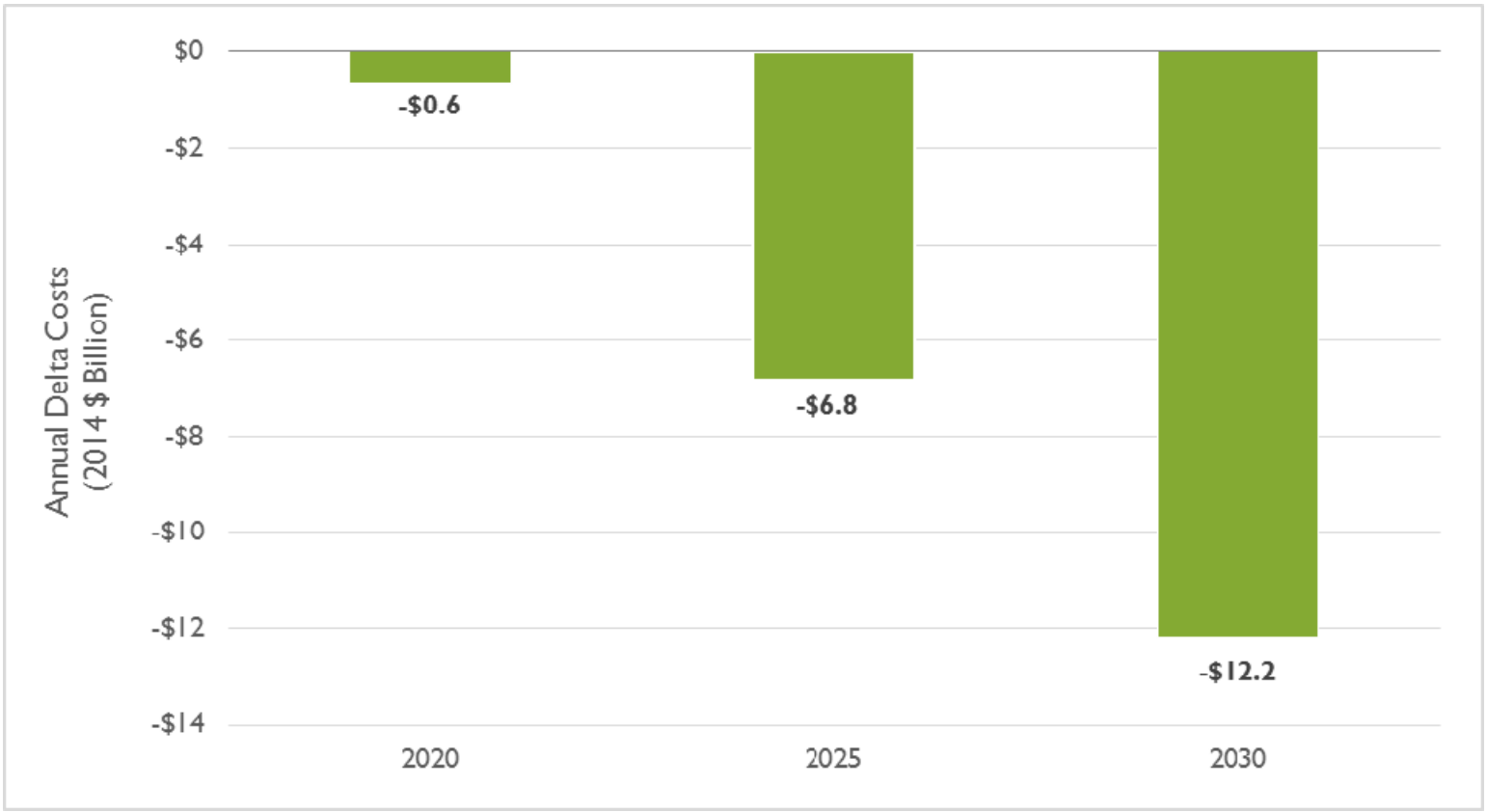
Step 5: Interpret the impact



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

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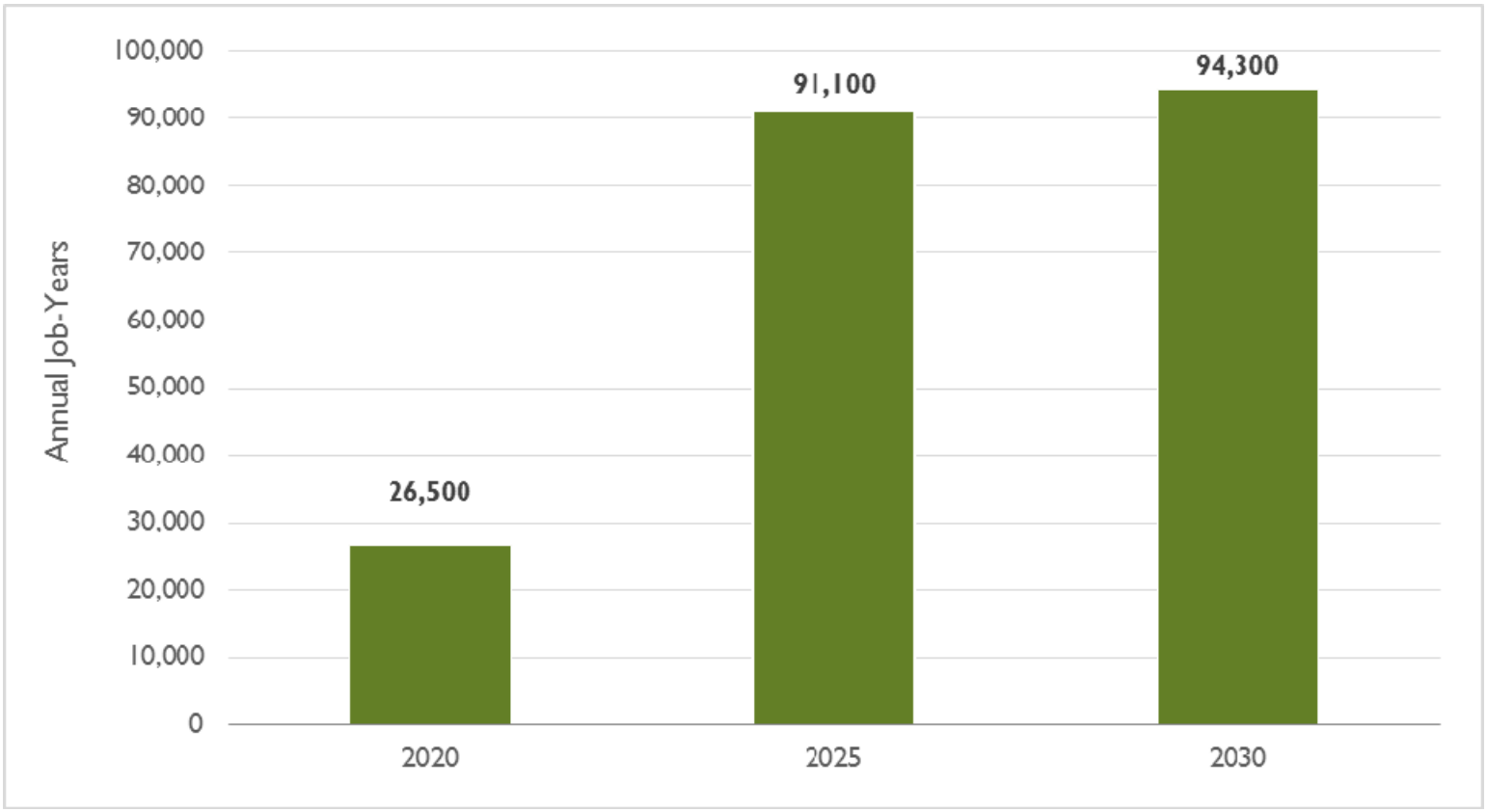
Step 5 (continued): Interpret the impact



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

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The Synapse Multi-Sector Toolkit

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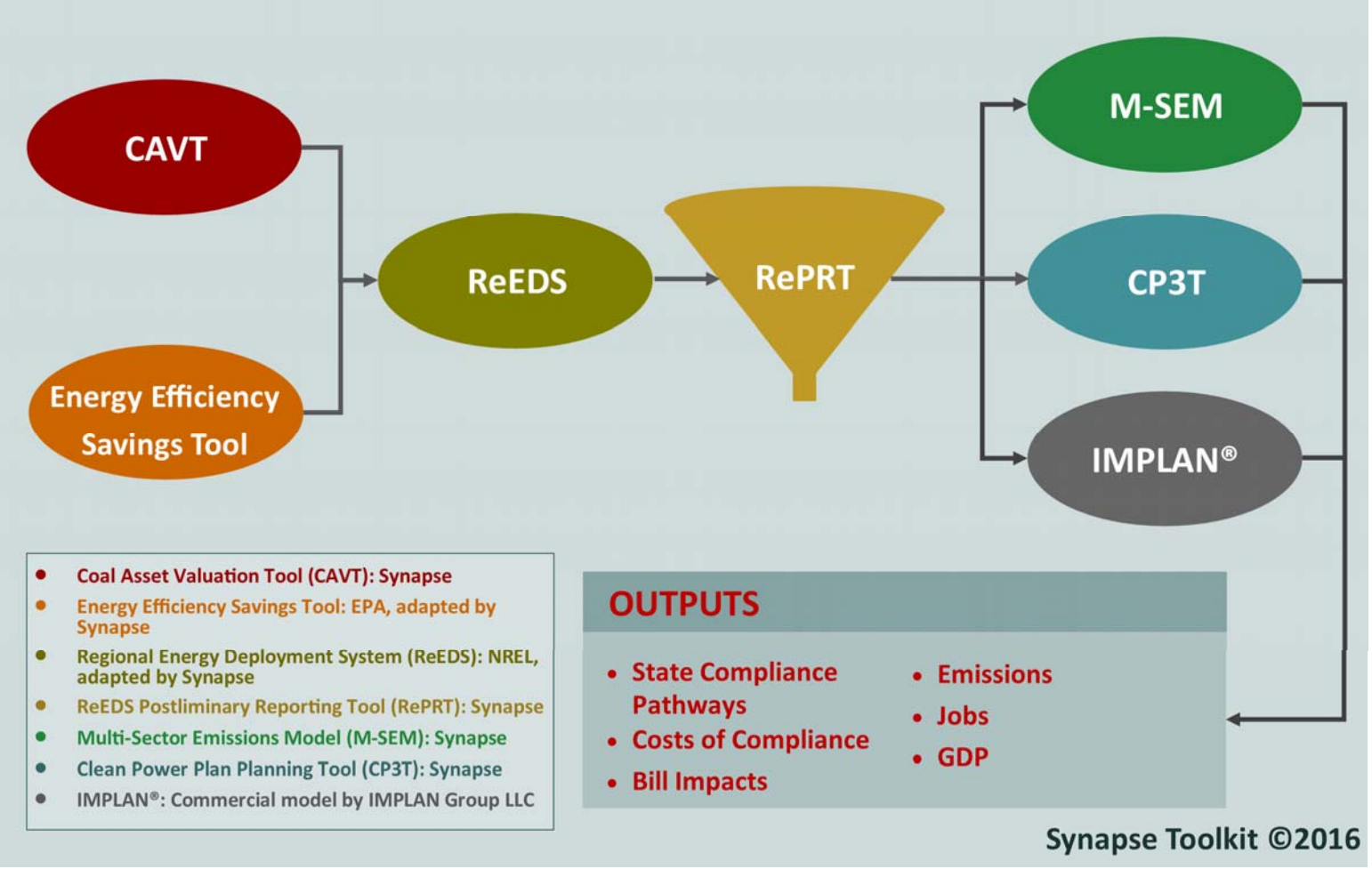

The Synapse Multi-Sector Toolkit

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)

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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

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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/.

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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/.

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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.

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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.

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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.

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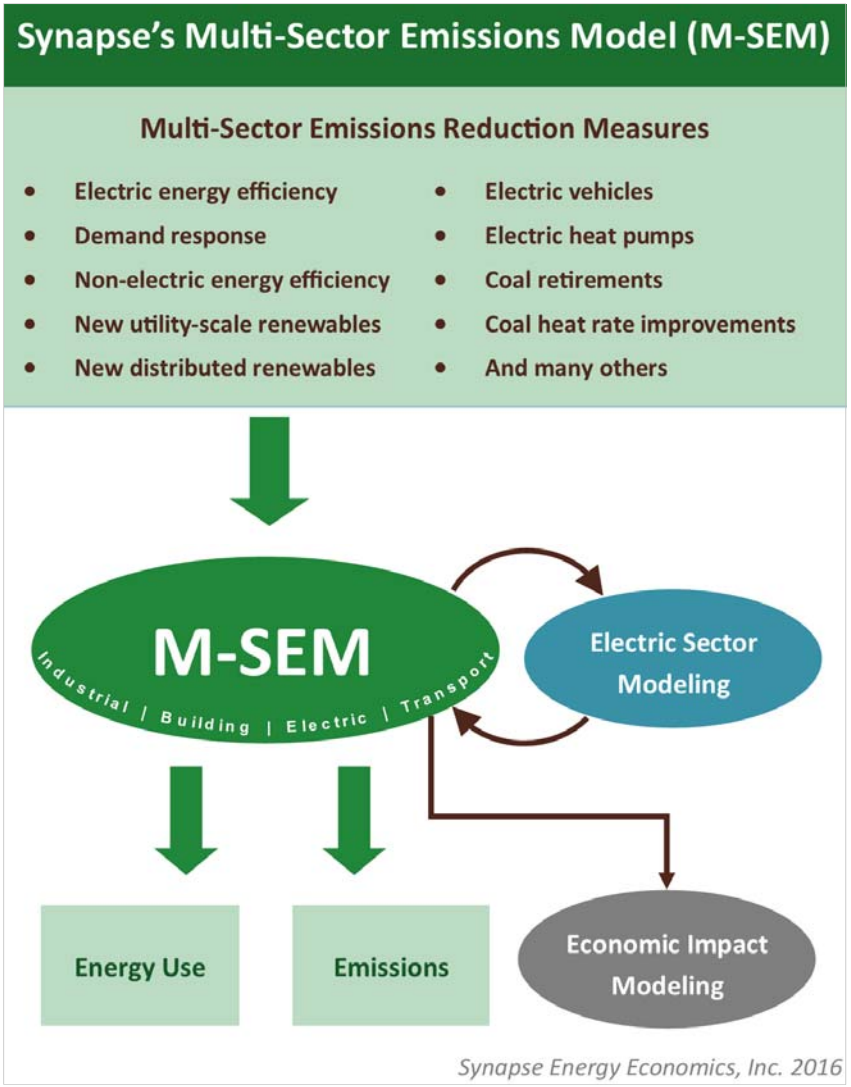
In-House Tools: Multi-Sector Emissions Model (M-SEM)

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



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Related Resources

Synapse Clean Power Plan Toolkit: http://synapse-energy.com/CleanPowerPlan

Past Clean Power Plan Webinars: http://synapse-energy.com/synapse-projects-and-webinars-related-clean-power-plan

Consumer Costs of Low-Emissions Futures Factsheets and Reports: http://synapse-energy.com/project/consumer-costs-low-emissions-futures

Clean Power Plan Handbook for National Association of State Utility Consumer Advocates: http://synapse-energy.com/sites/default/files/Clean-Power-Plan-Handbook.pdf

Synapse Blog Posts on Clean Power Plan: http://synapse-energy.com/tags/clean-power-plan

Guide to Clean Power Plan Modeling Tools (Synapse with Argonne National Laboratory): http://www.synapse-energy.com/project/clean-power-plan-modeling-tools-states-and-stakeholders

Synapse Electricity Snapshot 2016: http://www.synapse-energy.com/about-us/blog/synapse-electricity-snapshot-2016

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