

EIA Perspective on U.S. Nuclear Power



For

*Nuclear Workshop: EIA's Annual Energy Outlook and Status of U.S. Nuclear Power Generation
March 7, 2017 | Washington D.C.*

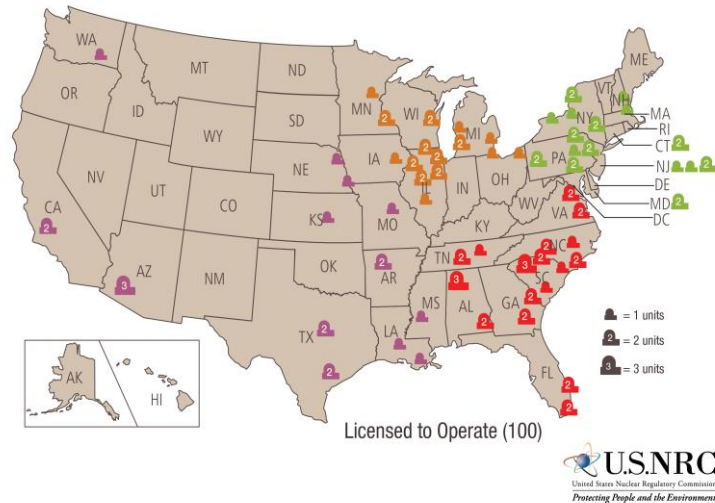
By

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EIA's Objective

Properly *represent the nuclear power market* as it exists **today** and in the **near-term** and also how it might exist in the **long-term** under a set of scenarios (“cases”).

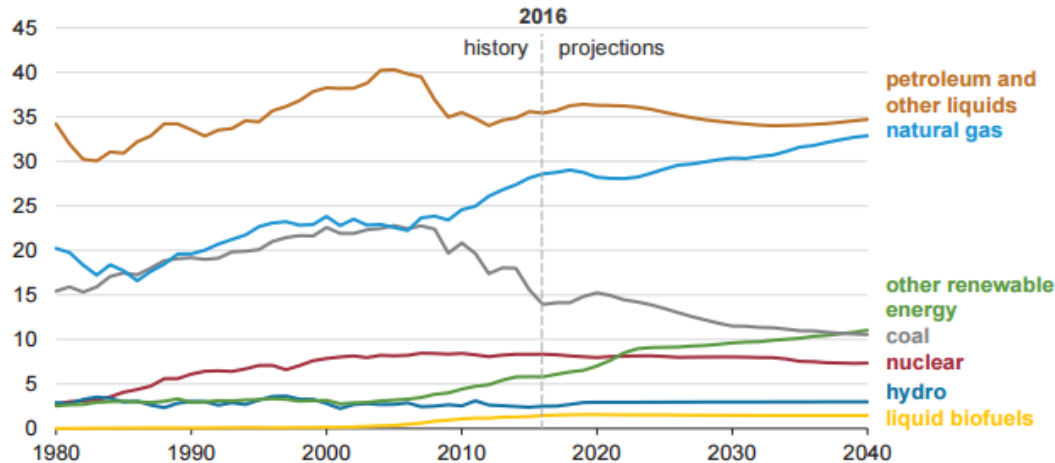
- Existing and Historical Conditions
- Future Market Conditions
- Future Plant Conditions



EIA's Annual Energy Outlook 2017

Domestic energy consumption remains relatively flat in the Reference case—

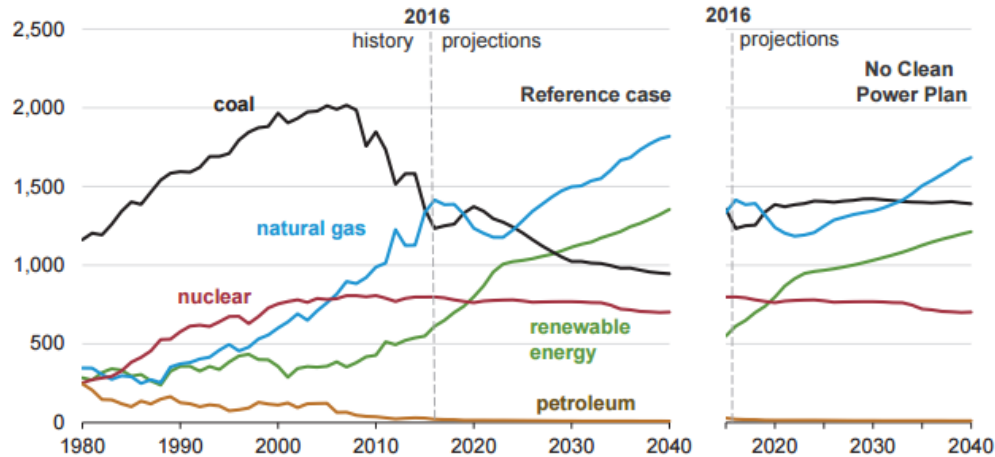
Energy consumption (Reference case)
quadrillion British thermal units



Nuclear generation declines modestly over 2017–40 in the Reference case as new builds already being developed and plant uprates nearly offset retirements. The decline in nuclear generation accelerates beyond 2040 as a significant share of existing plants is assumed to be retired at age 60.

Fuel prices and current laws and regulations drive growing shares of renewables and natural gas in the electricity generation mix

U.S. net electricity generation from select fuels
billion kilowatthours



Market share for nuclear power is boxed in by flat demand and push for more renewables and natural gas replacing coal

Near and Long Term Uncertainties

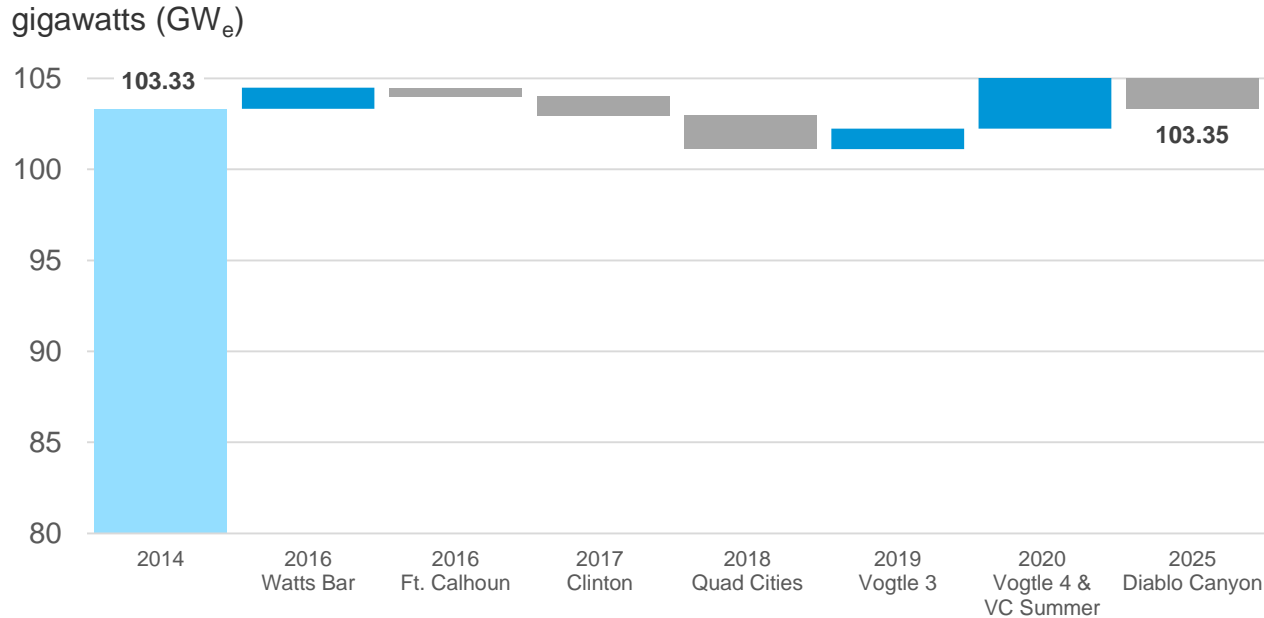
Future Market Conditions

- Electricity Demand and Prices
- Transmission Access and Congestion
- State and Public Support
 - Clean energy plan (mandates)
 - Price support (e.g. Ill & NY)
 - Valuation of nuclear power
 - Baseload
 - Clean
 - Reliable
 - Cost Certainty

Future Nuclear Plant Conditions

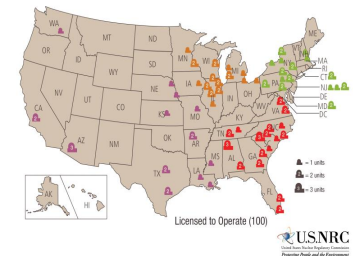
- Future O&M Costs
- Subsequent License Renewals Cost/Risks
- NRC Licensing Risks
- Overnight Costs
- Cost of Capital
- Technology Advantages and Risks

Actual and announced U.S. nuclear power closings and new builds

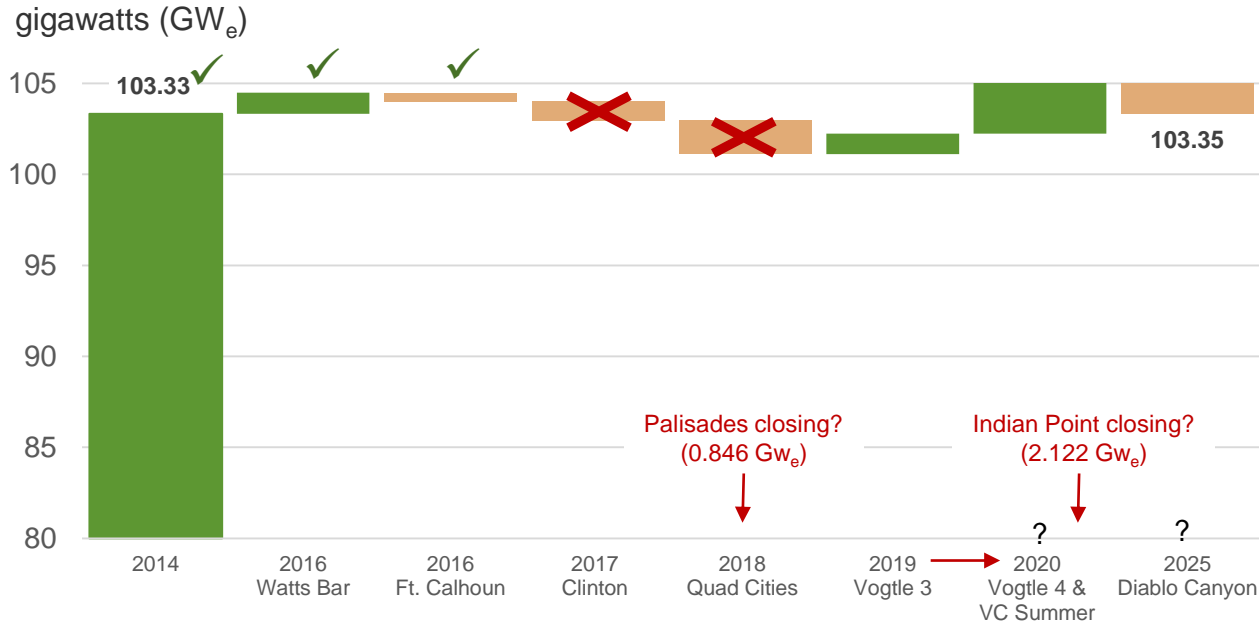


Sources: EIA, NRC, Utility Announcements

- Ft. Calhoun, Clinton, and Quad Cities closings due to economics
- Diablo Canyon closing due to public concerns
- Additions are all in regulated electricity markets

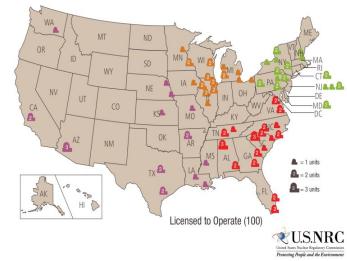


The near-term U.S. nuclear power projection is a rapidly moving target



Sources: EIA, NRC, Utility Announcements

- Ft. Calhoun, ~~Clinton~~, and ~~Quad Cities~~ closings due to economics
- Diablo Canyon closing due to public concerns and over supplied market
- Additions are all in regulated electricity markets
- Indian Point and Palisades closure announcements for 2021 and 2018



One month's example of EIA's effort to remain current with fleet performance changes

- **V.C. Summer 2 and 3:** startup dates moved back based on latest news (April and Dec 2020) The reactors now are expected to start producing electricity in April and December of 2020.
- **Vogtle units 3 and 4: startup dates** moved back to December 2019 and September 2020
- **Hope Creek:** uprate date and capacity changed to reflect latest reporting (Nov 2016).
- **Catawba 1, 2:** uprate date and capacity changed to reflect latest reporting.
- **Clinton and Quad Cities:** un-retired both following Illinois energy jobs bill.
- **Peach Bottom 3:** update capacity to reflect new capacity (uprate AEO2017 showed 1123).
- **Indian Point 2, 3:** use announced retirement dates (2021 and 2022) Indian Point Unit 2 will shut down by April 30, 2020 and Unit 3 by April 30, 2021.
- **Grand Gulf:** updated uprated capacity to 1401 MWe (AEO2017 showed 1190).
- **Susquehanna:** updated to reflect uprate 1185 to 1257 FOR UNIT 1 AND 1190 to 1257 FOR UNIT 2.
- **Palisades:** retirement date not added until official actions taken.
- **Watts Bar 2:** no change from current assumption of start date
- **St Lucie 2:** Updated capacity (AEO2017 showed 981).

What happening?

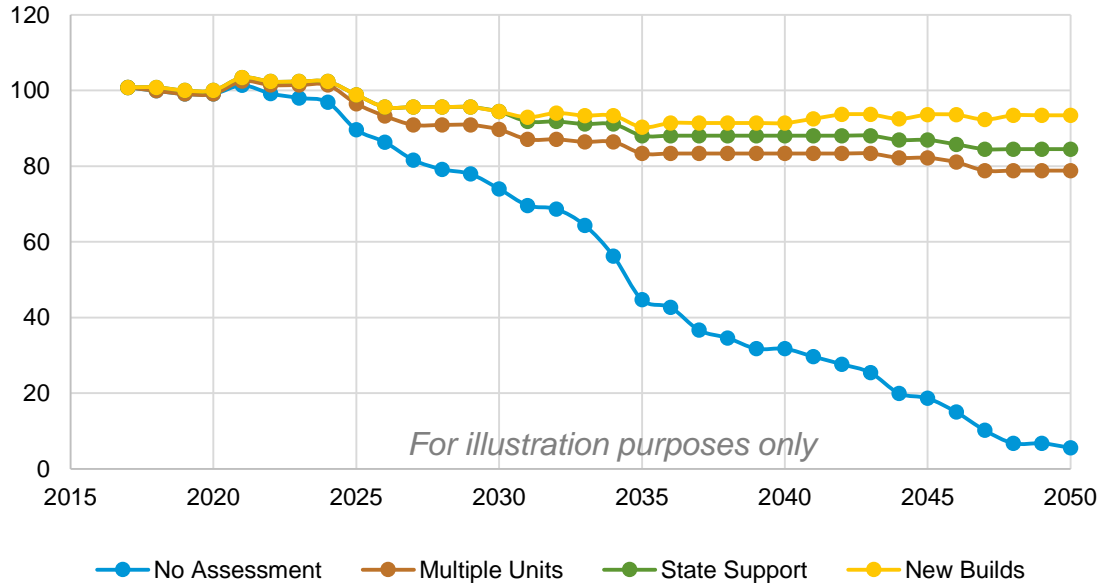
- **PRICES** - Some of the most expensive nuclear plants in **deregulated markets** are losing money at current **low electricity prices**
- **PRICE SUPPORT** - States are beginning to acknowledge value of nuclear power and act with **price supports** (NY, IL, OH, PA, CT, NJ, MI)
- **DEMAND** - U.S. **demand growth** is flat & oversupplied in some markets
- **COMPETING FUELS** – **North American natural gas** is plentiful and inexpensive
- **GEN III+ - Nuclear builds** are occurring in regulated markets (V.C. Summer, Vogtle, and Watts Bar) but are experiencing delays and cost overruns
- **CAPITAL COSTS** - **Near-term planned projects** are at-risk for a variety of reasons (demand, costs, Toshiba, transmission issues)
- **O&M COSTS** – Fleet limited on controlling O&M costs to compensate for low prices

Large uncertainties
create a large range
of potential futures

What is most likely?

Subsequent License Renewals and New Builds

Gigawatts (electric)



Long-term future of nuclear power is highly sensitive to

- Competitiveness
- Valuation by Stakeholders

EIA Data Sources

- EIA Industry Surveys

- Form EIA-858, "Uranium Marketing Annual Survey"
- Form EIA-851A "Domestic Uranium Production Report (Annual)"
- Form EIA-861 "Annual Electric Power Industry Report"
- Form EIA-906 "Power Plant Report"
- Form EIA-923 "Power Plant Operations Report"
- Form GC-859 "Nuclear Fuel Data Survey"

- NRC Publications

- NRC Datasets
- Reactor Status Reports
- Plant Licenses and Renewals
- Power Uprates
- Status of Applications

- Data Subscriptions

- U_x Consulting
- SNL S&P Global
- Bloomberg New Energy Finance
- Energy Intelligence
- TradeTech

- Industry Announcements

- Owner/Operators
- Utilities
- FERC
- ISOs
- Governments

- Trade and International Groups

- Nuclear Energy Institute (NEI)
- International Atomic Energy Administration (IAEA)
- International Energy Agency (IEA)
- OECD Nuclear Energy Agency (NEA)
- World Nuclear Association (WNA)
- American Nuclear Society (ANS)
- American Public Power Association (APPA)

- Internal Analysis and Modeling

- Electricity Generation Cost Analysis
- National Energy Modeling System (NEMS) Modeling

- Contracted and External Analysis and Modeling

- MIT Technology Review
- DOE/INL/NREL/NETL
- Joint Institute for Strategic Energy Analysis (JISEA)
- Institute of Electrical and Electronics Engineers (IEEE)
- Electric Power research Institute (EPRI)
- International Association of Energy Economics (IAEE)
- Institute for Energy Research (IER)
- Various Colleges and Universities
- BP Energy Economics

Most Uncertain Variables

- When and how will market conditions be resolved to **fully value nuclear power**?
- How **level of investment** is being planned for NPP projects and SLRs?
- What strategies are available to companies and states for future use & growth of nuclear power?
- Other than low prices, what are the other **Achilles heels** and what early warning indicators exist?
- What are **advanced technologies barriers**, including SMRs?
- How might **next generation technology impact** the existing fleet?