June 6, 2018

MEMORANDUM FOR: Ian Mead
                        Assistant Administrator for Energy Analysis

FROM: Jim Turnure
                        Director, Office of Energy Consumption and Efficiency Analysis

SUBJECT: Summary of AEO2019 Transportation Working Group held on Thursday,
                        May 31, 2018

The first Transportation Working Group presented the results from the Annual Energy Outlook 2018 (AEO2018) and modeling updates for the AEO2019 Reference case. Afterwards, input was solicited on additional model updates in subsequent years. The presentation for this meeting is available in a separate document on EIA's website.

Model updates (AEO2019)

Highlights from the presentation related to planned updates including model improvements to capture the addition of crossover utility vehicles (CUVs) and the development of an economic model for fleet operator adoption of highly automated and autonomous vehicles.

Discussion

The discussion mainly focused on questions related to AEO2018 results and planned AEO2019 modeling updates.

Model results (AEO2018)

Several questions dealt with light-duty vehicles. In particular, these questions focused on obtaining a better understanding of why the demand for motor gasoline and the energy demand for light-duty vehicles decreases in the short- to mid-term and then increases in the long term. Participants also asked for further clarification and explanation on why the car and light truck sales split was significantly different between AEO2017 and AEO2018.

Staff explained that the reason light-duty vehicle energy consumption (which is primarily motor gasoline) decreases in the near and mid run and increases in the long run is related to fuel economy and vehicle miles traveled (VMT). Over the near horizon, the effects of an increase in light-duty vehicle fuel economy outpaces energy demands resulting from increases in VMT. Over the more distant horizon, because fuel economy standards are not increasing through the whole projection period, increases in consumption related to increases in VMT overtake decreases resulting from fuel economy improvements.

The change in the car and light-truck sales split between the AEOs results from a data update. For AEO 2017, base-year sales data from mid-year 2015 used in the model had significantly more light-trucks

than the final 2015 dataset. Further, AEO2018 received the final model year 2016 data set which changed the split further.

Further, participants asked how changes in fuel prices and macroeconomic growth affected the projections in AEO2018 and how further changes may affect the results in subsequent AEOs. EIA analysts discussed how AEO2019 would include historical data updates that may require updates to important model parameters. This discussion also included how EIA models current laws and regulations and that these effect projections along with fuel price and macroeconomic factors.

Model updates (AEO2019)

This discussion focused primarily on light-duty vehicles, automated vehicles, and maritime transport.

Light duty vehicles. EIA is proposing to add crossover utility vehicles (CUVs) as four size classes to the light-duty vehicle model (small and large CUV in both the car and light-truck vehicle types). In general, the participants were pleased to hear that EIA is considering adding CUVs because of their large market share. Participants asked for further explanation of how the addition of these size classes will affect modeling and results. EIA staff explained that the CUVs will be added as an option in the consumer vehicle choice model. Each category of CUVs will have their own set of vehicle attributes and adopt vehicle technology to meet fuel economy standards. Because of differences in vehicle attributes and fuel economy, energy consumption may change.

Related to consumer choice and the shift to CUVs and vehicles with lower fuel economy, participants wanted to better understand how often EIA updates its consumer choice coefficients to reflect changing market dynamics. EIA staff explained that it updates its consumer choice coefficients yearly to try to reflect changes in consumer preference. However, EIA also models current law and regulation which may result in model results that do not align with changing trends in consumer preference. Further, EIA does not model all state or local laws that could affect light-duty vehicle sales.

For new light-duty vehicle sales, EIA uses the National Highway Traffic Safety Administration (NHTSA) and U.S. Environmental Protection Agency (EPA) definitions of car and light-truck. Based on the NHTSA and EPA definition, a vehicle of the same make and model could be classified as a car and a light-truck depending on if it is two-wheel or all-wheel drive or based on another specification. However, the stock data that EIA uses is based on the traditional definitions of car and light-truck. EIA is proposing to align the stock data with NHTSA's and EPA's definition of car and light-truck.

The discussion then turned towards the expected changes from the redefinition of cars and light trucks. EIA staff indicated that while the updated stock data has not been added to the model the expectation is that there will not be large changes to the total stocks of cars and light-trucks or to energy consumption. The reason for this expected outcome is that the last stock update in AEO2018 was for 2014. The definitional change did not take effect until model year 2011. This means that only four model years of vehicles will need to be redefined.

There was also a discussion on VMT. Participants asked about how VMT is changing and if there is a regional or urbanization change taking place affecting this measure. Staff explained that there are indeed regional differences—for example, California has a law (SB32) to reduce GHG emissions. The targeted reductions in vehicle travel outlined in this law are included in the transportation model, lowering VMT below the projected levels in Census Division 9 if the law was not in place. To better

reflect these differences and their effect on regional fuel consumption, EIA is considering the addition of a regional component to the stock fuel economy calculations based on region specific VMT and scrappage rates. EIA staff are also beginning to investigate the differences in light-duty vehicle travel based on the proportion of Census Divisions that are considered urban, suburban, or rural.

Automated vehicles. EIA is in the beginning stages of a multi-year model update to better incorporate automated and autonomous vehicles and ride-hailing into the transportation model. Because of the uncertainties surrounding the development and adoption of autonomous vehicles, EIA plans to host an autonomous vehicle and ride-hailing workshop or working group later this year. Participants seemed excited about the idea of an autonomous vehicle workshop and were encouraged to reach out to EIA if they were interested in participating.

EIA presented the automated and autonomous vehicle model updates in three sections. The first section discussed completed updates, including the addition of levels 1-3 automation to the technology adoption menu and the addition of platooning by class 7 and 8 tractors. The second section discussed the conceptual concept of the complete model update. The third section discussed proposed updates to be completed for AEO2019.

Participants asked for clarification on how levels 1-3 vehicle automation inclusion would affect model results and dynamics, including compliance with Corporate Average Fuel Economy Standards (CAFE). Explanation included how these technologies have attributes such as additional cost and weight, how changes in weight can affect fuel economy, and a reminder that manufacturer groups in the model comply with CAFE standards.

The proposed AEO2019 updates include an economic model for the new taxi/ride-hail fleet category and non-economic assumptions of household adoption. EIA is currently assuming that the adoption of highly-automated and autonomous vehicles by households will lag that of fleet vehicles. Participants asked EIA to clarify this assumption. The reason for this assumption is based on reports by manufacturers and technology developers. The manufacturers and technology developers that are furthest along in the development of autonomous technology say that the vehicles will enter fleets as ride-hailing vehicles. These vehicles may not be for sale but instead owned and managed by the developers. However other manufactures and technology developers believe that the vehicles will be available for household purchase.

Participants also wanted to understand how EIA is considering connectivity. Currently EIA is approaching highly automated and autonomous vehicles without assuming connectivity is essential to their development. While we understand that connectivity could speed up the development of highly automated and autonomous vehicles, improve the throughput on roads, change the interaction between light-duty vehicle and public transportation use, affect fuel efficiency, and have infrastructure implications, this is not something we will be adding to our model in AEO2019. It is something that we will look into for future AEOs as the new model is developed.

Maritime transport. The discussion centered on the demand for heavy (high-sulfur) residual fuel oil by the international marine sector, penetration of liquefied natural gas as a fuel in the global marine sector, and use of on-board scrubbers by ship operators to comply with global sulfur regulations. Participants

noted that fuel costs range between 40% and 60% of a vessel's operating total cost, depending on the type of vessel. Participants also related discussions on the recent international maritime de-carbonization efforts.

As background, about 3 million barrels per day of high-sulfur petroleum product is consumed globally by ocean-going vessels, mainly residual or intermediate fuel oil. The current global limit for sulfur content of ships' fuel oil is 3.5% m/m (mass by mass). The new global limit will be 0.5% m/m and will apply on and after January 1, 2020, which was the one of two dates adopted in 2008 by member countries of the International Maritime Organization (IMO) and subsequently decided upon in October 2016.

IMO monitors the sulfur content of fuel oil used on ships globally. Samples taken of residual fuel oil–the "heavy" fuel oil commonly used on ships–estimate sulfur content at 2.45% m/m, based on 2015 IMO testing.

Participants generally agreed that the global fleet's uptake of on-board scrubbers has been negligible and on the general reasonableness of the AEO2018 projections with respect to international marine fuel demands. EIA stated that it plans to maintain an ongoing review of model projections (both supply and demand) by the National Energy Modeling System analysts with respect to international maritime activity for AEO2019.

Attendees

Guests (in person)

Alicia Birky	Energetics
Steve Chalk	DOE
Michael Dwyer	Energetics
Karl Fails	Sunoco
Kelly Fleming	DOE
Sarah Garman	DOE
Jennifer Li	DOE
John Meyer	Leidos
Maria Cecilia P. Moura	Union of Concerned Scientists
Rachael Nealer	DOE
Kara Podkaminer	DOE
Clayton Vernon	Sunoco
Tom White	DOE

Guests (WebEx/phone)

Youngsun Baek	Union of Concerned Scientists
Austin Brown	UC Davis
Ed Coe	EPA
Angela Cullen	EPA
John Davies	DOT
Dominic DiCicco	Ford
David Gohlke	DOE

Mike Hartick	Auto Alliance
Whitney Herndon	Rhodium Group
Ken Howden	DOE
Aaron Hula	EPA
Bryan Just	API
Tina Kaarsberg	DOE
Ken Katz	DOT
Ryan Keefe	DOT
Ria Kontou	NREL
Nico Kydes	OnLocation
Michael Laughlin	Energetics
Amanda Levin	NRDC
Dana Lowell	MJ Bradley
Chris Nevers	Auto Alliance
Steve O'Malley	Leidos
David Pickeral	
Don Pickrell	DOT
Hannah Pitt	Rhodium Group
Christopher Ramig	EPA
Michael Schaal	Energy Ventures Analysis
Robert Schutz	Leena Labs
Michael Shelby	EPA
Thomas Stephens	ANL
Wyatt Thompson	University of Missouri
John Van Schalkwyk	DOT
Jake Ward	DOE
Jarrett Whistance	University of Missouri
Evelyn Wright	Sustainable Energy Economics
Lester Wyborny	EPA
Starla Yeh	NRDC
Arthur Yip	CMU
Yan Zhou	ANL

EIA attendees (in person)
Nicholas Chase
Michael Cole
John Conti
David Daniels
Steve Hanson
Melissa Lynes
John Maples
Fred Mayes
Shirley Neff
James Preciado

Mark Schipper
David Stone
Russ Tarver

<u>EIA attendees (WebEx/phone)</u>
Mindi Farber-DeAnda
Beth May
Mike Stanley