Near-Term Outlook for Domestic Energy Markets

For
39th USAEE/IAEE North American Conference
October 25, 2022 | Houston, TX

By
Joseph DeCarolis, Administrator
@EIA_One
What does EIA do?

The U.S. Energy Information Administration (EIA) is the statistical and analytical agency within the U.S. Department of Energy.

EIA collects, analyzes, and disseminates independent and impartial energy information to promote sound policymaking, efficient markets, and public understanding of energy and its interaction with the economy and the environment. EIA is the nation's premier source of energy information and, by law, its data, analyses, and forecasts are independent of approval by any other officer or employee of the U.S. government.
Talk Overview

Winter Fuels Outlook
- Propane
- Fuel Oil
- Natural gas
- Electricity

EIA Priorities and Plans
Winter Fuels Outlook
Findings

- Winter energy expenditures for most households are likely to be higher than last winter.
- Expenditures could be much higher if the weather is very cold.
- Inventories are low, which could lead to volatile commodity prices.

Average nominal winter household energy expenditures (winter = Oct–Mar)
change from previous winter, dollars

- **$1,000**
- **$800**
- **$600**
- **$400**
- **$200**
- **$0**
- **-$200**
- **-$400**

- **natural gas**
- **electricity**
- **propane**
- **heating oil**

- +40% in colder case
- +27% in base case
- +15% in warmer case

- +36%
- +51%
- +28%
- +20%
- +10%
- +8%
- +5%
- -12%

Joseph DeCarolis, 39th USAEE/IAEE North American Conference
October 25, 2022
Key notes and definitions

• Winter season: October – March.

• Forecast expenditures for households grouped by their primary space heating fuel.

• The reported expenditures represent the total bill for the primary heating fuel, not just for heating.

• We use the Residential Energy Consumption Survey (RECS) as a baseline for the average amount of energy that homes use for space heating and other appliances.

• Fuel expenditures for individual homes depend on their size, energy efficiency, and heating equipment, along with thermostat settings and local weather conditions.

• Each fuel also has its own market structure, physical infrastructure, regulations, and limitations that can affect the connection between wholesale and retail market events.

• To produce this outlook, we use the Short-Term Integrated Forecasting System, which mostly comprises a system of linear regressions with several exogenous inputs including forecasts for weather and macroeconomic variables.
Actual heating degree days tend to be within 10% of the forecast

U.S. population-weighted winter heating degree days (winter = Oct–Mar, 2011–2022)

- Actual heating degree days
- NOAA forecast
- Forecast +10% (colder than expected)
- Forecast -10% (milder than expected)

Data source: National Oceanic and Atmospheric Administration (NOAA)
Almost 90% of U.S. homes are primarily heated by natural gas or electricity; heating oil and propane are regionally concentrated.

**Most prevalent home heating fuel by state (2021)**

- **natural gas (46%)**
- **electricity (41%)**
- **propane (5%)**
- **heating oil (4%)**
- **other / none (3%)**

Share of U.S. households from 2021 ACS

**Primary home heating fuel by state (2021)**

Data source: U.S. Census Bureau, American Community Survey (ACS) 2021
For most fuels, residential consumption is concentrated in winter.

For most fuels, residential consumption is concentrated in winter.

The winter months of October through March account for 79% of annual residential natural gas consumption...

...and 66% of annual residential distillate fuel oil consumption.

Note: Reflects consumption in all households for all uses, not just those using the fuel for primary space heating.

Data source: U.S. Energy Information Administration, Monthly Energy Review
We expect real energy expenditures to increase for heating fuels, excluding propane, primarily driven by higher prices.

Average real winter household energy expenditures (winter = Oct–Mar, 2012–2023)

<table>
<thead>
<tr>
<th>Year</th>
<th>Heating Oil</th>
<th>Propane</th>
<th>Electricity</th>
<th>Natural Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012–2013</td>
<td>$1,300</td>
<td>$1,300</td>
<td>$1,000</td>
<td>$1,000</td>
</tr>
<tr>
<td>2014–2015</td>
<td>$1,400</td>
<td>$1,200</td>
<td>$1,050</td>
<td>$1,100</td>
</tr>
<tr>
<td>2016–2017</td>
<td>$1,500</td>
<td>$1,100</td>
<td>$1,100</td>
<td>$1,150</td>
</tr>
<tr>
<td>2018–2019</td>
<td>$1,600</td>
<td>$1,000</td>
<td>$1,150</td>
<td>$1,200</td>
</tr>
<tr>
<td>2020–2021</td>
<td>$1,700</td>
<td>$900</td>
<td>$1,200</td>
<td>$1,250</td>
</tr>
<tr>
<td>2022–2023</td>
<td>$1,800</td>
<td>$800</td>
<td>$1,250</td>
<td>$1,300</td>
</tr>
</tbody>
</table>

Note: Propane price reflects the average of Northeast and Midwest regions through winter 2013–14 and average of Northeast, Midwest, and South regions after winter 2013–14. Expenditures are adjusted for inflation based on the Consumer Price Index history and forecasts from the S&P Global macroeconomic model.

Data source: U.S. Energy Information Administration, Short-Term Energy Outlook, October 2022 and S&P Global
Real prices for natural gas are up the most compared with last winter; we expect propane prices will be lower than last year.

**Natural gas**
- Dollars per thousand cubic feet

**Electricity**
- Cents per kilowatthour

**Propane**
- Dollars per gallon

**Heating oil**
- Dollars per gallon

*Data source: U.S. Energy Information Administration, Short-Term Energy Outlook, October 2022 and S&P Global*
Propane and heating oil expenditures have the widest range of expenditures across weather cases

**Average nominal winter household energy expenditures (winter = Oct–Mar)**
change from previous winter, dollars

<table>
<thead>
<tr>
<th></th>
<th>natural gas</th>
<th>electricity</th>
<th>propane</th>
<th>heating oil</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average expenditure</strong></td>
<td>$400</td>
<td>$200</td>
<td>$800</td>
<td>$1,000</td>
</tr>
<tr>
<td><strong>Change from previous winter</strong></td>
<td>+19%</td>
<td>+10%</td>
<td>+36%</td>
<td>+5%</td>
</tr>
<tr>
<td><strong>Range across side cases</strong></td>
<td>+51%</td>
<td>+20%</td>
<td>+40%</td>
<td>+27%</td>
</tr>
<tr>
<td><strong>Change in colder case</strong></td>
<td>+12%</td>
<td>+10%</td>
<td>+40%</td>
<td>+15%</td>
</tr>
<tr>
<td><strong>Change in base case</strong></td>
<td>+20%</td>
<td>+10%</td>
<td>+27%</td>
<td>+19%</td>
</tr>
<tr>
<td><strong>Range across warmer case</strong></td>
<td>+28%</td>
<td>+10%</td>
<td>+10%</td>
<td>+18%</td>
</tr>
<tr>
<td><strong>Change in warmer case</strong></td>
<td>+8%</td>
<td>+10%</td>
<td>+5%</td>
<td>+15%</td>
</tr>
</tbody>
</table>

Data source: U.S. Energy Information Administration, *Short-Term Energy Outlook, October 2022*
Natural Gas
Nominal natural gas prices and expenditures are higher than last winter

U.S. average
change from previous winter

nominal retail price  +22%
consumption         +5%
expenditures        +28%

heating fuel share within region

<table>
<thead>
<tr>
<th>Region</th>
<th>Heating Fuel Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. total</td>
<td>46%</td>
</tr>
<tr>
<td>Northeast</td>
<td>55%</td>
</tr>
<tr>
<td>Midwest</td>
<td>64%</td>
</tr>
<tr>
<td>South</td>
<td>28%</td>
</tr>
<tr>
<td>West</td>
<td>53%</td>
</tr>
</tbody>
</table>

Data source: U.S. Energy Information Administration, Short-Term Energy Outlook, October 2022
High natural gas prices in Europe and Asia continue to support U.S. liquefied natural gas exports

International natural gas futures prices
dollars per million British thermal units

2020 2021 2022

Europe (Netherlands)

Asia (Japan / Korea)

United States (Henry Hub)

Data source: CME Group and Bloomberg L.P.
Natural gas inventories are likely to be lower than the five-year average in the base case and cold scenarios

End-of-month U.S. working natural gas in storage (2020–2023)

Data source: U.S. Energy Information Administration, Short-Term Energy Outlook, October 2022
Futures and options markets data implies the 95% confidence interval for Henry Hub prices in early 2023 ranges from $2 to $22.

Henry Hub natural gas price and NYMEX confidence intervals

Data sources: CME Group and Refinitiv, an LSEG Business
Electricity
With relatively flat retail electricity prices, expenditures rise with consumption.

**U.S. average**
change from previous winter

- nominal retail price: +6%
- consumption: +4%
- expenditures: +10%

**Heating fuel share within region**

<table>
<thead>
<tr>
<th>Region</th>
<th>Heating Fuel Share</th>
<th>U.S. Total</th>
<th>Northeast</th>
<th>Midwest</th>
<th>South</th>
<th>West</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>41%</td>
<td>17%</td>
<td>24%</td>
<td>65%</td>
<td>36%</td>
</tr>
</tbody>
</table>

**Data source:** U.S. Energy Information Administration, Short-Term Energy Outlook, October 2022
Coal stocks held by utilities have been declining; natural gas share of daily generation is high despite higher natural gas prices

Sources: U.S. Energy Information Administration, Forms 923 and 930, Bloomberg, L.P.
Forecasted decline in natural gas and coal; increased renewables deployment in the short-term

U.S. electricity generation by source, all sectors

billions of kilowatt-hours

- Natural gas
- Coal
- Nuclear
- Renewables (non-hydro)
- Hydropower
- Other source

Source: U.S. Energy Information Administration, Short-Term Energy Outlook, September 2022
Propane
Propane retail prices are similar to last winter in our forecast.

### U.S. average
change from previous winter

- Nominal retail price: 0%
- Consumption: +5%
- Expenditures: +5%

### Northeast
- Retail price: -3%
- Consumption: +7%
- Expenditures: +4%

### West
- Retail price: +4%
- Consumption: +4%
- Expenditures: +8%

### South
- Retail price: 0%
- Consumption: +4%
- Expenditures: +5%

### Midwest
- Retail price: +4%
- Consumption: +4%
- Expenditures: +5%

### U.S. total
- Heating fuel share within region:
  - U.S. total: 5%
  - Northeast: 5%
  - Midwest: 8%
  - South: 4%
  - West: 4%

*Data source: U.S. Energy Information Administration, Short-Term Energy Outlook, October 2022*
Propane inventories, already low, could fall to record lows if weather is colder-than-forecast

End-of-month U.S. propane and propylene inventories (2020–2023)

million barrels

Data source: U.S. Energy Information Administration, Short-Term Energy Outlook, October 2022
Propane inventories are particularly low in the Midwest, but average at the U.S. level

**Weekly propane inventories by region (through Sep 30, 2022)**

- **Gulf Coast**: 4% higher
- **Midwest**: 9% lower
- **Northeast**: 2% higher

*Data source: U.S. Energy Information Administration, Short-Term Energy Outlook, October 2022*
Propane spot prices have fallen relative to Brent crude oil but distillate spot prices have increased relative to Brent.

**Spot prices of selected petroleum fuels (Jan 2019–Sep 2022)**

Price ratio to Brent crude oil, adjusted for relative energy content, seven-day moving average.

Data source: Refinitiv, an LSEG business.
Heating oil prices are up this winter as a result of tight distillate fuel market conditions globally

**U.S. average**
change from previous winter

- nominal retail price: +16%
- consumption: +9%
- expenditures: +27%

### Heating fuel share within region

<table>
<thead>
<tr>
<th>Region</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. total</td>
<td>4%</td>
</tr>
<tr>
<td>Northeast</td>
<td>18%</td>
</tr>
<tr>
<td>Midwest</td>
<td>1%</td>
</tr>
<tr>
<td>South</td>
<td>1%</td>
</tr>
<tr>
<td>West</td>
<td>1%</td>
</tr>
</tbody>
</table>
Forecast nominal heating oil prices are higher than last winter because of higher wholesale margins

Estimated components of U.S. heating oil retail price (1Q21–1Q23)
dollars per gallon (nominal)

Data source: U.S. Energy Information Administration, Short-Term Energy Outlook, October 2022 and Refinitiv, an LSEG Business
Distillate inventories in the East Coast region are relatively low because of recent geopolitical events and reductions in refining capacity.

End-of-month East Coast distillate fuel inventories (2020–2023)
million barrels

Data source: U.S. Energy Information Administration, Short-Term Energy Outlook, October 2022
Other winter heating fuels resources at EIA

- Availability and pricing for the four principal heating fuels
  - Propane
  - Heating oil
  - Natural gas
  - Electricity

- Data for each state are available on the clickable map
- Links to resources for each state
- Current week and three-month weather forecasts from the National Oceanic and Atmospheric Administration (NOAA)
- Downloadable graphs as an image or as a spreadsheet
- New England Dashboard
- Natural Gas Storage Dashboard
Natural Gas Storage Dashboard

Source: U.S. Energy Information Administration, Natural Gas Storage Dashboard
New England Dashboard

Source: U.S. Energy Information Administration, New England Dashboard
EIA Priorities and Plans
EIA priorities

• Ensure our hybrid workplace promotes a diverse, equitable, and inclusive culture

• Modernize EIA’s IT enterprise

• Provide new insight into energy trends and their community-level impacts

• Expand energy modeling capabilities to examine a wider range of future scenarios

• Strive to make EIA’s information more transparent and accessible
AEO 2023: Expand and explain the range of results

The Annual Energy Outlook is one of our highest visibility and most scrutinized products.

1. Increase the range of results to better capture real world possibilities.
   - For the core cases, update input assumptions extensively while remaining plausible
   - Rather than considering one-at-a-time perturbations to the Reference case, consider additional cases that combine scenario assumptions.

2. Focus on the range of results to communicate uncertainty.
   - Communicate the importance of the Reference case, but emphasize the range of results drawn from the side cases
   - Consistently present results from across all cases

3. Focus on the narrative, which allows us to contextualize the results.
Expanding the range of modeled scenarios in AEO 2023

• The Reference case and the following core side cases:
  – Low Oil Price case
  – High Oil Price case
  – High Oil and Gas Supply case
  – Low Oil and Gas Supply case
  – High Economic Growth case
  – Low Economic Growth case
  – High Renewables Cost case
  – Low Renewables Cost case

• Exploring **new combination cases**:
  – High Economic Growth case + High Renewables Cost
  – Low Economic Growth case + High Renewables Cost
  – High Economic Growth case + Low Renewables Cost
  – Low Economic Growth case + Low Renewables Cost
### The 2023 Reference case includes the Inflation Reduction Act

<table>
<thead>
<tr>
<th>Section of Legislation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTC/ITC Tax Credit Extension - Zero Emitting Source (Section 45 PTC, Section 48 ITC) (Section 13102)</td>
<td>The federal renewable electricity production tax credit (PTC) is an inflation-adjusted per-kilowatt-hour (kWh) tax credit for electricity generated by qualified energy resources. The duration of the credit is 10 years after the date the facility is placed in service. The ITC allows taxpayers to receive a percentage of the cost of installing a qualified energy system as a credit toward their federal taxes.</td>
</tr>
<tr>
<td>Prevailing wage &quot;bonus credit&quot; for PTC/ITC (Section 13102)</td>
<td>Starting in 2023 zero emission projects that take the PTC/ITC can gain an additional credit 5 times the size of the base credit for meeting requirements for prevailing wages and apprenticeships during the project construction and subsequent maintenance</td>
</tr>
<tr>
<td>Storage ITC (Section 13102)</td>
<td>30% ITC included for standalone storage</td>
</tr>
</tbody>
</table>
Under Carbon Fees, Renewables and Storage Deployment Are Significant Through 2050

Total all-sector cumulative capacity additions and retirements, Reference case and carbon fee cases (2021 to 2050) gigawatts

Source: U.S. Energy Information Administration, Annual Energy Outlook 2022

Joseph DeCarolis, 39th USAEE/IAEE North American Conference
October 25, 2022
Clarifying the meaning of the Reference Case

The Reference Case is characterized as a “baseline for comparison” but it is also presented as a best guess:

- Terminology for our cases: “Reference” versus “Side” cases
- 70% of AEO Narrative figures focus exclusively on the Reference Case
- AEO Retrospective focuses exclusively on the Reference Case

From the AEO 2022:

“Projections in the Reference case of our Annual Energy Outlook 2022 (AEO2022) are not predictions of what will happen, but rather, they are modeled projections of what may happen given certain assumptions and methodologies. The Reference case serves as a baseline for comparison between side cases that explain alternative trends. By varying Reference case assumptions and methodologies in side cases, AEO2022 can illustrate important factors in future energy production and use in the United States.”

Even if the Reference Case is our best guess, the probability of realizing a single point drawn from the distribution of a continuous variable is zero.
Recent communication around the Reference case


This goes deeper than just terminology, e.g., “prediction” vs “projection” vs “scenario”

Our communication in the narrative, chart library, and in TIEs effectively treats the Reference case like a forecast.
Exploring new ways to visualize uncertainty

- Reference Case in black
- Blue lines indicate side cases
- Dotted blue lines represent the most extreme cases
- Range in light blue indicates a continuous solution space rather than a set of discrete outcomes
- No line labels emphasize uncertainty range than rather case specifics

Source: U.S. Energy Information Administration, Annual Energy Outlook 2022

Joseph DeCarolis, 39th USAEE/IAEE North American Conference
October 25, 2022
Planned modeling advancements

Short-Term: Open source model code

- Plan to release main components of NEMS via GitHub under a well-established open source license
- Governance plan to process public feedback in a consistent way
- A small step towards greater transparency

Long-Term: Reimagine our long-term modeling capabilities

- We are at a critical juncture for re-imagining the future of our modeling program.
- Initiated a “blue sky” process to fundamentally re-examine our modeling objectives and think creatively about next generation modeling capabilities
EIA products

EIA is committed to providing unbiased data and analysis on the full range of energy challenges that confront us.


Today in Energy | www.eia.gov/todayinenergy

Consumption and Efficiency Data | www.eia.gov/consumption

Monthly Energy Review | www.eia.gov/totalenergy/data/monthly

State Energy Portal | www.eia.gov/state

Short-Term Energy Outlook | www.eia.gov/forecasts/steo

Annual Energy Outlook | www.eia.gov/forecasts/aeo
EIA jobs

Current open positions at EIA can be found here: https://www.eia.gov/about/careers/

EIA is looking for people to work on model integration, macroeconomics, emissions analysis, regional energy market analysis, and fuel data analysis.

We also have open positions that are specifically targeted towards advancing the next generation of energy models.

Please consider applying!