AMERICAN PUBLIC POWER ASSOCIATION
Powering Strong Communities

FACT SHEET January 2022

Electricity Generation

Background

Electricity is created from the conversion of a fuel or other source of energy into electrons. This process occurs on a large scale at an electricity generating plant, and on a smaller scale through distributed energy resources. Even with continuing advances in, and increased deployment of, energy storage technology, most electricity must be generated the instant it is used, requiring forms of generation that must always be available to "keep the lights on." Electricity in the United States is generated by a range of fuels and technologies, including natural gas, coal, nuclear, hydropower, and non-hydropower renewable resources, such as solar, wind, biomass, and geothermal power. Each fuel source and generating technology has advantages and disadvantages, which is why having a diverse portfolio of fuels is a priority for electric utilities. This fact sheet uses the most recent data (2020) from the U.S. Energy Information Administration (EIA).[1]

1 https://www.eia.gov/energyexplained/electricity/electricity-in-the-us-generation-capacity-and-sales.php

Summary

Of total U.S. power generation in 2020, natural gas produced 1.6359 billion megawatt-hours (MWh) of electricity, coal produced 773.4 million MWh, nuclear produced 789.9 million MWh, hydro produced 280 million MWh, non-hydro renewables (wind, solar, biomass, geothermal, and other sources) produced 497.7 million MWh, and oil provided 17.3 million MWh. This data can also be seen in percentages in Figure 1.

For generation owned by public power utilities in 2020, 124.3 million MWh of electricity were produced from natural gas, 91 million MWh of electricity were generated from coal, 75.1 million MWh were generated from hydro, 61.5 million MWh were generated from nuclear, and 7.1 million MWh were generated from non-hydro renewables. This data can be seen in percentages in Figure 2. It is important to note, however, that public power utilities supply approximately 15 percent of electricity to end-users in the United States, but they only produce approximately 9.3 percent of the MWh generated. Collectively, end-use public power utilities are net purchasers of power from other sources (i.e., investor-owned utilities, independent power producers, rural electric cooperatives, federal power marketing administrations, and the Tennessee Valley Authority).

Figure 1– Electricity Net Generation, Total (All Sectors) by Source, 2020

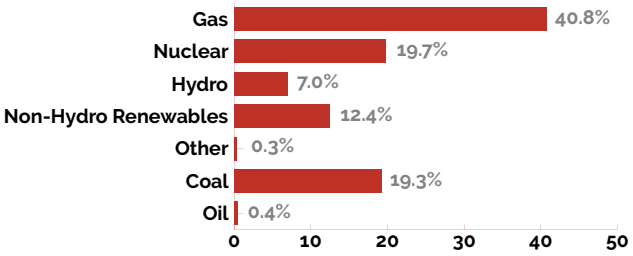
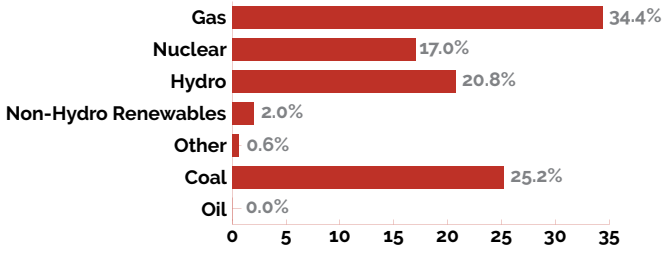


Figure 2: Public Power Generation by Energy Source – National, 2020



Major Fuel Sources For Electricity

Fossil Fuels: Natural Gas, Coal, and Oil

The two leading fuel sources used to generate electricity in the U.S. are natural gas and coal – in 2020, natural gas was responsible for 40.8 percent of total U.S. generation and 34.4 percent of total generation owned by public power, and coal accounted for 19.3 percent of the nation's generation and 25.2 percent of generation owned by public power. Oil was responsible for 0.4 percent of total U.S. generation and 0.045 percent of generation owned by public power in 2020.

The demand for natural gas in the electric sector has grown immensely in recent years. This is partly a result of large amounts of natural gas capacity built by merchant generators in areas served by regional transmission organizations because of lower capital costs and faster build time. The increased demand is also due to the lower carbon dioxide (CO_2) emissions profile of natural gas (it produces approximately half the CO_2 emissions as that produced by coal, on average). Despite these benefits, concerns with natural gas include significant historic price volatility; the need for additional pipeline construction in certain parts of the country; limitations on natural gas storage capabilities; and emissions.

For many decades, coal was the leading fuel used to generate electricity because it was cheaper than other fuels and it provides reliable baseload generation. Its use has steadily declined due to several factors, such as lower natural gas prices and the cost of compliance with current and proposed environmental regulations on CO_2 and criteria pollutant (such as sulfur dioxide (SO_2) and nitrogen oxides (NOx)) emissions resulting from coal combustion. Coal also faces the major obstacle of its CO_2 content and the current lack of affordable technology to capture and sequester CO_2 on a commercial scale from power plants. The major unknown going forward is the viability of carbon capture and sequestration or another, unknown technology that may reduce the CO_2 emitted from coal combustion.

Oil is primarily used for emergencies, peak shaving, and as a source of backup generation in times of high electricity demand. It is also used as baseload generation in areas that have limited access to other generation resources, such as Alaska and Hawaii, and the territories of the U.S. (Note however, that the latter are not included in EIA's data.)

Nuclear

Nuclear was responsible for 19.7 percent of total U.S. generation and 17.0 percent of total generation owned by public power utilities in 2020. Nuclear power is an extremely reliable source of baseload generation that produces no CO_2 or other air emissions (e.g., SO_2 and NOx). The main challenge associated with existing nuclear facilities is the disposal of nuclear waste. Nuclear facilities also have high capital costs given the complexity of the units and safety features that must be included and monitored on an ongoing basis.

The construction of new, large-scale, nuclear facilities is challenging due to financing difficulties and rigorous regulatory hurdles. In addition, continued low natural gas prices make construction of combined cycle natural gas turbines far less expensive than constructing a nuclear power plant. The most recently completed plant is the Watts Bar 2 nuclear power plant, which started operation in October 2016. Construction is ongoing on new reactor units Vogtle 3 and 4 in Georgia.

A promising new technology in nuclear is small modular reactors. These smaller scale plants are less expensive and require less infrastructure. Because of the potential benefits, the Department of Energy has provided significant funding to accelerate the development and commercialization of this technology. Several APPA members are actively engaged in the development and deployment of this technology.

Hydropower

Hydropower is the nation's second largest source (behind wind) of emissions-free, renewable electricity, accounting for approximately 36.0 percent of domestic renewable generation and 7 percent of total electricity generation in 2020. For generation owned by public power utilities in 2020, hydro was responsible for 20.8 percent of total generation. It is a reliable source of baseload energy.

While hydropower is expanding into exciting new areas like tidal and in-stream, large dams still provide the bulk of the resource, and the impacts of those dams on fish and other wildlife will continue to be a concern for some stakeholders. Furthermore, as environmental mitigation measures have been addressed, hydropower output from these large dams has been reduced. Federal permitting has been, and will continue to be, a hurdle to any new hydropower development, large or small. With less than three percent of the nation's more than 80,000 dams generating electricity, this is problematic.

Non-Hydro Renewables

Non-hydro renewables were responsible for 12.4 percent of total U.S. generation and 2.0 percent of total generation owned by public power utilities in 2020. The main challenges facing non-hydro power renewables are the intermittent nature of wind and the sun; the need to have them backed up with baseload

generation (typically natural gas); limited access to transmission lines; and financing. Concerns about integrating wind have arisen because the wind often blows when demand is not high, which thereby requires a ratcheting down of other resources that can often be uneconomic and cause stresses to the operation of a regional or sub-regional system. Some of these challenges may be mitigated in the future as more energy storage technologies are deployed. The benefits of renewable resources include that most of them do not emit pollutants or CO_2 and their ongoing fuel costs are low or non-existent.

Distributed Generation

As of October 2021, approximately 37,000 MWs of distributed solar capacity have been installed in the United States.[2] DG is power produced at the point of consumption. More than 90 percent of DG is rooftop solar, but it can include small wind turbines, combined heat and power, fuel cells, microturbines, and other sources. Under a policy called net-metering, customers with on-site generation are credited for the amount of kilowatt-hour sales sold back to the distribution grid. This rate can vary per utility, but is generally set at the retail rate, as opposed to the wholesale rate, which is the rate utilities use to purchase power for their customers.

Due to this rate structure, concerns have arisen that net metering customers are not paying their fair share of the costs of keeping the grid operating safely and reliably. DG also has operational issues that pose challenges for utilities, such as maintenance of electric grid system balance, safety issues for line-workers, load forecasting impairment, and increased strain on the distribution system. Potential benefits of DG include the need to build less new generation, reduced air pollution and greenhouse gas emissions, and in some cases, mitigation against outages on the distribution grid. For more information on DG, see APPA's issue brief, "Distributed Energy Resources."

2 https://www.seia.org/solar-industry-research-data

APPA Position

Every fuel type has its advantages and disadvantages that require substantial risk management planning. Therefore, it is very important for today's electric utilities (where possible) to have a balanced generating portfolio with multiple fuel types, particularly dispatchable resources. An over-reliance on one fuel can and will create potential risk that could substantially increase prices to consumers and reduce reliability. APPA supports federal policies that support and promote such fuel diversity in electric generation.

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The American Public Power Association is the voice of not-for-profit, community-owned utilities that power 2,000 towns and cities nationwide. We represent public power before the federal government to protect the interests of the more than 49 million people that public power utilities serve, and the 96,000 people they employ. Our association advocates and advises on electricity policy, technology, trends, training, and operations. Our members strengthen their communities by providing superior service, engaging citizens, and instilling pride in community-owned power.