Independent Statistics & Analysis
U.S. Energy Information Administration

September 28, 2021

MEMORANDUM FOR: Angelina LaRose
Assistant Administrator for Energy Analysis

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

SUBJECT: Summary of second AEO2022 Buildings Working Group held on September 28, 2021

This memorandum provides an overview of the presentation given at the second *Annual Energy Outlook 2022* (AEO2022) Buildings Working Group meeting and summarizes the discussion. The meeting focused on how preliminary AEO2022 Reference case results compare with AEO2021 Reference case results. It also highlighted the major modeling and data updates that we incorporated for AEO2022. The presentation for this meeting is available in a separate document.

AEO2022 results overview and comparison with AEO2021

The meeting began with a discussion about the preliminary delivered energy consumption projections by fuel and sector. We then compared preliminary AEO2022 results with AEO2021 results. We showed a comparison of residential and commercial electricity and natural gas prices, and we explained that near- and long-term differences in fuel prices represent uncertainty associated with the recovery from the pandemic. We shared preliminary projections of higher residential electricity prices and lower natural gas prices compared with the AEO2021. We tentatively project the opposite in the commercial sector, where electricity prices are lower through 2050 than in the AEO2021 and natural gas prices are slightly higher.

We shared projected heating and cooling degree day data and described how we use a 30-year linear trend based on historical weather data from the National Oceanic and Atmospheric Administration (NOAA) for 1999 to 2020. The starting point for this trend (in 2023) begins from the end of NOAA's 15-month short-term forecast. Generally, we project fewer heating degree days than in AEO2021 and similar or slightly more cooling degree days through 2050.

We presented residential housing stocks and commercial floorspace, which grow at 0.7% and 1% per year, respectively, from 2021 to 2050. The Macroeconomic Activity Module of the National Energy Modeling System (NEMS) projects growth in residential housing starts and commercial floorspace, both key drivers of buildings energy consumption. Increasing energy efficiency of major end-use equipment is offsetting some growth in energy use even as housing stocks and total floorspace continue to grow.

We then presented AEO2022 Reference case data for residential- and commercial-sector energy consumption. We project electricity consumption to grow in both the residential and commercial sectors, as fast as or slightly slower than in the AEO2021 Reference case. Natural gas and petroleum use decrease in the residential sector and increase slightly in the commercial sector relative to AEO2021. In the commercial sector, electricity consumption grows three-times faster than natural gas consumption, which is consistent with the AEO2021. Overall, buildings consumption of petroleum liquids and other fuels decreases from 2021 to 2050.

AEO2022 model updates, policy updates, and historical updates

We discussed various updates for the AEO2022. We highlighted our work to incorporate a new contractor report that updates and adds new characterizations for residential and commercial miscellaneous electric loads (MELs). We showed how electricity use for television and computer-related consumption projections have changed since AEO2021 based on this report. As the installed base and the unit energy consumption (UEC) of devices change over time, related energy consumption changes as well. For example, we shared that plug-in devices are generally consuming less energy as over-the-top streaming devices replace more energy-intensive Blu-ray players and VCRs. Starting with the AEO2022, we no longer explicitly model Blu-ray and VCR consumption, reflecting the decline of these devices in U.S. households since our last MELs update in 2013.

We project more residential computing equipment and related energy consumption in AEO2022, compared with past AEOs, based on growing rural broadband availability, more monitors per computer, and increased use of integrated access devices that combine modems and routers into a single unit. In addition, laptop and desktop computer UECs do not decrease over time as much as in the past report.

Increasing use of data center services in commercial buildings has increased commercial computing consumption relative to AEO2021 and is projected to increase over time. Electricity use from video displays is significantly lower than in AEO2021.

For the first time, the residential model endogenously accounts for historical housing demolitions to calculate average annual reductions in housing stocks. We use historical changes in housing stocks and starts from 1991 through 2015—the base year of our residential model—to project future demolitions. This model update allows interactions that can automatically account for revised historical data and potentially allow for more dynamic projections in side cases where macroeconomic activity varies.

We discussed residential and commercial solar photovoltaic (PV) capacity projections. The AEO2022 reflects historical capacity through 2020. Revised higher historical installed system costs and smaller average system sizes reflected in Lawrence Berkeley National Laboratory's latest *Tracking the Sun* report account for some differences in solar PV capacity between AEO2021 and AEO2022. AEO2022 includes

extended federal energy efficiency rebates and renewables tax credits from the Consolidated Appropriations Act, 2021, which were not included in the AEO2021.

We described how installed PV system costs have been relatively flat in the residential sector and that commercial sector PV system cost declines have slowed in recent years. For this reason, we used National Renewable Energy Laboratory's *2021 Annual Technology Baseline* conservative case to develop projected PV costs.

Other items

We shared the latest available information about our publications, including the upcoming release of the *Short-Term Energy Outlook* on October 13, the availability of buildings characteristics tables from the *2018 Commercial Buildings Energy Consumption Survey* (CBECS), and information about the *2020 Residential Energy Consumption Survey* to be released in early 2022.

We highlighted a list of buildings-related reports, including recently updated reports on modeling distributed generation in the buildings sector and the latest MELs report.

Finally, we mentioned that we are hiring new employees and indicated that further information is available on our careers web page.

Discussion

A participant asked for more information about a planned set of side cases exploring the impact of alternative weather assumptions. We explained that we are exploring altering the projected rate of change for heating and cooling degree days and using fewer historical years to define our projected weather trend. We intend to explore impacts not only on commercial and residential buildings but also on fuel supply.

A participant requested more information about whether we assume that demolished homes are automatically replaced with new homes or if demolished homes represent a net decrease in housing stock. We do not assume demolished homes are automatically replaced, nor do we assume any equipment from demolished homes goes to a second-hand market. We use housing starts projected from the Macroeconomic model.

Finally, a participant asked whether data centers are treated as a distinct building type in NEMS, and whether we will consider treating cloud service data centers and on-premises data centers as a separate building type in the future. We explained that NEMS buildings types are based on the principal building activities listed in CBECS, which we use to estimate the share of data centers among large office buildings. Although we don't currently have a separate building type for data centers or different data center types in NEMS, we do account for additional data center ventilation, cooling, and other data center energy uses in large office buildings.

We shared that the Transportation Energy Consumption and Efficiency Modeling group analyzes electric vehicles (EVs) so that attendees who are interested in EV charging can learn about the latest modeling developments in this area by attending the Transportation working group meeting. We directed participants to the AEO Working Group schedule.

Attendees

Name	Affiliation
John Agan	U.S. Department of Energy
Justin Baca	Solar Energy Industries Association
Youngsun Baek	Union of Concerned Scientists
Alan Cooke	Pacific Northwest National Laboratory
Eric Fox	Itron
Adam Guzzo	U.S. Department of Energy
Chioke Harris	National Renewable Energy Laboratory
Robert Hershey	Robert L. Hershey, P.E.
Rachel Hoesly	OnLocation, Inc.
Ben King	Rhodium Group
Hannah Kolus	Rhodium Group
Jared Langevin	Lawrence Berkeley National Laboratory
Jack Mayernik	National Renewable Energy Laboratory
Cecily McChalicher	Northeast Energy Efficiency Partnerships
Elizabeth McNamee	U.S. Department of Energy
John Meyer	Leidos, Inc.
Amir Roth	U.S. Department of Energy
Glen Salas	SMS
Marina Sofos	U.S. Department of Energy
David White	Synapse Energy Economics

EIA staff attendees

Tuncay Alparslan
Stacy Angel
Erin Boedecker
Grace Deng
Jim Diefenderfer
Travis Freidman
Sarah Grady
Peter Gross
Thaddeus Huetteman
Kevin Jarzomski
Mala Kline
Greg Lawson
Janice Lent
Katie Lewis
Ruey-Pyng Lu
Nilay Manzagol
Laura Martin
Joelle Michaels
Kevin Nakolan
Jay Olsen
Kelly Perl
Nicholas Skarzynski
Courtney Sourmehi
Michael Stanley
Manussawee Sukunta