Transportation & Climate Initiative

Reference Case Assumptions Webinar

May 23, 2019
Reference Case Assumptions

• The TCI analysis process begins with a Reference Case, which estimates emissions, fuel use, and other aspects of the transportation system in the absence of any TCI cap and invest policy.

• The states’ model is pre-loaded with assumptions set by the Energy Information Administration in the 2018 Annual Energy Outlook (AEO 2018).

• Those assumptions can be changed.

• The states seek input on what assumptions are most appropriate to include in the Reference Case.
Transportation Modeling using the National Energy Modeling System (NEMS)

May 23, 2019

Tracy Terry
Overview of NEMS

• The National Energy Modeling System (NEMS) is an integrated energy model that includes energy supply and production by fuel type, energy consumption by end-use sector, and energy conversion (electricity production & refining)

• NEMS was developed by the Energy Information Administration (EIA) – an independent agency within the Department of Energy
  – Used by EIA for its Annual Energy Outlook (AEO) projections, as well as Congressional and other agency requests
  – Also used extensively outside of EIA (NGOs, private sector, etc.)

• NEMS provides annual results through 2050 with significant detail by fuel and sector
Transportation Model Overview

• Energy use is modeled by transportation mode: light-duty vehicles, freight, aviation, bus, rail, etc.
• Transportation model uses a variety of inputs from other modules within NEMS to determine vehicle shares, fuel consumption, Vehicle Miles Traveled (VMT), etc.
  – GDP; sales of new cars and trucks; disposable income; population; industrial output; fuel prices
• Calculates transportation energy demand by fuel and feeds it back to the overall NEMS system
• Greatest detail for light-duty vehicles (LDVs) and freight trucks
Light-Duty Vehicles

• Significant technology detail for LDVs
  – Includes conventional/gasoline vehicles, hybrid and plug-in hybrid electric vehicles, CNG & LPG, fuel cell, and dedicated electric
• Market shares for vehicle types are calculated based on consumer preferences, vehicle costs, cost of driving, acceleration, range, etc.
• Model estimates new LDV fuel economy, price, horsepower, weight and range
  – Fuel economy is primarily driven by standards
• VMT is calculated based on the cost of driving (fuel & miles per gallon), disposable income per capita, employment rate, number of vehicles per driver
• NEMS tracks the vehicle stock by technology and vintage and accounts for sales, retirements and transfers each year
Key Assumptions and Inputs

• The analysis will be based on EIA’s Annual Energy Outlook 2018, but assumptions in AEO 2018 can be changed
  – Some assumptions can generally be changed easily (e.g., battery costs for EVs), while other can be somewhat more difficult.
• Battery costs for EVs and other technology cost assumptions
• Regional VMT growth
• Existing federal and state policies such as fuel economy standards for LDVs and commercial trucks, tax incentives for EVs, zero emission vehicle (ZEV) mandates, etc.
• Gasoline and diesel prices (calculated by NEMS based on world oil prices, U.S. oil production, refinery costs and inputs, demand)
Key NEMS Outputs

- CO$_2$ emissions by region and sector (including power sector CO$_2$ emissions)
- Price of CO$_2$ allowances and total revenue generated
- Annual energy consumption by fuel type, transportation mode, and region
  - Includes biofuels such as corn ethanol, cellulosic ethanol, biodiesel, biobutanol, and others
- Sales and stocks of LDVs by type (conventional gasoline, hybrids, PHEV, EV, etc)
- Fuel economy
- LDV and freight truck VMT
Reference Case Assumptions Review

- Electricity Sector & Regional Greenhouse Gas Initiative (RGGI)
- Technology Costs: Electric Vehicles & Batteries
- Federal Policies
- State Electric Vehicle Policies
- Fuel Prices
- Vehicle Miles Traveled (VMT) Growth
ELECTRICITY SECTOR & RGGI
Electricity Sector & RGGI

States’ Leaning: Adjust 2018 Annual Energy Outlook (AEO 2018) assumptions to reflect assumptions from latest NJDEP modeling of RGGI:

- Firm Builds & Retirements ([https://www.state.nj.us/dep/aqes/rggi.html](https://www.state.nj.us/dep/aqes/rggi.html))
- State Offshore Wind Goals & Procurements (8,480MW by 2030)
- State Renewable and Clean Energy Programs
- State Load Forecasts & Energy Efficiency Programs

- The states seek input on other important electricity assumptions to adjust.
AEO 2018 includes estimated per-kWh battery costs, which affect the cost of electric vehicles.

The states have identified a number of alternate sources for battery cost projections.

States’ leaning: use assumptions in recent NYSERDA-sponsored study.
2018: $209/kWh
2030: $99/kWh
2050: $90/kWh

The states seek input on the most appropriate projection source.

SOURCES:
New vehicle types are assumed to be introduced over time, but not all are available in every size class.

### AEO 2018 vehicle introduction year assumptions:

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>CARS</th>
<th>LIGHT TRUCKS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 Seater Cars</td>
<td>Mini Cars</td>
</tr>
<tr>
<td>Diesel/Electric Hybrid</td>
<td>2051</td>
<td>2051</td>
</tr>
<tr>
<td>Plug-In Hybrid (10 mile)</td>
<td>2015</td>
<td>2051</td>
</tr>
<tr>
<td>CNG Bi-Fuel</td>
<td>2051</td>
<td>2051</td>
</tr>
<tr>
<td>Dedicated CNG</td>
<td>2051</td>
<td>2051</td>
</tr>
</tbody>
</table>

The states seek input on introduction years for light truck EVs.
Fuel Economy Standards

• AEO 2018 includes current Federal fuel economy standards for light-duty vehicles (including light trucks) and heavy-duty vehicles (freight trucks).
  – Fuel economy standards for LDVs reach an average 46 mpg (tested mpg) by 2025.
  – Phase 2 standards for medium and heavy-duty vehicles apply to certain trailers of model years 2018-2027 and to semi-trucks, large pickup trucks, vans, and all buses and work trucks of model years 2021-2027.

• In August 2018, the Administration proposed freezing standards for LDVs in 2021 at 37 mpg.

• States’ leaning: Assume no freeze; explore impacts of freeze in sensitivity analysis later.

• The states seek input on what to assume for fuel economy standards, including after 2025.
Federal EV Tax Credit

• States’ leaning: Use OnLocation estimates for tax credit phase-out
• The Federal government offers tax credits of up to $7,500 for the purchase of electric vehicles.
• The tax credit eligibility and phase-out are tied to individual vehicle manufacturers and the phase-out begins when cumulative sales of qualified vehicles reach 200,000.
  – Because NEMS does not track vehicles sales by manufacturer, the credits are assumed to phase-out over time.
  – The AEO2018 phase-out rate appeared out-of-date, so OnLocation has modified it based on projections of manufacturers EV sales expectations.
STATE EV POLICIES
ZEV Mandates & State EV Incentives

• The AEO 2018 Reference Case includes Zero Emission Vehicle (ZEV) mandates for California, Connecticut, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Rhode Island, and Vermont.

• The requirement for sales of ZEVs starts at 4.5% of total sales for model year 2018 and increases to 22% for model year 2025. After 2025, requirements remain at 22%.

• TCI states currently provide a range of incentives for clean vehicles that meet the ZEV mandate requirements -- electric vehicles, plug-in hybrid electric vehicles, and fuel cell vehicles.

• These incentives could result in sales of ZEVs beyond the current state mandates.

• States’ Leaning: Include in the Reference Case both state ZEV mandates and existing state incentive programs.
Fuel Prices

- States' leaning: Use AEO 2018 Reference Case assumptions for oil and natural gas prices.
- In the AEO 2018 Reference Case, gasoline and diesel prices rise by 1.2% and 1.3% annually, respectively, from 2017 through 2050.
VMT GROWTH
VMT Growth

• States’ leaning: calibrate NEMS VMT growth to correspond to state projections.

Cumulative State-Determined VMT Projections for TCI Region

- TCI region Annual vehicle-miles traveled (billions)
- 2020-2030: 8% Increase
- 2020-2040: 16% Increase
OTHER STAKEHOLDER INPUT ON REFERENCE CASE ASSUMPTIONS
SUBMIT WRITTEN INPUT TO:
HTTPS://WWW.TRANSPORTATIONANDCLIMATE.ORG/MAIN-MENU/TCI-REGIONAL-POLICY-DESIGN-STAKEHOLDER-INPUT-FORM

BY 5PM, MAY 29TH