Independent Statistics & Analysis
U.S. Energy Information Administration

October 20, 2021

MEMORANDUM FOR: Angelina LaRose
Assistant Administrator for Energy Analysis

FROM: Jim Diefenderfer
Director, Office of Long-Term Energy Modeling

SUBJECT: Summary of AEO2022 Transportation Working Group held on Thursday, September 30, 2021

This memorandum summarizes our presentation and discussion at the second *Annual Energy Outlook 2022* (AEO2022) Transportation Working Group meeting. The Transportation Working Group presentation covered preliminary results from the AEO2022 Reference case transportation projections. It also highlighted historical transportation data and modeling updates in progress for the Transportation Demand Module (TDM) for the AEO2022 Reference case, as set up in our National Energy Modeling System (NEMS). After the presentation, meeting participants commented on additional model and data topics. The presentation for this meeting is available in a separate document on our website.

Preliminary Model Updates (AEO2022)

Highlights from the presentation primarily relate to preliminary AEO2022 Reference case model results. These results include:

- Macroeconomic assumptions and projections
- Light-duty vehicle (LDV) travel demand projections
- Medium- and heavy-duty vehicle (HDV) energy consumption
- Aviation model updates

We presented updates on progress in the following model areas:

- Light-duty vehicles—Light-duty vehicle stock data update, new battery model integration, regional sales and stock distribution revision, and pending policy changes under consideration
- Heavy-duty vehicles—Regional travel and stock data update, new electric vehicle (EV) powertrain, and battery model integration
- Public transit—Bus and passenger rail travel update, travel demand equation re-estimation, and transit bus fuel choice update

Discussion

During the discussion, participants' questions primarily focused on potential policy changes, EV topics including battery technology, charging infrastructure, and battery model updates, as well as model technologies for freight and heavy-duty vehicles.

Potential policy changes

Participants asked if the LDV fuel economy projections account for the U.S. Environmental Protection Agency's (EPA) proposed rule to revise existing national greenhouse gas emissions standards for passenger cars and light trucks through model year 2026. We answered that the AEO2022 Reference case reflects current laws and regulations and does not account for proposed rulemaking. Therefore, the AEO2022 Reference case includes the Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule issued for model years 2021 through 2026 passed in early 2020, and it includes the One National Program Rule passed in late 2019. One participant asked us to clarify the source of EV technology costs, and we referred to the SAFE ruling, but we assured participants that EV technology costs will be updated to reflect values based on the review of the 2020 model input files underlying National Highway Traffic Safety Administration (NHTSA) final Environmental Impact Statement.

We were asked to specify which state programs and regulations are accounted for in the model. We responded that the NEMS TDM accounts for California's Senate Bill 32 (SB-32), which aims to reduce passenger vehicle travel. SB-32 does not account for other state goals such as internal combustion engine (ICE) bans or zero emission vehicle (ZEV) mandates. ICE bans and ZEV mandates are not enforceable under current law and regulations applied for AEO2022.

A participant asked if the AEO2022 Reference case contains a scenario where the U.S. government defaults and ends up in a recession. We explained that cases for this specific scenario are not included in the AEO2022 Reference case. However, we publish High and Low Macroeconomic side cases that can be used to analyze economic growth and energy consumption. Another participant asked a follow-up question on whether or not we have assumptions for the proposed Infrastructure Investment and Jobs Act, to which we responded we do not have current assumptions for proposed infrastructure bills because the bill is not reflective of current law and regulation.

Electric vehicle topics

The majority of discussion questions focused on topics related to EVs. A participant asked if we plan on updating other EV cost modeling for vehicle components while implementing the new battery cost model. We responded that our non-battery vehicle component costs are based on NHTSA data and that we plan to update other EV operations parameters that influence total cost including battery energy density and maximum depth of discharge.

A participant asked us to clarify the share of EVs in the LDV stock for current AEO projections and inquired how updated battery cost figures will perform after implementing updated battery figures. Currently, we are improving several components of the model that make predicting how the EV share of stocks will perform. However, AEO2021 projected that plug-in EVs (including fully electric and plug-in hybrid EVs) reach 8% of the total LDV stock in 2050. We expect the battery cost update will result in a higher share of plug-in EV stock when compared with AEO2021, but we cannot confirm at this time.

A participant asked if we could provide more information and data for battery costs and performance. We answered that the assumptions, methodology, and input parameter values will be available when the AEO2022 is published in early 2022. Currently, the NEMS TDM assumes battery cost reductions are related to cumulative production and are similar to Wright's Law. Each doubling in cumulative production results in a corresponding percentage decrease in the battery cost, otherwise called the *learning rate*. A key update to the model is to increase this learning rate. We noted that the battery cost model provides an estimate of retail price equivalent battery costs, or the cost to the consumer purchasing the vehicle. A follow-up question asked us to clarify whether the battery price model is based on domestic or global battery production and requested information regarding the markup of battery price. We informed the participant that learning rate is based on global battery production and pricing but model production values are domestic only and that batteries prices assume a 50% markup.

Next, participants inquired about our data source for battery EV (BEV) fleet penetration. We informed them that we annually purchase Polk vehicle registration data to understand how many vehicles are in the fleet by region, powertrain, vintage, and type, which informs our BEV fleet penetration. A participant asked whether BEVs will reach purchase price parity with gasoline LDVs. We explained that price parity does not seem likely unless a battery technology revolution further reduces prices. In addition, EVs would need to reach both purchase price parity as well as performance and functionality parity. Battery powered vehicles need to be as affordable as gasoline vehicles while also being equally convenient to refuel and equally equipped to drive long distances.

Participants asked a few questions about the NEMS TDM. First, a participant asked about our assumptions regarding the number of EV charging stations. We answered that the NEMS TDM does not project counts or locations for EV charging infrastructure. We plan to talk with NEMS Electricity Market Module (EMM) staff about implementing new model components that account for the cost of EV infrastructure and availability. A participant followed up and asked if access to charging is a component of the LDV consumer choice model, which would mean EV deployment could be based on infrastructure constraints. We responded that whole access to charging is an important consideration for consumers who decide whether or not to purchase a vehicle with plug-in capabilities. Although important, it is not clear if the lack of infrastructure is restraining sales or if infrastructure is waiting on sales to provide a feasible business model. NEMS TDM assumes that infrastructure will increase proportionally with EV sales and neither promote nor limit EV adoption. However, the consumer choice model does include fuel availability in the utility equation used.

Other topics

Specific to the impact of the COVID-19 pandemic, a participant asked how the pandemic has affected freight demand and to what extent medium- and heavy-duty truck (MHDV) electrification are included within the model. First, we explained that industrial output is the driver for on-road freight demand in the NEMS TDM. We did not apply adjustments to freight model results since the results respond appropriately to industrial output projections from the macroeconomic module. Second, the freight truck vehicle choice component of NEMS TDM includes electric trucks as an option, and we are currently working on updates to the model as well as tracking the latest market developments for electric freight trucks.

A participant asked for the difference in battery pack prices when comparing light-duty vehicle pack prices to freight truck battery pack prices. We noted that data on freight truck battery prices can sometimes be unreliable, and our current research of freight truck battery pack prices has alluded to a price 1.5−2 times higher when compared with LDV battery packs.

Regarding heavy-duty trucks, a participant asked if we made changes to heavy-duty truck technology or efficiency and how much oil price matters. We answered that we made no additional changes to heavy-duty truck technology or efficiency for AEO2022. Also, oil price is important in the fuel choice component, but whether oil price is the major driver or another driver in the freight truck projections remains unclear. A follow-on question by a participant asked if we have specifics on which HDV industry outputs have changed. We answered that agriculture, mining, and construction all decreased in the projection when compared with AEO2021. However, for industry outputs not mentioned, we recommend contacting the Macroeconomic team for further insight.

A participant commented that work-from-home does not appear to be relevant in the long-term projections and asked if we could comment on the trend within the TDM model. We explained that we do not explicitly account for the telework trend. Instead, we apply COVID-19 assumptions to reduce vehicle miles travelled (VMT) by a small percentage. This small percentage reduction applied to VMT in the long term accounts for some of the potential long-term downward pressure on VMT.

Lastly, a participant inquired about side cases included alongside the AEO2022 Reference case. We replied that we are planning on including side cases, although the specific side cases have not been determined yet.

Attendees

Guests (Webex/phone)

Samaneh Babaee	OnLocation, Inc
Megan Beardsley	U.S. Environmental Protection Agency
Daniel Bizer-Cox	U.S. Environmental Protection Agency
Akshay Delity	U.S. Environmental Protection Agency
Katya Garcia-Israel	U.S. Department of Transportation
David Gohlke	Argonne National Laboratory
Kevin Green	U.S. Department of Transportation
Michael Hartrick	Alliance For Automotive Innovation
Robert Hershey	Professional
Michael Hilliard	Oak Ridge National Laboratory
Aaron Hula	U.S. Environmental Protection Agency
Bryan Just	American Petroleum Institute
Ben King	Rhodium Group
Hannah Kolus	Rhodium Group
Elizabeth McNamee	U.S. Department of Energy
John Meyer	Leidos
Neil Miller	U.S. Environmental Protection Agency
Tiffany Mo	U.S. Environmental Protection Agency
Evvan Morton	U.S. Department of Energy
Steve Plotkin	Argonne National Laboratory
Gregory Powell	U.S. Department of Transportation
Christopher Ramig	U.S. Environmental Protection Agency
Kevin Shen	Union of Concerned Scientists
Wyatt Thompson	University of Missouri
Clayton Vernon	Sunoco
Alex Wang	U.S. Environmental Protection Agency
Jarrett Whistance	University of Missouri
Frances Wood	OnLocation, Inc
Arthur Yip	National Renewable Energy Laboratory

EIA attendees (Webex/phone)

Erin Boedecker	Mala Kline	Mark Schipper
Caroline Campbell	John Maples	Nicholas Skarzynski
Jim Diefenderfer	Elizabeth May	Courtney Sourmehi
Michael Dwyer	Kelly Perl	Michael Stanley
Travis Freidman	James Preciado	Thomas White
Mindi Farber-DeAnda	Mark Schipper	