Transportation & Climate Initiative

Reference Case Assumptions Webinar

May 23, 2019

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Of the Northeast and Mid-Atlantic States

Reference Case Assumptions

- The TCI analysis process begins with a <u>Reference Case</u>, 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.**

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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

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ELECTRICITY SECTOR & RGGI

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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)
- State Offshore Wind Goals & Procurements (8,480MW by 2030)
- State Renewable and Clean Energy Programs
- State Load Forecasts & Energy Efficiency Programs
- National Renewable Energy Laboratory (NREL) Renewable Energy Cost Projections (2018 Annual Technology Baseline)

- The states seek input on other important electricity assumptions to adjust.

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TECHNOLOGY COSTS: EVS & BATTERIES

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Battery Costs

- 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.
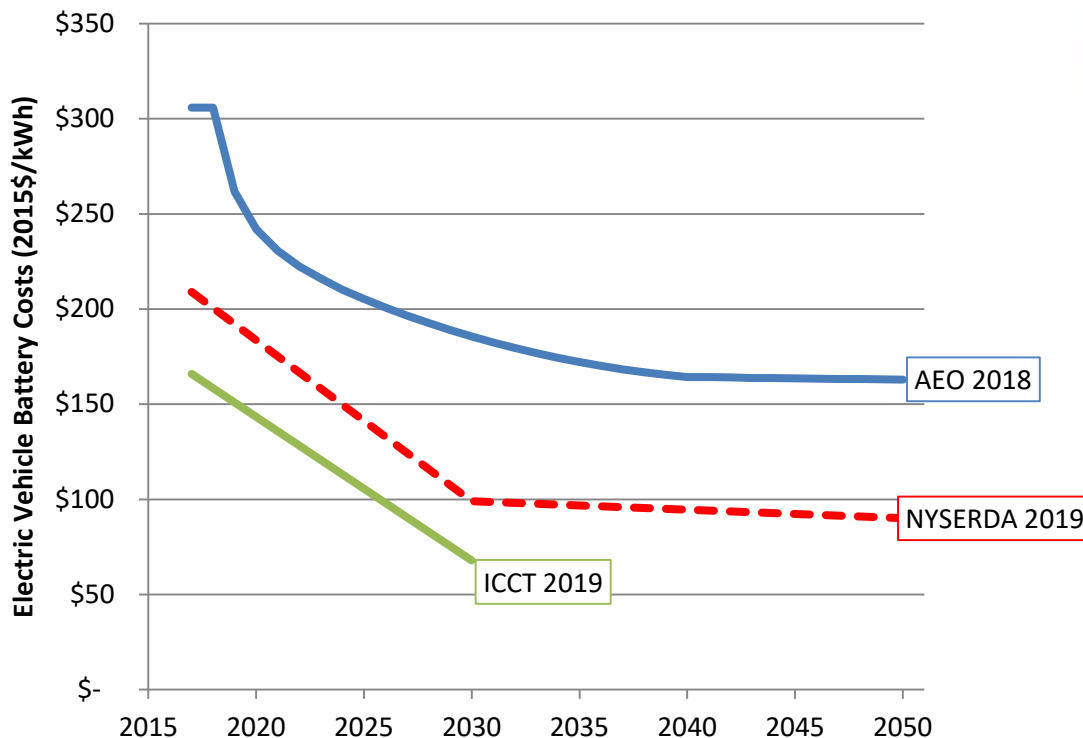
Vehicle Introduction Years

- 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:

	CARS						LIGHT TRUCKS					
	2 Seater Cars	Mini Cars	Subcom Cars	Compact Cars	Midsize Cars	Large Cars	Compact Pickups	Std Pickups	Compact Vans	Std Vans	Compact SUVs	Std SUVs
Turbo DI Diesel	2051	2051	2010	1990	2004	2007	2007	1995	2010	1990	2010	1995
Flex-Fuel Ethanol	2013	2015	2011	2009	2003	1993	1999	2002	1998	2003	2007	2002
Gasoline/Electric Hybrid	2015	2041	2011	1999	2005	2009	2017	2011	2016	2018	2008	2005
Diesel/Electric Hybrid	2051	2051	2040	2030	2030	2030	2051	2026	2030	2030	2030	2030
Plug-In Hybrid (10 mile)	2015	2051	2025	2014	2012	2014	2051	2051	2018	2051	2016	2051
Plug-In Hybrid (40 mile)	2020	2051	2018	2011	2014	2015	2019	2051	2020	2051	2018	2020
Electric Vehicle - 100 mile	2014	2015	1995	2011	2011	2051	2051	2051	2018	2051	2018	2051
Electric Vehicle - 200 mile	1995	2051	2020	2018	2018	2013	2019	2051	2020	2051	2016	2020
Electric Vehicle - 300 mile	2020	2051	2020	2020	2015	2012	2051	2051	2051	2051	2016	2016
CNG Bi-Fuel	2051	2051	2051	1990	2051	2000	2051	1990	2051	1990	2051	2051
Dedicated CNG	2051	2051	2051	1990	2051	1990	2051	1990	2051	1990	2051	2051
Hydrogen Fuel Cell	2051	2051	2012	2020	2012	2012	2051	2051	2015	2051	2015	2025

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

FEDERAL POLICIES

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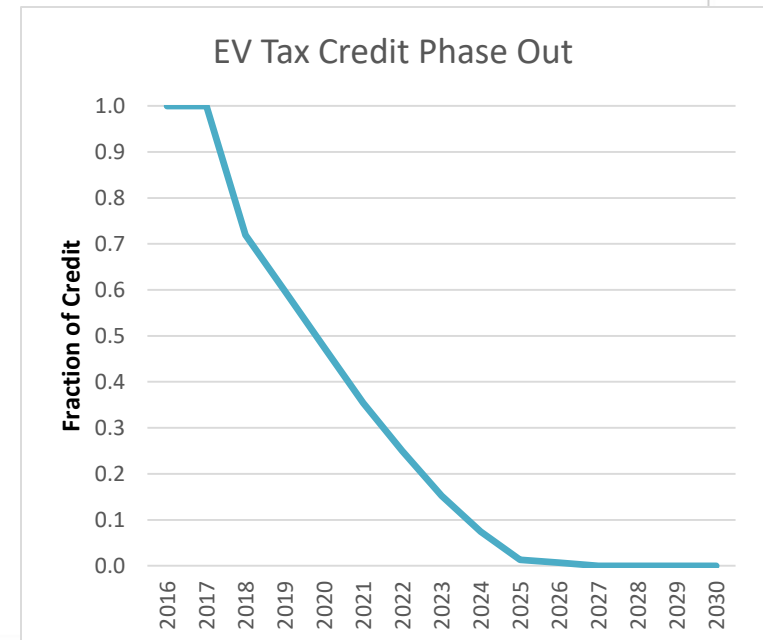Of the Northeast and Mid-Atlantic States

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.

EV Tax Credit Phase Out

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STATE EV POLICIES

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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.

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FUEL PRICES

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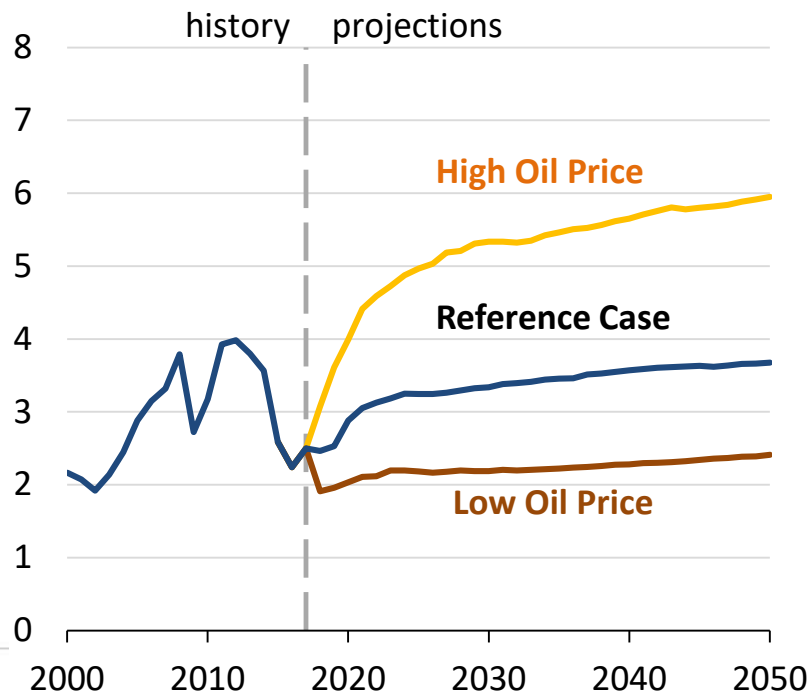Of the Northeast and Mid-Atlantic States

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.

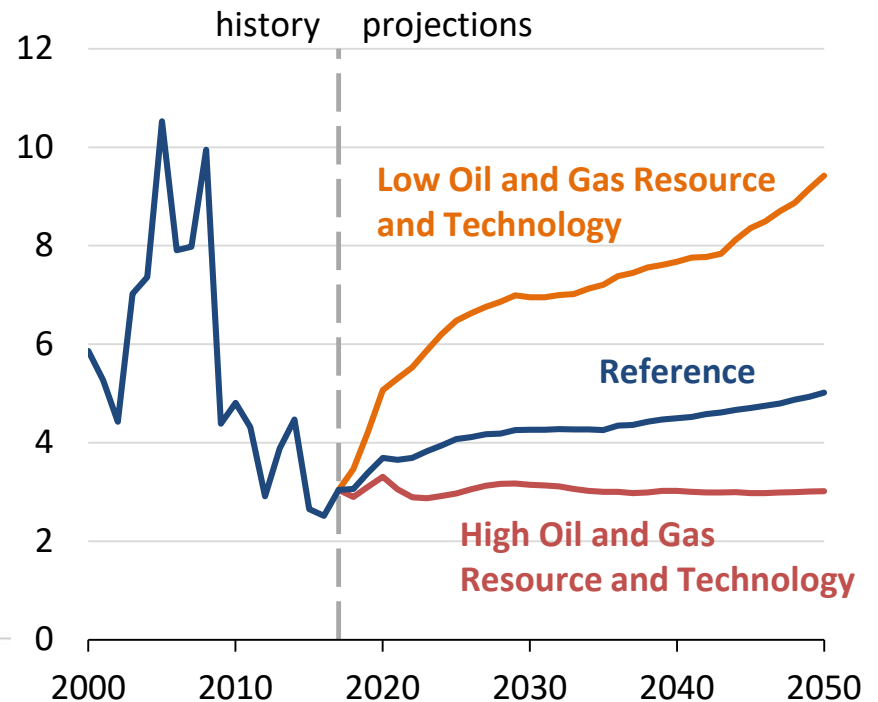**Motor gasoline retail prices**
2017 dollars per gallon

Natural gas spot price at Henry Hub
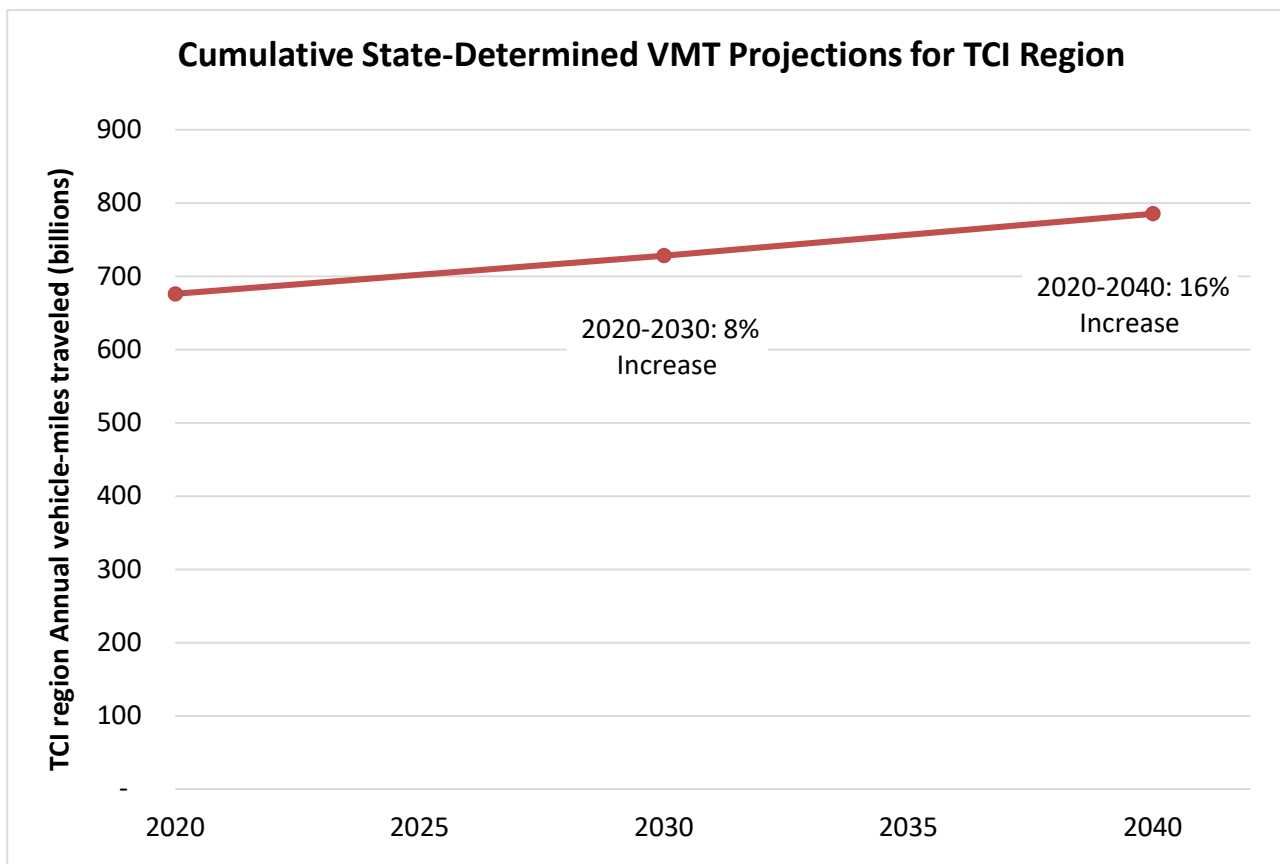2017 dollars per million British thermal units

VMT GROWTH

VMT Growth

- States' leaning: calibrate NEMS VMT growth to correspond to state projections.

Cumulative State-Determined VMT Projections for TCI Region

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

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