Idaho Energy Landscape 2021

IDAHO

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Note: All data referenced within this document is collected from entities that update information at different intervals. Research was conducted to find the most recent data available.

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1. Idaho's Energy Landscape

1.1 Energy and the Economy

The strength of Idaho's economy and the quality of life in Idaho depend upon access to affordable and reliable energy resources. Idaho's strong and diversified economy is fueled by energy-dependent sectors, including technology, manufacturing, agriculture, tourism, healthcare, and construction, all of which benefit from Idaho's low cost of energy.

Energy costs are affected by the economy, new technology, governmental regulation, and global market trends. For example, advancements in natural gas production technologies have increased the supply of domestically produced natural gas. This has substantially lowered the cost to consumers and nearly doubled consumption in the past decade.[1]

Historically, economic growth and energy consumption were strongly and positively correlated; however, technological changes and the increased utilization of energy efficiency have weakened this correlation. Idaho's Gross Domestic Product on average grew 4.8% annually from 1998 to 2018, while Idaho's energy consumption (transportation, heat, and power) only increased 0.5% annually from 1998 to 2018.[2] Today, approximately 13,300 people work in Idaho's energy sector, which pushes the boundaries of technology, launches start-ups, and fuels research, growth, and discovery.[3]

Energy statistics compiled for the Energy Landscape reflect the most recent data available from a wide variety of sources. Different sources will update energy data at irregular intervals, some more frequently than others. For that reason, the facts and statistics referenced in this document, including graphs and tables, represent the most up-to-date information available, but may be several years old. Each year, the Office of Energy and Mineral Resources staff conducts thorough research to ensure that the data presented in this document is accurate and complete.

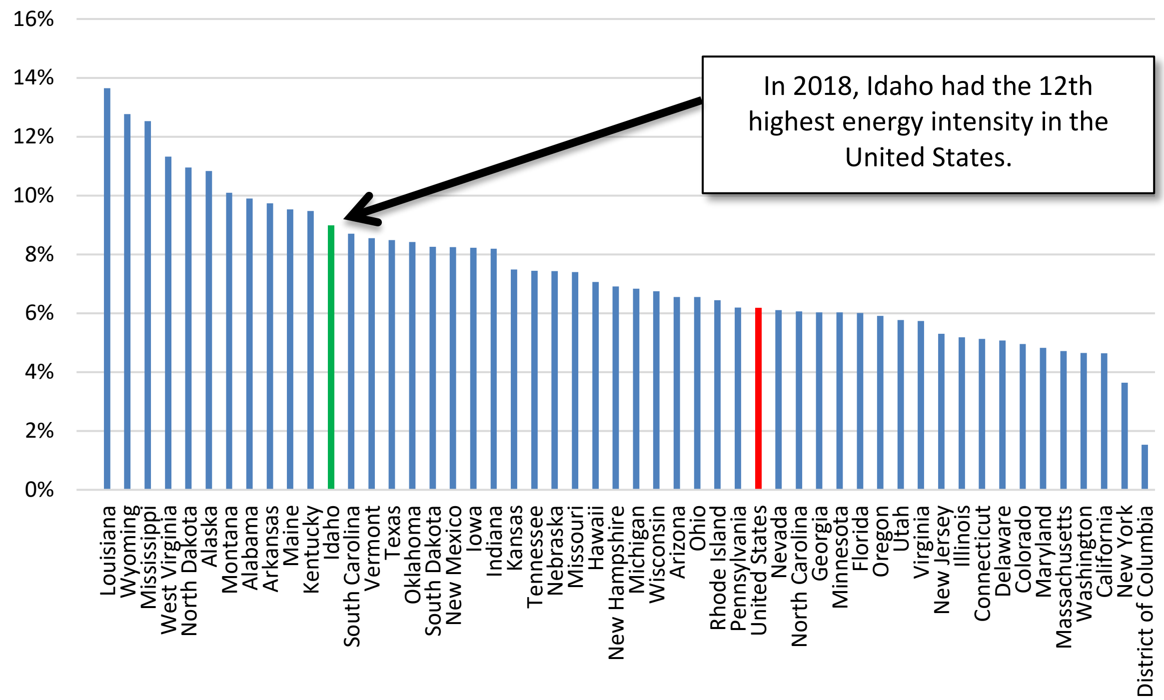
[1] U.S. Energy Information Administration. "U.S. Natural Gas Deliveries to Electric Power Consumers." www.eia.gov/dnav/ng/hist/n3045us2a.htm

[2] Federal Reserve Bank of St. Louis. "FRED: Total Gross Domestic Product for Idaho." https://fred.stlouisfed.org/series/IDNGSP; and U.S. Energy Information Administration. "Total End-Use Energy Consumption Estimates, 1960-2016, Idaho." www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep_use/tx/use_tx_ID.html&sid=ID

[3] National Association of State Energy Officials. "2020 U.S. Energy Employment Report: Idaho Report." https://static1.squarespace.com/static/5a98cf80ec4eb7c5cd928c61/t/5e7813adac49515565fbcaa1/1584927662182/Idaho-2020.pdf

1.1.1. Energy Costs

Figure 1.1 Idaho's Energy Intensity as a Share of the Economy[4]



Low energy rates have consistently attracted energy-intensive industries to Idaho, including mining, pulp and paper, agriculture, food processing, and computer chip manufacturing. As a result, Idaho's energy expenditures equated to almost 9% of the State's Gross Domestic Product (GDP) in 2018, placing Idaho 12th for total energy costs compared to the rest of the states.[5] The total energy costs per GDP illustrated in Figure 1.1 include the cost of gasoline to the State as well. Due to the rural nature of Idaho and the absence of a petroleum refinery in the State, Idahoans frequently spend more on transportation fuel than individuals who live in more densely populated regions of the country.

[4] U.S. Energy Information Administration. "Total Energy Price and Expenditure Estimates, Ranked by State, 2018." https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_sum/html/rank_pr.html&sid=US
[5] U.S. Energy Information Administration. "Total Energy Price and Expenditure Estimates, Ranked by State, 2018." https://www.eia.gov/state/seds/sep_sum/html/pdf/rank_pr.pdf

Table 1.1 Average Energy Bill per Person, 2018[6]

Energy Source	Dollars Per Year	Percentage of Total Cost
Gasoline	$1,199	63%
Electricity	$487	26%
Natural Gas	$111	6%
Propane	$58	3%
Wood	$40	2%
Coal	$0	0%
Total	**$1,895**	**100%**

Note: The fuel used to heat or power a home varies significantly across Idaho; therefore, the estimated cost per person is an average of all energy types. Some people may use more or less of a specific energy source.

Collectively, Idaho's residential, commercial, industrial, and transportation sectors spent almost $7 billion on energy in 2018.[7] When those dollars were adjusted specifically for residential use, the average Idahoan spent about $1,900 on direct energy products in 2018, as demonstrated in Table 1.1. This number was based on Idaho's 2018 residential energy expenditures and population estimate.

Figure 1.2 Hells Canyon Hydroelectric Dam[8]

[6] U.S. Energy Information Administration. "Idaho SEDS Data 2018 for the Residential, Commercial, Industrial and Transportation Sectors." https://www.eia.gov/state/seds/seds-data-complete.php?sid=ID; and Idaho Department of Labor. "Census." https://lmi.idaho.gov/census

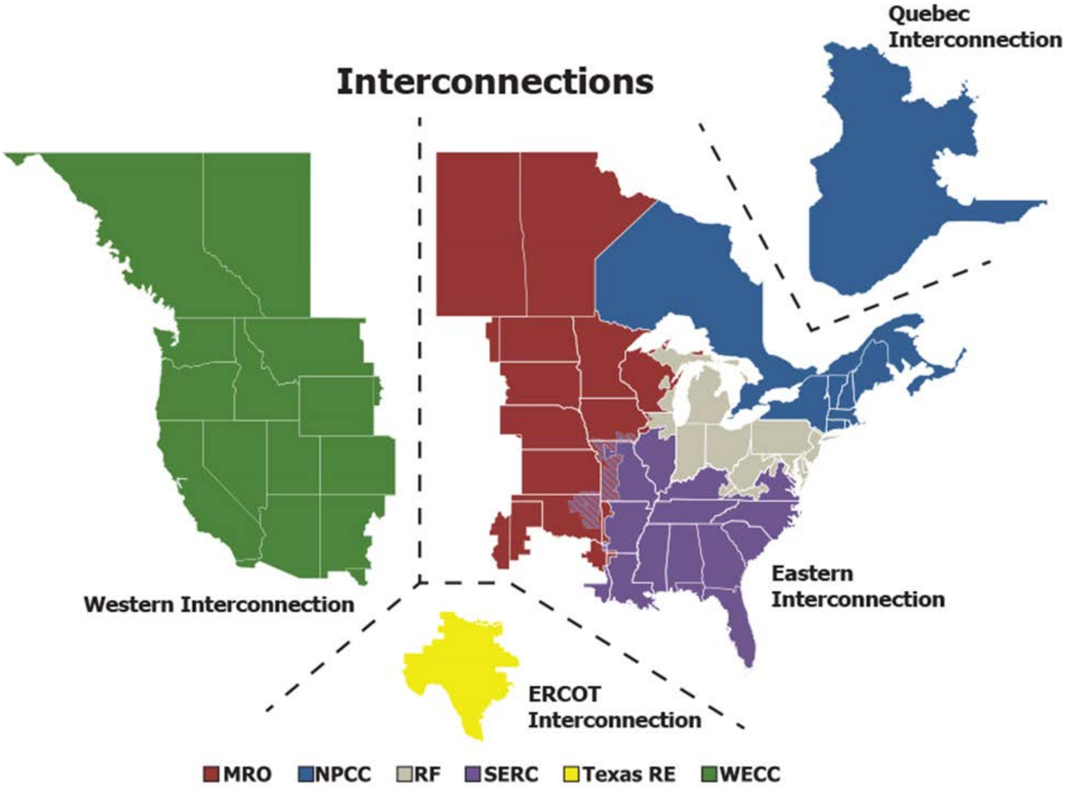
[7] U.S. Energy Information Administration. "Idaho SEDS Data 2018 for the Residential, Commercial, Industrial and Transportation Sectors." https://www.eia.gov/state/seds/seds-data-complete.php?sid=ID#PricesExpenditures

[8] Sam Judy. Adobe Photo Stock License 225224371. https://stock.adobe.com/images/hells-canyon-dam/225224371?prev_url=detail

1.2 Idaho Utilities, and Electric and Natural Gas Systems

1.2.1. Electricity

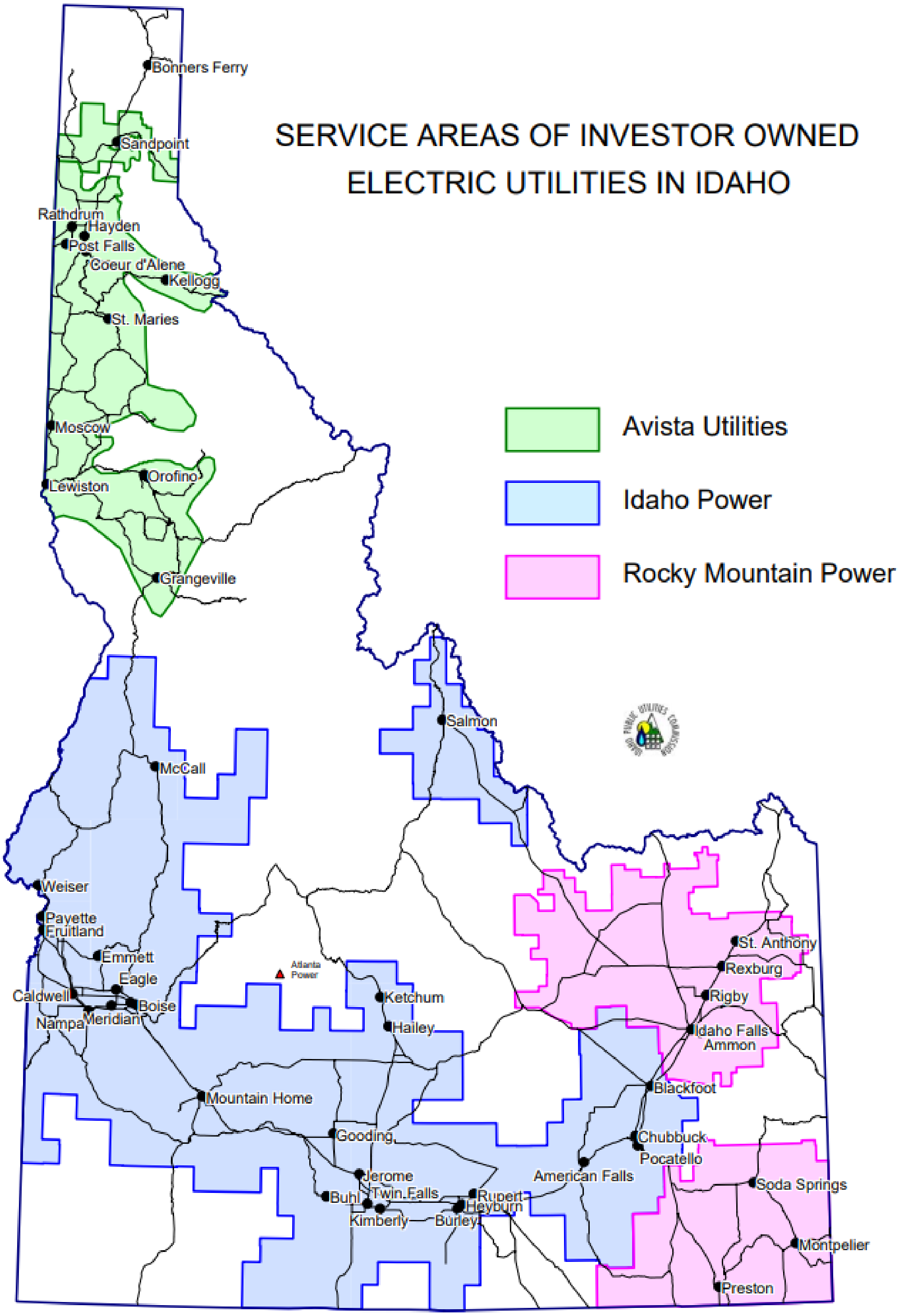
Figure 1.3 North American Electric Reliability Corporation Regional Electric Interconnections[9]



The electrical transmission network in the United States and Canada is made up of four separate interconnections. The Western Interconnection links Idaho with the rest of the western United States and two Canadian provinces as shown in Figure 1.3. Coordination throughout the Western Interconnection on a local, sub-regional, and regional basis ensures a reliable and adequate integrated system of electricity for consumers. The Western Electricity Coordinating Council (WECC) is the regional entity that monitors and enforces compliance with electricity reliability standards throughout the Western Interconnection, including Idaho.[10]

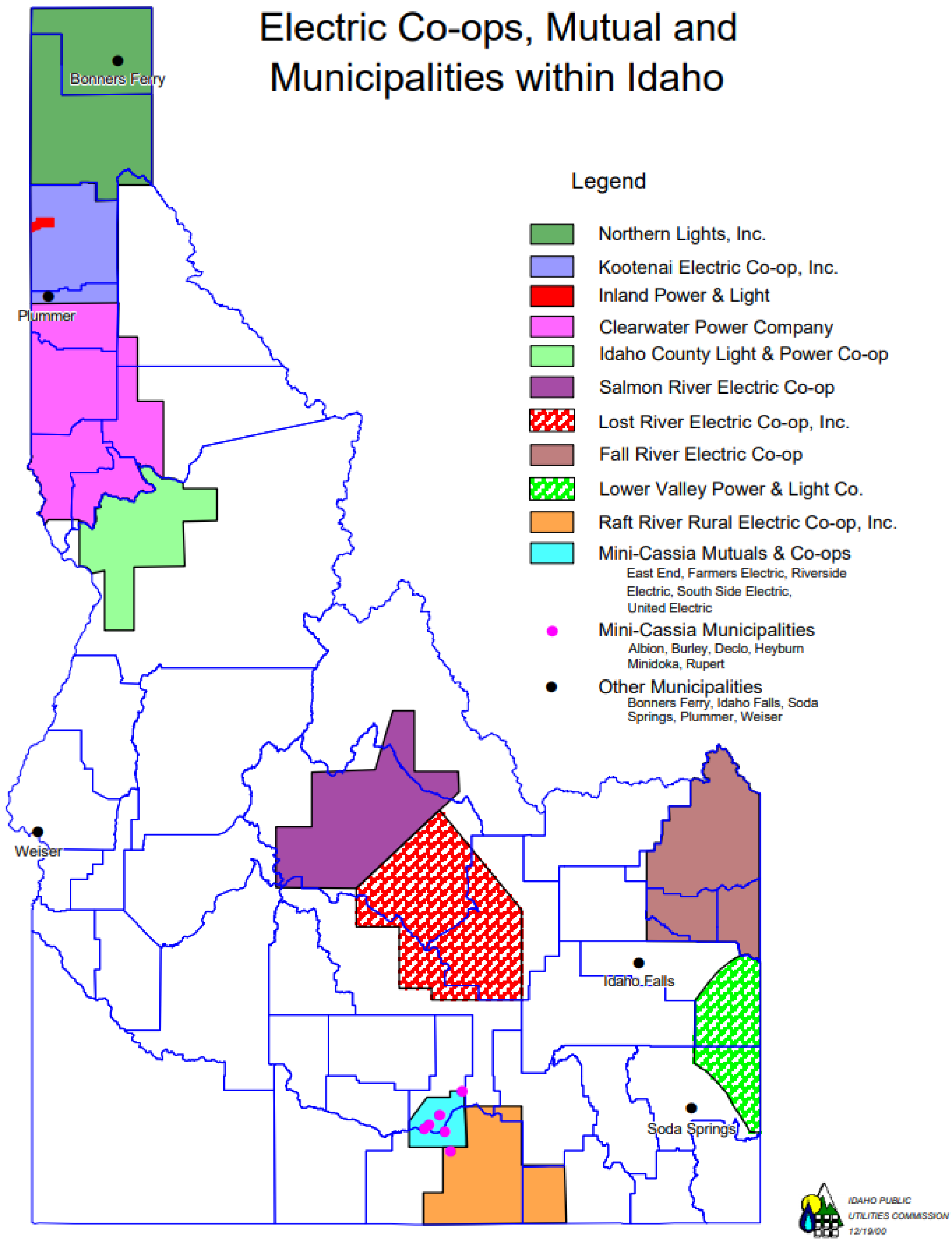
[9] North American Electric Reliability Corporation. "Maps: NERC Interconnections." https://www.nerc.com/AboutNERC/keyplayers/PublishingImages/NERC%20Interconnections.pdf
[10] Western Electricity Coordinating Council. "About WECC." https://www.wecc.org/Pages/AboutWECC.aspx

Figure 1.4 Idaho's Investor-Owned Electric Utilities Service Territories[11]



[11] Idaho Public Utilities Commission. "Service Areas of Investor Owned Electric Utilities in Idaho." https://puc.idaho.gov/Fileroom/PublicFiles/maps/elec.pdf

Figure 1.5 Idaho's Municipal and Cooperative Utilities Service Territories[12]



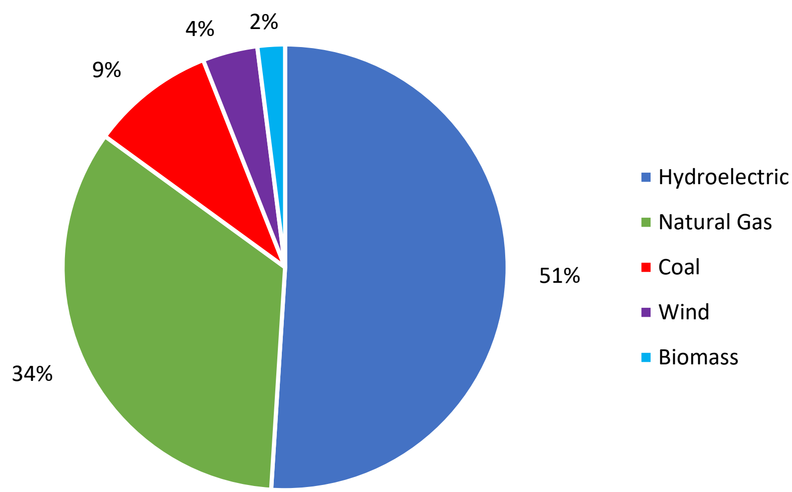
[12] Idaho Public Utilities Commission. "Electric Co-ops, Mutual and Municipalities within Idaho." https://puc.idaho.gov/Fileroom/PublicFiles/maps/elecoop.pdf

Idaho's electrical grid is operated by three investor-owned utilities (IOUs), as well as municipal and rural electric cooperative utilities, which are listed in Appendix A. The three IOUs serve approximately 84% of the State's electricity needs, while the municipal and rural electric cooperative utilities serve the remaining 16%, as illustrated on the previous pages by Figures 1.4 and 1.5.[13]

1.2.1.1. Avista Corporation

Avista is an investor-owned electric and natural gas utility headquartered in Spokane, Washington. Avista serves over 224,000 electric and natural gas customers in Idaho's northern and central regions. In April 2019, the company signed an agreement with the California Independent System Operator (CAISO) to participate in the Western Energy Imbalance Market (EIM) by the end of April 2022.[14] Additionally, in April 2019, Avista announced its goal to serve its customers with 100% clean electricity by 2045, as required under Washington law, and to have a carbon neutral portfolio by the end of 2027.[15]

Figure 1.6 Avista Energy Production Mix (2019)[16]



Avista generates electricity by utilizing a mix of hydroelectric, natural gas, coal, biomass, and wind generation delivered over 2,770 miles of electrical transmission lines, 19,100 miles of electrical distribution lines, and 8,000 miles of natural gas lines.[17] Avista's 2019 annual energy production mix and long-term contracted resources is shown in Figure 1.6. Hydroelectric generation accounts for over half of its electricity mix, which provides a significant price benefit for its customers. Avista's company-owned and contract

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[13] U.S. Energy Information Administration. "Annual Electric Power Industry Report, Form EIS-861 detailed data files." https://www.eia.gov/electricity/data/eia861/

[14] Avista. April 25, 2019. "Avista builds on commitment to renewable energy by joining the Western Energy Imbalance Market." https://investor.avistacorp.com/node/21551/pdf

[15] Avista. "Our Commitment." https://www.myavista.com/about-us/our-commitment

[16] Avista. "About Our Energy Mix." https://www.myavista.com/about-us/about-our-energy-mix

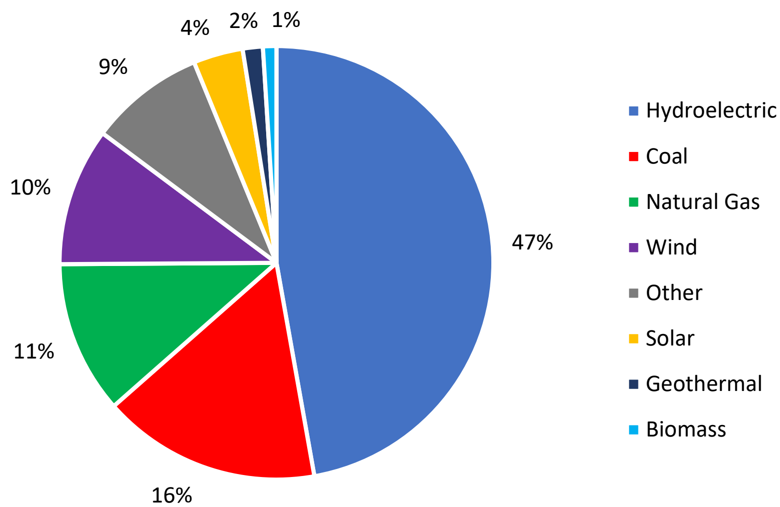
[17] Avista. "2020 Quick Facts." https://investor.avistacorp.com/static-files/437ad3b9-9fbf-4c20-a891-cbb4c2f1dcff

hydroelectric resources are located in western Montana, eastern Washington, and northern Idaho; and its natural gas-fired baseload and capacity resources are located in Idaho, Oregon, and Washington. It also has an ownership share in the Colstrip coal-fired power plant in Montana.[18]

1.2.1.2. Idaho Power Company

Founded in 1916, Idaho Power Company is the largest electricity provider in the State. Headquartered in Boise, it serves more than 570,000 customers across a 24,000 square mile service territory in southern Idaho and eastern Oregon.[19] Electricity is supplied through 4,800 miles of transmission lines and more than 27,000 miles of distribution lines.[20] Idaho Power has a significant hydroelectric generation power base. It has 17 low-cost, emission-free hydroelectric projects at the core of its generation portfolio, including a 1,167 megawatt (MW), three-dam complex in Hells Canyon.[21] Idaho Power entered the Western EIM in April 2018,[22] and announced its goal to provide 100% clean energy to its customers by 2045 in March 2019.

Figure 1.7 Idaho Power Energy Mix (2019)[23]



Idaho Power also generates electricity using natural gas at a combined-cycle combustion plant at Langley Gulch, near New Plymouth, Idaho, and two simple-cycle plants near Mountain Home. Additionally, it has partial ownership in baseload coal facilities located in Wyoming and Nevada, the Bridger and Valmy plants. Idaho Power exited the

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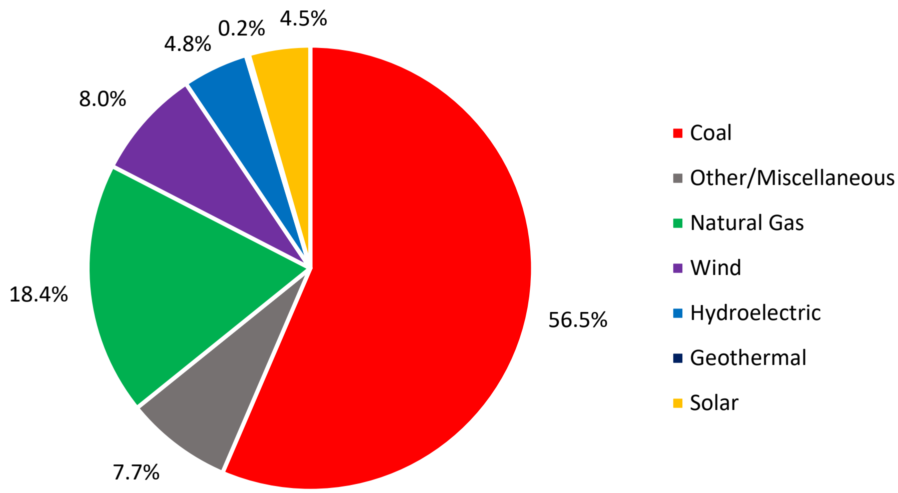
[18] Avista. "2020 Electric Integrated Resource Plan." https://www.myavista.com/about-us/integrated-resource-planning
[19] Idaho Power Company. "Company Facts." https://www.idahopower.com/about-us/company-information/company-facts/
[20] Idaho Power Company. "Transmission and Power Lines." https://www.idahopower.com/energy-environment/energy/delivering-power/transmission-and-power-lines/
[21] Idaho Power Company. "Hydroelectric Plants." https://www.idahopower.com/energy-environment/energy/energy-sources/hydroelectric/hydroelectric-plants/
[22] Western EIM. "About." https://www.westerneim.com/Pages/About/default.aspx, and Idaho Power Company. "Clean Today. Cleaner Tomorrow." https://www.idahopower.com/energy/clean-today-cleaner-tomorrow/
[23] Idaho Power Company. "Our Energy Sources." https://www.idahopower.com/energy-environment/energy/energy-sources/

Boardman coal facility located in Oregon in 2020 and half of its share of the Valmy coal facility in 2019. Idaho Power's resource portfolio fuel mix for 2019 is shown in Figure 1.7. Idaho Power-owned generating capacity was the source for 72.4% of the energy delivered to customers. Purchased power comprised 27.6% of the total energy delivered to customers.[24]

1.2.1.3. PacifiCorp / Rocky Mountain Power

PacifiCorp operates under the name Rocky Mountain Power in Idaho, Utah, and Wyoming, and serves 82,000 customers in 14 Idaho counties.[25] PacifiCorp serves more than 1.9 million retail customers across 141,390 square miles of service territory in California, Idaho, Oregon, Utah, Washington, and Wyoming.[26] PacifiCorp merged in 1989 with Utah Power & Light Company and was purchased by MidAmerican Energy Holdings Company in 2006, which later changed its name to Berkshire Hathaway Energy. In 2014, PacifiCorp helped launch the Western EIM.[27]

Figure 1.8 PacifiCorp's Energy Production Mix (2019)[28]



PacifiCorp owns 10,880 MW of net generation capacity, including coal, hydroelectric, natural gas, wind, and geothermal resources.[29] PacifiCorp's energy mix is shown in Figure 1.8. Wind, hydro, geothermal, and other non-carbon-emitting resources currently make up about 48% of PacifiCorp's owned and contracted generating capacity. PacifiCorp owns 2,222 MW of wind generation capacity and has long-term power

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[24] Idaho Power Company. "2019 Integrated Resource Plan, Second Amended." https://docs.idahopower.com/pdfs/AboutUs/PlanningForFuture/irp/2019/SecondAmended2019IRP.pdf

[25] Rocky Mountain Power. "Just the Facts." https://www.rockymountainpower.net/content/dam/pcorp/documents/en/rockymountainpower/about/2020_BHE_FactSheet-RockyMountainPower.pdf f

[26] PacifiCorp. "About." https://www.pacificorp.com/about.html

[27] PacifiCorp. "Grid Modernization." https://www.pacificorp.com/energy/grid-modernization.html

[28] PacifiCorp. "Rocky Mountain Power – Power Content Label." https://www.rockymountainpower.net/savings-energy-choices/blue-sky-renewable-energy/product-content-label.html

[29] PacifiCorp. "Generation Resources." https://www.pacificorp.com/energy.html

purchase agreements for 1,686 MW from wind projects owned by others.[30] PacifiCorp's customers receive electricity through approximately 16,500 miles of transmission lines, 64,000 miles of distribution lines, and 900 substations.[31]

1.2.1.4. Idaho's Municipal and Cooperative Utilities

Twenty-three electric utility municipalities and cooperatives are members of the Idaho Consumer Owned Utilities Association (ICUA), serving more than 137,000 customers throughout Idaho, accounting for about 16% of Idaho's electric consumers.[32] Municipal and cooperative utilities are not subject to regulation by the Idaho Public Utilities Commission (PUC).[33] Instead, Idaho's municipal and cooperative electric utilities provide competitively priced energy services to their members and residents and are generally governed by an independently elected Board of Directors or city councils.

Most of Idaho's municipalities and cooperatives purchase the bulk of their electricity, over 96%, from Bonneville Power Administration (BPA); however, some are beginning to acquire their own power generation resources and enter into power purchase agreements with other energy providers.[34] For example, Idaho Falls Power owns and operates five hydroelectric projects, owns a portion of the Horse Butte Wind project, and operates a small amount of solar.[35] The low-cost, renewable electricity provided by the Federal Columbia River Power System, including BPA and the four lower Snake River dams, is vital to public power utilities across Idaho and the communities they serve.

1.2.1.5. Utah Associated Municipal Power Systems

Three of Idaho's municipal and cooperative utilities and the Idaho Energy Authority, Inc. are members of the Utah Associated Municipal Power Systems (UAMPS). UAMPS is a project-based joint action agency headquartered in Salt Lake City, comprised of 48 public utilities in six western states. It provides comprehensive wholesale electric-energy services on a nonprofit basis to community-owned power systems throughout the Intermountain West. UAMPS conducts resource planning, evaluation of power resources or services for its members, and develops power-generating facility projects.[36]

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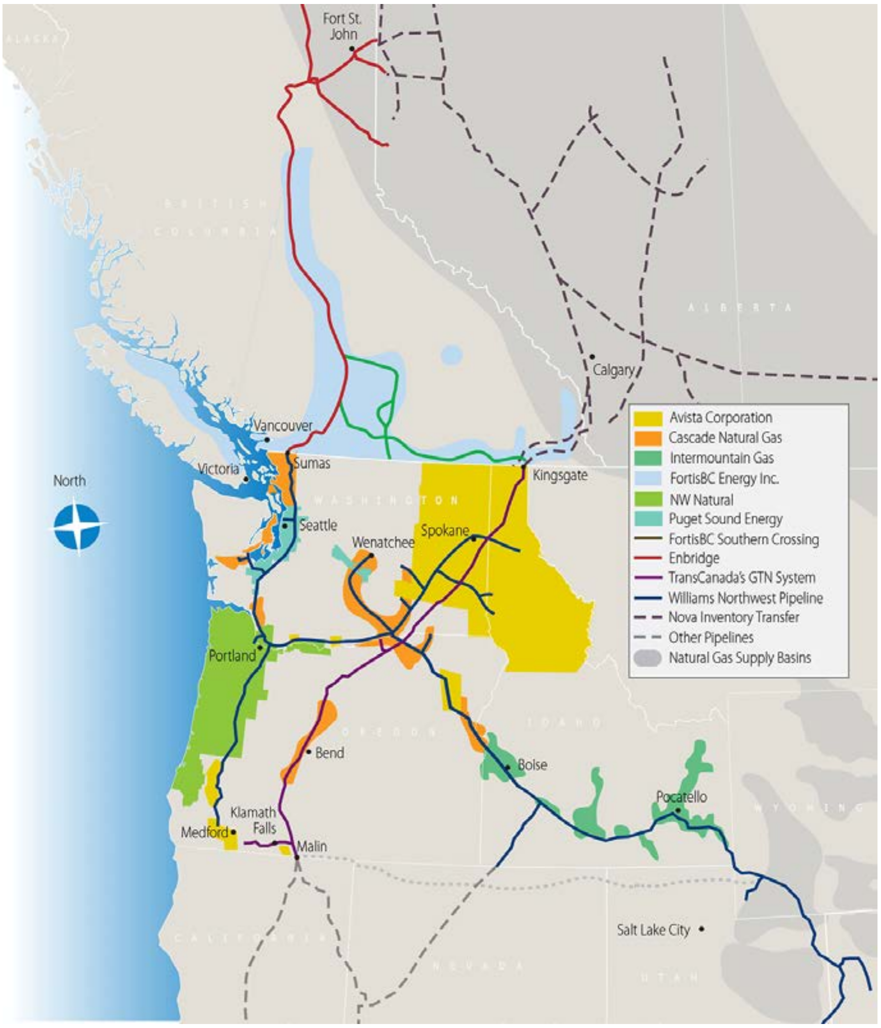
[30] PacifiCorp. "2019 Integrated Resource Plan – Volume I." https://www.pacificorp.com/energy/integrated-resource-plan.html
[31] PacifiCorp. "Transmission." https://www.pacificorp.com/transmission.html
[32] Idaho Consumer-Owned Utilities Association. "Members." https://www.icua.coop/members/
[33] Idaho Public Utilities Commission. "About the Commission." https://puc.idaho.gov/Home/About
[34] Idaho Consumer-Owned Utilities Association. "Members." https://www.icua.coop/members/
[35] Idaho Falls Power. "Power Portfolio." https://www.idahofallsidaho.gov/248/Power-Portfolio
[36] UAMPS. "About Us." http://www.uamps.com/About-Us

1.2.2. Natural Gas

Figure 1.9 Western U.S. Interstate Natural Gas Pipeline System and Natural Gas Service Territories[37]



Avista Utilities and Intermountain Gas Company provide the majority of natural gas service in Idaho. A third utility, Dominion Energy, provides service to Idaho customers in a portion of Franklin County in the southeastern part of the state.[38] Idaho has 380,000 residential, commercial and industrial natural gas customers.[39] Figure 1.9 shows the major natural gas infrastructure in Idaho and Idaho utility service territories.

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[37] Northwest Gas Association. "Natural Gas Facts." https://www.nwga.org/wp-content/uploads/2017/06/NWGA_FactsWEBF.pdf

[38] Dominion Energy "About Us – Western Gas Operations." https://www.dominionenergy.com/about-us/moving-energy/western-gas-operations

[39] Northwest Gas Association. "Natural Gas Fact Sheet Idaho." https://www.nwga.org/wp-content/uploads/2016/02/IdahoFactSheet2017ForWeb.pdf

1.2.2.1. Avista Utilities

Avista serves 87,000 Idahoans in its northern Idaho natural gas service area, 90% of whom are residential customers.[40] Avista's natural gas distribution system consists of approximately 3,300 miles of distribution pipelines in Idaho. Its North Division, which covers about 26,000 square miles primarily in eastern Washington and northern Idaho, is supplied by more than 40 points along interstate pipelines.

Avista holds firm access rights to both Canadian and Rocky Mountain natural gas supplies through the Williams Northwest and Gas Transmission Northwest pipelines. Avista also holds rights to the Jackson Prairie storage facility in Washington. According to Avista's latest Natural Gas Integrated Resource Plan (IRP), the number of customers in Washington and Idaho is projected to increase at an average annual rate of 1.3%.[41]

1.2.2.2. Intermountain Gas Company

Intermountain Gas Company (IGC) was founded in Idaho in 1950 and is a subsidiary of MDU Resources Group.[42] IGC distributes natural gas to approximately 350,000 residential, commercial, and industrial customers in 76 Idaho communities. IGC uses approximately 12,800 miles of pipelines across 50,000 square miles in southern Idaho.[43] IGC's 125 industrial and transport customers comprise 50% of its annual energy demand, while residential and commercial customers comprise 33% and 17% respectively.

IGC holds firm capacity rights on William's Northwest Pipeline as well as three upstream pipelines to deliver gas to the distribution system. The upstream systems are: Gas Transmission Northwest, Foothills Pipeline and Nova Gas Transmission. IGC owns and operates the Nampa liquified natural gas (LNG) storage facility and leases storage at the Jackson Prairie underground facility, the Plymouth LNG facility, and leases capacity from Dominion Energy's Clay Basin underground storage field. Residential, commercial, and industrial peak day load on IGC's system under design conditions is forecast to grow at an average annual rate of 2.08% over the five-year period of 2019-2023.[44]

1.2.2.3. Dominion Energy

Dominion Energy, formerly called Questar Gas, based in Salt Lake City, provides natural gas service to residential, commercial, and industrial customers in Utah, southwestern Wyoming and about 2,200 customers in Franklin County, Idaho.[45] The Idaho Public

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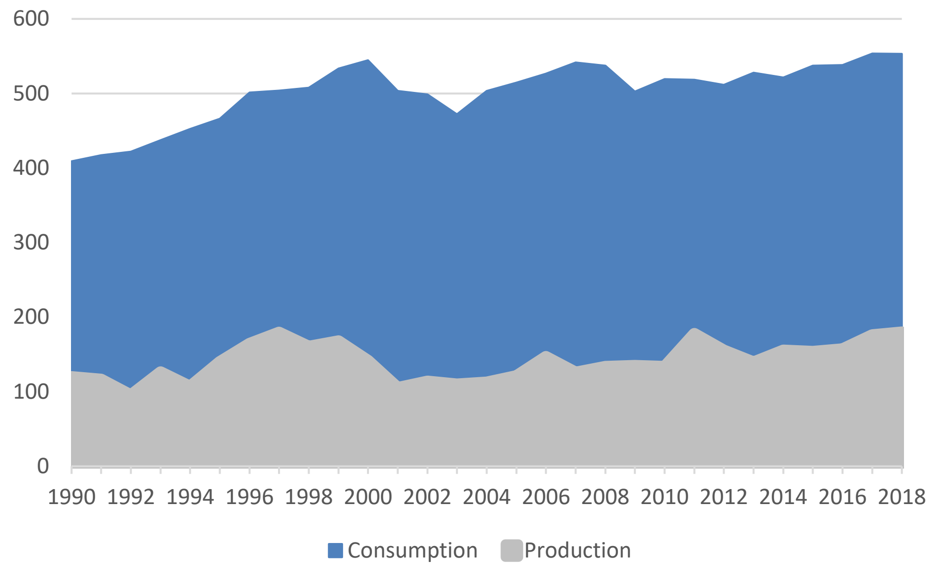
[40] Avista. "2018 Natural Gas Integrated Resource Plan." https://www.myavista.com/about-us/integrated-resource-planning
[41] Avista. "2018 Natural Gas Integrated Resource Plan." https://www.myavista.com/about-us/integrated-resource-planning
[42] Intermountain Gas. "About Us." https://www.intgas.com/in-the-community/about-us/
[43] Intermountain Gas. "2019-2023 IRP." https://www.intgas.com/wp-content/uploads/PDFs/commission_filings/IRP-Write-Up-Book-2019.pdf
[44] Intermountain Gas. "2019-2023 IRP." https://www.intgas.com/wp-content/uploads/PDFs/commission_filings/IRP-Write-Up-Book-2019.pdf
[45] Idaho Public Utilities Commission. "2018 Annual Report – Natural Gas." https://puc.idaho.gov/Fileroom/PublicFiles/annualreports/ar2018/Section%20III%20Natural%20Gas.pdf; and Dominion Energy. "Western Gas Operations." https://www.dominionenergy.com/company/moving-energy/western-gas-operations

Utilities Commission has elected to allow the Utah Public Service Commission to regulate Dominion Energy's activities in its small Idaho service area.[46]

1.3. Energy Consumption, Production, and Prices

Figure 1.10 Idaho Energy Production and Consumption[47]

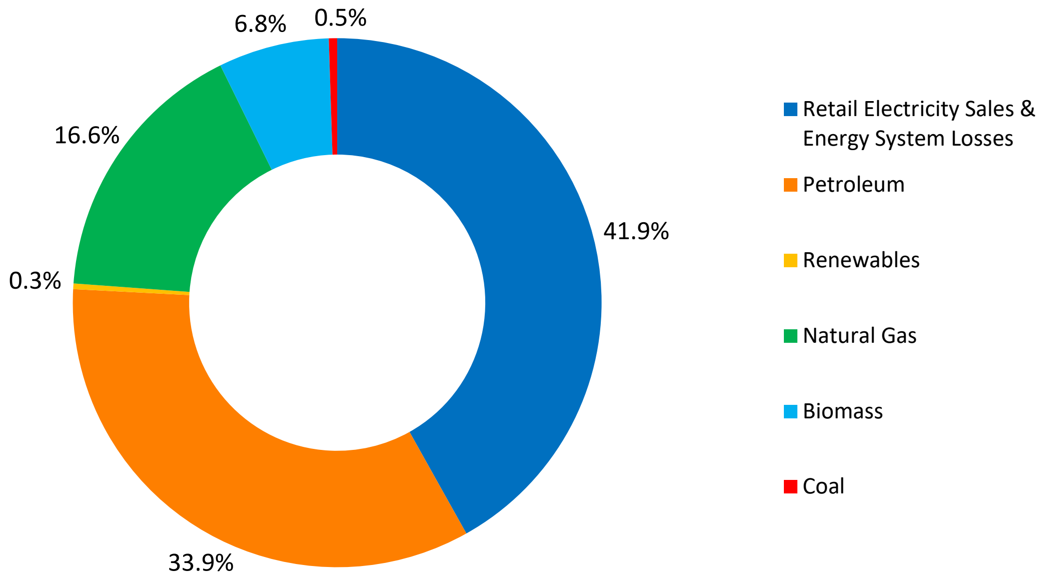


Idaho produces approximately 32% of the total energy it consumes, including electricity, transportation fuels, and heating fuels. This is demonstrated in Figure 1.10, with consumption and production of heat measured in increments of trillion BTUs, or British Thermal Units. The State's reliance upon imported energy requires a robust and well-maintained infrastructure of highways, railroads, pipelines, and transmission lines to facilitate economic development and maintain a high quality of life for Idaho's citizens.

[46] Idaho Public Utilities Commission. "Merger Agreement." https://puc.idaho.gov/Case/Details/3245
[47] U.S. Energy Information Administration. "State Energy Data System." https://www.eia.gov/state/seds/seds-data-complete.php?sid=ID#

1.3.1. Sources of Idaho's Energy

Figure 1.11 Sources of End Use Energy Consumed in Idaho in 2018[48]



As shown in Figure 1.11, petroleum–including those blended with ethanol–used primarily for transportation, accounts for approximately 34% of Idaho's end-use energy consumption. Important energy commodities such as electricity sales and system losses account for 42% and natural gas accounts for 17%, while the remaining 8% is attributable to coal, biomass, and other renewable energy sources. Idaho's total end-use energy consumption in 2018 was 553.9 trillion BTUs.

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[48] U.S. Energy Information Administration. "State Energy Consumption Estimates." https://www.eia.gov/state/seds/sep_use/notes/use_print.pdf

Figure 1.12 Idaho's 2019 Electricity Sources[49]

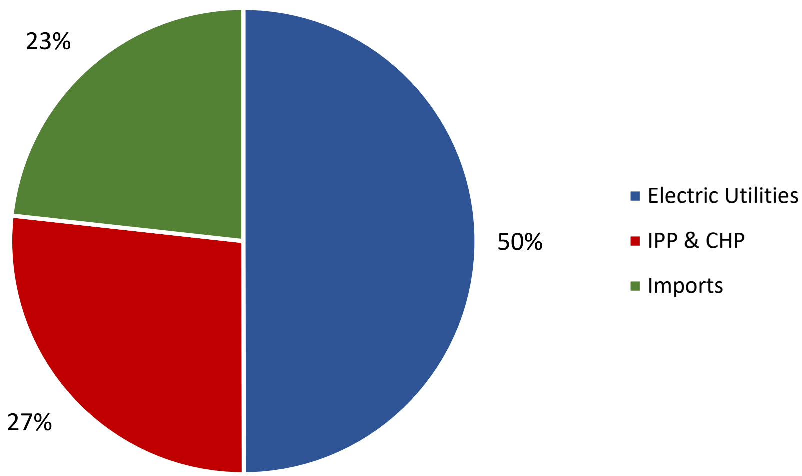
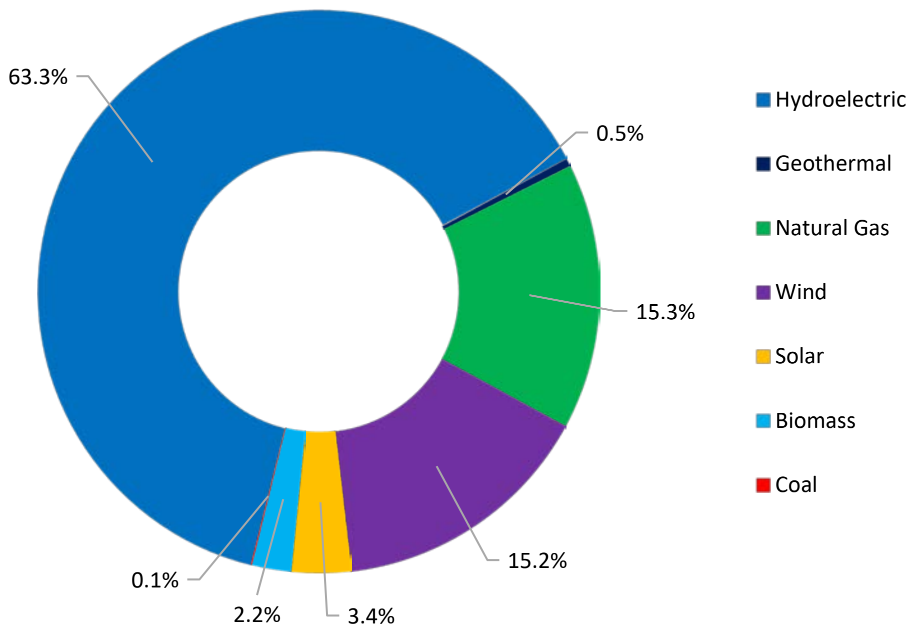


Figure 1.12 illustrates Idaho's dependence upon imported electricity to meet load demands. Idaho's utilities generate approximately 50% of the energy utilized in-state. 27% is provided by combined heat and power (CHP) or independent power producers (IPP). The remaining 23% is comprised of market purchases and energy imports from out-of-state generating resources owned by Idaho utilities. Idaho's retail sales of electricity totaled 23,985,275 MWh.

[49] U.S. Energy Information Administration. "Idaho Electricity Profile 2019." www.eia.gov/electricity/state/idaho/index.cfm

Figure 1.13 Idaho's 2018 Electricity Fuel Mix[50]



Note: The fuel mix percentages in this figure are based on Idaho's power sector electrical consumption data and not by generation data since Idaho consumes more electricity than it generates. These percentages only account for electric use of energy resources; neither thermal nor fuel usage are calculated into the percentages.

Shown in Figure 1.13, hydroelectricity is the dominant source of Idaho's electricity, comprising approximately 63%. Natural gas and wind both make up 15% each, and non-hydro renewables, principally solar power, geothermal and biomass, account for approximately 6%.

While hydroelectric is the primary resource utilized for electricity generation in Idaho, its percentage depends upon the quality of the water year.[51] For example, droughts may reduce the hydroelectric share, and non-hydroelectric sources must supply the remainder.

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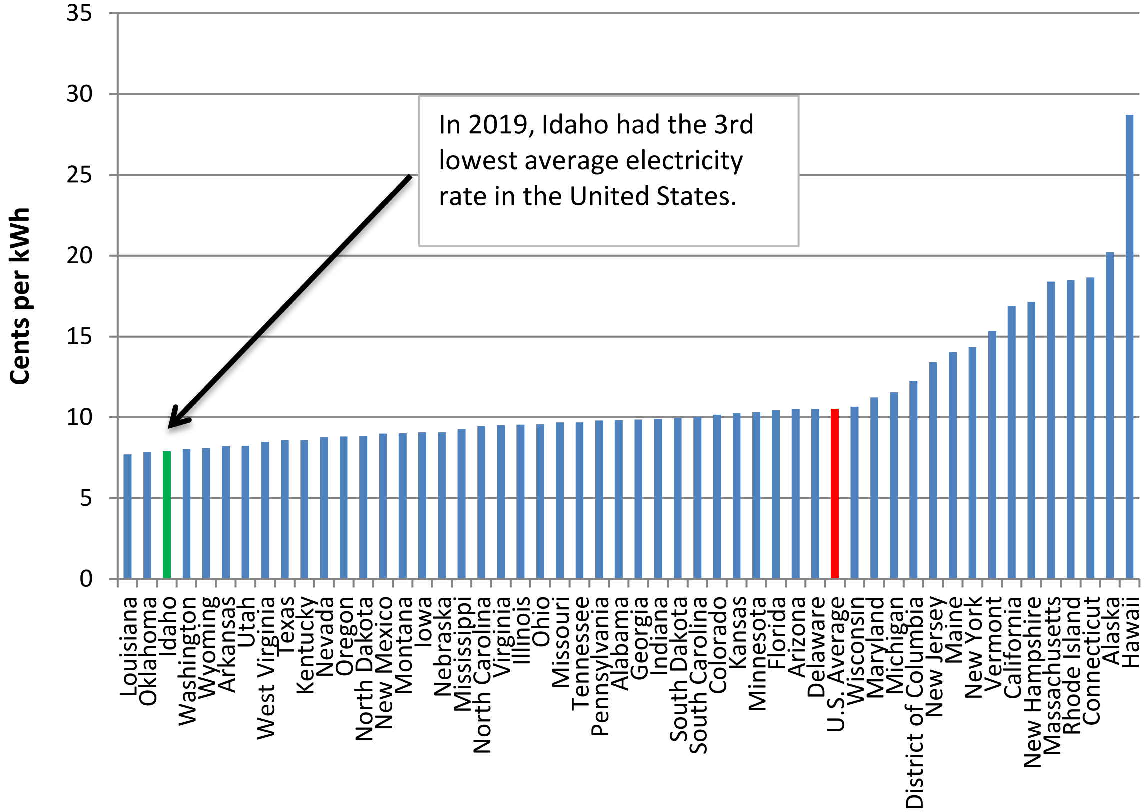
[50]; U.S. Energy Information Administration. "Detailed State Data." https://www.eia.gov/electricity/data/state/; U.S. Energy Information Administration. "State Energy Data System (SEDS): 1960-2018." https://www.eia.gov/state/seds/seds-data-complete.php?sid=US#Consumption

[51] U.S. Energy Information Administration. "Idaho State Electricity Profile." https://www.eia.gov/electricity/state/idaho/index.php

1.3.2. Energy Rates Compared to Other States

Figure 1.14 Idaho's 2019 Average Electricity Rates Compared to Other States[52]



Idaho's baseload resources, including hydro, thermal, and geothermal, provide a constant source of reliable low-cost electricity to Idaho utilities. As a result, Idaho's average electricity rates were the third lowest among the fifty states in 2019, shown in Figure 1.14.

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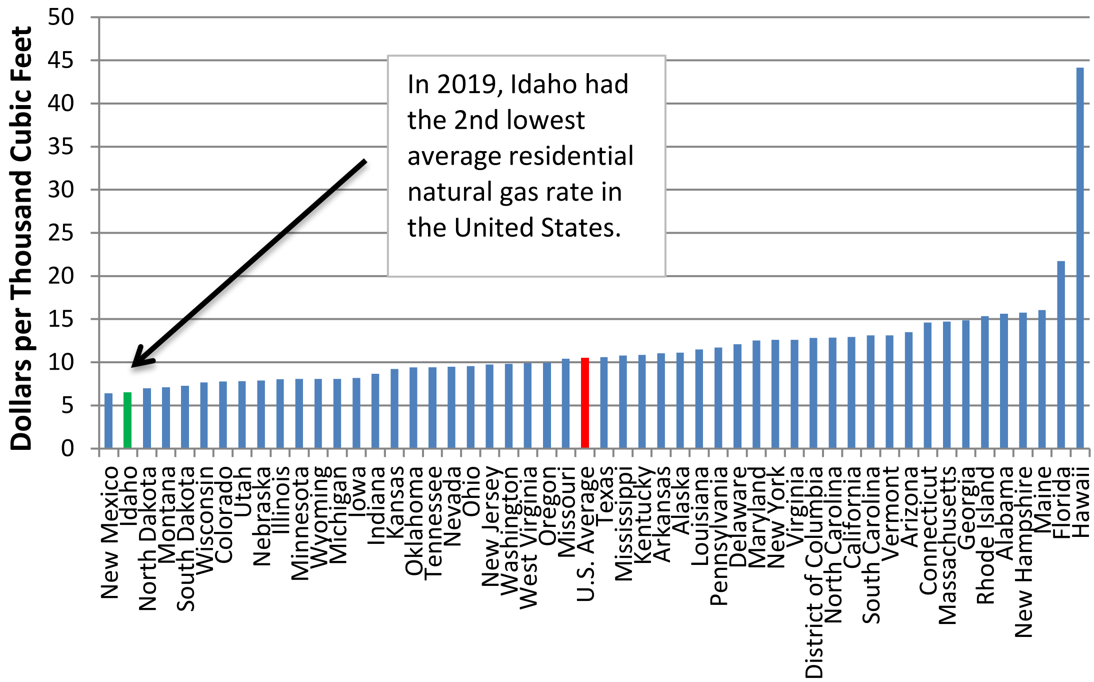
[52] U.S. Energy Information Administration. "Total Electricity Price." https://www.eia.gov/electricity/sales_revenue_price/pdf/table4.pdf

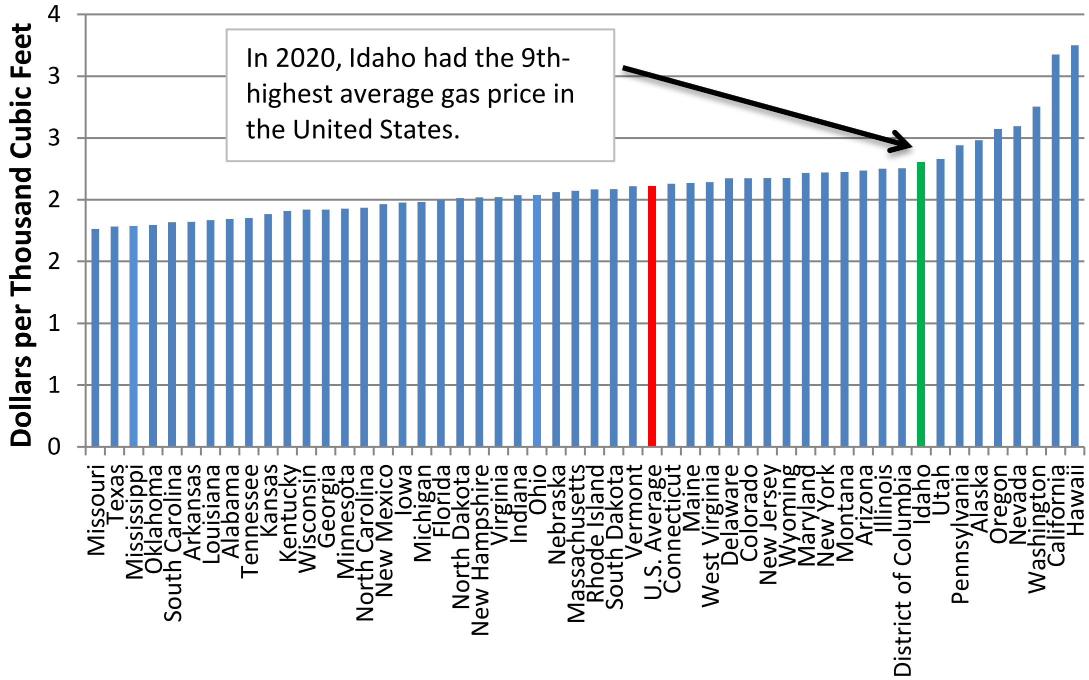
Figure 1.15 Idaho's 2019 Residential Natural Gas Prices Compared to Other States[53]



In 2019, Idaho's average residential natural gas rates were the second lowest in U.S., as shown in Figure 1.15.

[53] U.S. Energy Information Administration. "Natural Gas Prices." www.eia.gov/dnav/ng/NG_PRI_SUM_A_EPG0_PRS_DMCF_A.htm

Figure 1.16 Idaho's 2020 Retail Gasoline Prices Compared to Other States[54]



Note: The average combined (local, state and federal) gasoline tax in 2020 was 54.78 cents per gallon. Idaho's combined gasoline tax rate in 2020 was 51.40 cents per gallon.[55]

Idaho relies principally upon refineries in Utah and Montana for its supply of gasoline, diesel, and other refined petroleum products. Idaho's prices for these products are typically higher than the national average. Idaho had the ninth highest average gasoline price in the United States in 2020, as shown in Figure 1.16.

[54] AAA. "Gas Prices." https://gasprices.aaa.com/

[55] American Petroleum Institute. "Gasoline Taxes." http://www.api.org/~/media/Files/Statistics/Gasoline-Tax-Map.pdf

1.4. State, Regional, and Federal Energy Regulators

The entities listed below are involved in regulating aspects of Idaho's energy systems. A regulator is a government agency with authority to control energy services.

1.4.1. Idaho Public Utilities Commission

The Idaho PUC regulates Idaho's investor-owned electric, natural gas, telecommunications, and water utilities to ensure adequate service at just, reasonable, and sufficient rates. The Idaho PUC has authority to promulgate administrative rules under the Idaho Administrative Procedures Act.[56] The Idaho PUC consists of three commissioners, appointed by the Governor and subject to Senate confirmation, who serve staggered six-year terms. No more than two commissioners may be of the same political party. The Idaho PUC renders decisions about utilities based upon all the evidence that is presented in the case record. Idaho PUC orders may be appealed directly to the Idaho Supreme Court.

The Idaho PUC holds formal hearings that resemble judicial proceedings in which parties to the case may present testimony and evidence and may conduct cross-examinations. All cases are a matter of public record. Information about the Idaho PUC and its Consumer Assistance Section, which helps customers with billing and service-related questions, is available on its website. [57]

To ensure its decisions are based upon the best information available, the Idaho PUC employs approximately 50 people – including engineers, accountants, economists, and investigators – to analyze each matter before the Idaho PUC and issue recommendations. In the Idaho PUC's formal proceedings, the staff is a separate party to the case and may present its own testimony, evidence, and expert witnesses. Staff recommendations are considered by the Idaho PUC along with those of other parties to each case, which may include utilities, the public, and agricultural, industrial, business, or consumer groups.

1.4.2. Idaho Department of Lands and Oil and Gas Conservation Commission

The Idaho Department of Lands (IDL) leases and issues rights-of-way for energy projects on state endowment lands and provides some regulation of Idaho's mining industry.[58] IDL services are provided by 10 Supervisory Areas that include 14 offices.

The Oil and Gas Conservation Commission (OGCC) is administratively housed within the IDL.[59] The OGCC regulates the exploration, drilling, and production of oil and gas resources in Idaho to ensure the conservation of resources and the protection of surface water and groundwater.[60]

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[56] Idaho Statutes § 61and § 62.
[57] Idaho Public Utilities Commission. https://puc.idaho.gov/
[58] Idaho Department of Lands. "About Us." https://www.idl.idaho.gov/about-us/; and "Oil & Gas Leasing." https://www.idl.idaho.gov/leasing/oil-gas-leasing/
[59] Idaho Statute §47-314.
[60] Idaho Oil and Gas Conservation Commission. "About the Commission." https://ogcc.idaho.gov/

The IDL reviews applications for drilling, well treatment, pit construction, and other activities in conjunction with the Idaho Department of Water Resources and the Idaho Department of Environmental Quality. The Director or her/his designee may hold administrative hearings on applications for activities that may affect other mineral interest owners. The OGCC consists of the Director of IDL, as well as a Governor-appointed county commissioner from an oil and gas producing county and three Governor-appointed technical experts with degrees in geosciences or engineering and at least ten years of experience in the oil and gas industry.

1.4.3. Idaho Department of Environmental Quality

The Idaho Department of Environmental Quality (DEQ) is responsible for enforcing state environmental regulations and administers a number of federal environmental protection laws including the Clean Air Act, the Clean Water Act, and the Resource Conservation and Recovery Act.[61] DEQ issues permits under the Idaho Pollutant Discharge Elimination System, which began phasing authority from the Environmental Protection Agency to DEQ in 2018. DEQ will have full permitting authority as of July 1, 2021.[62] DEQ has six regional offices across the State that work in partnership with local communities, businesses, and citizens to identify and implement cost-effective environmental solutions for projects.[63]

1.4.4. Idaho State Department of Agriculture, Bureau of Weights and Measures

The Bureau of Weights and Measures (Bureau) is responsible for assuring the accuracy of commercial weighing and measuring devices such as petroleum meters, fuel pumps, and propane meters. The Bureau monitors gasoline octane levels and is responsible for Idaho's fuel quality and labeling.[64] It assures national traceability to Idaho's primary mass and volume standards through a nationally recognized metrology laboratory.

1.4.5. Idaho Energy Resources Authority

The Idaho Energy Resources Authority (IERA) is an energy lending/financing entity authorized to issue revenue bonds to municipal and cooperative electric utilities. It was established by the Idaho State Legislature in 2005 to promote transmission, generation, and renewable energy development in the State and the region.

The IERA allows for Idaho utilities to jointly own and finance transmission and generation projects for the benefit of their ratepayers. The IERA can participate in planning, financing, constructing, developing, acquiring, maintaining, and operating electric generation and transmission facilities and their supporting infrastructure. While the IERA has bonding authority to promote specific projects, it has no legislative appropriation, no full-time staff, and no ability to finance projects that are not backed by ratepayers. The services provided by the IERA offer unique opportunities for Idaho's

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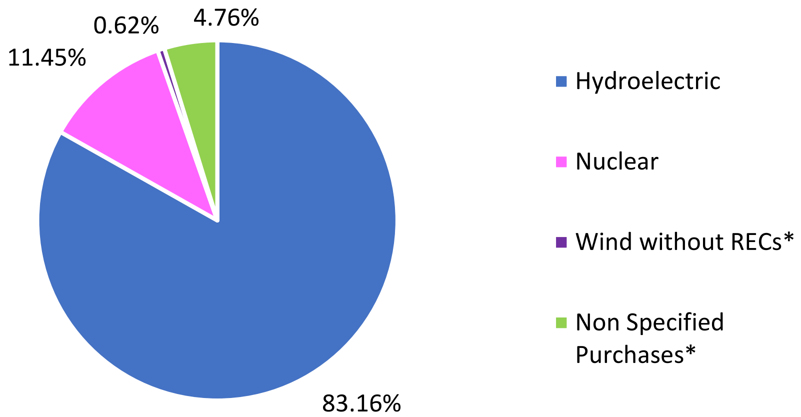
[61] Idaho Department of Environmental Quality. "About." http://deq.idaho.gov/about-us/
[62] Idaho Department of Environmental Quality. "Idaho Pollutant Discharge Elimination System." http://deq.idaho.gov/water-quality/wastewater/
[63] Idaho Department of Environmental Quality. "Regional Offices & Issues." http://deq.idaho.gov/regional-offices/
[64] Idaho State Department of Agriculture. "Weights and Measures." https://agri.idaho.gov/main/weights-and-measures/

municipal and cooperative electric utilities help to materially lower the development costs of critical energy projects in the State.

1.4.6. Bonneville Power Administration

The Bonneville Power Administration (BPA) is one of four Power Marketing Administrations (PMAs) under the U.S. Department of Energy (DOE) that supply power throughout their regions.[65] BPA is a separate and distinct entity in the DOE under the DOE Organization Act of 1977.[66] BPA is self-funded and has its own federal borrowing and procurement authorities which it utilizes to serve the Northwest. BPA supplies about 28% of regional power.[67] BPA's territory includes Idaho, Oregon, Washington, western Montana and small parts of eastern Montana, California, Nevada, Utah and Wyoming. BPA works with cooperatives, municipalities, IOUs, and directly provides electric power to a number of federal installations, industrial, and irrigation customers in a practice known as direct service.[68]

Figure 1.17 BPA Resources (2019)[69]



*Note: *BPA conveys its Renewable Energy Certificates to other parties and does not retire them.*

BPA sources power from 31 federal hydroelectric dams that are operated by the U.S. Army Corps of Engineers and the Bureau of Reclamation. These dams are referred to as the Federal Columbia River Power System. It also markets power generated from some non-federal plants in the Northwest, as well as additional power from the 1,169 MW

[65] U.S. Energy Information Administration. "Federal Power Marketing Administrations operate across much of the United States." https://www.eia.gov/todayinenergy/detail.php?id=11651
[66] Bonneville Power Administration. "About Us." https://www.bpa.gov/news/AboutUs/Pages/default.aspx
[67] Bonneville Power Administration. "BPA Facts." https://www.bpa.gov/news/pubs/GeneralPublications/gi-BPA-Facts.pdf
[68] Bonneville Power Administration. "BPA Facts." https://www.bpa.gov/news/pubs/GeneralPublications/gi-BPA-Facts.pdf
[69] Bonneville Power Administration. "Fuel Mix." https://www.bpa.gov/p/Generation/Fuel-Mix/FuelMix/BPA-Official-Fuel-Mix-2019.pdf

Columbia Generating Station nuclear power plant in Richland, Washington.[70] BPA's energy resources are shown in Figure 1.17. BPA operates and maintains approximately 15,000 miles of the high-voltage transmission lines and 261 substations to 546 transmission customers that serve about 14 million people in its service territory.[71]

BPA annually updates a Pacific Northwest Loads and Resources Study (White Book) which documents regional retail loads and resource capabilities that serve the federal system and Pacific Northwest for 10 years. The most recent White Book details resource capabilities from 2021 through 2030. The study uses public resource planning reports submitted by individual utilities, the Northwest Power and Conservation Council, and the Pacific Northwest Utilities Conference Committee. Under average water conditions, the Federal System is projected to have annual energy surpluses through the study period.[72] Under the Northwest Power Act, BPA is responsible for providing the net load requirements of its requesting customers. This includes IOUs in the Pacific Northwest.

Under BPA's current 20-year power sales contract, Idaho municipal and cooperative utilities (customers) purchase power under a tiered rate methodology. Tier 1 locks in the federal base system's lowest cost generation portfolio. When the customer exceeds their Tier 1 allocation, they can purchase a Tier 2 resource from BPA, acquire resources independently, or jointly with other utilities to meet future demands.

1.4.7. U.S. Department of Energy

The U.S. Department of Energy (DOE) administers national energy, environmental, and nuclear policies through science and technology solutions.[73] DOE oversees the nation's nuclear infrastructure, and operates energy research facilities throughout the nation, including 17 national laboratories, among them Idaho National Laboratory.

1.4.8. U.S. Federal Energy Regulatory Commission

The Federal Energy Regulatory Commission (FERC) is an independent regulatory agency within the U.S. DOE. FERC has jurisdiction over interstate electricity sales, wholesale electric rates, hydroelectric licensing, natural gas transmission and related services, pricing, oil pipeline rates and gas pipeline certification.[74]

1.4.9. North American Electric Reliability Corporation

The North American Electric Reliability Corporation (NERC) is a non-profit subject to oversight by the FERC and governmental authorities in Canada whose mission is to ensure the reliability and security of the bulk power system in North America. NERC accomplishes this by developing and enforcing reliability standards and assessing

[70] U.S. Nuclear Regulatory Commission. "Columbia Generating Station." https://www.nrc.gov/info-finder/reactors/wash2.html
[71] Bonneville Power Administration. "Newsroom." https://www.bpa.gov/news/newsroom/Pages/BPA-powers-up-future-energy-industry-workers.aspx
[72] Bonneville Power Administration. "2019 Pacific Northwest Loads and Resources Study." https://www.bpa.gov/p/Generation/White-Book/wb/2019-WBK-Summary.pdf
[73] U.S. Department of Energy. "About Us." https://www.energy.gov/about-us
[74] Federal Energy Regulatory Commission. "About FERC." https://www.ferc.gov/about/what-ferc p

seasonal and long-term reliability.[75] NERC has four interconnection regions and Idaho is located in the Western Interconnection.

NERC's GridEx exercise is an opportunity for utilities to train how they would respond to and recover from simulated coordinated cyber and physical security threats and incidents, strengthen their crisis communications relationships, and provide input for lessons learned. The first exercise facilitated by NERC took place in November 2011. The fourth exercise, GridEx IV, was held in November 2017 and had more than 6,500 participants representing 450 organizations. GridEx V, held in November 2019, had more than 7,000 participants from 526 organizations.[76]

1.4.10. Western Electricity Coordinating Council

The Western Electricity Coordinating Council (WECC) is the regional entity that monitors and enforces reliability standards in the Western Interconnection subject to oversight by NERC and FERC. These reliability standards apply to electric utilities and other entities that own or operate generation, transmission, or other facilities in the bulk electric system. WECC promotes reliability in the Western Interconnection by serving as a central repository of data and other technical metrics about the grid.[77]

1.4.11. RC West

A Reliability Coordinator (RC) coordinates with electric utilities and transmission operators to ensure the bulk electric system is operated within specified limits and that system conditions are stable across the area. RC West is currently the RC for 42 entities in the Western Interconnection, overseeing 87% of the load in the western United States.[78]

1.4.12. Western Energy Imbalance Market and Extended Day-Ahead Market

The California Independent System Operator (CAISO) is one of nine independent system operators/regional transmission organizations (ISOs/RTOs) in the country and serves all three of Idaho's IOU providers. ISOs/RTOs operate and provide non-discriminatory access to transmission systems for regions of the country where they provide wholesale energy marketplaces.

The Western Energy Imbalance Market (EIM) was first launched in 2014 as an agreement between PacifiCorp and CAISO. In 2020, 11 utilities with service territories in the western U.S. and British Columbia, Canada have joined, and 11 confirmed pending participants will enter the EIM before the end of 2022.[79] Idaho Power joined the EIM in April 2018 and Avista will begin participating in April 2022. On September 16, 2019, the

[75] North American Electric Reliability Corporation. "About NERC." https://www.nerc.com/AboutNERC/Pages/default.aspx
[76] North American Electric Reliability Corporation. "GridEx." https://www.nerc.com/pa/CI/ESISAC/Pages/GridEx.aspx
[77] Western Electricity Coordinating Council. "About WECC." https://www.wecc.biz/Pages/AboutWECC.aspx
[78] California ISO. "Reliability Coordinator FAQ." http://www.caiso.com/Documents/ReliabilityCoordinatorFAQ.pdf
[79] Western Energy Imbalance Market. "About." https://www.westerneim.com/Pages/About/default.aspx

BPA signed an implementation agreement with CAISO and a record of decision in a move toward joining the EIM in 2022.[80]

The EIM utilizes regional transmission systems to balance supply and demand across a larger geographical footprint in real time. The EIM manages transmission congestion and optimizes procurement of imbalance energy (positive or negative) through economic bids submitted by the EIM Participating Resource Scheduling Coordinators in the fifteen-minute and five-minute markets.[81] The EIM's daily operations are managed by CAISO.[82]

In 2019, CAISO announced an initiative to develop an extended day-ahead market (EDAM) to improve market efficiency by integrating renewable resources using day-ahead unit commitment and scheduling across a larger area.[83] Fifteen EIM entities participated in the EDAM Feasibility Assessment in January 2019, and CAISO plans to request approval to launch the EDAM in 2021.[84]

1.4.13. U.S. Nuclear Regulatory Commission

The U.S. Nuclear Regulatory Commission (NRC) is an independent federal agency that oversees licensing, safety, security, storage, and disposal of nuclear materials. The State works with NRC on small-scale nuclear projects at INL, and to ensure that materials transported through the State for disposal and the materials present at INL adhere to appropriate safety guidelines.[85]

1.4.14. U.S. Department of the Interior

The U.S. Department of the Interior (DOI) manages public lands, territories, and tribal matters in the United States through the bureaus and offices it administers, which includes the Bureau of Land Management (BLM), the Bureau of Reclamation (BOR), the National Park Service (NPS), the U.S. Fish and Wildlife Service (FWS), and many others. The State and developers must work with DOI and its offices to secure permitting approval under the National Environmental Policy Act (NEPA), among other federal laws, for energy and mineral projects on federal land.[86]

Some examples of cooperative efforts include the following; the BOR oversees federal water resource management efforts and manages several dams in Idaho including Anderson Ranch, Arrowrock, American Falls, and Palisades. The BLM administers

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[80] Bonneville Power Administration. "Energy Imbalance Market." https://www.bpa.gov/Projects/Initiatives/EIM/Pages/Energy-Imbalance-Market.aspx

[81] Western Energy Imbalance Market. "EIM Track 2 Overview – Agreements." https://www.westerneim.com/Documents/EIMTrack2Overview-Agreements.pdf

[82] Western Energy Imbalance Market. "About." https://www.westerneim.com/Pages/About/default.aspx

[83] California ISO. "Public Comment Letter." http://www.caiso.com/Documents/PublicCommentLetter-EIMEntites-EDAM-Sep16-2019.pdf

[84] California ISO. "Extending the Day-Ahead Market to EIM Entities Issue Paper." http://www.caiso.com/InitiativeDocuments/IssuePaper-ExtendedDayAheadMarket.pdf

[85] U.S. Nuclear Regulatory Commission. "The Commission." https://www.nrc.gov/about-nrc/organization/commfuncdesc.html

[86] U.S. Department of Interior. "About." https://www.doi.gov/about; and National Environmental Policy Act. "Laws & Regulations." https://ceq.doe.gov/laws-regulations/states.html

mineral leases throughout Idaho, and is the lead permitting agency for transmission line siting projects. The State and developers work closely with the FWS on the impact of energy generation and transmission on endangered species and migratory birds.

1.4.15. U.S. Forest Service

The U.S. Forest Service (USFS), administered under the U.S. Department of Agriculture, is responsible for managing and protecting the nation's national forests and grasslands. The State and developers work with USFS on transmission rights-of-way through national forests, energy and mineral development on National Forest System lands, revision of forest land management plans, and development of woody biomass as a source of energy.[87]

1.4.16. National Marine Fisheries Service

The National Marine Fisheries Service (NMFS), administered under the U.S. Department of Commerce through the National Oceanic and Atmospheric Association, oversees endangered anadromous fish species and ensures compliance with fisheries regulations. The State and utilities work closely with NMFS on fisheries issues, including those related to salmon, steelhead, and hydroelectric facilities in the Federal Columbia River Power System.[88]

1.4.17. U.S. Environmental Protection Agency

The U.S. Environmental Protection Agency (EPA) establishes minimum standards for clean air, land and water in energy-generating processes including those involving nuclear, coal, and hydroelectric. EPA works closely with the state departments responsible for air and water quality, including DEQ, to develop and ensure compliance with environmental standards.[89] EPA administers the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as "Superfund," which allows EPA to clean up contaminated sites.[90] There are currently six sites in Idaho on the Superfund National Priorities List.[91]

[87] U.S. Forest Service. "About the Agency." https://www.fs.fed.us/about-agency
[88] National Oceanic and Atmospheric Administration Fisheries. "About Us." https://www.fisheries.noaa.gov/about-us
[89] U.S. Environmental Protection Agency. "About EPA." https://www.epa.gov/aboutepa/our-mission-and-what-we-do
[90] U.S. Environmental Protection Agency. "What is Superfund?" https://www.epa.gov/superfund/what-superfund
[91] U.S. Environmental Protection Agency. "National Priorities List by State." https://www.epa.gov/superfund/national-priorities-list-npl-sites-state#ID

1.5. State, Regional, and Federal Energy Coordinators

The entities listed below are involved in the coordination of Idaho's energy systems, providing direction and organization in energy policy and project development.

1.5.1. Idaho Governor's Office of Energy and Mineral Resources

The Idaho Governor's Office of Energy and Mineral Resources (OEMR), continued by Executive Order 2020-17, coordinates energy and mineral planning and policy development in the State of Idaho.[92] OEMR works to ensure that Idaho's energy and mineral resources are developed and utilized in an efficient, effective, and responsible manner that enhances the economy and sustains the quality of life for its citizens.

OEMR serves as the clearinghouse and first point of contact for the State on energy and mineral matters. It oversees the Idaho Strategic Energy Alliance, serves as a resource for policymakers, and coordinates efforts with federal and state agencies and local governments. OEMR administers energy efficiency programs, including Government Leading by Example and the State Energy Loan Program. Information about Idaho's energy and mineral resources is available to the public on OEMR's website.[93]

1.5.2. Idaho Strategic Energy Alliance

Idaho Strategic Energy Alliance (ISEA), continued by Executive Order 2020-18, engages stakeholders through its Board of Directors and Task Forces to develop recommendations for effective and long-lasting responses to existing and future energy challenges. The information and recommendations provided by ISEA will: increase the public's understanding of Idaho's diverse energy resources and the cost-effective energy efficiency opportunities in the state; improve communication and collaboration between Idaho's public and private sector on energy efficiency, conservation and sustainable energy development; and showcase new and innovative energy technologies developed in state.[94]

1.5.3. Leadership in Nuclear Energy Commission

The Leadership in Nuclear Energy Commission (LINE), continued by Executive Order 2019-05, makes recommendations to the Governor on policies and actions of the State of Idaho to support and enhance the long-term viability and mission of Idaho National Laboratory (INL) and other nuclear industries in Idaho. Membership of the Commission includes cabinet officials, local government leaders, representatives from Idaho tribes, INL, Idaho universities, the nuclear industry, and members of the public.

1.5.4. Northwest Power and Conservation Council

The U.S. Congress created the Northwest Power and Conservation Council (Council) in 1980 through the Northwest Power Act, to better engage with Idaho, Montana, Oregon, and Washington to ensure an affordable and reliable energy system while enhancing fish

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[92] Governor Brad Little. "Executive Order 2020-17." https://gov.idaho.gov/executive-orders/
[93] Idaho Governor's Office of Energy and Mineral Resources. "Welcome." https://oemr.idaho.gov/
[94] Idaho Governor's Office of Energy and Mineral Resources. "Idaho Strategic Energy Alliance." https://oemr.idaho.gov/isea/

and wildlife in the Columbia River Basin.[95] The Council is an independent entity controlled by the states that does not have a vested interest in selling electricity. It forecasts future electricity load growth in the region and helps plan how to best meet future needs. The Council informs the public about regional energy issues.[96]

The Council prepares and updates a least-cost Power Plan to advise the BPA, which is updated at least every five years. Included are electricity demand forecasts, electricity and natural gas price forecasts, an assessment of cost-effective energy efficiency that can be acquired over the life of the plan, and a least-cost generating resources portfolio.[97] The Council is currently in the process of developing the 8th Power Plan. The draft is expected to be released for public comment in the summer of 2021.

Additionally, the Council updates the BPA-funded Columbia River Basin Fish and Wildlife Program every five years. The latest complete update was adopted in October of 2014. In 2018, the Council proposed to amend the 2014 Columbia River Basin Fish and Wildlife Program through a two-part Addendum. The 2020 Addendum to the 2014 Columbia Basin Fish and Wildlife Program was completed in October 2020.[98]

1.5.4.1 Northwest Power Pool

The Northwest Power Pool (NWPP) is a Portland-based voluntary organization that coordinates power plant operational data and provides guidelines for power system operations in the Northwest. NWPP's members include electric utilities that own generating plants and sell power throughout the Northwestern US and Western Canada. NWPP activities are largely determined by major committees – the Operating Committee, the PNCA Coordinating Group, the Reserve Sharing Group Committee, and the Transmission Planning Committee.[99]

Given the recent trend in decommissioning coal plants and increasing renewable integration, NWPP is working to coordinate activities related to a comprehensive review of resource adequacy in the NWPP region and develop and implement a regional Resource Adequacy Program (RAP). In July 2020, NWPP published a Conceptual Design document describing the work done and progress accomplished towards developing a regional RAP.[100]

1.5.5. Western Interstate Energy Board

The Western Interstate Energy Board (WIEB) is an organization of 11 western states and

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[95] Northwest Power and Conservation Council. "About." https://www.nwcouncil.org/about

[96] Northwest Power and Conservation Council. "2019 Overview." https://www.nwcouncil.org/sites/default/files/2019Overview.pdf

[97] Northwest Power and Conservation Council. "Seventh Northwest Power Plan Summary Brochure." https://www.nwcouncil.org/sites/default/files/finalplanbrochure.pdf

[98] Northwest Power and Conservation Council. "Columbia River Basin Fish and Wildlife Program Amendment Process." https://www.nwcouncil.org/fw/program/2018-amendments

[99] Northwest Power Pool. "About." https://www.nwpp.org/resources/?tags=47

[100] Northwest Power Pool. "Resource Adequacy Program – Conceptual Design." https://www.nwpp.org/private-media/documents/2020-07-31_RAPDP_PublicCD_v2.pdf

three western Canadian provinces. WIEB provides the instruments and framework for cooperative state efforts to enhance the economy of the west and contribute to the well-being of the region's people. The Board seeks to achieve this purpose by promoting energy policy that is developed cooperatively among member states and provinces and with the federal government.[101] Much of the work of the Board is conducted through its two committees, the Committee on Regional Electric Power Cooperation (CREPC) and the High-Level Radioactive Waste Committee (HLRW).

1.5.5.1. Committee on Regional Electric Power Cooperation

The Committee on Regional Electric Power Cooperation (CREPC) was established in 1984. CREPC is a joint committee of WIEB and the Western Conference of Public Service Commissioners (WCPSC). Membership in CREPC is not formal. CREPC is comprised of the public utility commissions, energy and facility siting agencies, and consumer advocates in the western states and Canadian provinces and works to improve the efficiency of the western electric power system.[102]

1.5.5.2. WIEB's High-Level Radioactive Waste Committee

The High-Level Radioactive Waste Committee (HLRW) is composed of nuclear waste transportation experts appointed by the Governors of 11 western states. The Committee works with the U.S. Department of Energy to develop a safe and publicly acceptable system for transporting spent nuclear fuel and high-level radioactive waste under the Nuclear Waste Policy Act.[103] HLRW's primary management directives come from a series of Western Governors' Resolutions dating back to 1985, which express the Governors' goal of safe and uneventful transport of nuclear waste.[104]

1.5.6. Western Interconnection Regional Advisory Body

The Western Interconnection Regional Advisory Body (WIRAB) was created by Western Governors under Section 215(j) of the Federal Power Act of 2005, which provides for the establishment of a federal regulatory system of mandatory and enforceable electric reliability standards for the nation's bulk power system.[105] WIRAB's membership is composed of representatives from all states and International provinces that have load within the Western Interconnection. Members are appointed by Governors or Premiers.[106]

WIRAB was established in the Western Interconnection to advise the NERC, FERC, and WECC on whether proposed reliability standards within the region, as well as the governance and budgets of NERC and WECC, are just, reasonable, not unduly discriminatory or preferential, and in the public interest.

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[101] WIEB. "WIEB Board." https://www.westernenergyboard.org/western-interstate-energy-board/
[102] WIEB. "CREPC." https://www.westernenergyboard.org/committee-on-regional-electric-power-cooperation/
[103] U.S. Department of Energy. "Nuclear Waste Policy Act." https://www.energy.gov/downloads/nuclear-waste-policy-act
[104] WIEB. "High-Level Radioactive Waste." https://www.westernenergyboard.org/high-level-radioactive-waste-committee/
[105] Federal Power Act. https://www.govinfo.gov/content/pkg/USCODE-2018-title16/html/USCODE-2018-title16-chap12-subchapII-sec824.htm
[106] WIEB. "WIRAB." https://www.westernenergyboard.org/western-interconnection-regional-advisory-body/

1.6 Regional and National Energy Issues

1.6.1. Transmission Planning

Pursuant to rules adopted by the FERC, Idaho's Investor Owned Utilities (IOUs) are required to participate in local and sub-regional transmission planning and to coordinate with neighboring sub-regional planning groups and local stakeholders.[107] NorthernGrid, the planning association which facilitates regional transmission planning across the Pacific Northwest and Intermountain West, is responsible for producing transmission expansion and economic study plans on a periodic basis.[108] These local, sub-regional, and regional planning processes identify transmission project costs, benefits, and risks and their allocation to customer group beneficiaries. They explore opportunities for project coordination at the sub-regional and regional levels to avoid costly duplication of facilities. OEMR and the Idaho Public Utilities Commission (PUC) participate in the development of these plans.

1.6.2. Public Utility Regulatory Policies Act of 1978

The Public Utility Regulatory Policies Act of 1978 (PURPA), requires utilities to purchase energy from qualifying facilities (QFs) —such as wind, solar, geothermal, and biomass—at the cost that the utility would otherwise incur if it self-generated the electricity or obtained it from elsewhere. This calculation is called the avoided cost rate.[109]

PURPA categorizes QFs as either small power production facilities, or cogeneration facilities. To qualify for the required purchase at the avoided cost rate, a small power production facility must generate 80 MW or less, with a primary energy source that is renewable, biomass, waste, or geothermal resources. In 2020, the Idaho PUC established a separate QF category for energy storage. Energy storage QFs over 100 kW are limited to two-year-long power purchase agreements using published, rather than negotiated, rates.

Furthermore, to qualify as a QF, a cogeneration facility must sequentially produce electricity and another form of useful thermal energy in a manner that is more efficient than the separate production of both forms of energy. For example, a large cogeneration facility may produce both electricity and provide steam for industrial uses.[110]

While PURPA requires utilities to buy from QFs, it is the responsibility of the Idaho PUC to determine the avoided-cost rate and other contract terms and conditions for utilities within the State. 200 MW of QF resources were developed in Idaho by the early 1990s, consisting principally of industrial co-generation and small hydro projects.

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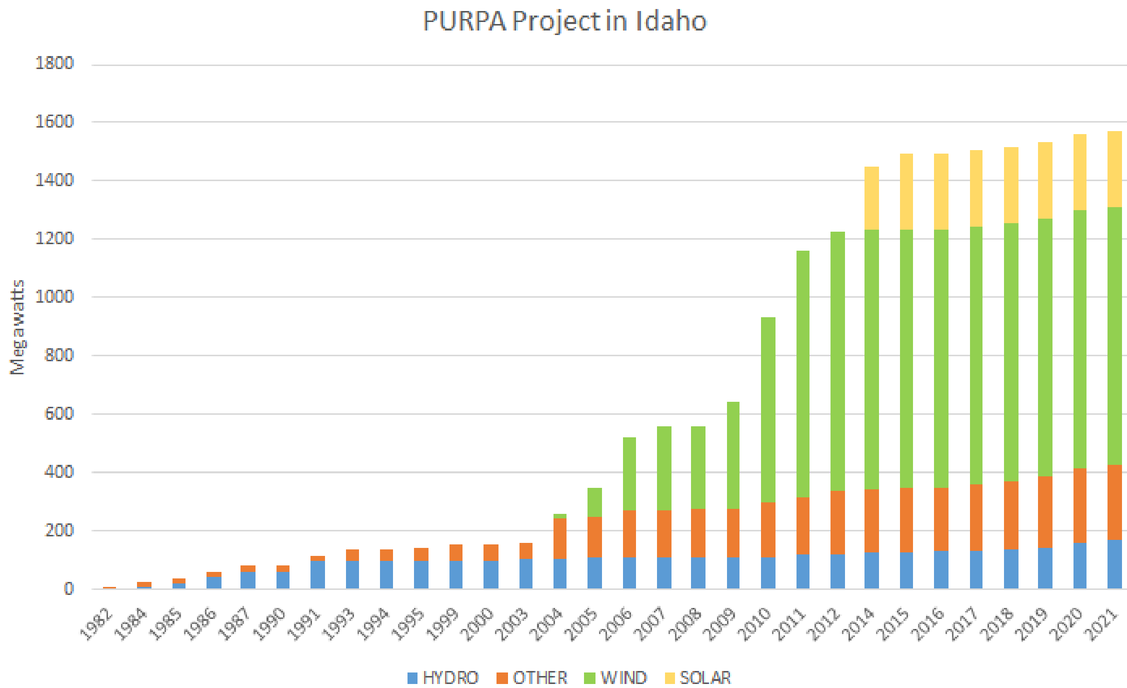
[107] Federal Energy Regulatory Commission. FERC Order Nos. 890 and 1000.
[108] Northern Grid. "Purpose." https://www.northerngrid.net/northerngrid/purpose/
[109] Federal Energy Regulatory Commission. "PURPA Qualifying Facilities." https://www.ferc.gov/qf
[110] Federal Energy Regulatory Commission. "PURPA Qualifying Facilities." https://www.ferc.gov/qf

In recent years, wind developers disaggregated large-scale projects into 10 MW units in order to qualify for the published PURPA rates. In response, the Idaho PUC reduced the eligibility to published rate contracts from 10 MW to 100 kW for intermittent resources (wind and solar) in 2010.[111] Additionally, the Idaho PUC reduced contract length in 2015 for non-published rate (a.k.a. negotiated) PURPA contracts from 20 years to two years.[112] The change in contract length does not abrogate or eliminate the utility's mandatory purchase obligation.

Figure 1.18 PURPA Generation in Idaho, 1982-2021[113]



As illustrated in Figure 1.18, as of 2021 almost 1,600 MW of QF resources were online in Idaho, comprised principally of wind and solar projects.

[111] Idaho Public Utilities Commission. "CASE NO. GNR-E-10-04, PRESS RELEASE." https://puc.idaho.gov/fileroom/cases/elec/GNR/GNRE1004/staff/20110329PRESS%20RELEASE.PDF
[112] Idaho Public Utilities Commission. "CASE NO. IPC-E-15-01, AVU-E-15-01, PAC-E-15-03, ORDER NO. 33357." http://www.puc.idaho.gov/fileroom/cases/elec/IPC/IPCE1501/ordnotc/20150820FINAL_ORDER_NO_33357.PDF
[113] Idaho Public Utilities Commission. Graph created by Yao Yin, emailed to OEMR by Yao and Kevin Keyt.

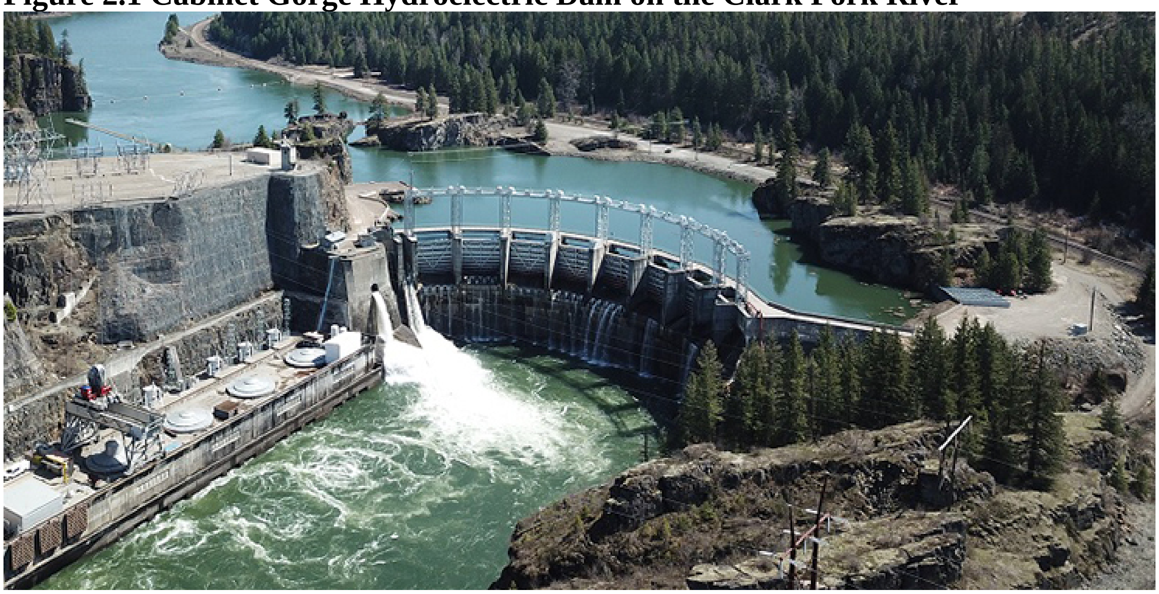
2. Idaho Energy Sources

2.1. Hydroelectricity

Hydroelectricity is an emissions-free energy resource generated by using the force of moving water. Idaho has more than 140 generating hydropower plants with a combined capacity of 2,700 MW, which constitutes some of the most valuable hydroelectric infrastructure in the nation.[114] Idaho's largest hydroelectric projects are the 1,167 MW Hells Canyon Complex (consisting of the Hells Canyon, Oxbow, and Brownlee dams) owned by Idaho Power Company, the 400 MW Dworshak dam operated by the U.S. Army Corps of Engineers, and the 260 MW Cabinet Gorge Project owned by Avista Corporation.[115]

The flexible nature of hydroelectricity enables it to meet the fluctuating demands of the electric grid and mitigate losses of supply associated with intermittent contributions from wind and solar generation. Hydroelectric power supplies about 60% of Idaho's in-state electricity and contributes to Idaho-based energy providers' ability to supply low-cost power to customers.[116]

Figure 2.1 Cabinet Gorge Hydroelectric Dam on the Clark Fork River[117]



[114] U.S. Energy Information Administration. "Idaho Renewable Electricity Profile 2010." https://www.eia.gov/renewable/state/Idaho/

[115] Idaho Governor's Office of Energy and Mineral Resources. "Hydroelectric" https://oemr.idaho.gov/sources/re/hydropower/

[116] U.S. Energy Information Administration. "Idaho: State Profile and Energy Estimates" https://www.eia.gov/state/?sid=ID#tabs-3

[117] Avista. "Part of this Small Town's Appeal Is It's Proximity to Two Very Large Attractions." https://www.myavista.com/connect/articles/2018/06/part-of-this-small-towns-appeal-is-its-proximity-to-two-very-large-attractions

2.2. Wind

Wind is a renewable energy resource that utilizes a turbine mechanism to harness power from wind and generate electricity. Idaho's wind production grew from 207,000 MWh at the end of 2008 to a total greater than 2,655,000 MWh in 2018 (a little less than 1,000 MW).[118] Wind power accounts for approximately 16% of Idaho's electricity and there are currently 33 wind projects and 3 wind-related manufacturing facilities in the state. At the end of 2019, the wind industry directly employed over 500 Idahoans.[119]

Wind mapping studies estimate that Idaho has almost 212,830 MW of potential wind generation.[120] Idaho's most promising wind resources are located in the Snake River Plain area of Southern Idaho.[121] The State of Idaho through the Department of Lands encourages the development of wind power on state endowment lands, which created income for the Idaho State Endowment Fund, funding schools and other state institutions.

Figure 2.2 Power County Wind Farm in Eastern Idaho. [122]

To supplement wind's intermittent nature, dispatchable resources, including hydroelectric, nuclear power, and natural gas-fired generators, must be ready to meet and/or supplement load requirements when wind generation is not available.

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[118] U.S. Energy Information Administration. "Electricity Data Browser." https://www.eia.gov/electricity/data/browser/#/topic/0?agg=1,0,2&fuel=008&geo=vvvvvvvvvvvvo&sec=o3g&linechart=ELEC.GEN.WND-US-99.A~ELEC.GEN.WND-IA-99.A~ELEC.GEN.WND-TX-99.A&columnchart=ELEC.GEN.WND-US-99.A~ELEC.GEN.WND-IA-99.A~ELEC.GEN.WND-TX-99.A&map=ELEC.GEN.WND-US-99.A&freq=A&ctype=linechart&ltype=pin&rtype=s&maptype=0&rse=0&pin=

[119] American Wind Energy Association. "AWEA State Wind Facts" https://www.awea.org/resources/fact-sheets/state-facts-sheets

[120] American Wind Energy Association. "Wind Energy in Idaho." https://www.awea.org/Awea/media/Resources/StateFactSheets/Idaho.pdf

[121] U.S. Energy Information Administration. "Profile Analysis." https://www.eia.gov/state/analysis.php?sid=ID#88

[122] American Wind Energy Association. https://awea.filecamp.com/s/v8rp4uKcLm4PpFiS/d/u3ECi7PXaFHZmj1v

The federal renewable electricity production tax credit (PTC) for land-based wind is a federal tax credit included under Section 45 of the U.S. tax code for electricity generated by wind energy on a per kilowatt-hour (kWh) basis.[123] The PTC for land-based wind power projects has been extended an additional year and will remain at 60% of the project's value, on a per kWh basis, for projects that begin construction by the end of 2021. Previous law had the rate decreasing to 40%. Without any future legislative actions, there will be no wind PTC starting in 2022.

2.3. Solar

Solar power is an emissions-free renewable energy resource that harnesses the abundance of energy coming from the sun. Electricity can be produced either through photovoltaic (PV) solar cells, or through concentrated solar power (CSP). PV solar cells convert sunlight directly into electricity using solar plates stationed on an array angled towards the sun. CSP technologies reflect sunlight from mirrors and concentrate it onto receivers that convert the solar energy into heat. This thermal energy can then be used to produce electricity via a steam turbine, or to heat an engine that drives a generator.[124]

Figure 2.3 American Falls II Solar Project[125]

Utility-scale solar power generation in Idaho began in August 2016 and produced 0.2% of the total power generated in Idaho that year. As of September 2020, the total installed solar had grown to 559.97 MW, enough to power 77, 966 homes. There are currently 50 total solar companies consisting of manufacturers, developers, installers, and other

[123] 26 U.S. Code § 45 - Electricity Produced from Certain Renewable Resources, etc.
[124] U.S. Department of Energy. "Solar Energy Technology Basics." https://energy.gov/eere/energybasics/articles/solar-energy-technology-basics
[125] Swinerton Renewable Energy. "American Falls 2." https://www.swinertonrenewable.com/projects/american-falls-2

companies operating in Idaho that employ over 500 people.[126] Among the largest installed solar projects in Idaho, Grand View PV Solar Two has a total generating capacity of 80 MW while American Falls Solar I and II have a combined capacity of 60 MW.[127]

Solar energy can be used to generate hot water and heat residential and commercial buildings. There are two types of solar water heating systems, active and passive. Active solar water heating systems circulate liquid, either water or an anti-freezing heat-transfer fluid, through a series of pumps and controls located in pipes throughout a home. Passive solar water heating systems use the movement of hot water rising and cool water sinking to push water through a pipe system in the home without the use of pumps. Both types of systems need a storage tank for the water and solar panels to collect the needed heat.[128]

The federal renewable investment tax credit (ITC) for solar is a tax credit that can be claimed on the federal income taxes of individuals or corporations for a portion of the cost of installing. The ITC is currently a federal tax credit claimed against the tax liability of residential[129] and commercial/utility[130] investors in solar energy property. Section 25D of the residential ITC allows the homeowner to apply the credit to their personal income taxes. This credit is used when homeowners purchase solar systems and have them installed on their homes. Section 48 of the ITC allows the business that installs and/or finances the project claims the credit. The ITC for solar power projects which would have expired in 2020 will now remain at 26% for projects that begin construction in 2021 and 2022, be reduced to 22% in 2023, and decrease to 10% in 2024 for commercial size projects. There will be no credit for small-scale solar by 2024.

2.4. Bioenergy

Bioenergy is renewable and derived from biological sources, such as agricultural crops, animal and plant waste, algae, and wood products for uses associated with heating, electricity, or vehicle fuel. It can be produced efficiently from agricultural wastes and dedicated energy crops such as switchgrass, miscanthus, and poplar, that are used to make advanced biofuels.

Biomass is used to generate 84 MW of electricity in Idaho, which accounted for about 465,402 MWh, or 2.7%, of the state's electricity generation in 2019. As of 2019, Idaho has one operating ethanol plant capable of producing 60 million gallons per year.[131] There is currently no commercial production of biodiesel in Idaho.

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[126] Solar Energy Industries Administration. "Idaho Fact Sheet." https://www.seia.org/sites/default/files/2020-09/Idaho.pdf
[127] Solar Energy Industries Association. "Idaho Solar." https://www.seia.org/state-solar-policy/idaho-solar
[128] U.S. Department of Energy. "Solar Water Heaters." https://energy.gov/energysaver/solar-water-heaters
[129] 26 U.S. Code § 25D - Residential Energy Efficient Property
[130] 26 U.S. Code § 48 - Energy Credit
[131] Official Nebraska Government Website. "Ethanol Facilities Capacity by State and Plant." www.neo.ne.gov/statshtml/122.htm

Feedstock projections indicate that Idaho produces over 2.5 million metric tons of wood-waste from forests, mills, and urban sources respectively.[132] Idaho has three dedicated biomass production facilities and many research-based operations across the state.[133] While the state does not currently play a role in the production of biodiesel, its biogas or renewable natural gas (RNG) potential is promising.

The Department of Energy's (DOE) Bioenergy Program provides technical assistance, educational workshops, and cost sharing to help the citizens and companies of Idaho take advantage of local renewable biomass energy resources. Since 2005, the DOE has awarded more than $77 million to national laboratory, university, and industrial partners in Idaho to research, develop, and deploy sustainable bio-based fuels and products[134]

2.5. Geothermal

Geothermal energy is a renewable energy resource derived from the heat within the sub-surface of the Earth. Unlike intermittent resources, geothermal energy provides reliable baseload power generation because it can be utilized 24 hours a day, or whenever it is needed. An estimated 17,000 GWh of geothermal power potential exists in Idaho, much of it in the southern portions of the state as depicted in Figure 2.2.[135] Ormat manages Idaho's only operating commercial geothermal power plant, the 11 MW Raft River Enhanced Geothermal System Project, located in Cassia County.[136] Idaho is one of seven states with utility-scale electricity generation from geothermal energy.[137]

In addition to electric generation, direct use of geothermal waters is the oldest, most versatile, and most prevalent utilization of geothermal energy.[138] There are over 1,000 wells and 200 springs across Idaho. Wells that have a bottom hole temperature greater than 85 degrees Fahrenheit and less than 212 degrees Fahrenheit are designated as low-temperature geothermal (LTG) resource wells.[139] These LTG resources are used for space heating, aquaculture, greenhouses, and recreation throughout the state.

Idaho's capital city, Boise, is home to the nation's first geothermal district heating system, Warm Springs Heating District, which was built in the late 19th century and continues to service over 300 customers in the East End neighborhood of Boise.[140] The City of Boise's geothermal heating utility delivers naturally heated water to more than 6 million square feet of building space. The Capitol Mall Geothermal Energy Project was

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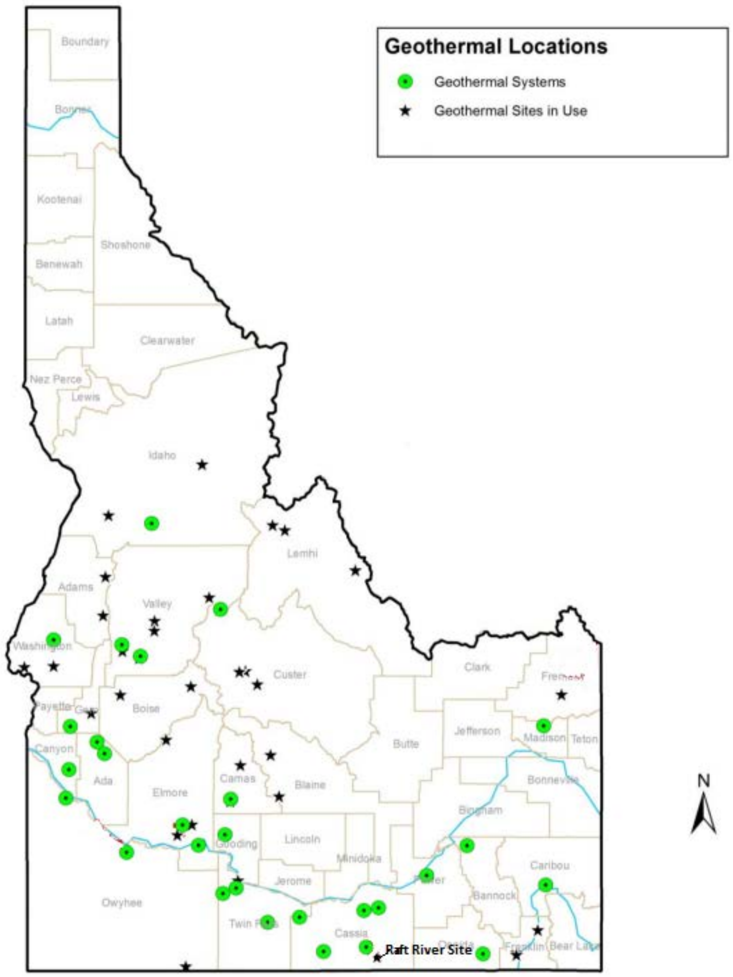
132 U.S. Department of Energy. "Benefits of Biofuel Production and Use in Idaho." https://www.energy.gov/sites/prod/files/2015/10/f27/idaho_biofuels_benefits.pdf
133 EIA. "Monthly Biomass Fuel Report." https://www.eia.gov/biofuels/biomass/#dashboard
134 U.S. Department of Energy. https://www.energy.gov/sites/prod/files/2015/10/f27/idaho_biofuels_benefits.pdf
135 Geothermal Resources Council. "Geothermal Energy Potential: State of Idaho." https://archive.geothermal.org/PDFs/Final_Idaho.pdf
136 Ormat. "Global Projects." https://www.ormat.com/en/projects/all/main/
137 U.S. Energy Information Administration. "Profile Analysis." https://www.eia.gov/state/analysis.php?sid=ID#88
138 U.S. Department of Energy. "Low Temperature Deep Direct-Use Program Draft White Paper." http://energy.gov/eere/geothermal/low-temperature-deep-direct-use-program-draft-white-paper
139 Idaho Department of Water Resources. "Geothermal Resource Wells." https://idwr.idaho.gov/wells/geothermal-wells.html
140 Boise Warm Springs Water District. "About." https://bwswd.com/about/

completed in 1982 and continues to provide low-cost space and hot water heating to the Idaho State Capitol and eight other major State buildings. The Idaho Statehouse is the only geothermally heated capitol building in the nation. District heating is also currently being used for space heating at several of the Boise State University campus buildings.[141]

Figure 2.4 Geothermal Locations in Idaho[142]



2.6. Combined Heat and Power

Several Idaho facilities and industrial users have incorporated systems that generate on-site electricity and thermal energy in a process known as combined heat and power (CHP). CHP is typically deployed at sites such as industrial operations and university or corporate campuses, which have high demand for electricity and hot water or steam. As of the end of 2020, there are 21 CHP systems in Idaho, predominantly used in wood

[141] Idaho Capitol Commission. "Facts about the Idaho Capitol Building." https://capitolcommission.idaho.gov/education/facts-about-the-idaho-capitol-building/; and City of Boise. "Geothermal Heating." https://publicworks.cityofboise.org/services/geothermal/

[142] Idaho Governor's Office of Energy and Mineral Resources. "Direct Use." https://oemr.idaho.gov/sources/re/geothermal/

product facilities, dairies, hotels, and large industrial food processors. Half of the 21 facilities utilize renewable fuels.[143]

2.7. Nuclear

Nuclear energy is a carbon-free power source. While no commercial-scale nuclear power generation exists in Idaho today, the state does receive some electricity from the Columbia Generating Station through BPA. On a national scale, nuclear power generation from 95 operating reactors in 29 states accounts for nearly 20% of the electricity, and 55% of carbon-free electricity, produced in the United States.[144]

INL, located in southeastern Idaho, is the nation's lead laboratory for nuclear energy research. INL has influenced every reactor designed in the United States and INL researchers are working on several initiatives, including advanced nuclear reactors such as microreactors and small modular reactors, that will help shape the future of nuclear energy worldwide.

Figure 2.5 Idaho National Lab Advanced Test Reactor Facility[145]

2.8. Natural Gas

Natural gas is utilized in Idaho to heat homes, power businesses, move vehicles, and serve as a key component in many industrial processes. More than half of Idaho households use natural gas as their primary energy source for heating their home.[146]

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[143] U.S. Department of Energy. "Combined Heat and Power Installations in Idaho." https://doe.icfwebservices.com/chpdb/state/ID
[144] U.S. Department of Energy. "5 Fast Facts about Nuclear Energy." https://www.energy.gov/ne/articles/5-fast-facts-about-nuclear-energy
[145] Idaho National Laboratory. "Capabilities of Idaho National Laboratory." https://inl.gov/about-inl/capabilities/
[146] U.S. Energy Information Administration. "Idaho State Profile and Energy Estimates – Profile Analysis." https://www.eia.gov/state/analysis.php?sid=ID

Natural gas power plants can adjust generation in real-time to adapt to the ebbs and flows of electricity generated by intermittent resources. Advances in gas turbine design and natural gas-fired internal combustion engines have improved the operating flexibility of natural gas generation. Natural gas reserves were detected in the Payette Basin of western Idaho in 2010.[147] These discoveries led to Idaho's first commercial production of natural gas and natural gas liquids in 2015.[148] In 2019, Idaho produced over 1 billion cubic feet of natural gas.[149]

As a transportation fuel, natural gas is used as compressed natural gas (CNG) or as liquefied natural gas (LNG). Both compression and liquefaction are methods employed to increase the amount of natural gas storage in the vehicle and thus increase its driving range. Renewable natural gas (RNG) is an emerging resource essentially made of biogas, the gaseous product of the decomposition of organic matter. Like conventional natural gas, RNG is pipeline-quality gas that is fully interchangeable with conventional natural gas and can be used as a transportation fuel in the form of CNG or LNG. Furthermore, RNG qualifies as an advanced biofuel under the Renewable Fuel Standard.[150]

Idaho has two public CNG vehicle refueling stations, one in Boise and another in Nampa. Some municipal and commercial fleets utilize natural gas and operate their own CNG refueling stations.[151] There are no commercial RNG facilities in Idaho as of 2020, however, the State expects to see increased interest in RNG development given Idaho's unique resource portfolio and noted success in other biomass industries.

2.9. Propane

Propane is used to heat homes and businesses throughout the State of Idaho, particularly in rural areas. Residential propane prices in Idaho fluctuated between $1.615/gallon to $1.854/gallon in 2020.[152] Since January 2019, propane prices have fallen approximately 36%. As of November 2020, propane prices were $1.648/gallon. Propane consumption is highly seasonal, with peak consumption in fall and winter. Propane is also used as a transportation fuel.

2.10. Petroleum

There are no petroleum refineries located in Idaho and there is limited storage capacity. Pipeline routes are depicted in Figure 2.2. Petroleum pipeline infrastructure within Idaho includes the Northwest Products Pipeline, which connects Salt Lake City refineries with

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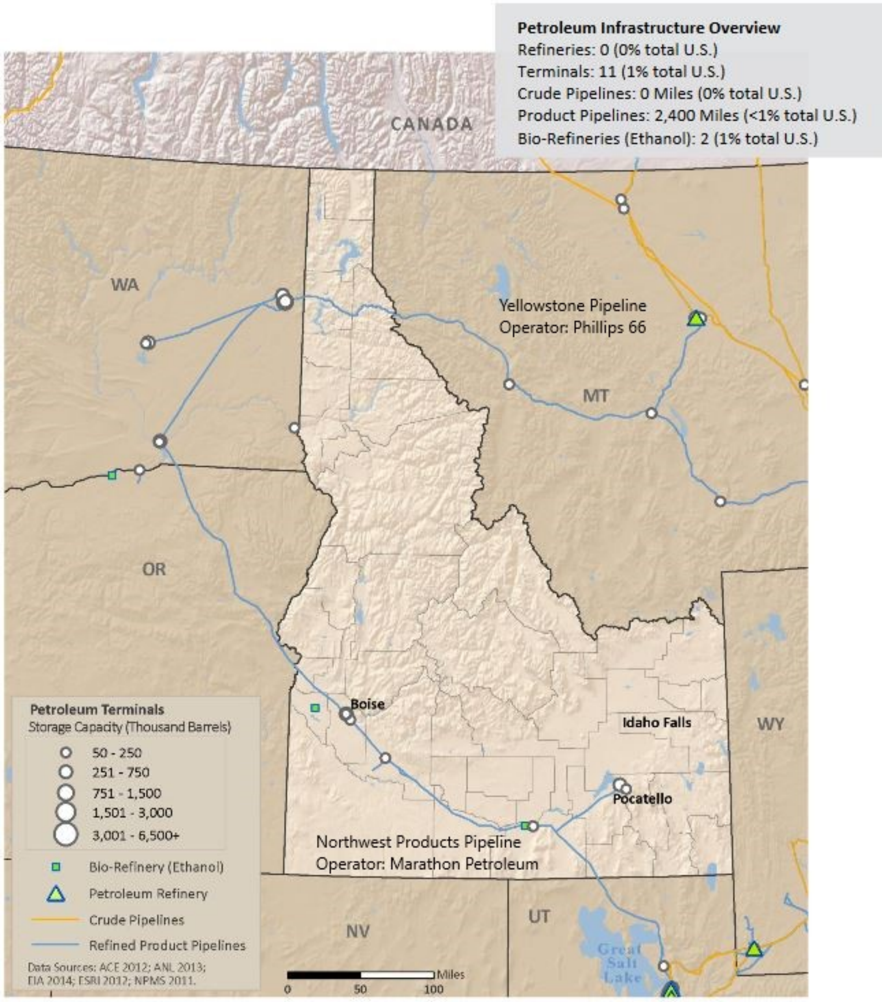
[147] Dunnahoe, Tayvis. "Idaho enters ranks of hydrocarbon producing states." Oil and Gas Journal (February 6, 2017).
[148] U.S. Energy Information Administration. "Natural Gas Gross Withdrawals and Production, Gross Withdrawals, Annual, 2012-2017." https://www.eia.gov/dnav/ng/NG_PROD_SUM_DC_NUS_MMCF_A.htm
[149] U.S. Energy Information Administration. "Natural Gas – Idaho Marketed Production of Natural Gas." https://www.eia.gov/dnav/ng/hist/ngm_epg0_vgm_sid_mmcfa.htm
[150] U.S. Department of Energy. "Alternative Fuels Data Center." https://afdc.energy.gov/fuels/natural_gas_renewable.html
[151] U.S. Department of Energy. "Boise Buses Running Strong with Clean Cities." https://energy.gov/articles/boise-buses-running-strong-clean-cities; and Intermountain Gas. "Natural Gas Vehicles." https://www.intgas.com/rates-services/naturalgas-vehicles
[152] U.S. Energy Information Administration. "Weekly Idaho Propane Residential Price (Dollar per Gallon)." https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=W_EPLLPA_PRS_SID_DPG&f=W

Pocatello, Burley, and Boise, and continues to Spokane. This pipeline delivers refined petroleum products predominantly to southern Idaho. Refineries near Billings, Montana transport refined petroleum products to northern Idaho via the Yellowstone Pipeline.

Figure 2.6 Transportation Fuel Pipelines and Refineries Serving Idaho[153]



2.11. Coal

Idaho has no in-state utility-scale coal-fired power plants. However, Idaho utilities hold ownership shares in coal-fired power plants located in neighboring states that supply a share of Idaho's electricity.[154] In close proximity to Idaho, Wyoming is the nation's largest coal exporter and Montana has the nation's largest identified recoverable coal reserve. Some industrial users in Idaho still utilize coal at their facilities for power and steam generation (cogeneration) purposes.

[153] U.S. Department of Energy. "State of Idaho Energy Sector Risk Profile." https://energy.gov/sites/prod/files/2016/09/f33/ID_Energy%20Sector%20Risk%20Profile.pdf

[154] U.S. Energy Information Administration. "Idaho State Profile and Energy Estimates." www.eia.gov/state/analysis.cfm?sid=ID&CFID=19979425&CFTOKEN=6ac60633ec26f3b3-9C7FAA90-237D-DA68-24023FFD41A835EC&jsessionid=8430bccceb80dc2263757c222e31663d5a40

3. Conservation, Energy Efficiency, and Energy Storage

Conservation, energy efficiency, and demand response practices may not generate any new energy, but they do constitute another economically attractive resource that can be utilized to meet the energy needs of customers.

“Conservation” refers to a consumer’s personal actions that reduce their use of energy-consuming devices. For example, turning the lights off when leaving a room.[155] “Energy efficiency” refers to processes of utilizing technology that consumes a lower amount of electricity while providing sufficient service. For example, switching from incandescent lights bulbs to LED light bulbs.[156]

“Demand response” refers to customers temporarily altering their energy-consuming behavior during times of higher demand for electricity, usually in response to signals from the utility or grid operator. For example, authorizing a utility to remotely control heating and ventilation systems during times of high electricity demand.[157]

Collectively, these resources are often referred to as “demand-side management” (DSM), by utilities and other companies in the power industry. Sometimes the terms “conservation” or “efficiency” are used to refer to all DSM measures.

Idaho utilities have utilized cost-effective, sustainable energy efficiency programs for over four decades in an effort to conserve both company and customer resources. Cost-effectiveness of an energy measure means that the lifecycle energy, capacity, transmission, distribution, and other quantifiable savings to Idaho citizens and businesses exceed the direct costs of the measure to the utility and participant. Cost-effective energy measures can provide economic benefits to Idaho utilities by increasing the capacity for energy within their system to meet future energy demands.

The Idaho Public Utilities Commission directs Idaho investor-owned electric utilities to continue to place an emphasis on cost-effective conservation, energy efficiency, and demand response.[158] Each IOU calculates the level of cost-effective efficiency potential in their IRP and offers a suite of efficiency programs for customers to achieve energy efficiency goals.

Idaho Power, BPA and Avista belong to the Northwest Energy Efficiency Alliance (NEEA), which provides support to regional utilities and groups in the northwest that implement energy efficiency and conservation programs. NEEA provides funding for

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155 U.S. Energy Information Administration. “Use of Energy Explained.” https://www.eia.gov/energyexplained/index.cfm?page=about_energy_efficiency

156 U.S. Energy Information Administration. “Use of Energy Explained.” https://www.eia.gov/energyexplained/index.cfm?page=about_energy_efficiency

157 U.S. Energy Information Administration. “Demand response saves electricity during times of high demand.” https://www.eia.gov/todayinenergy/detail.php?id=24872

158 Idaho Public Utilities Commission. “CASE NO. IPC-E-1O-27, ORDER NO. 32245.” www.puc.idaho.gov/fileroom/cases/elec/IPC/IPCE1027/ordnotc/20110517ORDER_NO_32245.PDF

initiatives such as increasing compliance of energy codes and provides a vehicle through which collective industry consensus can be achieved on market acceptance of energy efficient products, like LED light bulbs.[159]

3.1. Northwest Power and Conservation Council's Seventh Power Plan

The Northwest Power Planning Council's Seventh Power Plan, released in 2016, identifies the potential of cost-effective energy measures for the region. It estimates that approximately 4,300 aMW of cost-effective energy efficiency can be developed in the Pacific northwest region of Washington, Oregon, Idaho and Montana by 2035.[160] An important finding of the plan is that future electricity needs can no longer be adequately addressed by only evaluating average annual energy requirements. Planning for flexibility and capacity to meet peak loads will need to be considered. The Northwest Power council will be releasing their next Power Plan in 2021.[161]

3.2. Bonneville Power Administration Energy Efficiency

BPA works with its public utility customers to fund and implement energy-efficiency programs. Since the early 1980s, BPA and its customers have acquired more than 2,238 average megawatts (aMW) in electricity savings through energy efficiency efforts.[162] The municipal and cooperative utilities BPA supplies wholesale electric power to typically engage in the Integrated Program Review processes. In its 2020 Energy Efficiency Action Plan Update, BPA set a goal for achieving at least 532-567 aMW of energy-efficiency savings from 2016 to 2021.[163] To accomplish this, BPA offers its municipal and cooperative customers an extensive energy-efficiency program, which includes rebates and incentives that are passed on to the retail customer. BPA sets an energy efficiency incentive budget every two-year rate period and monitors cost-effective efforts of individual public utilities.

3.3. Idaho Power Energy Efficiency

Since 2002, Idaho Power has achieved a cumulative average annual load reduction of 256 aMW due to their energy efficiency investments. In its 2019 IRP, Idaho Power analyzed the amount of achievable, cost-effective energy efficiency potential for the period of 2019 – 2038. Idaho Power predicts their potential energy efficiency savings to be approximately 234 aMW. As part of the 2021 IRP process Idaho Power will complete a new potential study and determine a new forecast for energy efficiency.

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[159] Northwest Energy Efficiency Alliance. "About NEEA." http://neea.org/about-neea
[160] The Northwest Power and Conservation Council. "About the Seventh Power Plan." www.nwcouncil.org/energy/powerplan
[161] The Northwest Power and Conservation Council. "The 2021 Northwest Power Plan." https://www.nwcouncil.org/2021-northwest-power-plan
[162] Bonneville Power Administration. "EE Action Plan Update." https://www.bpa.gov/EE/Policy/EEPlan/Documents/2016-21_BPA_EE_Action_Plan_Update.pdf
[163] Bonneville Power Administration. "2016-2021 Energy Efficiency Action Plan." https://www.bpa.gov/EE/Policy/EEPlan/Documents/2016-2021_BPA_EE_Action_Plan.pdf

In 2019, Idaho Power's energy efficiency programs had energy savings of 203,041 MWh; this is enough energy to power more than 18,000 average homes for one year.[164] The 2019 savings from Idaho Power's energy efficiency programs alone, without the estimated savings from the Northwest Energy Efficiency Alliance, was 184,934 MWh. This is a 17% increase from the 2018 energy savings of 158,412 MWh.[165] Idaho Power offers educational information to all customer segments to drive behavior change and create awareness of, and demand for, energy efficiency programs.

3.4. PacifiCorp Energy Efficiency

PacifiCorp plans to increase their demand side management resources across their entire service territory over the next twenty years. By the end of 2023, PacifiCorp's preferred portfolio anticipates more than 700 MW of energy efficiency and direct load control resource capacity. By the end of their 2019 IRP's 20-year planning horizon, PacifiCorp expects to have more than 2,700 MW of energy efficiency and direct load control resource capacity. Energy efficiency programs are expected to meet 84% of that predicted capacity.[166]

3.5. Avista Energy Efficiency

Avista has acquired a total of 252 aMW of electricity savings since it began offering energy efficiency incentives to consumers in 1978. Current Avista energy efficiency programs reduce loads by nearly 12.2 percent, or by 153 aMW.[167]

In their 2020 IRP, Avista highlighted that, over their 25-year forecast, Avista's energy efficiency programs reduce regional emissions by 3.25 million metric tons between 2021 and 2045. In addition, they now predict that energy efficiency will serve 71 percent of their future load growth, an increase from 53% in their 2017 IRP.[168]

Avista commissions a Conservation Potential Assessment (CPA) every two years to assess the energy conservation potential in its service area, and to utilize the findings in its 20-year conservation analysis. The CPA analyzes economic and technical potential, which are then rationalized with customers' likely participation rate to determine the overall achievable conservation potential.

3.6. Intermountain Gas Energy Efficiency

In 2017, Intermountain Gas was granted authority by the Idaho PUC to implement an energy efficiency program. The residential energy efficiency program was designed to acquire cost-effective demand side management (DSM) resources in the form of natural

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[164] Idaho Power Company. "Demand-Side Management 2019 Annual Report" https://docs.idahopower.com/pdfs/EnergyEfficiency/Reports/2019DSM.pdf
[165] Idaho Power Company. "Demand-Side Management 2019 Annual Report" https://docs.idahopower.com/pdfs/EnergyEfficiency/Reports/2019DSM.pdf
[166] PacifiCorp. "2019 Integrated Resource Plan." https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2019_IRP_Volume_I.pdf
[167] Avista. "2020 Electric IRP." https://www.myavista.com/about-us/integrated-resource-planning
[168] Avista. "2020 Electric IRP." https://www.myavista.com/about-us/integrated-resource-planning

gas therm savings. The program includes rebates for residential customers that purchase and install qualifying high-efficiency natural gas equipment in their homes. In addition, Intermountain Gas offers a rebate for the completion of new ENERGY STAR® qualified homes that have a Home Energy Rating Score (HERS) of 75 or less.[169]

In 2018, Intermountain Gas commissioned the first Conservation Potential Assessment (CPA) to support both short term energy-efficiency planning and long-term resource planning activities. The CPA is used for resource planning, identifying achievable, cost-effective energy efficiency opportunities, and program design while taking into consideration factors like funding and market readiness.

In 2019, a total of 3,335 high-efficiency measures were rebated to Intermountain Gas customers, a 61% increase from the previous year. After CPA adjustments were made to Intermountain Gas's Energy Efficiency Program data, total annual savings were estimated at 389,213 therms for the year 2019.[170] The 2018 Energy Efficiency Annual Report states that Intermountain Gas exceeded the 2018 savings goal of 65,000 therms and achieved a savings of over 283,000 therms during the first year. [171]

3.7. Energy Storage Technologies and Approaches

Energy storage technologies give us the ability to store energy for use at later times, adding enhanced control, reliability, and resiliency to our electricity grid. As of 2019, the United States had approximately 24 GW of installed energy storage and another 7 GW have been announced or are currently under construction.[172] Almost all the existing storage is pumped-hydropower storage. Energy storage is particularly important as our grid evolves to incorporate more intermittent renewable and emissions-free energy resources such as wind and solar. These resources are not able to constantly supply our grid with energy; therefore, storage helps balance energy demands when the sun is not shining, or the wind is not blowing.

While the energy storage sector is evolving and new research and development is continuously occurring, there are some technologies we already widely deploy to help provide added resiliency and reliability to the grid. Common storage technologies include pumped-storage hydropower, batteries, hydrogen, thermal, and other mechanical storage technologies.

Energy storage can play a key role in providing overall grid security and resilience, while allowing critical infrastructure such as hospitals, police stations, and other key services to remain operational during emergency situations. The federal government has programs promoting the adoption of more energy storage in the United States, particularly for

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[169] Intermountain Gas. "Energy Efficiency Program." https://www.intgas.com/energy-efficiency/
[170] Intermountain Gas. "2019 Annual Energy Efficiency Report." https://www.intgas.com/energy-efficiency/
[171] Intermountain Gas. "2018 Annual Energy Efficiency Report." https://www.intgas.com/energy-efficiency/2018-intermountain-gas-energy-efficiency-annual-report/
[172] CAISO. "Energy Storage Perspectives." https://www.caiso.com/Documents/EnergyStorage-PerspectivesFromCalifornia-Europe.pdf

resiliency purposes at critical facilities. The cost of energy storage infrastructure is a significant hurdle; however, more affordable utility-scale storage systems are currently under development.[173]

3.8. Distributed Energy Resources

Distributed energy resources (DER), also called on-site generation, dispersed or decentralized generation, are small power sources that can be combined to provide power to satisfy demand.[174] Such sources can include micro-turbines, small natural gas-fueled generators, combined heat and power plants, battery storage, biomass, wind and solar thermal or photovoltaic installations. Use of DERs is becoming more common due to the potential for more affordable renewable energy, and an increased desire for grid resiliency, especially during disasters.[175] However, complex and expensive integration upgrades and power-balancing mechanisms will be required as use of DERs increases.

3.9. Pumped Hydroelectric Storage

Pumped hydroelectric storage facilities, commonly referred to as pumped-hydro or pumped-storage, store energy by utilizing excess electricity when energy demand is low and pumping water from a lower to a higher reservoir to be released through turbines when energy demand is high. Pumped hydroelectric storage is a form of mechanical storage that provides storage in addition to added reliability or ancillary services.[176]

Pumped hydroelectric storage can require very specific geographic terrain when compared to other types of storage. Much of the pumped hydroelectric storage infrastructure across the nation was created during the 1970s. Currently about 90% of the world's energy storage and 95% of United States' energy storage is pumped-hydro based.

Pumped hydroelectric storage projects can be open-loop or closed-loop. Open-loop projects are connected to a naturally existing body of water and closed-loop projects are connected to a man-made reservoir. There are currently 43 pumped-storage hydropower projects with a combined generation capacity of approximately 22 GW in the United States, but projections show that number is likely to grow as storage demands rise in the coming years. While there have been proposed pumped-storage projects in Idaho, there are currently no operational projects.[177]

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[173] U.S. Department of Energy: Office of Electricity. "Energy Storage." https://www.energy.gov/oe/activities/technology-development/energy-storage

[174] Electric Power Research Institute. "The Integrated Grid: Realizing the Full Value of Central and Distributed Energy Resources 2014." https://www.epri.com/#/pages/product/3002002733/?lang=en-US

[175] North American Electric Reliability Corporation. "Distributed Energy Resources: Connection Modeling and Reliability Considerations." https://www.nerc.com/comm/Other/essntlrlbltysrvcstskfrcDL/Distributed_Energy_Resources_Report.pdf

[176] Energy Storage Association. "Pumped Hydropower." https://energystorage.org/why-energy-storage/technologies/pumped-hydropower/

[177] Energy Storage Association. "Pumped Hydropower." https://energystorage.org/why-energy-storage/technologies/pumped-hydropower/

3.10. Battery Storage

Battery storage can be utilized to store excess energy at the residential and commercial-scales, as well as at the utility-scale. Energy storage batteries work similarly to regular batteries used in our everyday lives but have much greater storage capacities. Battery storage technology is rapidly growing and evolving because of its scalability and accessibility, and projections show an estimated 25-35 GW of battery storage being added online by 2025.[178] Small-scale batteries are being added to approximately one-third of residential solar systems amongst the nation's leading solar installers.

Energy storage batteries usually have short to mid-range response times of a few seconds to a few hours. There are two categories of batteries used for energy storage, these being solid-state and flow batteries. Solid-state batteries utilize different solid chemical compounds for varying grid services while flow batteries utilize chemical compounds that are dissolved in liquid within the battery to create a reaction that produces electricity. Typical solid-state battery types include the highly popular lithium ion as well as the sodium ion, but hybrid batteries and flow or redox flow with a wide range of chemistries are becoming increasingly popular. Research studies are being conducted on both types of batteries to discover more effective ways to use battery storage.[179]

3.11. Thermal Storage

Thermal storage traps energy temporarily in the form of heat or cold which allows the energy to be turned into electricity at a later time. An example of this on a utility scale includes solar thermal power plants that use molten salt or other heat-retaining substance to store the sun's energy, which can be utilized later in steam generating processes.[180]

3.12. Mechanical Storage

Mechanical storage systems use kinetic or gravitational forces to store inputted energy. One example of a mechanical storage system is the flywheel, a mechanism in which rotational energy is stabilized and maintained through movement of an accelerating wheel that can then store the energy kinetically for future use. A generator is then applied to easily convert the stored energy from mechanical to electrical energy.[181]

3.13. Hydrogen Storage

Electricity can be converted into hydrogen through electrolysis. The hydrogen can then be stored and eventually re-electrified; this can occur in fuel cells or through burning in combined cycle gas power plants. Small amounts of hydrogen can be stored in pressurized vessels, and very large amounts of hydrogen can be stored in constructed underground salt caverns. This method of storage can mitigate the grid impacts

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[178] Energy Storage Association. "Enabling the Clean Power Transformation." https://energystorage.org/wp/wp-content/uploads/2020/08/100x30-Empowering-Clean-Power-Transformation-ESA-Vision.pdf

[179] Energy Storage Association. "Batteries." https://energystorage.org/why-energy-storage/technologies/solid-electrode-batteries/

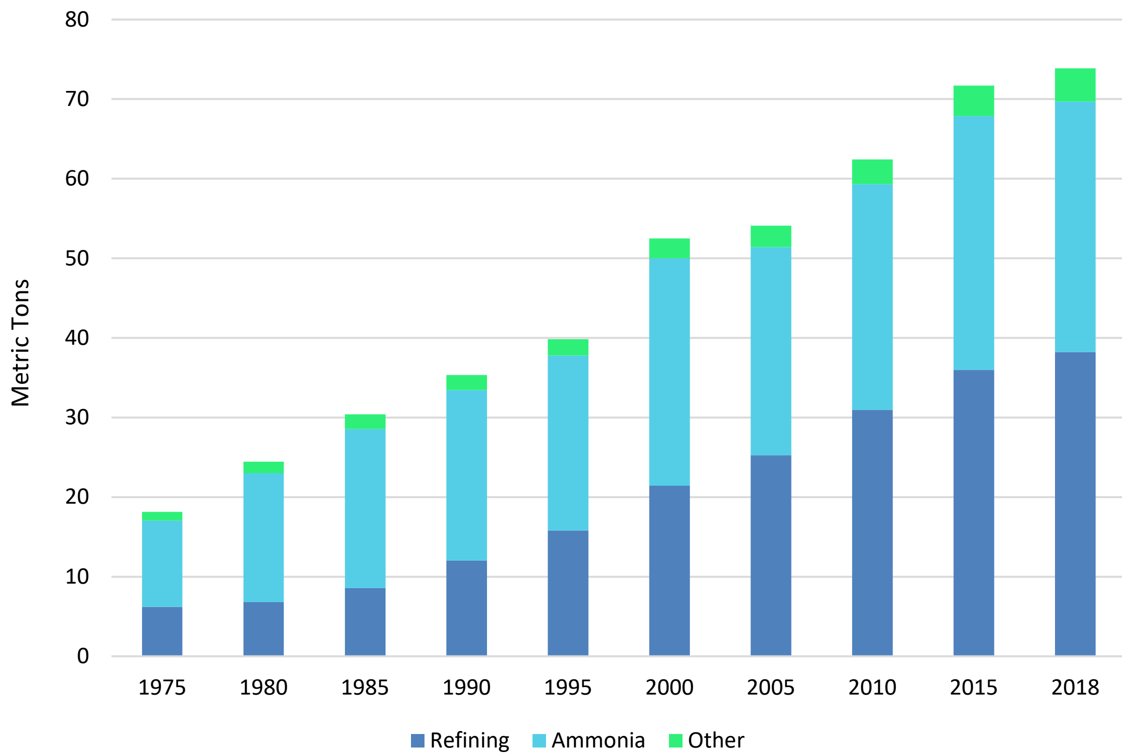
[180] Energy Storage Association. "Thermal Energy Storage." https://energystorage.org/why-energy-storage/technologies/thermal-energy-storage/

[181] Energy Storage Association. "Mechanical Energy Storage." https://energystorage.org/why-energy-storage/technologies/mechanical-energy-storage/

associated with excess wind or solar production, including seasonal-scale variations. Hydrogen energy storage is growing globally due to its much higher storage capacity compared to small-scale batteries, large-scale compressed air energy storage (CAES), or pumped hydroelectric, illustrated in Figure 3.1.[182] Hydrogen projects range in size from 1 GWh to 1 TWh, while battery projects typically range from 10 kWh to 10 MWh and pumped hydroelectric storage projects range from 10 MWh to 10 GWh.

Like pumped-storage, hydrogen storage relies on using energy when demand is low (or generation is particularly high) to power an electrolysis mechanism and ultimately create hydrogen. This hydrogen has a multitude of uses once it is created – it can be used in stationary fuel cells, for power generation, to provide fuel for fuel cell vehicles, injected as green hydrogen into natural gas pipelines, or stored as compressed gas or other compounds for later use. Unlike batteries that degrade over time, hydrogen can be stored for long periods of time and in very large quantities.

Figure 3.1 Global Demand for Pure Hydrogen in Metric Tons, 1975-2018[183]



[182] Energy Storage Association. "Hydrogen Energy Storage." https://energystorage.org/why-energy-storage/technologies/hydrogen-energy-storage/
[183] International Energy Agency. "The Future of Hydrogen." https://www.iea.org/reports/the-future-of-hydrogen

4. Outlook

4.1. Utility Integrated Resource Plans

Idaho's Investor Owned Utilities (IOUs) work with local stakeholders to develop Integrated Resource Plans (IRPs) that must be filed with the Idaho PUC every two years. IRPs forecast energy demands over 20 years and evaluate a variety of different resources to meet demand, including the addition of generation resources and demand-side measures such as conservation and energy efficiency programs. IRPs typically select a "preferred resource strategy" based on evaluation criteria including cost, risk, reliability and environmental concerns. Idaho IOU IRPs are available to the public on the Idaho PUC's website and via the utility's websites listed below:

Avista:
https://www.myavista.com/about-us/integrated-resource-planning

Idaho Power:
https://www.idahopower.com/energy-environment/energy/planning-and-electrical-projects/our-twenty-year-plan/

PacifiCorp/Rocky Mountain Power:
https://www.pacificorp.com/energy/integrated-resource-plan.html

Idaho PUC:
http://www.puc.idaho.gov

Intermountain Gas:
https://www.intgas.com/wp-content/uploads/PDFs/commission_filings/IRP-Write-Up-Book-2019.pdf

4.2. Future Planned Development

Table 4.1 Planned Investments in Electric Generating Facilities by Idaho Investor-Owned Utilities, 2020-2030[184]

Year	Utility	Investment Type	Nameplate Capacity (MW)
2022-2023	Idaho Power	Jackpot Solar	120
2023	Avista	New Wind	300
2023	PacifiCorp	New Wind	69
2023	PacifiCorp	New Battery Storage	600
2024	PacifiCorp	New Solar	2,013
2024	PacifiCorp	New Wind	1,920
2024	Avista	Kettle Falls Generating Station Modernization	12
2026	Avista	Post Falls Hydroelectricity Facility Modernization	8
2026	Avista	Long Duration Pumped Hydro Storage	175
2026-2029	Avista	Rathdrum CT 1&2 Modernization	24
2027	Avista	New Wind	200
2028	PacifiCorp	New Storage	1,400
2029	PacifiCorp	New Wind	10
2030	PacifiCorp	New Wind	1,040
2030	Idaho Power	New Battery Storage	30
2030	Idaho Power	New Solar	40
2030	PacifiCorp	New Solar	500

Table 4.1 shows planned generation projects listed by Idaho's three electric IOUs in their most recent IRPs or IRP updates. These resources may be physically located outside of Idaho. Additional renewable generation may be developed by independent power producers under Public Utility Regulatory Policies Act (PURPA) or developed as net metering projects.

[184] Avista. "2020 Electric IRP." https://www.myavista.com/about-us/integrated-resource-planning; PacifiCorp. "2019 IRP Volume I." https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2019_IRP_Volume_I.pdf; and Idaho Power. "Second Amended 2019 IRP." https://docs.idahopower.com/pdfs/AboutUs/PlanningForFuture/irp/2019/SecondAmended2019IRP.pdff

Table 4.2 Major Planned Transmission Projects by Idaho Investor-Owned Utilities, 2020-2027[185]

Year	Utility	Investment Type	Capacity (kV)
2023	PacifiCorp	Windstar to Aeolus (Gateway West)	230
2023	PacifiCorp	Aeolus to Mona	500
2024	PacifiCorp	Oquirrh to Terminal	345
2024	PacifiCorp	Bridger/Anticline-Populus (Gateway West)	500
2025	PacifiCorp, Idaho Power	Populus to Hemingway (Gateway West)	500
2026	PacifiCorp, BPA, Idaho Power	Boardman to Hemingway	500

Note: Tables 3.1 & 3.2 report the generation and transmission facilities included in the preferred resource strategy from each utility based upon their 2019 IRPs or IRP Updates.

IOU planned transmission projects are listed in Table 4.2. Other organizations are continuing plans on transmission projects around Idaho. BPA's Hooper Springs transmission line completed construction in southeast Idaho in Fall 2019.[186] LS Power, a commercial energy developer, is continuing to explore development of the Southwest Intertie Project, Northern Section through southern Idaho.

Figure 4.1 Construction of the Gateway West Transmission Line[187]

[185] Avista. "2020 Electric IRP." https://www.myavista.com/about-us/integrated-resource-planning; PacifiCorp. "2019 IRP Volume I." https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2019_IRP_Volume_I.pdf; and Idaho Power "Second Amended 2019 IRP." https://docs.idahopower.com/pdfs/AboutUs/PlanningForFuture/irp/2019/SecondAmended2019IRP.pdff
[186] Bonneville Power Administration. "Project models new collaborative approach for transmission expansion." https://www.bpa.gov/news/newsroom/Pages/Project-models-new-collaborative-approach-for-transmission-expansion.aspx
[187] HDR Engineering. "Gateway West Transmission Line, Aeolus to Jim Bridger." https://www.hdrinc.com/portfolio/gateway-west-transmission-line-aeolus-jim-bridger

Table 4.3 Announced Coal-fired Generation Facility Exits or Retirements by Idaho Investor-Owned Utilities, 2019-2037[188]

Year	Utility	Investment Type	Capacity (MW)
2019	Idaho Power	North Valmy 1	-127
2019	PacifiCorp	Naughton 3[189]	-280
2020	Idaho Power	Boardman	-58
2022	Idaho Power	North Valmy 2[190]	-133
2022	Idaho Power	Jim Bridger 1[191]	-177
2023	PacifiCorp	Jim Bridger 1	-354
2025	PacifiCorp	Naughton 1 & 2	-357
2026	Idaho Power	Jim Bridger 2[192]	-180
2026	Avista	Colstrip 3 & 4[193]	-222
2027	PacifiCorp	Dave Johnston 1 – 4	-755
2027	PacifiCorp	Colstrip 3 & 4	-148
2028	Idaho Power	Jim Bridger 3[194]	-174
2028	PacifiCorp	Jim Bridger 2	-359
2030	Idaho Power	Jim Bridger 4[195]	-177
2036	PacifiCorp	Huntington 1 & 2	-909
2037	PacifiCorp	Jim Bridger 3 & 4	-702

Note: Table 3.3 reports the exit dates and retired generation of coal-fired facilities that provide energy to Idaho and are included in the preferred resource strategy from each utility based upon their most recent IRP Updates.

Table 4.3 shows the coal-fired facilities that are owned by Idaho utilities. This table reflects the exit dates for each of the utilities from the coal units as utilities move away from coal-fired energy generation. Based on state and local policies, as well as market changes, a utility may choose to exit ownership of a coal facility before the facility is retired.

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188 Avista. "2020 Electric IRP." https://www.myavista.com/about-us/integrated-resource-planning; PacifiCorp "2019 IRP Volume I." https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2019_IRP_Volume_I.pdf; and Idaho Power "Second Amended 2019 IRP." https://docs.idahopower.com/pdfs/AboutUs/PlanningForFuture/irp/2019/SecondAmended2019IRP.pdf

189 Naughton 3 was converted to a natural gas facility in 2020.

190 Idaho Power is conducting further analysis of North Valmy Unit 2 exit timing.

191 Idaho Power and PacifiCorp have not developed contractual terms that would be necessary to allow for the potential earlier exit of a Jim Bridger unit by one party, and not both parties. Exit order is to be determined.

192 Idaho Power and PacifiCorp have not developed contractual terms that would be necessary to allow for the potential earlier exit of a Jim Bridger unit by one party, and not both parties. Exit order is to be determined.

193 Avista has received approval for the 2025 life in Washington but has not received authorization in Idaho to recover all costs through 2027.

194 Idaho Power and PacifiCorp have not developed contractual terms that would be necessary to allow for the potential earlier exit of a Jim Bridger unit by one party, and not both parties. Exit order is to be determined.

195 Idaho Power and PacifiCorp have not developed contractual terms that would be necessary to allow for the potential earlier exit of a Jim Bridger unit by one party, and not both parties. Exit order is to be determined.

4.3. Microgrids

A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to its relationship with the grid. This means a microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode.[196] The development of microgrids as an emerging resource provides practical answers to the energy challenges of the 21st century by creating an optimized way to access reliable, clean, and resilient energy through local, interconnected energy systems that incorporate loads, decentralized energy resources, battery storage, and control capabilities.

4.3.1. Smart Grid

Technologies that not only allow for two-way communication between a utility and its customers but sensing capabilities along transmission lines that respond to needed load in real time describes smart grid technologies. Emerging smart grid technologies could make it possible for consumers to individually balance their energy supply and demand. Allowing consumers to adjust electricity use in response to available supplies and costs could enhance the capacity and flexibility of the power system and may have a significant impact on Idaho energy networks. Smart grid development may facilitate the deployment of electric vehicles and help reduce carbon emissions in the transportation sector. The development of new energy storage technologies will impact both the feasibility of fuel-switching in the transportation sector (gas to electric) as well as grid stability through grid-scale energy storage.[197]

4.4. Electric Vehicles

Electric vehicles (EV) are vehicles that run off of batteries charged by electricity rather than a combustion engine and fossil fuel. The rate of electric vehicle ownership is rising due to affordability and advances in battery technology performance. The costs of charging an EV in Idaho are reflective of Idaho's affordable electricity rates and can cost significantly less than the price of an equivalent amount of gasoline.[198] However, the current typical range that many EVs are able to travel on a single charge and a limited network of EV charging stations across the State restricts where an Idahoan can travel in an EV, given the State's rural geography.

EV owners have a variety of charging options to recharge their battery that require differing types of infrastructure. For example, EVs can be charged overnight via common 120-volt outlets, also called Level 1 chargers. Level 2 charging stations have a 240-volt capacity, which can be installed at residences, businesses or fleet locations to charge at a faster rate (about 3-5 hours for a full charge).[199] Direct charge or DC "fast chargers"

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[196] U.S. Department of Energy. "The U.S. Department of Energy's Microgrid Initiative." https://www.energy.gov/sites/prod/files/2016/06/f32/The%20US%20Department%20of%20Energy's%20Microgrid%20Initiative.pdf

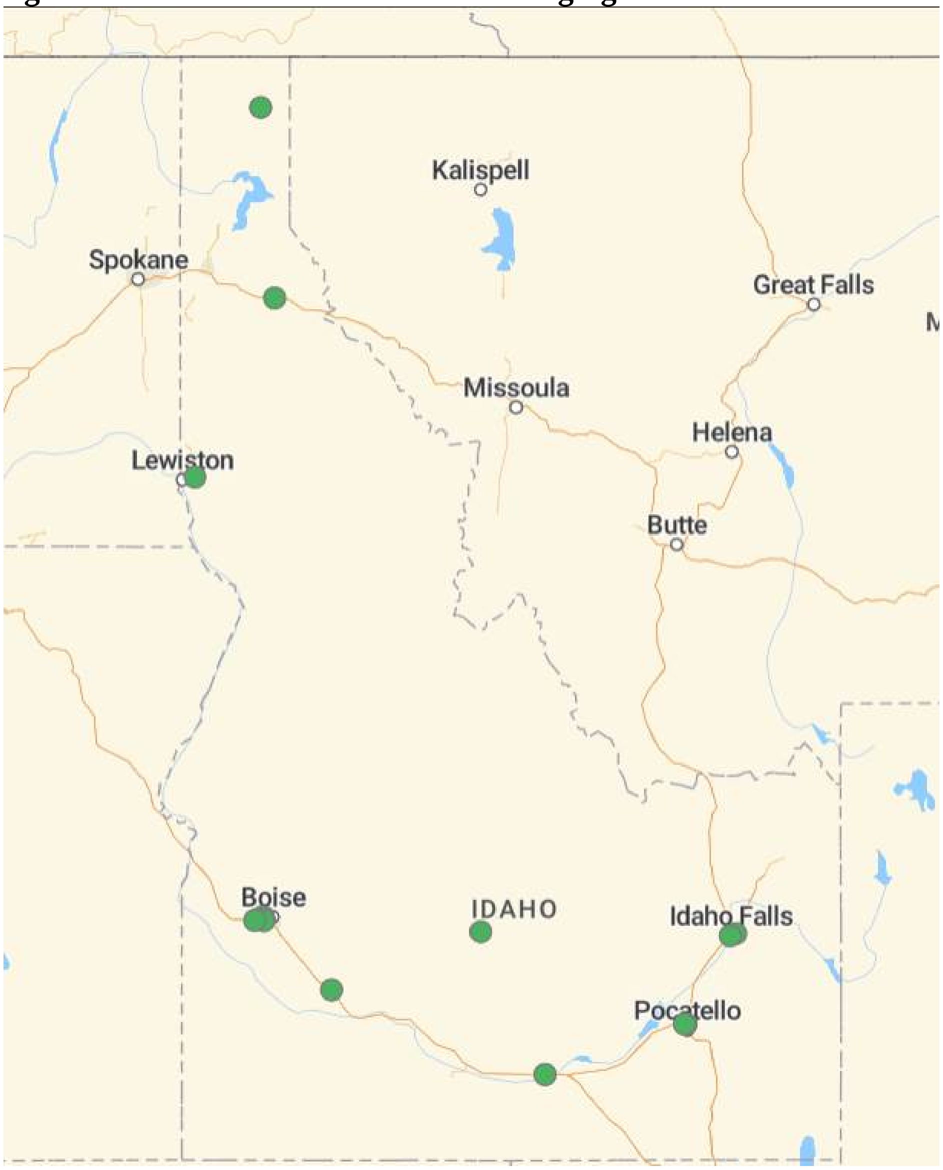
[197] U.S. Department of Energy: Office of Electrical Delivery and Energy Reliability. "What is the Smart Grid." https://www.smartgrid.gov/the_smart_grid/smart_grid.html

[198] Idaho Power. "Calculate Your Savings Potential." https://idahopower.chooseev.com/savings/f

[199] U.S. Department of Energy. "Electric Vehicles: Charging at Home." https://www.energy.gov/eere/electricvehicles/charging-home

require a specialized, 480-volt outlet and can provide a full charge after 20-30 minutes. Level 1 and 2 chargers are likely to be more frequently used day-to-day, but DC fast chargers are the most popular options for long range road trips.[200]

Figure 4.2 Electric Vehicle DC Fast Charging Station Locations in Idaho[201]



[200] U.S. Department of Energy. "Electric Vehicles: Vehicle Charging." https://energy.gov/eere/electricvehicles/vehicle-charging

[201] U.S. Department of Energy. "Electric Vehicle Charging Station Locations Idaho." https://afdc.energy.gov/fuels/electricity_locations.html#/analyze?region=US-ID&fuel=ELEC&show_map=true

5. Energy Research and Education Entities in Idaho

5.1. Research at Idaho National Laboratory

INL is one of the State's largest employers, and the U.S. Department of Energy's (DOE) nuclear energy research, development, and demonstration laboratory. INL is a leading contributor to a variety of non-nuclear clean energy technologies research on cybersecurity and protecting critical infrastructure.[202] Within its 890 square miles of research space, INL has numerous unique research facilities and capabilities.

Nuclear Science and Technology: In addition to the Gateway for Accelerated Innovation in Nuclear (GAIN) initiative,[203] which was created to provide technical, regulatory, and financial support to move advanced nuclear reactor technologies toward commercialization, INL was recently named home to the National Reactor Innovation Center (NRIC). NRIC is the next step toward commercialization of advanced nuclear reactors. It provides private sector technology developers access to facilities and expertise within the national laboratory system. Through NRIC, new reactor demonstrations will be able to accelerate technology readiness from proof of concept to proof of operations. This includes demonstration of the first of its kind small modular reactors (SMRs) and microreactors.[204]

Through its nuclear research program, INL is currently engaging in the development and deployment of three advanced nuclear reactor technologies.

- The NuScale SMR power plant for the Utah Associated Municipal Power Systems (UAMPS) Carbon Free Power Project (CFPP) is currently set for full operation at the INL site by 2030.[205]
- Oklo Power LLC (Oklo) is preparing to license, build, and operate the company's Aurora microreactor design at the INL site. On Feb. 19, 2020, INL announced it will provide Oklo with access to recovered spent nuclear fuel to aid the company in its efforts to develop and demonstrate the Oklo Aurora design.
- As required by the "Nuclear Energy Innovation Capabilities Act of 2017", the U.S. DOE must construct a Versatile Test Reactor (VTR) and approve the start of facility operations, to the maximum extent practicable, by December 31, 2025.To this end, the DOE's Office of Nuclear Energy is currently undergoing environmental review for a VTR at the INL site.

Energy Environment Science and Technology: INL is working to help accelerate cost-effective integration of clean energy sources, including geothermal, wind, bio-based, nuclear and solar power into the grid. Additionally, INL leads research into electric

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[202] Idaho National Laboratory. "INL Research Areas." https://www.inl.gov/research-programs/
[203] Gateway for Accelerated Innovation in Nuclear. "What is GAIN?" https://gain.inl.gov/SitePages/What%20is%20GAIN.aspx
[204] U.S. Department of Energy "National Reactor Innovation Center Fact Sheet." https://www.energy.gov/sites/prod/files/2019/08/f65/NRIC_Fact_Sheet.pdf
[205] NuScale Power, LLC. "Fact Sheet - Carbon Free Power Project." https://newsroom.nuscalepower.com/media-center/media-resources/fact-sheets/default.aspx

vehicle (EV) charging technologies and the charging habits of EV owners, hoping to discover safer, faster, and more efficient means of dispatching energy on smart grids, charging, and utilizing battery technologies.[206] Effective charging will enhance EV owner security, while increasing domestic energy independence. INL's extensive research can help inform decisions on how to most effectively deploy EV charging opportunities.

National and Homeland Security: In addition to the global leading work on cybersecurity and critical infrastructure protection, INL has unparalleled assets such as a wireless test bed and over 111 miles of transmission lines to be utilized for testing real world scenarios by industry, government, and other partners.

INL recently opened two new state-owned world class facilities dedicated to cybersecurity (Cybercore Integration Center) and nuclear modeling and simulation (Collaborative Computing Center). These facilities will significantly enhance the cutting-edge research being done by INL in collaboration with Idaho's colleges and universities. INL is a prominent resource of energy education and outreach throughout Idaho.

5.2. Center for Advanced Energy Studies

The Center for Advanced Energy Studies (CAES) is a research, education, and innovation consortium that brings together INL, Boise State University, Idaho State University, the University of Idaho, and the University of Wyoming. CAES headquarters is a state-owned, energy-efficient facility located near INL and University Place campus in Idaho Falls. With complimentary capabilities and research programs at each of the participating universities, CAES works to solve regional energy challenges that have national impact.[207] CAES leverages the expertise, facilities, and capabilities of the member organizations to collaboratively address challenges in these focus areas: nuclear energy; energy-water nexus; cybersecurity; advanced manufacturing; innovative energy systems; energy policy; and computing, data and visualization.[208]

Based at Boise State University, the Energy Policy Institute is the policy arm of the Center for Advanced Energy Studies (CAES). The Institute is a non-partisan and evidenced-based research and advising center that specializes in energy systems change. It focuses on how to manage energy shifts—planned and unanticipated—in natural, technical, and human systems. The Institute's team works with policymakers, industry, and communities to advance understanding and decisions about clean, safe, and secure energy systems.

5.3. Universities, Colleges, and Technical Training

Many of Idaho's higher education institutions are engaged in educating tomorrow's energy workforce. For example, elective courses are offered in energy efficiency and

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[206] Idaho National Laboratory. "Clean Energy & Transportation." https://at.inl.gov/SitePages/Evaluation%20of%20Conductive%20and%20Wireless%20Charging%20Systems.aspx
[207] Center for Advanced Energy Studies. "About Us." https://caesenergy.org/about-us/
[208] Center for Advanced Energy Studies. "Core Capabilities." https://caesenergy.org/research/core-capabilities/

renewable energy at **Boise State University**.[209] The courses provide non-science or engineering students with a solid grounding in energy fundamentals, which is helping Boise State educate a knowledgeable generation of energy consumers, policymakers, teachers, and business leaders.

The **Micron School of Materials Science and Engineering (MSE)** at Boise State University is home to one of the most productive materials science and engineering programs in the northwest. Students and faculty collaborate on funded research in areas such as nanoscale fabrication, shape memory alloys, energy, biomaterials, and materials modeling. MSE is currently investigating a broad range of materials issues in areas such as nuclear fuels, biomaterials, glasses, semiconductors, electronic memories, computational modeling, and magnetic materials.[210]

The Department of Biological and Agricultural Engineering at the **University of Idaho** houses the **Biodiesel Fuel Education Program** which provides science-based information about biodiesel and assists in the development of educational tools for a national biodiesel outreach program. The program develops and distributes educational materials that support advances in biodiesel infrastructure, technology transfer, fuel quality, fuel safety, and increasing feedstock production.[211]

The **National Institute for Advanced Transportation Technology** at the University of Idaho is a center for transportation research, education, and technology transfer. It is committed to preserving and protecting the environments of the Pacific Northwest. The Institute contributes to the sustainability of the environment through the development of clean vehicles, alternative fuels, efficient traffic control systems, safe transportation systems, sound infrastructure, and the policies that support these systems.[212]

Idaho State University offers bachelor's and master's degree programs in Nuclear Science and Engineering and prepares graduates to excel in a wide range of careers associated with nuclear reactors, the nuclear fuel cycle, and other applications of nuclear technology.[213]

Idaho State University established the **Energy Systems Technology and Education Center** (ESTEC) in its College of Technology. ESTEC integrates the education and training required for graduates to maintain existing plants. They learn to install and test components in new plants in key areas of technology, including electrical engineering, instrumentation and control, mechanical engineering, wind engineering, instrumentation and automation, nuclear operations, and renewable energy.[214]

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[209] Boise State University. https://www.boisestate.edu/
[210] Boise State University. "Micron School of Materials Science and Engineering." http://coen.boisestate.edu/mse/
[211] University of Idaho. "Biodiesel Education." http://biodieseleducation.org/
[212] University of Idaho. "National Institute for Advanced Transportation Technology." www.uidaho.edu/engr/research/niatt
[213] Idaho State University. "Programs of Study." http://coursecat.isu.edu/programsofstudy/
[214] Idaho State University. "College of Technology." https://www.isu.edu/estec//

Idaho's community colleges also emphasize the importance of educating the energy workforce of the future. Instructors at the **College of Southern Idaho (CSI)** in Twin Falls have trained the next-generation energy workforce in renewable energy since 1981 through the **Renewable Energy Systems Technology Program.**[215] CSI received a $4.4 million Economic Development Administration federal grant in 2011 to help build the **Applied Technology and Innovation Center** in Twin Falls. Completed in 2014, the 29,600 square foot energy efficient center houses the college's expanding HVAC, environmental technology, wind energy, and machine technology programs with classrooms, hands-on labs, and administrative offices.[216]

College of Eastern Idaho (CEI) launched its **Energy Systems Technology Program** in 2010; it provides the first year of this two-year program at the CEI campus. After first-year completion, qualified students enter the second year of the ESTEC program at Idaho State University. The program equips students to become energy systems maintenance technicians with mechanical, electrical, and instrumentation and control skills.[217]

The **College of Western Idaho** (CWI) is looking to the future of managing a diverse energy sector with its Advanced Mechatronics Engineering Technology program. This one-to-two-year program teaches students about electricity, robotics, wireless communication, renewable energy, instrumentation, and computerized control systems.[218]

The **Northwest Lineman College,** based in Meridian, trains lineman apprentices and educates students in construction, maintenance, and operation of the electrical grid. It provides lineman certification for individuals already working in the trade and develops customized training services for power and construction companies worldwide. Founded in 1993, the college educates more trade professionals in the Power Delivery Industry than any other educational institution in the United States, training over 8,000 individuals annually.[219]

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[215] College of Southern Idaho. "Renewable Energy Systems Technology Program." https://www.csi.edu/programs/renewable-energy-systems-technology/default.aspx

[216] U.S. Economic Development Aadministration. "CSI Applied Technology & Innovation Center." https://www.eda.gov/success-stories/workforce/stories/college-of-southern-id.htm

[217] College of Eastern Idaho. "Energy Systems Technician." http://www.cei.edu/programs-of-study/trades-industry/energy-systems-technician, and Idaho State University. "Energy Systems Technology and Education Center." https://www.isu.edu/estec/

[218] College of Western Idaho. "Advanced Mechatronics Engineering Technology." https://cwi.edu/program/advanced-mechatronics-engineering-technology

[219] Northwest Lineman College. https://lineman.edu/students-home/campuses/idaho/

Appendix A: List of Idaho Electric and Natural Gas Utilities

Investor-Owned Utilities

Avista Utilities	800-227-9187
Dominion Energy (formerly Questar)	800-323-5517
Idaho Power Company	800-488-6151
Intermountain Gas	800-548-3679
Rocky Mountain Power	888-221-7070

Municipal Electric Utilities

Albion Light and Water Plant	208-673-5352
Bonners Ferry Light and Water	800-626-4950
Burley Electric Department	208-878-2224
Declo Municipal Electric Department	208-654-2124
Heyburn Electric Department	208-679-8158
Idaho Falls Power	208-612-8280
Minidoka Electric Department	208-531-4101
Plummer Electric Department	208-686-1641
Rupert Electric Department	208-436-9600
Soda Springs Electric Light and Power	208-547-2600
Weiser Electric Department	208-414-1964

Rural Electric Cooperatives

Bonneville Power Administration	800-282-3713
Atlanta Power	208-459-7014
Clearwater Power	888-743-1501
East End Mutual Electric	208-436-9047
Fall River Rural Electric	800-632-5726
Farmers Electric	208-436-6384
Idaho County Light and Power	877-212-0424
Inland Power and Light	800-747-7151
Kootenai Electric Cooperative	800-240-0459
Lost River Electric Cooperative	208-588-3311
Lower Valley Energy	800-882-5875
Northern Lights Incorporated	800-326-9594
Missoula Electric Cooperative	800-352-5200
Raft River Rural Electric	800-342-7732
Riverside Electric Cooperative	208-436-3855
Salmon River Cooperative	208-879-2283
South Side Electric	208-654-2313
United Electric Co-Op Inc.	208-679-2222
Vigilante Electric Cooperative	800-221-8271

Glossary:

Average Megawatt (aMW): An average megawatt is the amount of electricity produced by the continuous production of one megawatt over a period of one year. The term, sometimes also called average annual megawatt, defines power production in megawatt increments over time. Because there are 8,760 hours in a year, an average megawatt is equal to 8,760 megawatt-hours.

Avoided cost: The cost to produce or otherwise procure electric power that an electric utility does not incur because it purchases this increment of power from a qualifying facility (QF). It may include a capacity payment and/or an energy payment component.

Baseload: The minimum amount of electric power or natural gas delivered or required over a given period of time at a steady rate. The minimum continuous load or demand in a power system over a given period of time.

Baseload plant: A plant that is normally operated to take all or part of the minimum continuous load of a system and that consequently produces electricity at an essentially constant rate. These plants are operated to maximize system mechanical and thermal efficiency and minimize system operating costs. Traditionally, coal, nuclear plants and some high efficiency natural gas plants have been considered baseload plants. Baseload plants are also required to firm intermittent energy resources such as wind or solar.

Biomass: Plant materials and animal waste used as a feedstock for energy production.

British Thermal Units (BTUs): British Thermal Unit is a traditional unit of energy equal to about 1,055 joules. Production of 1 kWh of electricity generated in a thermal power plant requires about 10,000 BTUs. 1 gallon gasoline ≈ 125,000 BTUs.

Capacity (electric): The maximum power that can be produced by a generating resource at specified times under specified conditions.

Capacity factor: A capacity factor is the ratio of the average power output from an electric power plant compared with its maximum output. Capacity factors vary greatly depending on the type of fuel that is used and the design of the plant. Baseload power plants are operated continuously at high output and have high capacity factors (reaching 100%). Geothermal, nuclear, coal plants, large hydroelectric and bioenergy plants that burn solid material are usually operated as baseload plants. Many renewable energy sources such as solar, wind and small hydroelectric power have lower capacity factors because their fuel (wind, sunlight or water) is not continuously available.

Capacity (gas): The maximum amount of natural gas that can be produced, transported, stored, distributed or utilized in a given period of time under design conditions.

Capacity, peaking: The capacity of facilities or equipment normally used to supply incremental gas or electricity under extreme demand conditions. Peaking capacity is generally available for a limited number of days at a maximum rate.

Carbon capture and sequestration: An approach to mitigate climate change by capturing carbon dioxide from large point sources such as power plants and storing it instead of releasing it into the atmosphere. Technology for sequestration is commercially available and is used at many locations at a modest scale primarily for oil and gas recovery. However, technology needed for capturing carbon dioxide from large point sources has yet to be developed. Although carbon dioxide has been injected into geological formations for various purposes (such as enhanced oil recovery), long-term storage on a large scale has yet to be demonstrated. To date, no large-scale power plant operates with a full carbon capture and storage system.

Carbon dioxide (CO_2): A gaseous substance at standard conditions composed of one carbon atom and two oxygen atoms produced when any carbon-based fuels are combusted. It is considered by many scientists a major contributor to global climate change. Plants use carbon dioxide for photosynthesis and for plant growth and development.

Coal gasification: A process by which synthetic gases are made from coal by reacting coal, steam and oxygen under pressure and elevated temperature. These gases can be used in processes to produce electricity or to make a variety of carbon-based products, including methane (natural gas), gasoline, diesel fuel and fertilizer.

Cogeneration: Also known as “combined heat and power” (CHP) or cogen. The simultaneous production of heat (usually in the form of hot water and/or steam) and power utilizing one primary fuel. Cogeneration is often used to produce power as a secondary use of the waste steam/heat from a primary industrial process.

Commercial: A sector of customers or service defined as non-manufacturing business establishments, including hotels, motels, restaurants, wholesale businesses, retail stores and health, social and educational institutions. A utility may classify the commercial sector as all consumers whose demand or annual use exceeds some specified limit. The limit may be set by the utility based on the rate schedule of the utility.

Commission: State public utility commission(s); the Federal Energy Regulatory Commission.

Concentrating solar power (CSP): A process that uses lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. The concentrated light is then used as a heat source for a conventional power plant or is concentrated onto photovoltaic surfaces.

Conservation: Demand-side management (DSM) strategy for reducing generation capacity requirements by implementing programs to encourage customers to reduce their energy consumption. Program examples include incentives/savings for the installation of energy efficient appliances, lighting and electrical machinery, and weatherization materials.

Control area: A geographical area in which a utility is responsible for balancing generation and load. A control area approximates the service area of a utility.

Cooperative electric utility (Co-op): Private, not-for-profit electric utility legally established to be owned by and operated for the benefit of those using its service. It will generate, transmit and/or distribute supplies of electric energy to cooperative members. Such ventures are generally exempt from federal income tax laws. Many were initially financed by the Rural Electrification Administration, U.S. Department of Agriculture.

Demand: The amount of power consumers require at a particular time. Demand is synonymous with load. It is the amount of power that flows over a transmission line at a particular time. System demand is measured in megawatts.

Demand-side management (DSM): The term for all activities or programs undertaken by an electric system to influence the amount and timing of electricity use. Included in DSM are the planning, implementation and monitoring of utility activities that are designed to influence customer use of electricity in ways that will produce desired changes in a utility's load shape such as, among other things, direct load control, interruptible load and conservation.

Dispatch: The monitoring and regulation of an electrical or natural gas system to provide coordinated operation; the sequence in which generating resources are called upon to generate power to serve fluctuating load; the physical inclusion of a generator's output onto the transmission grid by an authorized scheduling utility.

Distribution (electrical): The system of lines, transformers and switches that connect the high-voltage bulk transmission network and low-voltage customer load. The transport of electricity to ultimate use points such as homes and businesses. The portion of an electric system that is dedicated to delivering electric energy to an end user at relatively low voltages.

Distribution (gas): Mains, service connections and equipment that carry or control the supply of natural gas from the point of local supply to and including the sales meters.

Distributed generation: Electric power produced other than at a central station generating unit, such as that using fuel cell technology or on-site small-scale generating equipment.

Electric utility: A corporation, person, agency, authority or other legal entity that owns and/or operates facilities for the generation, transmission, distribution or sale of electric energy primarily for use by the public. Facilities that qualify as co-generators or small power producers under the Public Utility Regulatory Policies Act (PURPA) are not considered electric utilities.

Electricity generation: The process of producing electric energy by transforming other forms of energy such as steam, heat or falling water. The amount of electric energy produced is expressed in kilowatt-hours or megawatt-hours.

Electricity transmission congestion: Transmission congestion results when transmission lines reach their maximum capacity, so no additional power transactions can take place, regardless of power needs. Attempting to operate a transmission system beyond its rated capacity is likely to result in line faults and electrical fires, so this can never occur. The only ways the congestion can be alleviated are to tune the system to increase its capacity, add new transmission infrastructure, or decrease end-user demand for electricity.

Forecasting: The process of estimating or calculating electricity load or resource production requirements at some point in the future.

Fuel-switching: Substituting one fuel for another based on price and availability. Large industries often have the capability of using either oil or natural gas to fuel their operation and of making the switch on short notice.

Generator nameplate capacity (installed): The maximum rated output of a generator or other electric power production equipment under specific conditions designated by the manufacturer. Installed generator nameplate capacity is commonly expressed in megawatts (MW) and is usually indicated on a nameplate physically attached to the generator.

Geothermal power: Power generated from heat energy derived from hot rock, hot water or steam below the earth's surface.

Gigawatt (GW): A gigawatt (GW) is equal to one billion (10^9) watts.

Gigawatt-hour (GWh): A gigawatt-hour (GWh) is a unit of electrical energy that equals one thousand megawatts of power used for one hour. One gigawatt-hour is equal to 1,000 megawatt-hours.

Greenhouse gases (GHG): Gases found within the earth's atmosphere including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), and sulfur hexafluoride (SF_6) that trap energy from the sun and warm the earth. Some greenhouse gases are emitted from the earth's natural processes; others from human activities, primarily the combustion of fossil fuels.

Grid: The layout of the electrical transmission system or a synchronized transmission network.

Head: The vertical height of the water in a reservoir above the turbine. In general, the higher the head, the greater the capability to generate electricity due to increased water pressure.

High-voltage lines: Wires composed of conductive materials that are used for the bulk transfer of electrical energy from generating power plants to substations located near to population (load) centers. Transmission lines, when interconnected with each other, become high voltage transmission networks. In the U.S., these are typically referred to as "power grids" or sometimes simply as "the grid". Electricity is transmitted at high voltages (110 kV or above) to reduce the energy lost in long distance transmission. Power is usually transmitted through overhead power lines. Underground power transmission has a significantly higher cost.

Hydroelectric plant: A plant in which the power turbine generators are driven by falling water.

Independent power producers: A non-utility power generating entity, defined by the 1978 Public Utility Regulatory Policies Act, that typically sells the power it generates to electric utilities at wholesale prices.

Industrial customer: The industrial customer is generally defined as manufacturing, construction, mining, agriculture, fishing and forestry establishments. The utility may classify industrial service using the Standard Industrial Classification codes or based on demand or annual usage exceeding some specified limit. The limit may be set by the utility based on the rate schedule of the utility.

Integrated Resource Plan (IRP): A plan that IOUs produce periodically for regulators and customers to share their vision of how to meet the growing need for energy. These plans contain a preferred portfolio of resource types and an action plan for acquiring specific resources to meet the needs of customers including conservation measures. Specific resources will be acquired as individual projects or purchases and, when appropriate, through a formal request for proposals (RFP) process.

Interconnection: A link between power systems enabling them to draw on one another’s reserves in times of need to take advantage of energy cost differentials resulting from such facts as load diversity, seasonal conditions, time-zone differences and shared investments in larger generating units.

Interstate pipeline: A natural gas pipeline company that is engaged in the transportation of natural gas across state boundaries and is therefore subject to FERC jurisdiction and/or FERC regulation under the Natural Gas Act.

Investor-owned utility (IOU): A utility that is a privately owned, often publicly traded corporation whose operations are regulated by federal and state entities.

Kilowatt (kW): A unit of electrical power or capacity equal to one thousand watts.

Kilowatt-hour (kWh): A unit of electrical energy that is equivalent to one kilowatt of power used for one hour. One kilowatt-hour is equal to 1,000 watt-hours. An average household will use between 800 and 1,300 kWhs per month, depending upon geographical area.

Load: The amount of electric power delivered or required at any specific point or points on a system. The requirement originates at the energy-consuming equipment of the consumers. The load of an electric utility system is affected by many factors and changes on a daily, seasonal and annual basis, typically following a general pattern. Electric system load is usually measured in megawatts (MW). It is synonymous with demand.

Local distribution company (LDC): A company that obtains the major portion of its revenues from the operations of a retail distribution system for the delivery of electricity or gas for ultimate consumption.

Megawatt (MW): A unit of electrical power equal to 1 million watts or 1,000 kilowatts. Plant power output is typically measured in megawatts.

Megawatt-hour (MWh): One million watt-hours of electric energy. A unit of electrical energy that equals one megawatt of power used for one hour.

Metering: Use of devices that measure and register the amount and/or direction of energy quantities relative to time.

Municipal utility: A utility owned and operated by a municipality or group of municipalities.

National Association of Regulatory Utility Commissioners (NARUC): A professional trade association, headquartered in Washington, D.C., composed of members of state and federal regulatory bodies that have regulatory authority over utilities.

Net metering: A method of crediting customers for electricity that they generate on site in excess of their own electricity consumption.

Network: An interconnected system of electrical transmission lines, transformers, switches and other equipment connected in such a way as to provide reliable transmission of electrical power from multiple generators to multiple load centers.

Nuclear power plant: A facility in which nuclear fission produces heat that is used to generate electricity.

Obligation to serve: In exchange for the regulated monopoly status of a utility for a designated service territory with the opportunity to earn an adequate rate of return, comes the obligation to provide electrical service to all customers who seek that service at fair, just, and reasonable prices. This has been part of what the utility commits to under the "regulatory compact" and also includes the requirement to provide a substantial operating reserve capacity in the electrical system. *(See Regulatory compact.)*

Off peak: The period during a day, week, month or year when the load being delivered by a natural gas or electric system is not at or near the maximum volume delivered by that system for a similar period of time (night vs. day, Sunday vs. Tuesday).

On peak: The period during a day, week, month or year when the load is at or near the maximum volume.

Open access: The term applied to the evolving access to the transmission system for all generators and wholesale customers. This is also the use of a utility's transmission and distribution facilities on a common-carrier basis at cost-based rates.

Peak demand: The maximum load during a specified period of time.

Peak load plant or peaker unit: A plant usually housing low-efficiency, quick response steam units, gas turbines, diesels or pumped-storage hydroelectric equipment normally used during the maximum load periods. Peakers are characterized by quick start times and generally high operating costs, but low capital costs.

Photovoltaic (solar) conversion: The process of converting the sun's light energy directly into electric energy through the use of photovoltaic cells.

Pipeline system: A collection of pipeline facilities used to transport natural gas from source of supply to burner tip, including gathering, transmission or distribution lines, treating or processing plants, compressor stations and related facilities.

Power plant: A plant that converts mechanical energy into electric energy. The power is produced from raw material such as gas, coal, nuclear or other fuel technologies.

Qualifying facility (QF): A designation created by PURPA for non-utility power producers that meet certain operating, efficiency and fuel-use standards set by FERC. To be recognized as a qualifying facility under PURPA, the facility must be a small power production facility whose primary energy source is renewable or a cogeneration facility that must produce electric energy and another form of useful thermal energy, such as steam or heat, in a way that is more efficient than the separate production of both forms of energy. It must meet certain ownership, operating and efficiency criteria established by FERC.

Regional transmission organization/group (RTO/RTG): A proposal advanced by FERC to establish regional groups to expedite the coordination of wholesale wheeling. The group is voluntary in each region and may include transmission system owners, wholesale purchasers and independent power generators. *(See wheeling)*

Regulatory compact: A traditional covenant between customers in a state and investor-owned utilities (IOUs) in exchange for providing service to all customers in a defined service territory. IOU is given a service area monopoly on service and allowed to earn a limited return set by state regulators. The commission enforces the terms of the regulatory compact. *(See Obligation to serve.)*

Reliability: The ability to meet demand without interruption. The degree of reliability may be measured by the frequency, duration and magnitude of adverse effects on consumer service.

Renewable resource: An energy source that is continuously or cyclically renewed by nature, including solar, wind, hydroelectric, geothermal, biomass or similar sources of energy.

Reserve capacity: Capacity in excess of that required to carry peak load, available to meet unanticipated demands for power or to generate power in the event of loss of generation.

Residential consumer: A consumer residing at a dwelling served by the company and using services for domestic purposes. This does not include consumers residing in temporary accommodations, such as hotels, camps, lodges and clubs.

Retail: Sales covering electrical energy supplied for residential, commercial and industrial end-use purposes. Agriculture and street lighting are also included in this category. Power sold at retail is not resold by the purchaser to another customer.

Rural electric cooperative: *See Cooperative electric utility.*

Service area: The territory in which a utility system is required or has the right to supply service to ultimate customers.

Smart grid: Smart grid is a concept that is currently undeveloped. Smart grids add monitoring, analysis, control and communication capabilities to the national electrical delivery system to maximize the throughput of the system. In theory, the smart grid concept might allow utilities to move electricity around the system as efficiently and economically as possible. Consumers will have the choice and flexibility to manage electrical use while minimizing bills. Smart grid could be described as overlaying a communication network on top of the power grid.

Solar generation: The use of radiation from the sun to substitute for electric power or natural gas heating.

Substation: Equipment that switches, changes or regulates electric voltage. An electric power station that serves as a control and transfer point on an electrical transmission system. Substations route and control electrical power flow, transformer voltage levels and serve as delivery points to industrial customers.

Tariff: A document filed by a regulated entity with either a federal or state commission, listing the rates the regulated entity will charge to provide service to its customers as well as the terms and conditions that it will follow in providing service.

Thermal generation: The production of electricity from plants that convert heat energy into electrical energy. The heat in thermal plants can be produced from a number of sources such as coal, oil or natural gas.

Transmission: The network of high-voltage lines, transformers and switches used to move electrical power from generators to the distribution system (loads). This network is utilized to interconnect different utility systems and independent power producers together into a synchronized network.

Transmission grid: An interconnected system of electric transmission lines and associated equipment for the transfer of electric energy in bulk between points of supply and points of demand.

Turbine: The part of a generating unit usually consisting of a series of curved vanes or blades on a central spindle that is spun by the force of water, steam or heat to drive an electric generator. Turbines convert the kinetic energy of such fluids to mechanical energy through the principles of impulse and reaction or a measure of the two.

Volt: A unit of measurement of electromotive force or electrical potential. It is equivalent to the force required to produce a current of one ampere through a resistance of one ohm. Typical transmission level voltages are 115 kV, 230 kV and 500 kV.

Watt: A measure of real power production or usage equal to one joule per second.

Watt-hour (Wh): An electrical energy unit of measure equal to one watt of power supplied to, or taken from, an electric circuit steadily for one hour.

Wheeling: The use of the transmission facilities of one system to transmit power for another system. Wheeling can apply to either wholesale or retail service.