Idaho Office of Energy and Mineral Resources

IDAHO ENERGY LANDSCAPE 2023

304 N. 8th Street, Suite 250
P.O. Box 83720
Boise, Idaho 83720

Governor's Office of IDAHO Energy and Mineral Resources

Created by the Idaho Governor's Office of Energy and Mineral Resources

304 N. 8th Street, Suite 250
P.O. Box 83720
Boise, Idaho 83720-0199

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Note: Energy statistics compiled for the 2023 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 Idaho Governor's Office of Energy and Mineral Resources staff conducts thorough research to ensure that the data presented in this document is accurate and complete.

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1. Idaho's Energy Landscape

1.1 Energy and the Economy

Idaho's abundant natural resources enable reliable and low-cost energy which sustains Idaho's economy and quality of life for citizens. Idaho's diverse economy is comprised of many energy-intensive sectors, including technology, manufacturing, agriculture, tourism, healthcare, and construction, all of which benefit from Idaho's low cost of energy.

Idaho's history is rich with energy innovation and its future is being propelled with pioneering technologies. From the first atomic-powered city in the world to the first public installation of solar-powered roads, parking lots and pathways, Idaho has long been a global energy innovator. The following key attributes enable a dynamic energy industry in Idaho:

- Low cost of doing business
- Access to affordable and reliable hydroelectricity
- Availability of an energy-ready workforce
- Access to leaders in carbon-free energy and energy innovation
- Sizable and diverse industry supply chain
- Friendly business climate and tax structures

Idaho's access to natural resources have paved the way for small and large energy producers to play a role in satisfying the state's energy needs. The state's energy industry contributes $6.3 billion to the State's GDP and provides approximately 50,800 jobs, spurring technology innovation, launching of start-ups, and fueling research, growth, and discovery.[1] Idaho has some of the lowest energy prices in the country and the fourth highest share of renewable energy across the nation. These attributes draw business into Idaho.

Figure 1: Micron Invests $15 Billion in Boise Expansion[2]

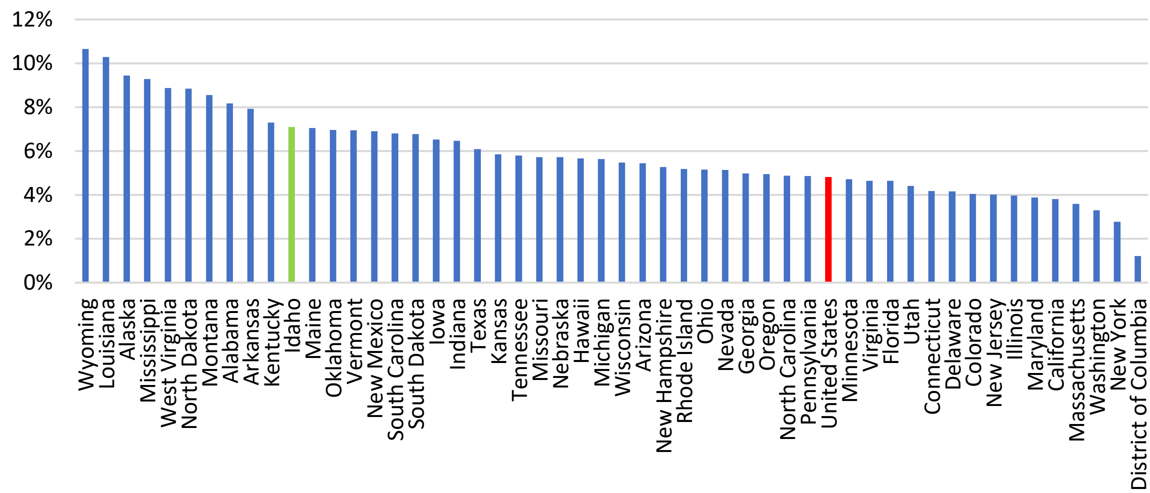
[1] Idaho Dept. of Commerce "Idaho's Expanding Energy Economy". https://commerce.idaho.gov/content/uploads/2022/02/Idahos-Expanding-Energy-Economy.pdf

[2] Micron. "Press Release". https://investors.micron.com/news-releases/news-release-details/micron-invest-15-billion-new-idaho-fab-bringing-leading-edge

In 2022, Micron Technology, an American semiconductor company headquartered in Boise, announced a $15 billion expansion project which will create over 2,000 local jobs. Semiconductor manufacturing is a highly energy intensive industry. Micron has a goal to reach net-zero in operations by 2050. In September 2022, Micron, along with 20 other semiconductor manufacturers, signed onto the Energy Efficiency Scaling for 2 Decades (EES2) pledge which aims to increase the economic competitiveness of American semiconductor manufacturers and strengthen domestic clean energy supply chains.

1.1.1 Energy Costs

Figure 2: Idaho's Energy Intensity as a Share of the Economy[3]



Low energy rates have consistently attracted energy-intensive industries to Idaho, including mining, pulp and paper, agriculture, food processing, and computer chip manufacturing. Electric rates in Idaho fall below the United States average in all sectors by over 25%.[4] As a result, Idaho's energy expenditures equated to just over 7% of the State's Gross Domestic Product (GDP) in 2020, placing Idaho 11th for total energy costs compared to the rest of the states.[5] The total energy costs per GDP illustrated in Figure 2 include the cost of gasoline to the state. 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.

Idaho has approximately 2,400 energy businesses operating, totaling $6.3 billion of the state's GDP. Wages in the sector average $91,000 per year, and the anticipated growth rate is 19% over the next 10 years.[6]

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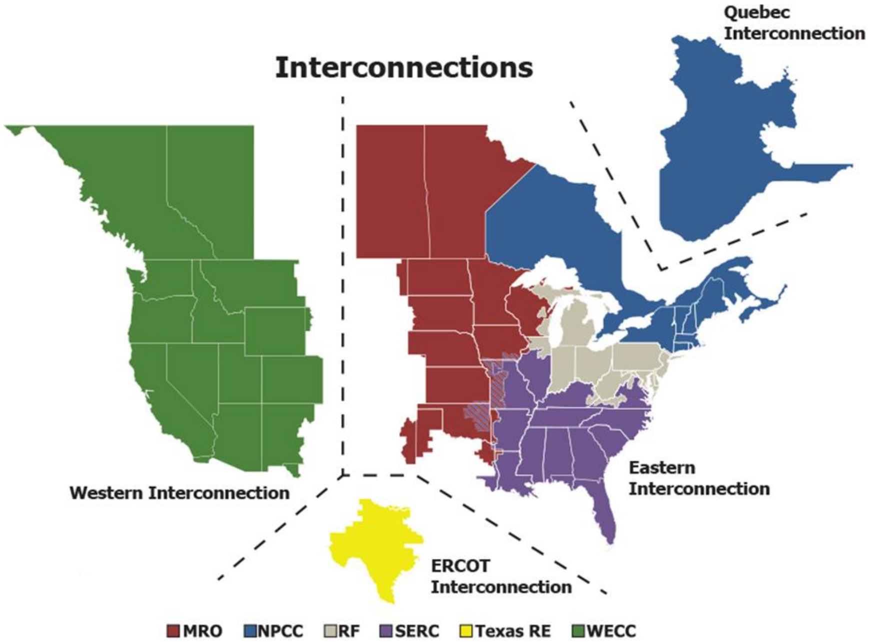
[3] U.S. Energy Information Administration. "Total Energy Price and Expenditure Estimates (Total, per Capita, and per GDP), Ranked by State, 2020". https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_sum/html/rank_pr.html&sid=US
[4] Idaho Dept. of Commerce. "Idaho's Expanding Energy Economy". https://commerce.idaho.gov/content/uploads/2022/02/Idahos-Expanding-Energy-Economy.pdf
[5] U.S. Energy Information Administration. "Total Energy Price and Expenditure Estimates (Total, per Capita, and per GDP), Ranked by State, 2020". https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_sum/html/rank_pr.html&sid=US
[6] Idaho Dept. of Commerce. "Idaho's Expanding Energy Economy". https://commerce.idaho.gov/content/uploads/2022/02/Idahos-Expanding-Energy-Economy.pdf

1.2 Idaho Utilities, and Electric and Natural Gas Systems

1.2.1 Electricity

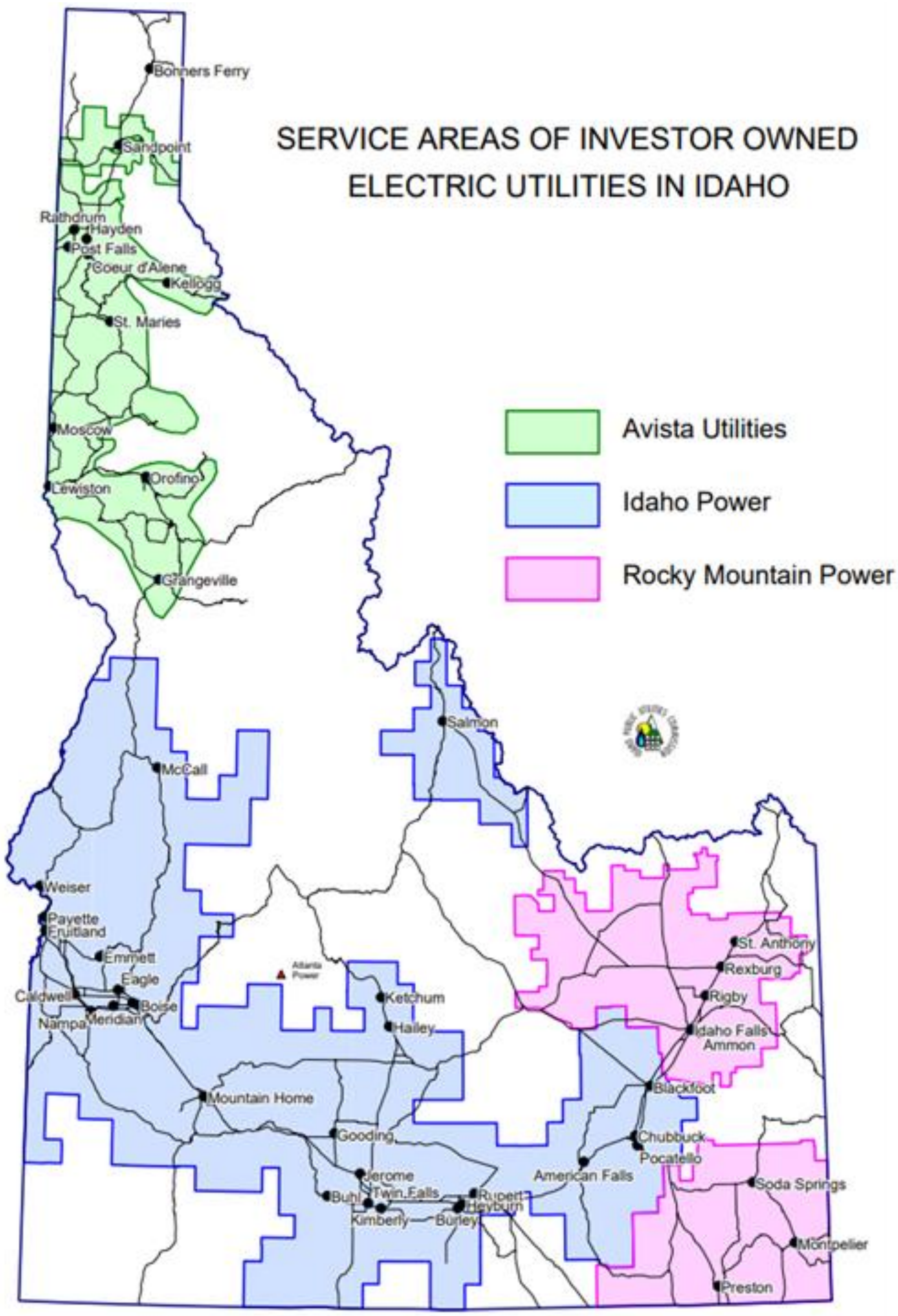
Figure 3: North American Electric Reliability Corporation Regional Electric Interconnections[7]



The electrical transmission network in the U.S. and Canada is made up of four separate interconnections. The Western Interconnection links Idaho with the rest of the western U.S. and two Canadian provinces as shown in Figure 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.[8]

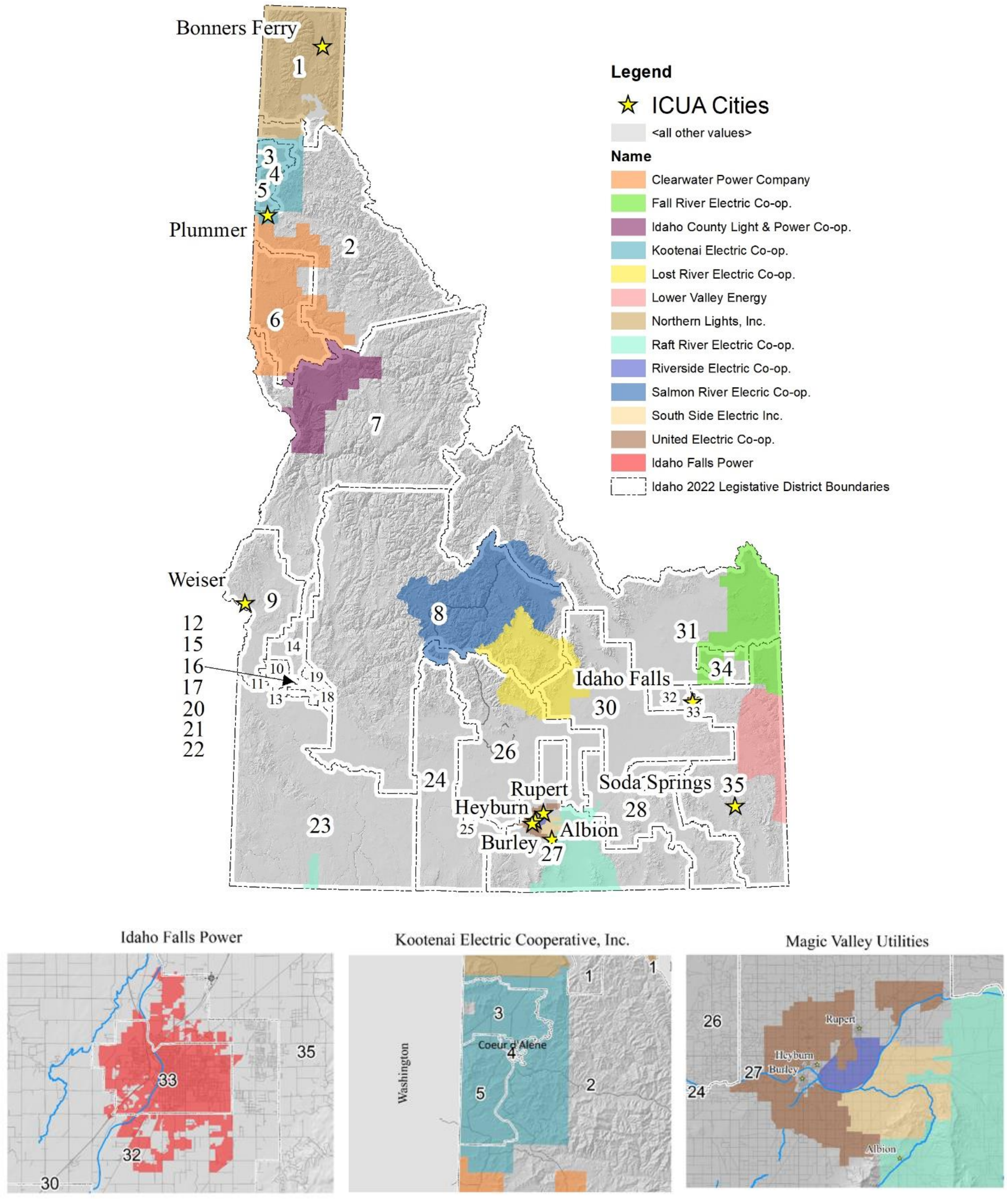
[7] North American Electric Reliability Corporation. "Maps: NERC Interconnections." https://www.nerc.com/AboutNERC/keyplayers/PublishingImages/NERC%20Interconnections.pdf
[8] Western Electricity Coordinating Council. "About WECC." https://www.wecc.org/Pages/AboutWECC.aspx

Figure 4: Idaho's Investor-Owned Electric Utilities Service Territories[9]



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

Figure 5: Idaho's Municipal and Cooperative Utilities Service Territories[10]



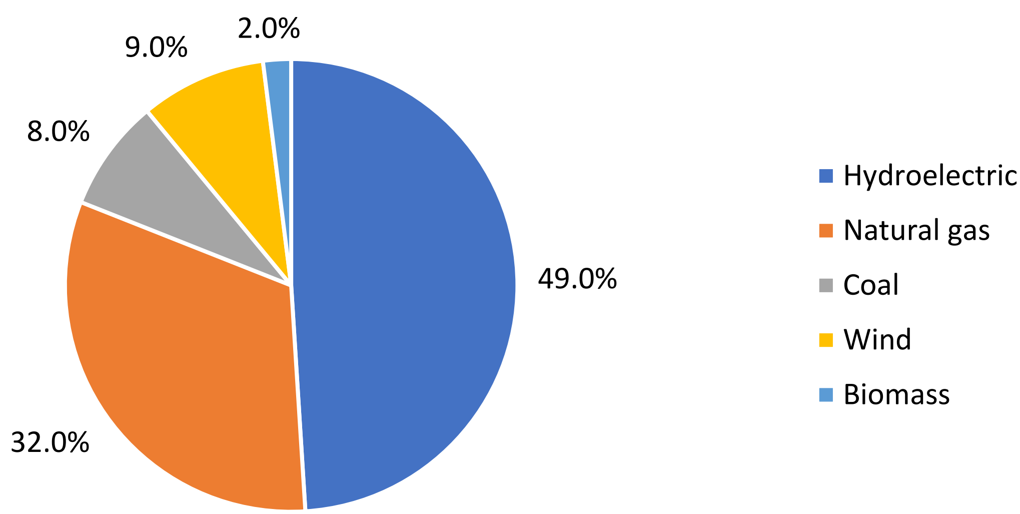
[10] Idaho Consumer-Owned Utilities Association (ICUA). "Idaho Municipal and Cooperative Utilities Service Territories." https://www.icua.coop

Idaho's 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 4 and 5.[11]

1.2.1.1 Avista Corporation

Avista is an investor-owned electric and natural gas utility headquartered in Spokane, Washington. Avista serves nearly 141,000 electric and 92,000 natural gas customers in Idaho's northern and central regions. 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. Avista has a near-term goal of 30% reduction in greenhouse gas emissions by 2030.[12] In March 2022, the company began its participation in the California Independent System Operator's (CAISO) Western Energy Imbalance Market (EIM).[13] In December of 2022, Avista formally committed to participate in the Western Resource Adequacy Program (WRAP).[14]

Figure 6: Avista Energy Production Mix (2021)[15]



Avista generates electricity by utilizing a mix of hydroelectric, natural gas, coal, biomass, and wind generation. This electricity is delivered through 2,800 miles of electrical transmission lines, 19,200 miles of electrical distribution lines, and 8,000 miles of natural gas lines.[16] Avista's current annual energy production mix and long-term contracted resources is shown in Figure 6.

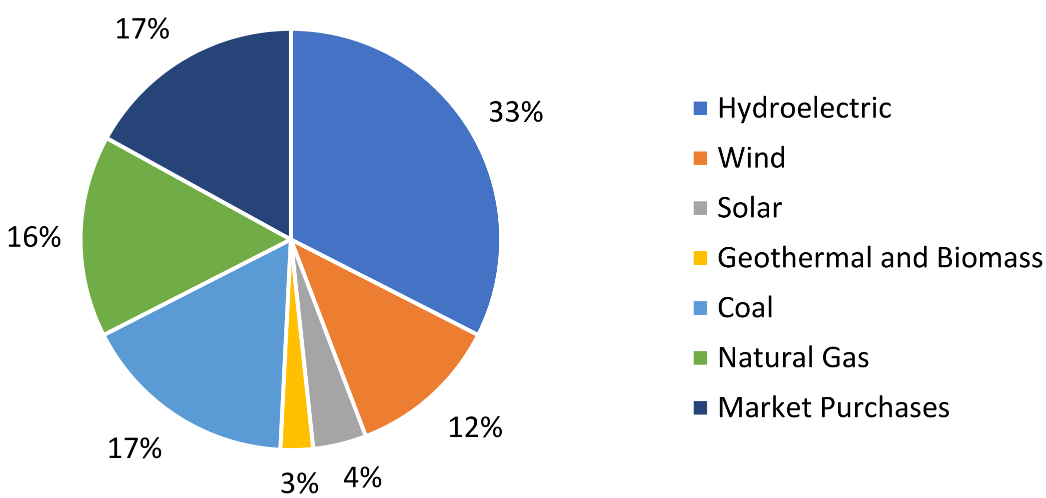
[11] U.S. Energy Information Administration. "Annual Electric Power Industry Report, Form EIS-861 detailed data files." https://www.eia.gov/electricity/data/eia861/
[12] Avista. "Avista Announces Natural Gas Emission Reduction Goal." https://www.myavista.com/about-us/our-commitment
[13] Avista. "Avista builds on commitment to renewable energy by joining the Western Energy Imbalance Market." https://investor.avistacorp.com/node/21551/pdf
[14] Western Power Pool. "WPP Welcomes First Participants for Next Phase of WRAP". https://www.westernpowerpool.org/news/wpp-welcomes-first-participants-for-next-phase-of-
[15] Avista. "About Our Energy Mix." https://www.myavista.com/about-us/about-our-energy-mix
[16] Avista. "2021 Quick Facts." https://investor.avistacorp.com/static-files/c9d21691-a5eb-4273-b4b9-710d3fde5c29

Hydroelectric generation accounts for over half of Avista's electricity mix, which provides a significant price benefit for its customers. Avista's company-owned and contract 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.[17]

1.2.1.2 Idaho Power Company

Founded in 1916, Idaho Power Company is the largest electricity provider in the state. Headquartered in Boise, Idaho Power services more than 610,000 customers in a 24,000 square mile service territory in southern Idaho and eastern Oregon.[18] Idaho Power entered the Western EIM in April 2018,[19] and announced its goal to provide 100% clean energy to its customers by 2045 in March 2019. In December of 2022, Idaho Power formally committed to participate in the WRAP.

Figure 7: Idaho Power Energy Mix (2021)[20]



Idaho Power has a significant hydroelectric generation power base, including a 1,167 megawatt (MW), three-dam complex in Hells Canyon. With 17 low-cost hydroelectric projects at the core of its diverse energy mix, Idaho Power's residential, business, and agricultural customers pay among the nation's lowest prices for electricity.[21] This electricity is supplied through 4,800 miles of transmission lines and more than 27,000 miles of distribution lines.[22] Idaho Power also generates electricity using natural gas at a combined-cycle combustion plant at Langley Gulch, near New Plymouth, 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

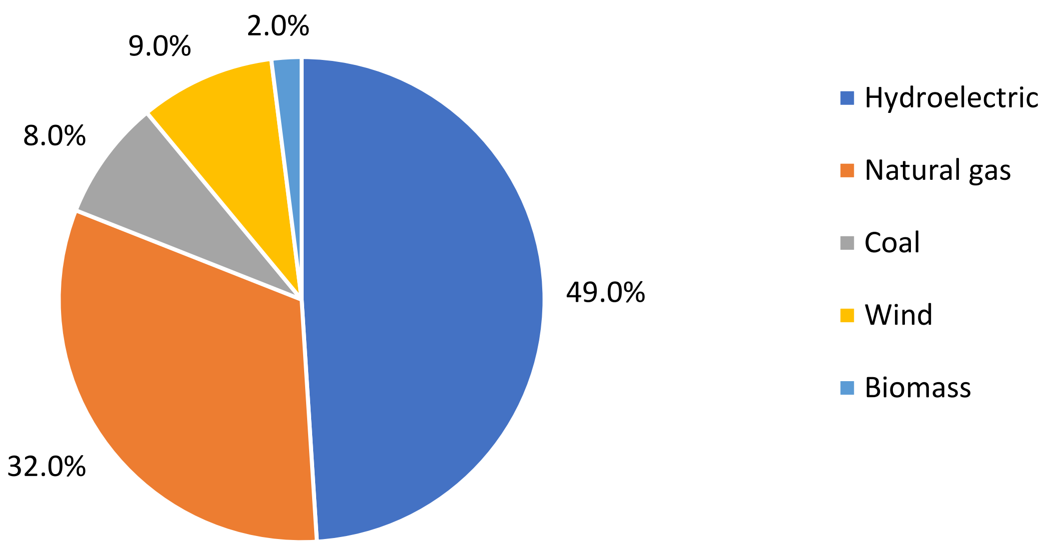
[17] Avista. "2021 Electric Integrated Resource Plan." https://www.myavista.com/about-us/integrated-resource-planning
[18] Idaho Power. "Company Facts." Company Facts - Idaho Power
[19] Western EIM. "About." https://www.westerneim.com/Pages/About/default.aspx
[20] Idaho Power Company. "Our Energy Sources". https://www.idahopower.com/energy-environment/energy/energy-sources/
[21] Idaho Power Company. "What Powers Us All? Affordable Energy." https://www.idahopower.com/about-us/company-information/what-powers-us-all/
[22] Idaho Power Company. "Transmission and Power Lines." https://www.idahopower.com/energy-environment/energy/delivering-power/transmission-and-power-lines/

plants. Idaho Power exited the 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 2021 is shown in Figure 7. Idaho Power-owned generating capacity was the source for 62% of the energy delivered to customers. Purchased power comprised 38% of the total energy delivered to customers.[23]

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. PacifiCorp serves more than 2 million retail customers across 141,390 square miles of service territory in California, Idaho, Oregon, Utah, Washington, and Wyoming.[24] In 2014, PacifiCorp helped launch the Western EIM.[25] In 2017, the company announced the Energy Vision 2020 initiative, which aims to add 1,150 MW of new wind resources, upgrade the existing wind fleet and construct/rebuild transmission segments.[26] Additionally, in December of 2022, the company announced plans to join the CAISO's Extended Day-Ahead Market (EDAM) and formally committed to participate in the WRAP.[27]

Figure 8: Rocky Mountain Power's Energy Production Mix (2021)[28]



PacifiCorp owns 11,668 MW of generation capacity from a diverse mix of hydroelectric, wind, natural gas, coal, solar and geothermal sources.[29] Rocky Mountain Power's energy mix is shown in Figure 8. PacifiCorp's customers receive electricity through approximately 17,000 miles of

[23] Idaho Power Company. "2021 Integrated Resource Plan." https://docs.idahopower.com/pdfs/AboutUs/PlanningforFuture/irp/2021/2021%20IRP_WEB.pdf
[24] PacifiCorp. "About." https://www.pacificorp.com/about.html
[25] PacifiCorp. "Grid Modernization." https://www.pacificorp.com/energy/grid-modernization.html
[26] PacifiCorp. "Renewable Energy." https://www.pacificorp.com/environment/renewable-energy.html
[27] PacifiCorp. ""PacifiCorp to build on success of real-time energy market innovation as first to sign on to new Western day-ahead market". https://www.pacificorp.com/about/newsroom/news-releases/EDAM-innovative-efforts.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. "Energy." https://www.pacificorp.com/energy.html

transmission lines, 64,000 miles of distribution lines, and 900 substations.[30] PacifiCorp's 2021 Integrated Resource Plan (IRP) identifies investments in modernized transmission, renewable energy, storage, demand response and advanced nuclear resources. The plan results in a 74% reduction of greenhouse gas emissions from 2005 levels by 2030.[31]

1.2.1.4 Idaho's Municipal and Cooperative Utilities

Twenty-two electric utility municipalities and cooperatives are members of the Idaho Consumer Owned Utilities Association (ICUA), serving more than 140,000 members/customers throughout Idaho, accounting for about 16% of Idaho's electric consumers.[32] The 32 municipal and cooperative utilities are not subject to regulation by the Idaho Public Utilities Commission (Idaho 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 (PPAs) 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 non-profit 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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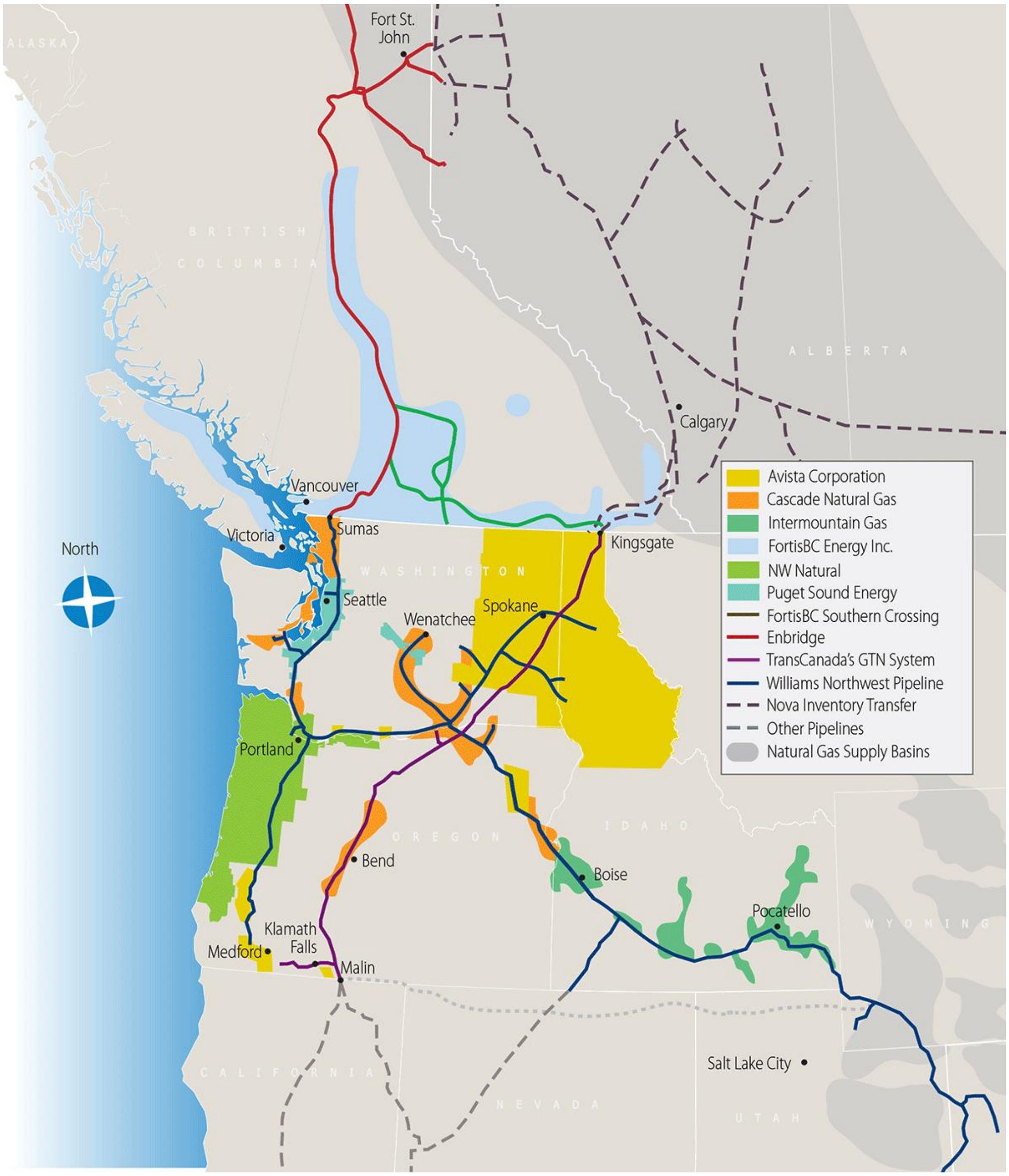
[30] PacifiCorp. "Transmission." https://www.pacificorp.com/transmission.html
[31] PacifiCorp. "2021 Integrated Resource Plan Update." https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2021_IRP_Update.pdf
[32] Idaho Consumer-Owned Utilities Association. "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.ifpower.org/about-us/generation-power-statistics
[36] UAMPS. "About Us." http://www.uamps.com/About-Us

1.2.2 Natural Gas

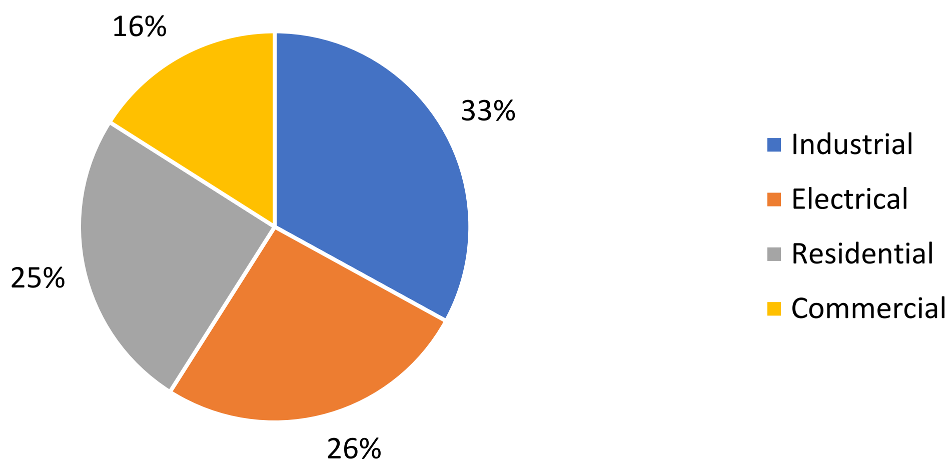
Figure 9: Western U.S. Interstate Natural Gas Pipeline System and Natural Gas Service Territories[37]



37 Northwest Gas Association. "Natural Gas Facts." https://www.nwga.org/_files/ugd/054dfe_5391c325d32346fbaedfb48af81d37a7.pdf

Between 2016-2021, natural gas consumption per capita in Idaho ranked among the lowest one-third of states, despite about half of Idaho households using natural gas as their primary energy source for heating.[38] 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.[39] Figure 9 shows the major natural gas infrastructure in Idaho and Idaho utility service territories. Figure 10 shows natural gas consumption by sector.

Figure 10: Natural Gas Consumption[40]



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.[41] 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. [42]

Avista's natural gas distribution system consists of approximately 3,300 miles of distribution pipelines in Idaho. 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 2021 Natural Gas IRP, the number of customers in Washington and Idaho is projected to increase at an average annual rate of 1.1%.[43]

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[38] U.S. Energy Information Administration. "State Energy Data System." https://www.eia.gov/state/seds/seds-data-complete.php?sid=ID#
[39] Dominion Energy "About Us – Western Gas Operations." https://www.dominionenergy.com/about-us/moving-energy/western-gas-operations
[40] U.S. Energy Information Administration. "Natural Gas Consumption by End Use". https://www.eia.gov/state/analysis.php?sid=ID
[41] Avista. "2021 Natural Gas Integrated Resource Plan." https://www.myavista.com/about-us/integrated-resource-planning
[42] Avista. "2021 Natural Gas Integrated Resource Plan." https://www.myavista.com/about-us/integrated-resource-planning
[43] Avista. "2018 Natural Gas Integrated Resource Plan." https://www.myavista.com/about-us/integrated-resource-planning

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. IGC distributes natural gas to approximately 402,300 residential, commercial, and industrial customers in 74 Idaho communities. IGC's 140 industrial and transport customers comprise 49% of its annual energy demand, while residential and commercial customers comprise 34% and 17% respectively.

IGC uses approximately 13,300 miles of pipelines across 50,000 square miles in southern Idaho.[44] 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 from Dominion Energy's Clay Basin underground storage field. Residential, commercial, and industrial peak day load growth on IGC's system is forecast to grow at an average annual rate of 1.14% (low growth), 2.18% (base case) and 3.10% (high growth) over the six-year period of 2021-2026, highlighting the need for long-term planning.[45]

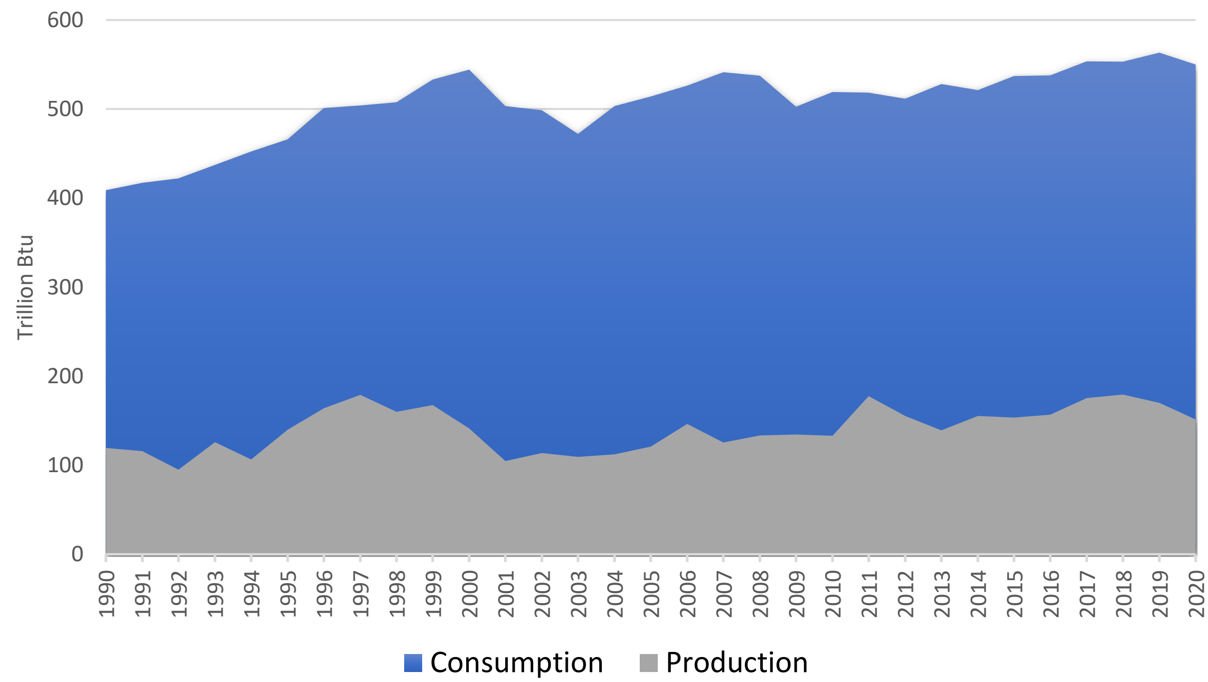
1.2.2.3 Dominion Energy

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.[46] The Idaho PUC has elected to allow the Utah Public Service Commission to regulate Dominion Energy's activities in its small Idaho service area.[47]

[44] Intermountain Gas. "About Us." https://www.intgas.com/in-the-community/about-us/
[45] Intermountain Gas. "2021 IRP." https://puc.idaho.gov/Fileroom/PublicFiles/GAS/INT/INTG2106/CaseFiles/20211220Integrated%20Resource%20Plan.pdf
[46] Dominion Energy. "Western Gas Operations." https://www.dominionenergy.com/company/moving-energy/western-gas-operations
[47] Idaho Public Utilities Commission. "Merger Agreement." https://puc.idaho.gov/Case/Details/3245

1.3 Energy Consumption, Production, and Prices

Figure 11: Idaho Energy Production and Consumption[48]



In 2020, Idaho produced approximately 28% of the total energy it consumed, including electricity, transportation fuels, and heating fuels. This is demonstrated in Figure 11, 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, discussed in Chapter 6, of highways, railroads, pipelines, and transmission lines to facilitate economic development and maintain a high quality of life for Idaho's citizens.

[48] 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 12: Idaho's 2021 Electricity Sources[49]

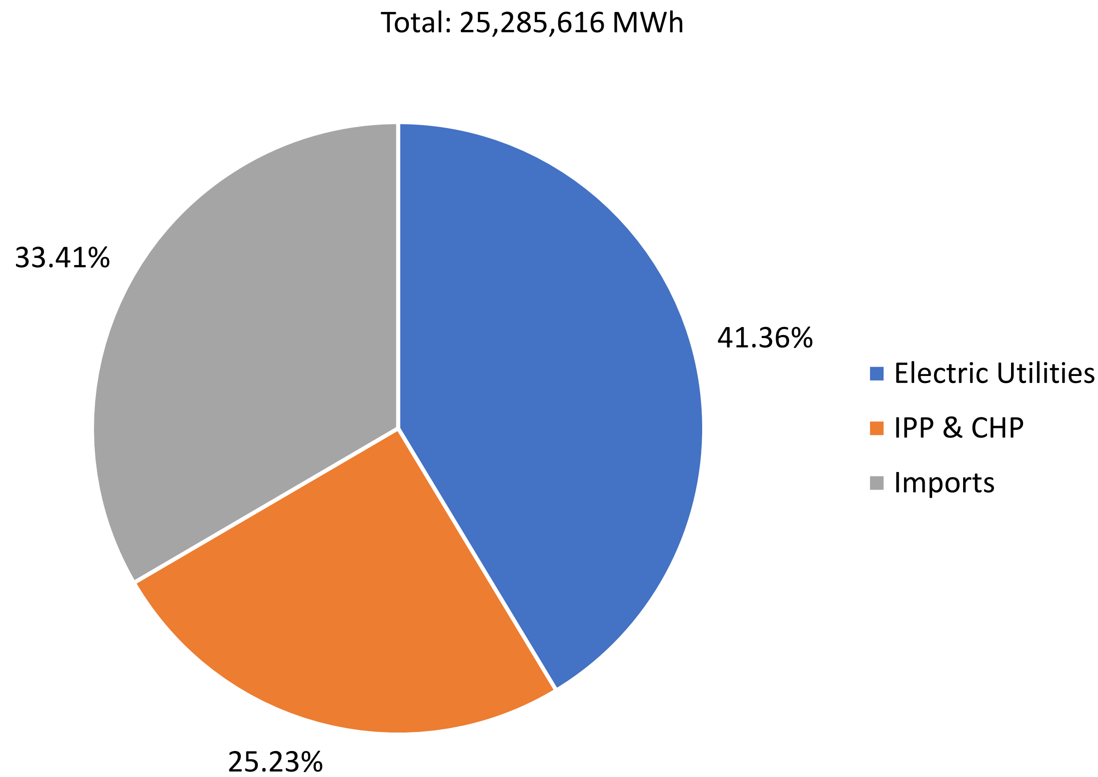
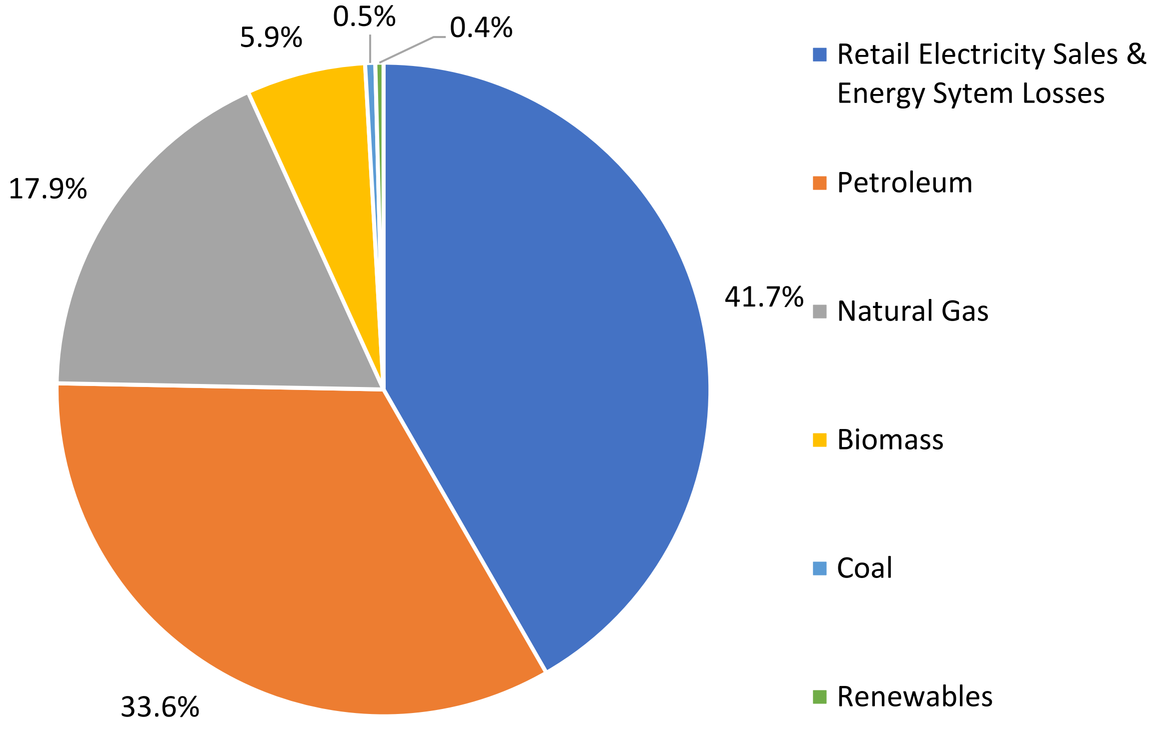


Figure 12 illustrates Idaho's dependence on imported electricity to meet load demands. Idaho's utilities generate approximately 41% of the electricity utilized in-state. 25% is provided by combined heat and power (CHP) or independent power producers (IPP). The remaining 33% is comprised of market purchases and energy imports from out-of-state generating resources owned by Idaho utilities. Idaho's retail sales of electricity totaled 25,285,616 megawatt hours (MWh).

Imports grew over 10% from 2019 to 2021. This is likely attributed to Idaho utilities' involvement in the Western EIM, discussed further in section 1.4.2.6.1.

[49] U.S. Energy Information Administration. "Idaho Electricity Profile 2021." www.eia.gov/electricity/state/idaho/index.cfm

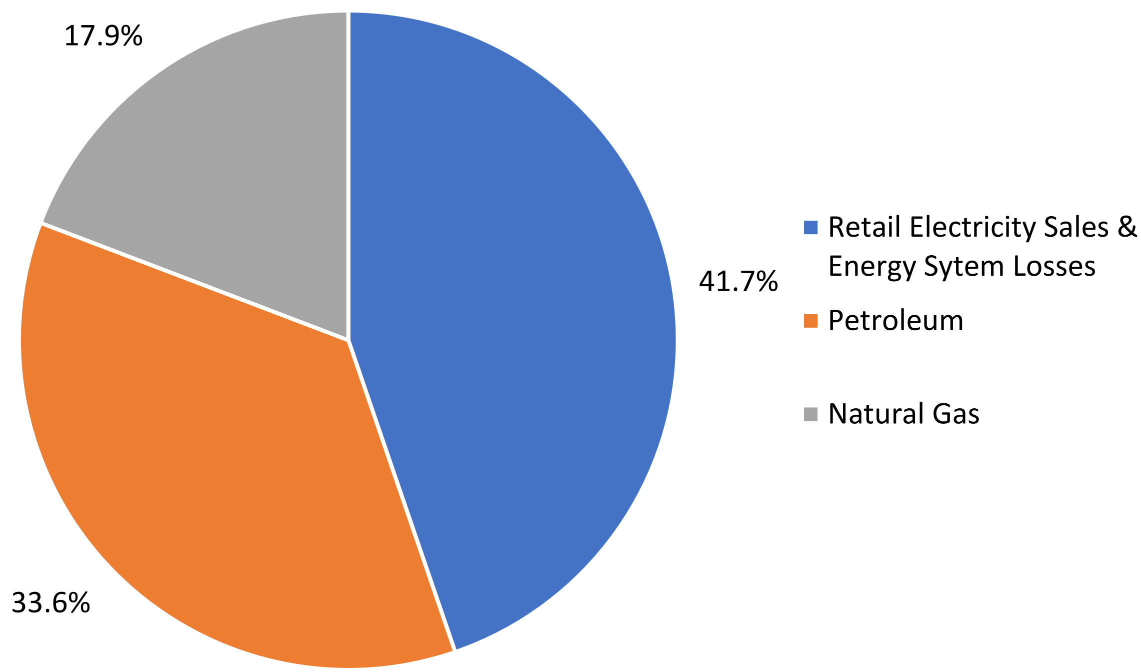
Figure 13: Sources of End Use Energy Consumed in Idaho in 2020[50]



As shown in Figure 13, 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 approximately 18%, while the remaining 7% is attributable to coal, biomass, and other renewable energy sources. Idaho's total end-use energy consumption in 2020 was 550.1 trillion BTUs.

[50] U.S. Energy Information Administration. "State Energy Data System." https://www.eia.gov/state/seds/seds-data-complete.php?sid=ID#

Figure 14: Idaho Net Electricity Generation by Source, August 2022[51]



In 2021, renewable energy sources generated 74% of the electricity in Idaho, the fourth highest share for any state after Vermont, South Dakota, and Washington.[52]

Hydroelectric power plants have typically supplied more than two-thirds of Idaho's in-state generation. However, in recent years, drought has reduced the hydroelectric share of the state's total annual generation to approximately 53%.[53]

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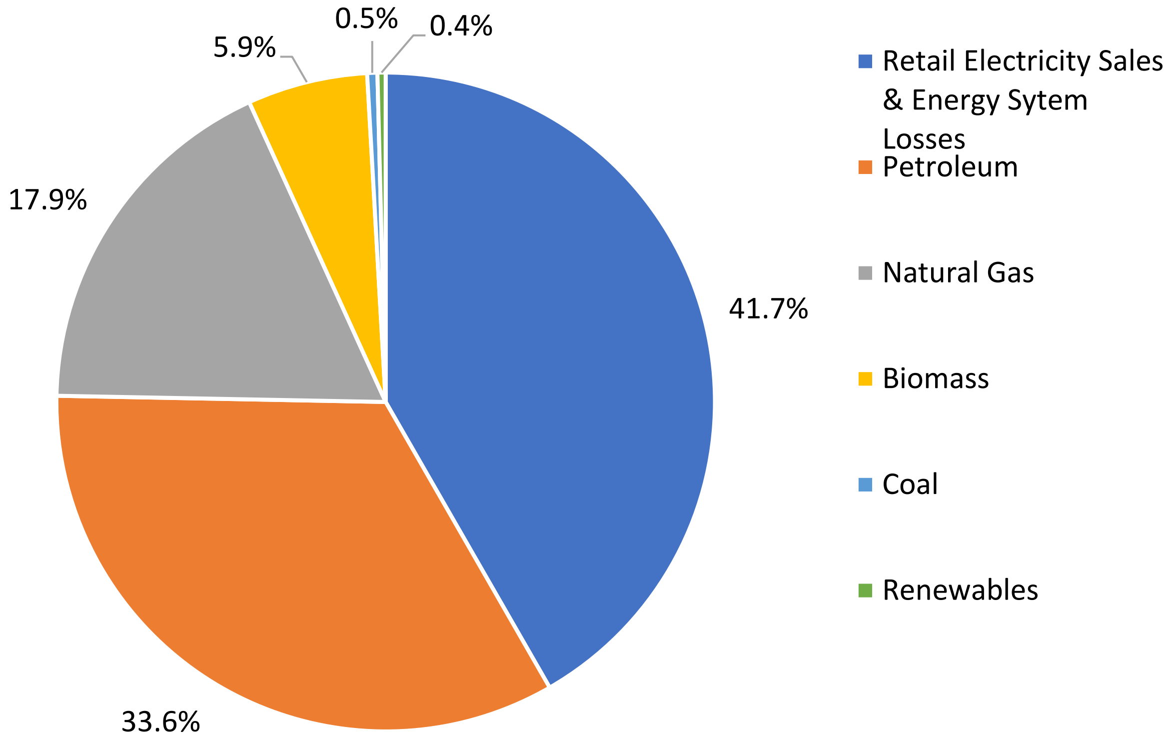
[51] U.S. Energy Information Administration. "Idaho Net Electricity Generation by Source, August 2022." https://www.eia.gov/state/?sid=ID#tabs-4

[52] U.S. Energy Information Administration. "Idaho State Profile and Energy Estimates." https://www.eia.gov/state/?sid=ID#:~:text=Quick%20Facts&text=Idaho%20has%20the%20lowest%20average,the%20state's%20generation%20in%202021.

[53] U.S. Energy Information Administration. "Idaho State Profile and Energy Estimates." https://www.eia.gov/state/?sid=ID#:~:text=Quick%20Facts&text=Idaho%20has%20the%20lowest%20average,the%20state's%20generation%20in%202021.

Figure 15: Idaho's 2020 Electric Consumption by Source[54]



Idaho consumes more electricity than it generates. Percentages in Figure 15 only account for electric use of energy resources; neither thermal nor fuel usage are calculated. Electric power consumed in Idaho is produced both in and out of the state with transmission lines most densely populating the southern portion of the state. Approximately 79% of electricity consumed in Idaho comes from renewable in-state resources like hydroelectric, wind, solar, and others. The remaining portion of electricity consumption in Idaho comes from neighboring states like Wyoming, Montana, and Utah, and is generated from hydroelectric, wind, natural gas, coal, and other sources.

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

1.3.2 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.[55]

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. 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.

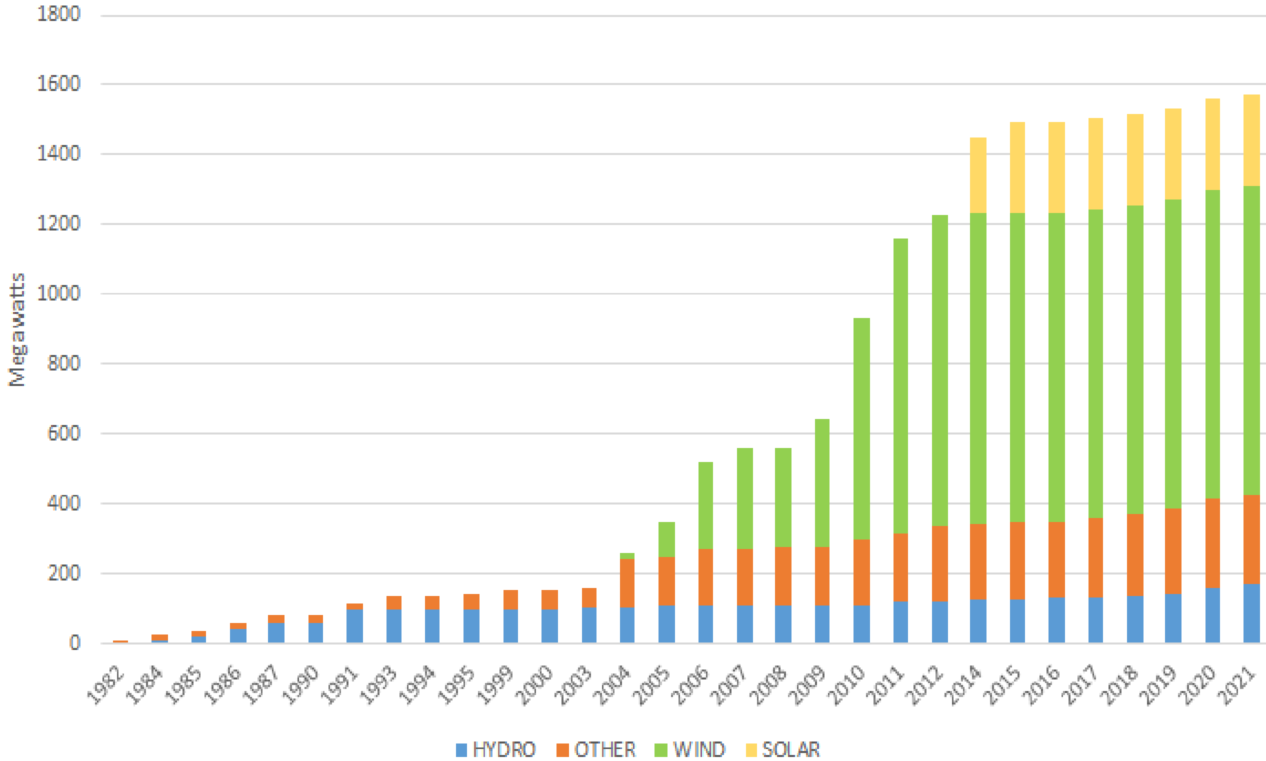
Furthermore, to qualify as a QF, a cogeneration facility must sequentially produce electricity and another form of useful thermal energy in a manner that is more efficient than the separate production of both forms of energy. For example, a large cogeneration facility may produce both electricity and provide steam for industrial uses.[56]

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 hydroelectric projects.

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.[57] 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.[58] The change in contract length does not abrogate or eliminate the utility's mandatory purchase obligation. As illustrated in Figure 23, as of 2021 almost 1,600 MW of QF resources were online in Idaho, principally wind and solar projects.

[55] Federal Energy Regulatory Commission. "PURPA Qualifying Facilities." https://www.ferc.gov/qf
[56] Federal Energy Regulatory Commission. "PURPA Qualifying Facilities." https://www.ferc.gov/qf
[57] 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
[58] 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

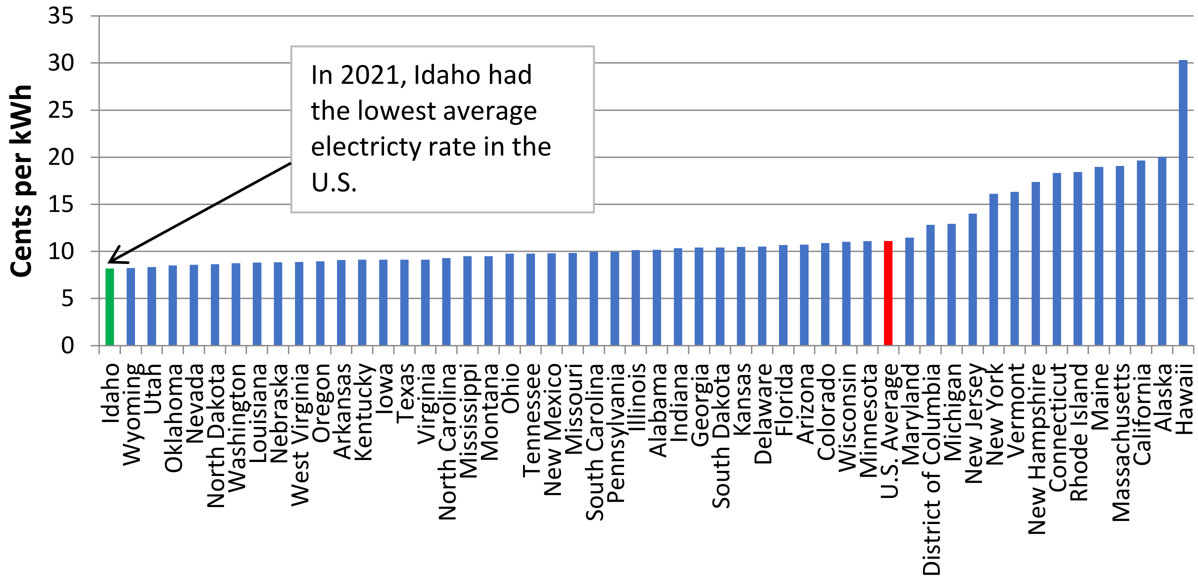
Figure 16: PURPA Generation in Idaho, 1982-2021[59]



[59] Idaho Public Utilities Commission. https://puc.idaho.gov/

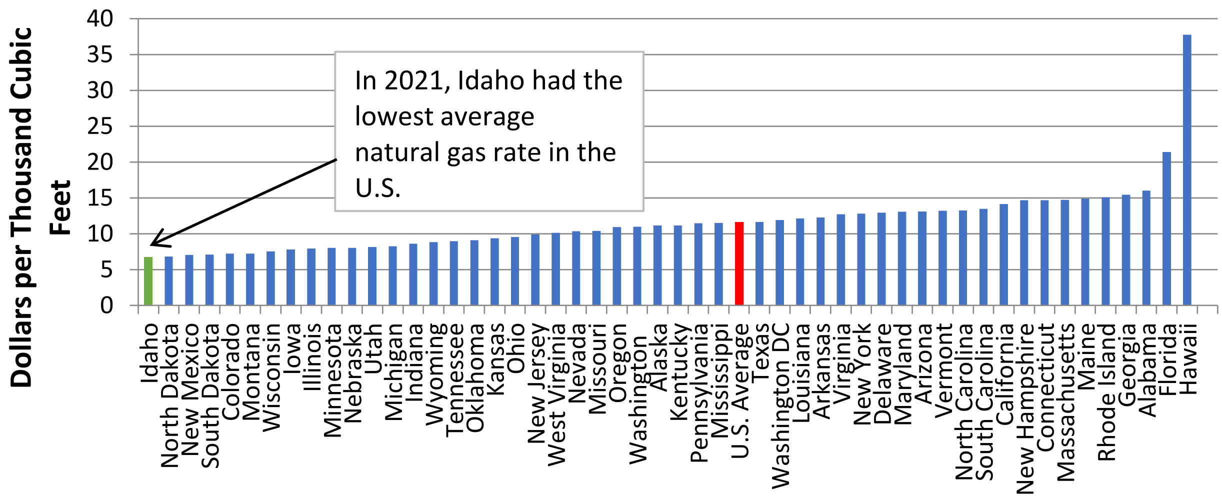
1.3.3 Energy Rates Compared to Other States

Figure 17: Idaho's 2021 Average Electricity Rates Compared to Other States[60]



Idaho's baseload resources, including hydroelectricity, 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 lowest among the fifty states in 2021, shown in Figure 16. Additionally, in 2021, Idaho's average residential natural gas rates were the lowest in the U.S., as shown in Figure 17.

Figure 18: Idaho's 2021 Residential Natural Gas Prices Compared to Other States[61]



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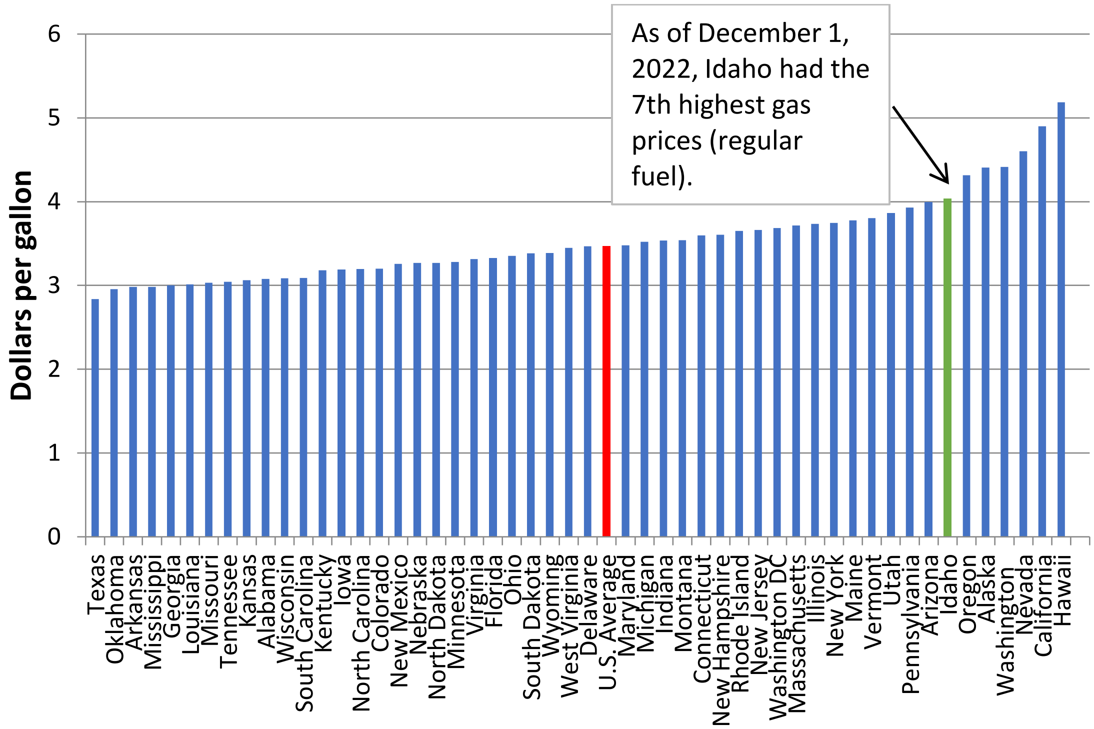
[60] U.S. Energy Information Administration. "State Electricity Profiles." https://www.eia.gov/electricity/state/#:~:text=Archived%20State%20Electricity%20Profiles%20%20%20%20Name,%20%2045%2C851%2C003%20%2039%20more%20rows%20

[61] U.S. Energy Information Administration. "Natural Gas Prices." https://www.eia.gov/energyexplained/natural-gas/prices.php

Figure 19: Idaho's 2022 Retail Gasoline Prices Compared to Other States[62]



Note: The average combined (local, state, and federal) gasoline tax in 2022 was 57.09 cents per gallon. Idaho's combined gasoline tax rate in 2022 was 51.40 cents per gallon.[63]

Idaho's small population contributes to it being among the 10 states with the lowest total petroleum consumption, but Idaho's per capita petroleum use is near the national average. 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 seventh highest average gasoline price in the U.S. in 2022, as shown in Figure 18.

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

[63] American Petroleum Institute. "Gasoline Taxes." https://www.api.org/oil-and-natural-gas/consumer-information/motor-fuel-taxes

2. Energy Stakeholders

2.1 State Entities

2.1.1 Idaho Governor's Office of Energy and Mineral Resources

The Idaho Governor's Office of Energy and Mineral Resources (OEMR) coordinates energy and mineral planning and policy development in the state of Idaho. 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 residents. The office 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. [64]

As of December 2022, OEMR administers the following energy-related programs:

- Government Leading by Example, which provides energy audits for rural cities and counties in Idaho to identify energy savings opportunities and retrofit funding to help lower energy costs and save taxpayer dollars.[65]
- State Energy Loan Program, which offers low-interest loans to develop and complete energy projects for homes and businesses located within Idaho.[66]
- Idaho Awards for Leadership in Energy Efficiency, which honors businesses and industrial facilities located in Idaho for their achievements in reducing their energy consumption over the past year.[67]
- National Electric Vehicle Infrastructure (NEVI) Program, which provides funding to strategically deploy electric vehicle (EV) charging infrastructure across the state.[68]
- Energy Resiliency Grant Program, which provides funding for projects that demonstrate measurable grid resiliency upgrades across Idaho.[69]

The office is responsible for maintaining the Idaho Energy Landscape, the Idaho Energy Plan, the Idaho Emergency Fuel Shortage Plan, and the Idaho Energy Security Plan.[70] Please contact OEMR for information on program participation or other energy and mineral related topics.

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[64] Governor Brad Little. "Executive Order 2020-17." https://oemr.idaho.gov/wp-content/uploads/eo-2020-17.pdf
[65] Idaho Governor's Office of Energy and Mineral Resources. "Government Leading by Example". https://oemr.idaho.gov/financial-information/government-leading-by-example/
[66] Idaho Governor's Office of Energy and Mineral Resources. "State Energy Loan Program". https://oemr.idaho.gov/loan-program/
[67] Idaho Governor's Office of Energy and Mineral Resources. " Idaho Awards for Leadership in Energy Efficiency". https://oemr.idaho.gov/energy-efficiency/energy_awards/
[68] Idaho Governor's Office of Energy and Mineral Resources. "National Electric Vehicle Infrastructure Program". https://oemr.idaho.gov/programs/national-electric-vehicle-infrastructure-program/
[69] Idaho Governor's Office of Energy and Mineral Resources. "Welcome". https://oemr.idaho.gov/
[70] Idaho Governor's Office of Energy and Mineral Resources. "Reports and Publications". https://oemr.idaho.gov/financial-information/reports-and-publications/

2.1.2 Idaho Strategic Energy Alliance

The Idaho Strategic Energy Alliance (ISEA) 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.[71] The information and recommendations provided by ISEA 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.

ISEA has published reports on woody bioenergy, baseload resources, wind energy, hydroelectric power, energy efficiency, geothermal energy, and municipal and cooperative utilities.[72] Other task force reports being actively developed include alternative fuels, energy storage, reliability and resiliency, and energy infrastructure.

2.1.3 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.[73]

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

[71] Governor Brad Little. "Executive Order 2020-18." https://oemr.idaho.gov/wp-content/uploads/eo-2020-18.pdf
[72] Idaho Governor's Office of Energy and Mineral Resources. "Idaho Strategic Energy Alliance." https://oemr.idaho.gov/isea/
[73] Idaho Energy Resources Authority. "Purpose". https://iera.info/purpose/

2.1.4 Leadership in Nuclear Energy Commission

The Leadership in Nuclear Energy (LINE) Commission 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.[74] 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.

2.1.5 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.[75] 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 evidence 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.

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.

[74] Idaho Leadership in Nuclear Energy Commission 3.0. "LINE Home." https://line.idaho.gov and Governor Brad Little. "Executive Order 2019-05." https://gov.idaho.gov/wp-content/uploads/2019/05/eo-2019-05.pdf
[75] Idaho Legislature. "Idaho Statutes § 61and § 62." https://legislature.idaho.gov/statuterules/idstat/

2.1.6 Idaho Office of Emergency Management

The Idaho Office of Emergency Management (IOEM) is the state's emergency management agency and part of the Idaho Military Division. IOEM is tasked by Idaho code in assisting the state and Tribes in navigating disasters in the state. IOEM prepares the State of Idaho in preparing, protecting, and mitigating the effects and potential damages from all hazards including energy and fuel related response during a disruption event. IOEM oversees the Emergency Operations Plan, Idaho Response Center, and State Hazard Mitigation Plan.[76]

IOEM manages the Idaho Response Center (IRC), which works with stakeholders to facilitate response and recovery operations resources during an emergency or disaster. The stakeholders may include but are not limited to; federal, local, and tribal governments and the private sector. The IOEM monitors incidents within the state that may solicit a state level response using the WebEOC. The Operations Branch of IOEM coordinates statewide alerts, warnings, notifications and conducts trainings for hazardous materials incidents.[77]

2.1.7 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.[78] Approximately 2.5 million acres of endowment lands exist in the state of Idaho. Projects on endowment lands are managed to secure long-term financial return for endowment beneficiaries. The endowment beneficiaries are the Idaho Department of Corrections, Idaho State Department of Education, Idaho Division of Veterans Services, Idaho Educational Services for the Deaf and the Blind, University of Idaho, Lewis and Clark State College, Idaho State University, and the Idaho Capitol Commission.[79] 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.[80] 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.[81]

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

[76] Idaho Office of Emergency Management. "About." https://ioem.idaho.gov/about/
[77] Idaho Office of Emergency Management. "Operations." https://ioem.idaho.gov/operations/
[78] 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/
[79] Idaho Department of Lands. "Understanding Endowment Land." https://www.idl.idaho.gov/about-us/understanding-endowment-land/
[80] Idaho Legislature. "Idaho Statutes §47-314." https://legislature.idaho.gov/statuterules/idstat/
[81] Idaho Oil and Gas Conservation Commission. "About the Commission." https://ogcc.idaho.gov/

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.

2.1.8 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.[82] DEQ issues permits for energy and mining projects under the Idaho Pollutant Discharge Elimination System, in which DEQ received full permitting authority as of July 1, 2021.[83] 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.[84] In additional to energy and mining related projects, DEQ has partnered with OEMR and the Idaho Transportation Department (ITD) to administer EV related programs.

2.1.9 Idaho State Department of Agriculture, Bureau of Weights, and Measures

Agriculture is Idaho's largest industry. The Idaho State Department of Agriculture (ISDA) oversees more than 60 sections of Idaho Code.[85] 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.[86] It assures national traceability to Idaho's primary mass and volume standards through a nationally recognized metrology laboratory.

2.1.10 Idaho Department of Water Resources and Idaho Water Resource Board

The Idaho Department of Water Resources (IDWR) approves or denies proposals to appropriate water or change existing water rights, archives water right records, recommends and records adjudicated water rights, and oversees the delivery of water in times of shortage.[87] This is important in the development of energy and mineral projects to ensure all water rights during project construction and operation are protected. IDWR is responsible for the safety of dams, geothermal drilling permits, ground

[82] Idaho Department of Environmental Quality. "About." http://deq.idaho.gov/about-us/

[83] Idaho Department of Environmental Quality. "Idaho Pollutant Discharge Elimination System." http://deq.idaho.gov/water-quality/wastewater/

[84] Idaho Department of Environmental Quality. "Regional Offices & Issues." http://deq.idaho.gov/regional-offices/

[85] Idaho State Department of Agriculture. "About ISDA." https://agri.idaho.gov/main/about/about-isda/

[86] Idaho State Department of Agriculture. "Weights and Measures." https://agri.idaho.gov/main/weights-and-measures/

[87] Idaho Department of Water Resources. "Strategic Plan FY2022-2025." https://idwr.idaho.gov/wp-content/uploads/sites/2/general/IDWR-SP-FY22-25_FINAL.pdf

water protection (well construction oversight), the regulation of stream channel alterations, and coordination with local communities to comply with the National Flood Insurance Program.

The Idaho Water Resource Board (IWRB) is responsible for the formulation and implementation of a state water plan, financing of water projects, and the operation of programs that support sustainable management of Idaho's water resources. IWRB was created by the Idaho legislature in 1965 and merged with IDWR in 1974.[88]

2.1.11 Idaho Department of Fish and Game

The Idaho Department of Fish and Game (IDFG) protects, preserves, perpetuates, and manages Idaho's wildlife resources.[89] IDFG provides data and technical assistance for energy and mineral projects to evaluate potential effects to fish, wildlife, and habitat as in-state and out-of-state energy demands are addressed. IDFG cooperates with project developers to mitigate and reduce impacts to wildlife. The agency is split into seven regions and one sub-region coordinated from the headquarters office in Boise.

2.1.12 Idaho Governor's Office of Species Conservation

The Idaho Governor's Office of Species Conservation (OSC) is dedicated to planning, coordinating, and implementing the state's actions to preserve, protect and restore species listed as candidate, threatened, and endangered under the federal Endangered Species Act.[90] This work is done in coordination with other state agencies and input from the citizens of Idaho for energy and mineral projects to ensure responsible development of resources and adequate protection for species. OSC is headquartered in Boise and has staff in Salmon, Sandpoint, and Moscow.

2.1.13 Idaho Department of Parks and Recreation

The Idaho Department of Parks and Recreation (IDPR) is the state authority on outdoor recreation and resource stewardship. IDPR manages thirty state parks and recreation programs throughout the state. IDPR analyzes impacts to recreation from energy and mineral project development, and administers the recreation programs for boats, snowmobiles, and other off-highway vehicles.[91]

[88] Idaho Department of Water Resources. "Idaho Water Resource Board Responsibilities and Authority." https://idwr.idaho.gov/iwrb/about-the-iwrb/
[89] Idaho Department of Fish and Game. "About Fish and Game." https://idfg.idaho.gov/about
[90] Idaho Governor's Office of Species Conservation. "Home – About OSC." https://species.idaho.gov/
[91] Idaho Department of Parks and Recreation. "Strategic Plan Fiscal Year 2022." https://parksandrecreation.idaho.gov/wp-content/uploads/IDPR_2021-2025_Strategic_Plan.pdf

2.1.14 State Historic Preservation Office

The Idaho State Historic Preservation Office (SHPO) is administratively housed within the Idaho State Historical Society. SHPO offices nationwide encourage the preservation, documentation, and use of cultural resources. For energy and mineral projects, the Idaho SHPO consults with federal agencies to review effects to historic properties under Section 106 of the National Historic Preservation Act.[92] SHPO maintains the Idaho State inventory of documented cultural resources in the state, administers the Historic Rehabilitation Tax Incentive program, and provides educational and technical assistance on historic preservation issues.

2.1.15 Idaho Transportation Department

The Idaho Transportation Department (ITD) is the state authority on transportation infrastructure. ITD maintains and operates existing roadways and plans transportation infrastructure for the future growth of the state. The agency is split into six districts and headquartered in Boise.[93]

OEMR serves as the lead agency, in close partnership with ITD and DEQ, to develop a program for entities to apply directly to the state of Idaho for National Electric Vehicle Infrastructure (NEVI) formula funds, as well as other EV related programs. The NEVI Program was enabled through the 2021 Bipartisan Infrastructure Law (BIL)[94] and established by the Federal Highway Administration (FHWA) to provide states with federal funding to strategically deploy EV charging infrastructure and establish an interconnected network of EV charging stations across the U.S.

2.1.16 Idaho Department of Health and Welfare

The Idaho Department of Health and Welfare (DHW) is the state lead on promoting and protecting Idahoans health and safety. DHW provides services to promote healthy people, safe children, and stable families.[95] DHW administers the State of Idaho Weatherization Assistance Program (WAP). The DHW contracts with local community action agencies and nonprofits to install weatherization improvements in low-income households throughout the state.[96]

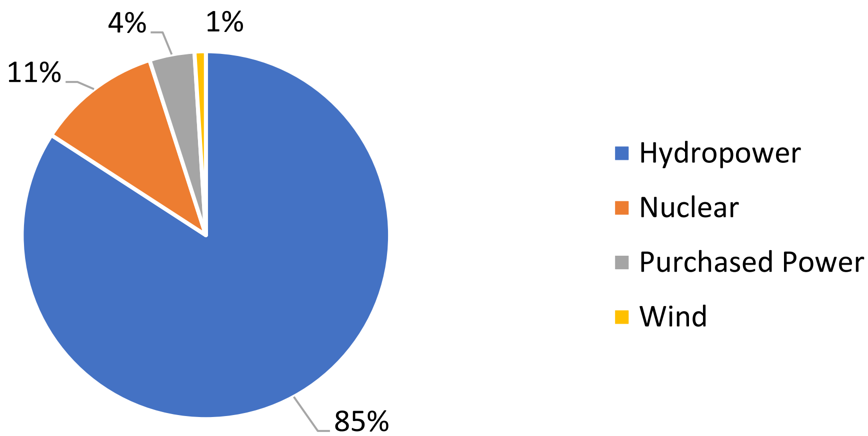
[92] Idaho State Historic Preservation Office. "Section 106 Project Review." https://history.idaho.gov/section-106/
[93] Idaho Transportation Department. "Home". https://itd.idaho.gov/
[94] Infrastructure Investment and Jobs Act of 2021. https://www.congress.gov/117/bills/hr3684/BILLS-117hr3684enr.pdf
[95] Idaho Department of Health and Welfare. "Agency Overview." https://healthandwelfare.idaho.gov/about-dhw/our-mission
[96] U.S. Department of Energy. "Weatherization Assistance Program Fact Sheet." https://www.energy.gov/eere/wap/articles/weatherization-assistance-program-fact-sheet

2.2 Regional Entities

2.2.1 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.[97] BPA is a separate and distinct entity in the DOE under the DOE Organization Act of 1977.[98] 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, primarily from hydroelectric generation. 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, and IOUs, and directly provides electric power to several federal installations, industrial, and irrigation customers in a practice known as direct service. [99]

Figure 20: BPA Resources (2021) [100]



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 Columbia Generating Station nuclear power plant in Richland, Washington.[101] BPA's energy resources are shown in Figure 19. BPA operates and maintains approximately 15,000 miles of high-voltage transmission lines and 262 substations servicing 323 transmission customers that serve about 14.4 million people in its service territory.[102]

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[97] 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

[98] Department of Energy. "DOE Organization Act in U.S.C." https://www.energy.gov/sites/prod/files/2017/10/f38/DOE%20Organization%20Act%20in%20U.S.C..pdf

[99] Bonneville Power Administration. "Annual Report 2022." https://www.bpa.gov/-/media/Aep/finance/annual-reports/ar2022.pdf

[100] Bonneville Power Administration. "BPA Fuel Mix 2021." https://www.bpa.gov/-/media/Aep/power/hydropower-data-studies/bpa-official-fuel-mix-2021-web-post-2.pdf

[101] U.S. Nuclear Regulatory Commission. "Columbia Generating Station." https://www.nrc.gov/info-finder/reactors/wash2.html

[102] Bonneville Power Administration. "Fact Sheets." https://www.bpa.gov/-/media/Aep/about/publications/general-documents/bpa-facts.pdf

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.[103] 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. BPA's current 20-year contracts run through 2028. BPA is conducting its "Provider of Choice" process to review its power sales products for consideration by customers for contract renewals for service after 2028.

2.2.2 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 and wildlife in the Columbia River Basin.[104] 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.

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. Since the release of the Council's first Northwest Power Plan in 1983, the region's utilities have achieved more than 7,200 aMW of energy efficiency, an amount of power equal to the annual energy consumption of 5.3 million Northwest homes or more than twice the annual average generation of Grand Coulee Dam. Energy efficiency is the Northwest's second-largest resource behind hydropower. [105]

[103] Bonneville Power Administration. "2019 Pacific Northwest Loads and Resources Study." https://www.bpa.gov/p/Generation/White-Book/wb/2019-WBK-Summary.pdf
[104] Northwest Power and Conservation Council. "About." https://www.nwcouncil.org/about
[105] Northwest Power and Conservation Council. "2021 Power Plan Summary". https://www.nwcouncil.org/media/filer_public/45/b0/45b02281-e3da-4788-ad74-355e5c755a75/2022-2.pdf

The Council published the 2021 Northwest Power Plan in May 2022.[106] The plan estimates the impacts of climate change on future demand for electricity, as well as impacts on hydroelectric and renewable energy generation in the region. In the 2021 Power Plan, the Council emphasizes that maintaining an adequate and reliable power supply over the action plan period will be challenging due to the region's increased dependence on variable renewable resources. Much of the cost-effective efficiency has already been realized, and the costs associated with additional energy efficiency efforts are nearly the same as new power from the least expensive generating resources. Accordingly, the Council recommends the region acquire at least 3,500 megawatts of renewable resources by 2027 as a cost-effective option for meeting energy needs and reducing emissions.[107]

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, with a two-part Addendum completed in October 2020.[108]

2.2.3 Western Interstate Energy Board

The Western Interstate Energy Board (WIEB) is an organization of 11 western states and two 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 legal basis of the Energy Board is the Western Interstate Nuclear Compact.[109] 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.[110] Much of the work of the Board is conducted through its committees, the Committee on Regional Electric Power Cooperation (CREPC), the High-Level Radioactive Waste Committee (HLRW), and the Western Interconnection Regional Advisory Body (WIRAB).

2.2.3.1 Committee on Regional Electric Power Cooperation

CREPC was established in the 1980s. CREPC is a joint committee of WIEB and the Western Conference of Public Service Commissioners (WCPSC). 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.[111]

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[106] Northwest Power and Conservation Council. "The 2021 Northwest Power Plan". https://www.nwcouncil.org/fs/17680/2021powerplan_2022-3.pdf
[107] Northwest Power and Conservation Council. "2021 Plan Summary". https://www.nwcouncil.org/media/filer_public/45/b0/45b02281-e3da-4788-ad74-355e5c755a75/2022-2.pdf
[108] Northwest Power and Conservation Council. "Columbia River Basin Fish and Wildlife Program Amendment Process." https://www.nwcouncil.org/fw/program/2018-amendments
[109] Western Interstate Energy Board. "WIEB- Western Interstate Energy Board." https://www.westernenergyboard.org/western-interstate-energy-board/
[110] WIEB. "WIEB Board." https://www.westernenergyboard.org/western-interstate-energy-board/
[111] WIEB. "CREPC." https://www.westernenergyboard.org/committee-on-regional-electric-power-cooperation/

2.2.3.2 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.[112] WIRAB's membership is composed of representatives from all states and international provinces that consumer electricity within the Western Interconnection. Members are appointed by Governors or Premiers.[113]

WIRAB was established in the Western Interconnection to advise the North American Electric Reliability Corporation (NERC), Federal Energy Regulatory Commission (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.

2.2.3.3 WIEB's High-Level Radioactive Waste Committee

HLRW is composed of nuclear waste transportation experts appointed by the Governors of 11 western states. HLRW works with the DOE to develop a safe and publicly acceptable system for transporting spent nuclear fuel and high-level radioactive waste under the Nuclear Waste Policy Act.[114] 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.[115]

2.2.4 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.[116]

2.2.5 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 U.S.[117]

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[112] United States Code, 2018 Edition. "Title 16-Conservation. Chapter 12- Federal Regulation and Development of Power." https://www.govinfo.gov/content/pkg/USCODE-2018-title16/html/USCODE-2018-title16-chap12-subchapII-sec824.htm U.S.C. Title 16 - CONSERVATION (govinfo.gov)

[113] WIEB. "WIRAB." https://www.westernenergyboard.org/western-interconnection-regional-advisory-body/

[114] U.S. Department of Energy. "Nuclear Waste Policy Act." https://www.energy.gov/sites/prod/files/edg/media/nwpa_2004.pdf

[115] WIEB. "High-Level Radioactive Waste." https://www.westernenergyboard.org/high-level-radioactive-waste-committee/

[116] Western Electricity Coordinating Council. "About WECC." https://www.wecc.biz/Pages/AboutWECC.aspx

[117] California ISO. "RC West." http://www.caiso.com/informed/Pages/RCWest/Default.aspx

2.2.6 California Independent System Operator

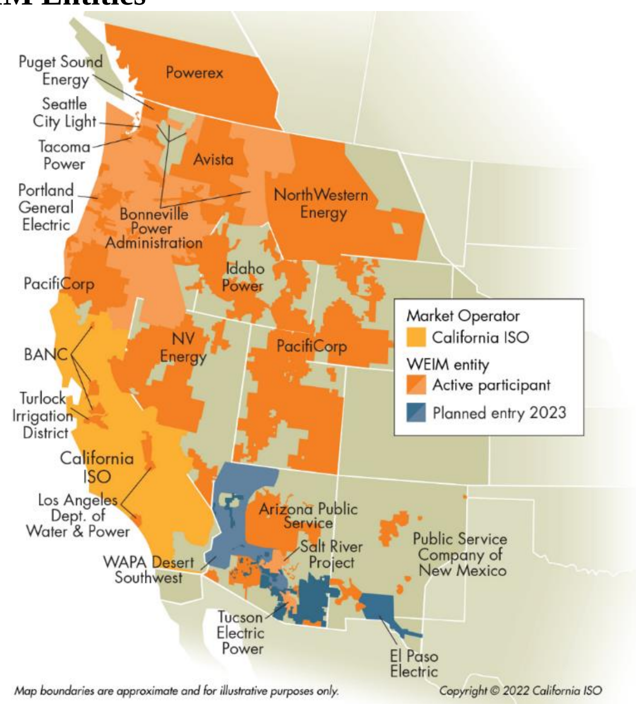
CAISO is one of nine independent system operators/regional transmission organizations (ISOs/RTOs) in the country and serves all three of Idaho's IOU providers. ISOs/RTOs operate and provide non-discriminatory access to transmission systems for regions of the country where they provide wholesale energy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

2.2.6.1 Western Energy Imbalance Market and Extended Day-Ahead Market

The Western EIM was launched in 2014 as an agreement between PacifiCorp and CAISO. The EIM's daily operations are managed by CAISO.[118] As of 2022, 19 utilities with service territories in the western U.S. and British Columbia, Canada have joined, and three confirmed pending participants will enter the EIM before the end of 2023.[119] Idaho Power joined the EIM in April 2018, Avista joined in March 2022, and BPA joined in May 2022. The service territories of all EIM participants are depicted in Figure 20.

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.[120]

Figure 21: Western EIM Entities*[121]*



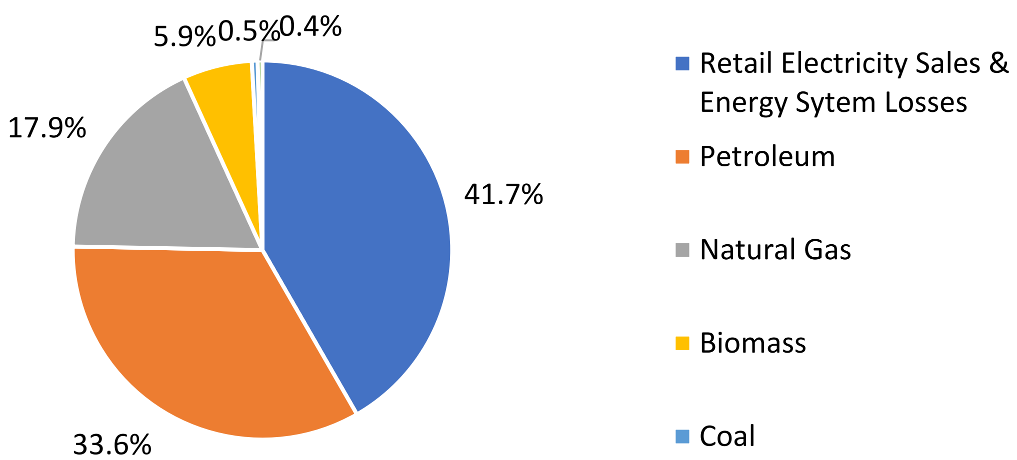
[118] Western Energy Imbalance Market. "About." https://www.westerneim.com/Pages/About/default.aspx
[119] Western Energy Imbalance Market. "About." https://www.westerneim.com/Pages/About/default.aspx
[120] Western Energy Imbalance Market. "EIM Track 2 Overview – Agreements." https://www.westerneim.com/Documents/EIMTrack2Overview-Agreements.pdf
[121] Western Energy Imbalance Market. "About." https://www.westerneim.com/Pages/About/default.aspx

In 2019, CAISO announced an initiative to develop the EDAM to improve market efficiency by integrating renewable resources using day-ahead unit commitment and scheduling across a larger area.[122] Fifteen EIM entities participated in the EDAM Feasibility Assessment in January 2019. The CAISO issued its draft final market design for the EDAM in December 2022 and expects a vote of the CAISO Board of Governors and EIM Governing Body under joint authority in February 2023.[123] Onboarding of the initial EDAM participants is expected to begin in early 2024. In December 2022, PacifiCorp was the first utility to publicly announce plans to join the EDAM.[124]

2.2.7 Southwest Power Pool

The Southwest Power Pool (SPP) is an RTO that is mandated by FERC to provide reliable power sources, transmission infrastructure, and competitive electricity prices. SPP offers a variety of services to its members including transmission expansion, market operations, tariff administration, regional scheduling, reliability coordination, and training. Arkansas, Iowa, Kansas, Louisiana, Minnesota, Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, and Wyoming are members of the SPP.

Figure 22: SPP Resources (2022)[125]



SPP sources power from 949 generation plants with a generation capacity of 105,464 MW. SPP's energy production fuel types are shown in Figure 21. SPP operates and maintains 70,025 miles of transmission lines and 5,180 substations.[126] SPP has initiated service offerings in the Western Interconnection in recent years and currently provides technical services for the WRAP and operates the EIM for several Intermountain balancing areas.

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

[123] California ISO. "Initiative: Extended Day-Ahead Market." https://stakeholdercenter.caiso.com/StakeholderInitiatives/Extended-day-ahead-market

[124] PacifiCorp. ""PacifiCorp to build on success of real-time energy market innovation as first to sign on to new Western day-ahead market". https://www.pacificorp.com/about/newsroom/news-releases/EDAM-innovative-efforts.html

[125] Southwest Power Pool. "Fast Fact." https://www.spp.org/about-us/fast-facts/

[126] Southwest Power Pool. "Fast Fact." https://www.spp.org/about-us/fast-facts/

2.2.7.1 SPP Markets+

SPP's Markets+ initiative is a day-ahead market proposed by SPP aimed to simplify transmission services, centralize day-ahead markets, and efficiently integrate the new fleet of renewable generation. Markets+ offers an opportunity for utilities that are not ready to join an RTO membership to see the RTO's benefits without a commitment. In 2022, SPP engaged western utilities in design of its proposed Markets+ day-ahead market, which would provide similar services but be an alternative market to the CAISO EDAM. SPP issued its final service offering in November 2022 and is seeking commitments from western utilities to share in funding its next phase of initial market design. BPA announced in summer 2022 that it intends to share in funding the next phase of Markets+ development, which would run through 2025.[127]

2.2.8 Western Power Pool

The Western Power Pool (WPP), formerly the Northwest Power Pool (NWPP), changed its name in 2022 to more accurately describe its scope. WPP is a Portland-based voluntary organization that coordinates power plant operational data and provides guidelines for power system operations in the West. WPP's members include electric utilities that own generating plants and sell power throughout the Western U.S. and Canada. WPP activities are largely determined by major committees – the Operating Committee, the PNCA Coordinating Group, the Reserve Sharing Group Committee, and the Transmission Planning Committee.[128]

2.2.8.1 Western Resource Adequacy Program

Given the recent trend in decommissioning coal plants and increasing renewable integration, WPP is working to coordinate activities related to a comprehensive review of resource adequacy in the WPP region and the development and implementation of the WRAP. The increased quantity and quality of information related to the WRAP will provide significantly enhanced visibility into the forward supply that enable load to be served reliably in the region.[129]

In December 2021, the WRAP announced that it entered the first stage of program implementation, a non-binding phase titled Phase 3A. Twenty-six western utilities are participating in Phase 3A of the WRAP, including Avista, BPA, Idaho Power, and PacifiCorp. These twenty-six participants represent an estimated peak winter load of 65,122 MW and an estimated peak summer load of 66,768 MW across 10 states and one Canadian province.[130] In December 2022, 11 utilities formally committed to moving forward with the WRAP, including PacifiCorp and Avista.[131]

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[127] Southwest Power Pool. "Markets+." https://www.spp.org/western-services/marketsplus/
[128] Western Power Pool. "Home". https://www.westernpowerpool.org/
[129] Western Power Pool. "NWPP Resource Adequacy Program – Detailed Design." https://www.westernpowerpool.org/private-media/documents/2021-08-30_NWPP_RA_2B_Design_v4_final.pdf
[130] Western Power Pool. "WRAP Announces Full Participation of Phase 3A." https://www.westernpowerpool.org/news/wrap-announces-full-participation-of-phase-3a
[131] Western Power Pool. "WPP Welcomes First Participants for Next Phase of WRAP". https://www.westernpowerpool.org/news/wpp-welcomes-first-participants-for-next-phase-of-

2.2.9 NorthernGrid

Pursuant to rules adopted by the FERC, Idaho's IOUs are required to participate in local and sub-regional transmission planning and to coordinate with neighboring sub-regional planning groups and local stakeholders.[132] 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.[133] 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 PUC participate in the development of these plans.

2.2.10 Northwest Energy Efficiency Alliance

The Northwest Energy Efficiency Alliance (NEEA) provides support to regional utilities and groups in the Northwest that implement energy efficiency and conservation programs. NEEA's purpose is to pool resources and share risks to transform the market for energy efficiency to the benefit of consumers in the Northwest. NEEA funds initiatives such as energy code compliance and serves as a forum for collective industry consensus on market acceptance of energy efficient products.[134] Idaho Power, BPA, and Avista belong to NEEA. The Idaho Governor appoints an individual to serve on the NEEA Board of Directors.[135]

2.2.11 Regional Electric Vehicle West Plan

In 2017, former Governor Otter signed a Memorandum of Understanding (MOU)[136] between Idaho and seven other western states (Signatory States) to collaborate on Regional Electric Vehicle infrastructure development in the West (REV West). The State of Idaho welcomes partnership opportunities with other REV West partners to create additional connection along major travel corridors.

In 2019, Governor Little and the Signatory States signed a revised REV West MOU[137] to update their EV corridor goals based on progress to date. Signatory States are committed to educating consumers, coordinating EV charging locations, using and promoting REV West Voluntary Minimum Standards[138], identifying and developing opportunities to incorporate EV charging stations into planning and development processes, encouraging EV manufacturing to stock and

[132] Federal Energy Regulatory Commission. FERC Order Nos. 890 and 1000. https://ferc.gov/industries-data/electric/industry-activities/open-access-transmission-tariff-oatt-reform/summary-compliance-filing-requirements-order-no-890 and https://www.ferc.gov/electric-transmission/order-no-1000-transmission-planning-and-cost-allocation

[133] Northern Grid. "Purpose." https://www.northerngrid.net/northerngrid/purpose/

[134] Northwest Energy Efficiency Alliance. "About NEEA." http://neea.org/about-neea

[135] Northwest Energy Efficiency Alliance. "Board of Directors." https://neea.org/about-neea/board-of-directors

[136] NASEO. "2017 REV West MOU." https://www.naseo.org/issues/transportation/rev-west

[137] NASEO "2019 REV West MOU." https://www.naseo.org/issues/transportation/rev-west

[138] 2 NASEO. "REV West Voluntary Minimum Standards." https://www.naseo.org/issues/transportation/rev-west

market a variety of EVs, collaborating on funding opportunities, and supporting the build-out of charging stations.

2.2.12 ChargeWest™

ChargeWest™, formerly known as CORWest, is an intermountain west (Idaho, Montana, Wyoming, Nevada, Utah, Colorado, New Mexico, and Arizona) effort that aims to support consumer education, stakeholder engagement and rural infrastructure development of EV charging from the expansion of alternative fuel corridors. The goal of ChargeWest™ is to support electrifying AFCs in three main areas: to remove investment barriers to enable private station development, identify key infrastructure gaps and develop solutions to deploy charging stations in rural regions required to complete corridors, and develop replicable educational tools to encourage EV consumer awareness.[139]

2.3 Federal Entities

2.3.1 U.S. Department of Energy

DOE administers national energy, environmental, and nuclear policies through science and technology solutions.[140] DOE oversees the nation's nuclear infrastructure, and operates energy research facilities throughout the nation, including 17 national laboratories, among them the INL.

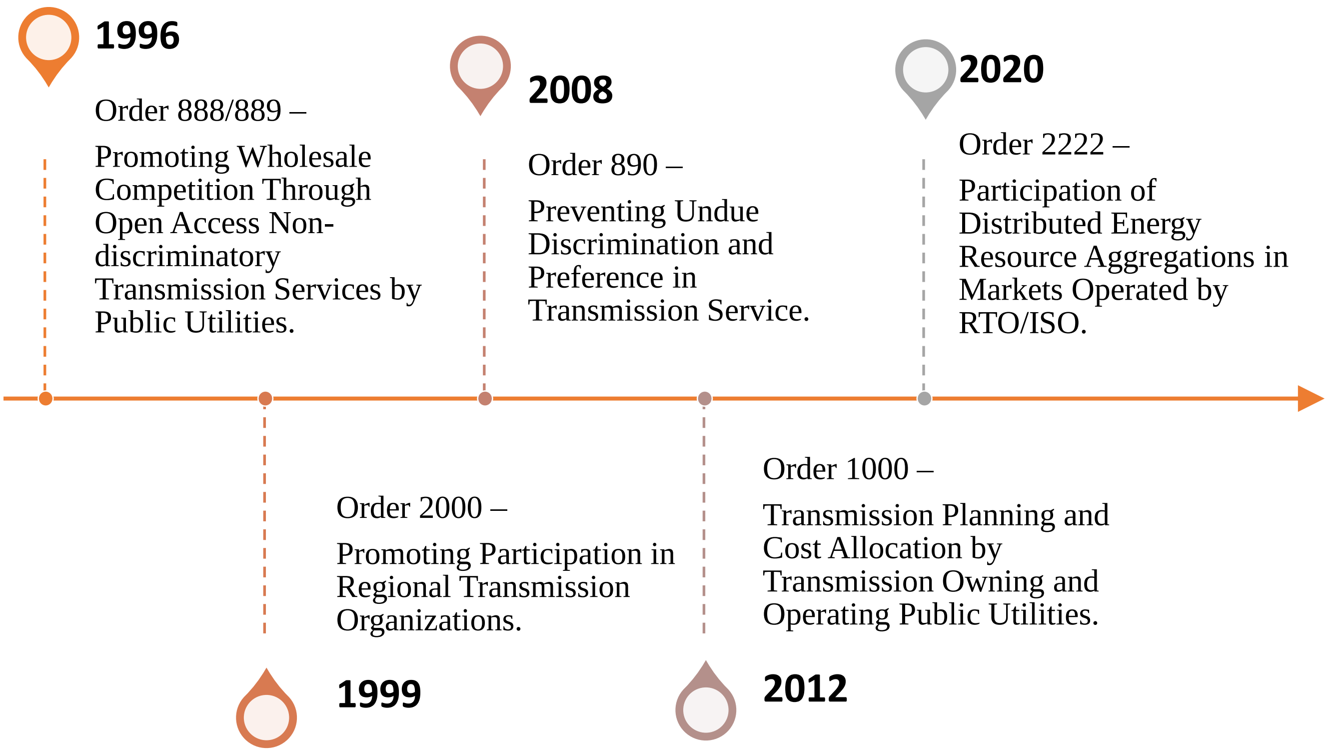
DOE provides state energy program funding to states to enhance energy security, advance state-led energy initiatives, and maximize the benefits of decreasing energy waste. DOE also administers the Weatherization Assistance Program, which reduces energy costs for low-income households by increasing the energy efficiency of their homes, while ensuring their health and safety.

2.3.2 U.S. Federal Energy Regulatory Commission

FERC is an independent regulatory agency within the 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.[141] Figure 22 depicts Landmark FERC Orders for transmission.

[139] ChargeWest™. "What is ChargeWest™?" https://chargewestev.org/
[140] U.S. Department of Energy. "About Us." https://www.energy.gov/about-us
[141] Federal Energy Regulatory Commission. "About FERC." https://ferc.gov/what-ferc

Figure 23: Landmark FERC Orders for Transmission[142]



2.3.3 North American Electric Reliability Corporation

NERC
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 seasonal and long-term reliability. NERC has four interconnection regions and Idaho is located in the Western Interconnection. NERC's bulk power system serves approximately 400 million people.[143]

2.3.3.1 GridEx

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 fifth exercise, GridEx V, was held in November 2019 and had more than 7,000 participants representing 526 organizations. The most

[142] Federal Energy Regulatory Commission. "Major Orders & Regulations". https://www.ferc.gov/major-orders-regulations
[143] North American Electric Reliability Corporation. "About NERC." https://www.nerc.com/aboutnerc/pages/default.aspx

recent GridEx simulation, GridEx VI, was held in November 2021. GridEx VII is scheduled for November 2023.

2.3.4 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.[144]

2.3.5 U.S. Department of the Interior

The U.S. Department of the Interior (DOI) manages public lands, territories, and tribal matters in the U.S. 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.[145]

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 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.

2.3.6 U.S. Forest Service

The U.S. Forest Service (USFS), administered under the U.S. Department of Agriculture, is responsible for managing and protecting 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.[146]

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

[145] 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

[146] U.S. Forest Service. "Energy." https://www.fs.usda.gov/science-technology/energy-forest-products/energy

2.3.7 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 (NOAA), 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.[147]

2.3.8 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.[148] EPA administers the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as "Superfund," which allows EPA to clean up contaminated sites.[149] There are currently six sites in Idaho on the Superfund National Priorities List.[150]

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[147] National Oceanic and Atmospheric Administration Fisheries. "About Us." https://www.fisheries.noaa.gov/about-us
[148] U.S. Environmental Protection Agency. "About EPA." https://www.epa.gov/aboutepa/our-mission-and-what-we-do
[149] U.S. Environmental Protection Agency. "What is Superfund?" https://www.epa.gov/superfund/what-superfund
[150] U.S. Environmental Protection Agency. "National Priorities List by State." https://www.epa.gov/superfund/national-priorities-list-npl-sites-state#ID

3. Idaho Energy Sources

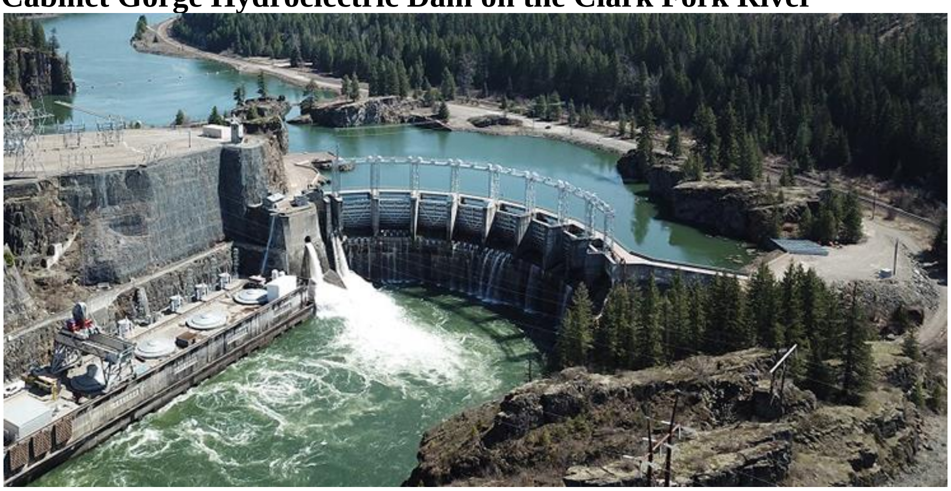
3.1 Hydroelectricity

Hydroelectric power is a carbon-free energy resource generated by using the force of moving water. Idaho has more than 140 generating hydroelectric power plants with a combined capacity of 2,704 MW, which makes Idaho the eighth-largest hydroelectric power producer in the nation.[151] Idaho's largest hydroelectric power 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.[152] Depending on water supply, the actual output of energy produced by hydroelectric power may vary.

The flexible nature of hydroelectric power enables it to meet the fluctuating demands of the grid and mitigate losses of supply associated with intermittent resources such as wind and solar. Idaho's robust water resources allow for hydroelectric power to be a valuable baseload renewable energy resource that provides clean and reliable energy to the State. Hydroelectric power supplies about 51% of Idaho's in-state electricity and contributes to Idaho-based energy providers' ability to supply low-cost power to customers.[153]

In addition to providing clean and reliable energy for Idaho hydroelectric power facilities also provides flood control and reliable irrigation for agriculture and creates recreational opportunities by providing public access to reservoirs and activities such as boating, fishing, and swimming throughout the state.

Figure 24: Cabinet Gorge Hydroelectric Dam on the Clark Fork River[154]



[151] U.S. Energy Information Administration. "Where Hydropower is Generated." https://www.eia.gov/energyexplained/hydropower/where-hydropower-is-generated.php
[152] Idaho Governor's Office of Energy and Mineral Resources. "Hydroelectric" https://oemr.idaho.gov/sources/re/hydropower/
[153] U.S. Energy Information Administration. "Idaho: State Profile and Energy Estimates." https://www.eia.gov/state/?sid=ID#tabs-4
[154] Avista. "Part of this Small Town's Appeal Is Its 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

3.2 Wind
Wind power is a carbon-free energy resource that utilizes a turbine to harness power and generate electricity. Idaho's wind production grew from 207,000 MWh at the end of 2008 to a total of 2,657,247 MWh in 2021.[155] Wind power accounts for approximately 16% of Idaho's electricity provided by nearly 550 wind turbines at utility-scale wind facilities. There are currently 33 wind projects and three wind-related manufacturing facilities in the state. At the end of 2019, the wind industry directly employed over 500 Idahoans.[156]

Figure 25: Power County Wind Farm in Eastern Idaho[157]

Wind mapping studies estimate that Idaho has almost 213,000 MW of potential wind generation.[158] According to EIA, the Snake River Plain in southern Idaho represents the greatest wind resource potential in Idaho.[159] The state of Idaho through IDL encourages the development of wind power on state endowment lands. Projects developed on endowment lands, create income for the Idaho State Endowment Fund, which funds schools and other state institutions. Annually, wind projects in the state of Idaho pay approximately $13 million to local communities.

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

155 U.S. Energy Information Administration. "Electricity Data Browser." https://www.eia.gov/electricity/data/browser/#/topic/0?agg=1,0,2&fuel=008&geo=00000000008&sec=o3g&freq=A&start=2001&end=2021&ctype=linechart&ltype=pin&rtype=s&pin=&rse=0&maptype=0
156 American Wind Energy Association. "AWEA Wind Energy in the United States." https://public.tableau.com/app/profile/american.wind.energy.association/viz/WindEnergyintheUnitedStates/AnnualReportViz
157 USGS. "Power County Wind Farm." https://www.usgs.gov/media/images/power-county-wind-farm-0
158 Wind Exchange. "US Installed and Potential Wind Power Capacity and Generation." https://windexchange.energy.gov/maps-data/321
159 U.S. Energy Information Administration. "Profile Analysis." https://www.eia.gov/state/analysis.php?sid=ID#88

3.3 Solar

Solar power is a carbon-free renewable energy resource that harnesses the abundant 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.[160]

Figure 26: American Falls II Solar Project[161]

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 2021, the total installed solar had grown to 618.5 MW, enough to power 83,211 homes. As of 2022, there are 32 total solar companies consisting of manufacturers, developers, installers, and other companies operating in Idaho that employ nearly 600 people.[162] In late 2022, Idaho Power completed construction on the 120 MW Jackpot Solar plant, which is currently Idaho's largest operating solar project. Another large project is the 108 MW Grand View Solar plant.

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

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[160] U.S. Department of Energy. "Solar Energy Technology Basics." https://energy.gov/eere/energybasics/articles/solar-energy-technology-basics
[161] Swinerton Renewable Energy. "American Falls 2." https://www.swinertonrenewable.com/projects/american-falls-2
[162] Solar Energy Industries Administration. "Idaho Fact Sheet." https://www.seia.org/sites/default/files/2022-09/Idaho%20State-Factsheet-2022-Q3.pdf

the home without the use of pumps. Both types of systems need a storage tank for the water and solar panels to collect the heat.[163]

3.3.4 Financial Incentives for Solar

The federal investment tax credit (ITC) for solar is a tax credit that can be claimed on the federal income taxes of individuals[164] or corporations[165] for a portion of the cost of installation. 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 to claim the credit.

The ITC for solar PV timeline has been extended with the Inflation Reduction Act (IRA) of 2022.[166] PV systems installed between 2022 and 2023 will receive a 30% tax credit, be reduced to 26% in 2033, and 22% in 2034. If a system was already installed in 2022, the tax credit increased from 22% to 30% if it hasn't already been claimed.[167]

The state of Idaho offers financial incentives for renewable energy such as the Residential Alternative Energy Tax Deduction and through the State Energy Loan Program which provides low interest loans up to $50,000 to residential applicants and up to $150,000 for commercial, multifamily, agricultural, and industrial businesses that are interested in installing energy efficient products and developing renewable energy projects within the state.[168]

3.4 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, which are used to make advanced biofuels.

Biomass, primarily from Idaho's forests, provided 3% of Idaho's electricity production in 2021.[169] As of 2022, Idaho has one operating ethanol plant capable of producing 60 million gallons per year.[170] There is currently no commercial production of biodiesel in Idaho.

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[163] U.S. Department of Energy. "Solar Water Heaters." https://energy.gov/energysaver/solar-water-heaters
[164] 26 U.S. Code § 25D - Residential Energy Efficient Property. https://www.law.cornell.edu/uscode/text/26/25D
[165] 26 U.S. Code § 25D - Residential Energy Efficient Property. https://www.law.cornell.edu/uscode/text/26/25D
[166] Inflation Reduction Act of 2022. https://www.congress.gov/117/plaws/publ169/PLAW-117publ169.pdf
[167] U.S. Department of Energy Office of Energy Efficiency and Renewable Energy. "Solar Investment Tax Credit: What Changed?" https://www.energy.gov/eere/solar/articles/solar-investment-tax-credit-what-changed
[168] Idaho Governor's Office of Energy and Mineral Resources. "State Energy Loan Program." https://oemr.idaho.gov/loan-program/
[169] EIA. "Idaho." https://www.eia.gov/state/analysis.php?sid=ID#:~:text=About%20two%2Dfifths%20of%20Idaho%20is%20covered%20by%20forests.&text=Biomass%2C%20primarily%20wood%20waste%20from,generate%20electricity%20in%20the%20state.
[170] EIA. "U.S. Fuel Ethanol Plant Production Capacity." https://www.eia.gov/petroleum/ethanolcapacity/

Feedstock projections indicate that Idaho produces over 2.5 million metric tons of wood waste from forests, mills, and urban sources respectively.[171] Idaho has three dedicated biomass production facilities and many research-based operations across the state.[172] While the state does not currently play a role in the production of biodiesel, its biogas or renewable natural gas (RNG) potential is promising.

DOE's 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.[173]

3.5 Geothermal

Geothermal energy is a renewable carbon-free 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 13,550 MW of undiscovered geothermal power exists in Idaho, much of it in the southern portions of the state.[174] Ormat Technologies manages Idaho's only operating commercial geothermal power plant, the 11 MW Raft River Enhanced Geothermal System Project, located in Cassia County.[175] Idaho is one of seven states with utility-scale electricity generation from geothermal energy.[176]

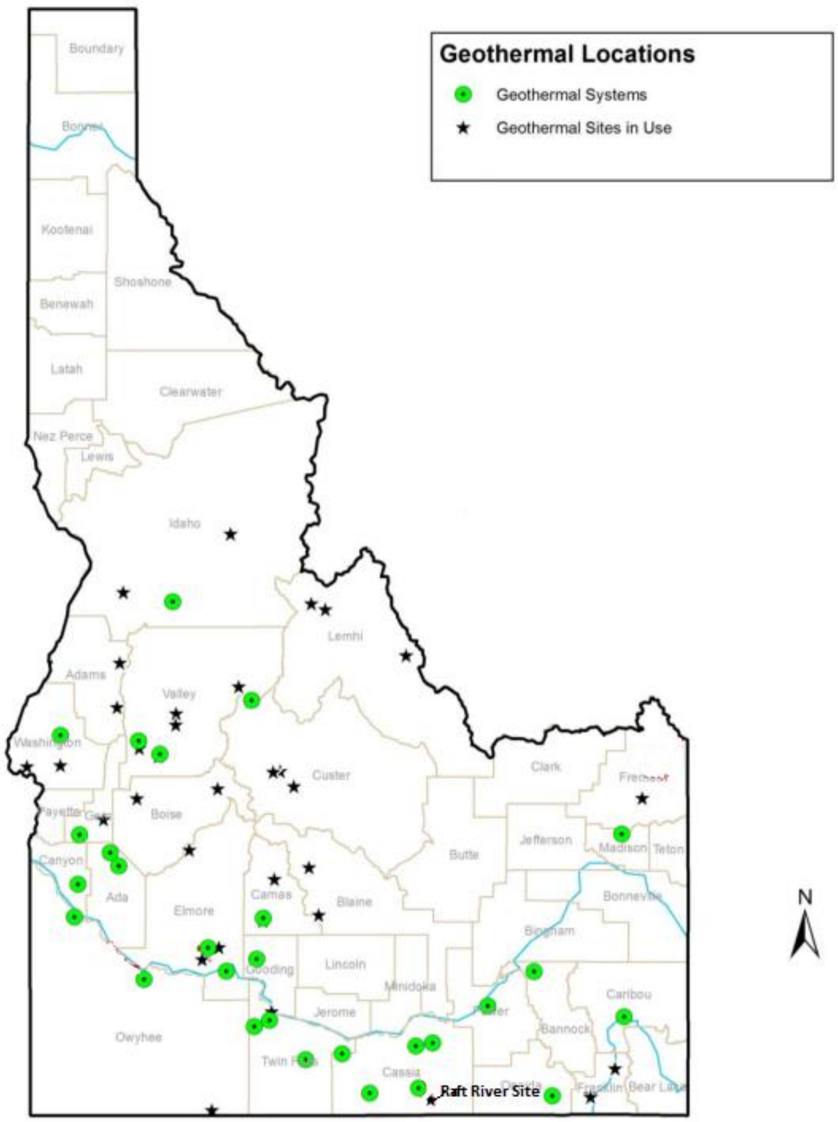
In addition to electric generation, direct use of geothermal waters is the oldest, most versatile, and most prevalent utilization of geothermal energy.[177] There are over 1,000 wells and 200 springs across Idaho. Wells that have a bottom hole temperature greater than 85 degrees Fahrenheit and less than 212 degrees Fahrenheit are designated as low-temperature geothermal (LTG) resource wells.[178] 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.[179] The City of Boise's geothermal heating utility delivers naturally heated water through over 20 miles of pipeline to more than 6 million square feet of building space and is planned to expand by 40% to help Boise achieve carbon neutrality by

[171] 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
[172] EIA. "Monthly Biomass Fuel Report." https://www.eia.gov/biofuels/biomass/#dashboard
[173] U.S. Department of Energy. https://www.energy.gov/sites/prod/files/2015/10/f27/idaho_biofuels_benefits.pdf
[174] Geothermal Energy Association. "Geothermal Development Needs in Idaho." https://www.idahogeology.org/pub/Geothermal/References/Miscellaneous/Fleischman.2006_GeothermalReport.pdf
[175] Ormat. "Global Projects." https://www.ormat.com/en/projects/all/main/
[176] U.S. Energy Information Administration. "Profile Analysis." https://www.eia.gov/state/analysis.php?sid=ID#88
[177] 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
[178] Idaho Department of Water Resources. "Geothermal Resource Wells." https://idwr.idaho.gov/wells/geothermal-wells/
[179] Boise Warm Springs Water District. "About." https://bwswd.com/about/

2050.[180] Additionally, the Capitol Mall Geothermal Energy Project was 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 Boise State University campus buildings.[181]

Figure 27: Geothermal Locations in Idaho[182]



180 City of Boise. "Boise's Climate Action Roadmap." https://www.cityofboise.org/media/12984/boise-climate-roadmap.pdf

181 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/

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

3.6 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 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 2021, there are 22 CHP systems in Idaho with a capacity of 213 MW, predominantly used in wood product facilities, dairies, hotels, and large industrial food processors. Half of the 21 facilities utilize renewable fuels.[183]

3.7 Nuclear

Nuclear energy is a carbon-free power source. Nuclear power provides 52% of clean energy in the nation, the largest source of clean energy in the U.S. While no commercial-scale nuclear power generation exists in Idaho today, the state receives some nuclear electricity from the Columbia Generating Station through BPA. Additionally, one of the first commercial-scale advanced nuclear plants in the world is expected to be built on the INL site by the end of the decade. In 2021, 93 nuclear reactors in 28 states provided the most reliable and largest source of clean energy in the U.S., providing 790 billion kilowatt hours (kWh) of electricity.[184]

Idaho supports the responsible development of nuclear energy and has taken action to protect Idahoans from any potential harm nuclear waste may present. The Idaho Settlement Agreement, implemented in 1995, agreed to allow the U.S. Navy and DOE to bring small amounts of spent nuclear fuel (SNF) into the state for 40 years. DOE agreed to not send certain types of SNF to the state and would treat and permanently remove waste and SNF from Idaho. Governor Batt had three conditions for the settlement agreement: Idaho will not become a default waste repository, DOE must address the waste already in Idaho, and INL must become a viable national lab. Since the Idaho Settlement Agreement in 1995, five agreements have been reached. These include: the Agreement to Implement of 2008, the Navy Addendum of 2004, the Commercial Fuel Memorandum of Agreement of 2011, the Supplemental Agreement of 2018, and the Advanced Test Reactor (ATR) Agreement.[185]

INL, located in southeastern Idaho, is the nation's lead laboratory for nuclear energy research. INL is the birthplace of nuclear energy for electricity generation and for Navy nuclear propulsion and has influenced every reactor designed in the U.S. INL researchers are working on several initiatives, including advanced nuclear reactors such as microreactors and small modular reactors as well as integrated energy systems, that will help shape the future of nuclear energy worldwide. INL's research will help create a more secure and modern grid.[186]

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183 U.S. Department of Energy. "The State of CHP." https://www.energy.gov/sites/prod/files/2017/11/f39/StateOfCHP-Idaho.pdf https://doe.icfwebservices.com/chpdb/state/ID

184 U.S. Department of Energy. "Five Fast Facts about Nuclear Energy (2021)." https://www.energy.gov/ne/articles/infographic-five-fast-facts-about-nuclear-energy-2020

185 Idaho Governor's Office of Energy and Mineral Resources. "Nuclear." https://oemr.idaho.gov/sources/nuclear/

186 Idaho National Laboratory. "About." https://inl.gov/about-inl/

Figure 28: INL ATR Facility[187]

3.7.1 Advanced Nuclear Reactors

Advanced nuclear reactors (ANRs) represent the cutting edge in nuclear technology. ANRs are being designed to more quickly adjust their electricity output to match demand, helping them stabilize the grid in areas with a high volume of intermittent renewables. Additionally, many ANRs are inherently safer by design, with some, like the small modular reactor (SMR) being developed by NuScale Power, capable of operating without the need for safety-related backup electrical systems. ANRs will use a variety of coolants including water, molten salt, high temperature gas and liquid metal, and come in a wide range of sizes, from a few MWs to more than 1,000 (like traditional nuclear reactors). This will allow owners to tailor their electricity generation to their energy demands. This is particularly important for smaller companies, rural electric cooperatives or municipal agencies and for isolated and distributed applications. Further, ANRs will offer a variety of benefits beyond electricity generation, such as water desalination, process heat and alternative fuels generation, and access to power beyond the grid. Some designs will also recover and recycle elements in used spent nuclear fuel that can still produce energy.[188]

Many advanced reactors are still in the development phase, which requires expensive research and testing before they can even begin to bring return on investment. Cost-sharing partnerships between the federal government and developers are working to ease the burden, such as access to INL's Gateway for Accelerated Innovation in Nuclear (GAIN) program.[189]

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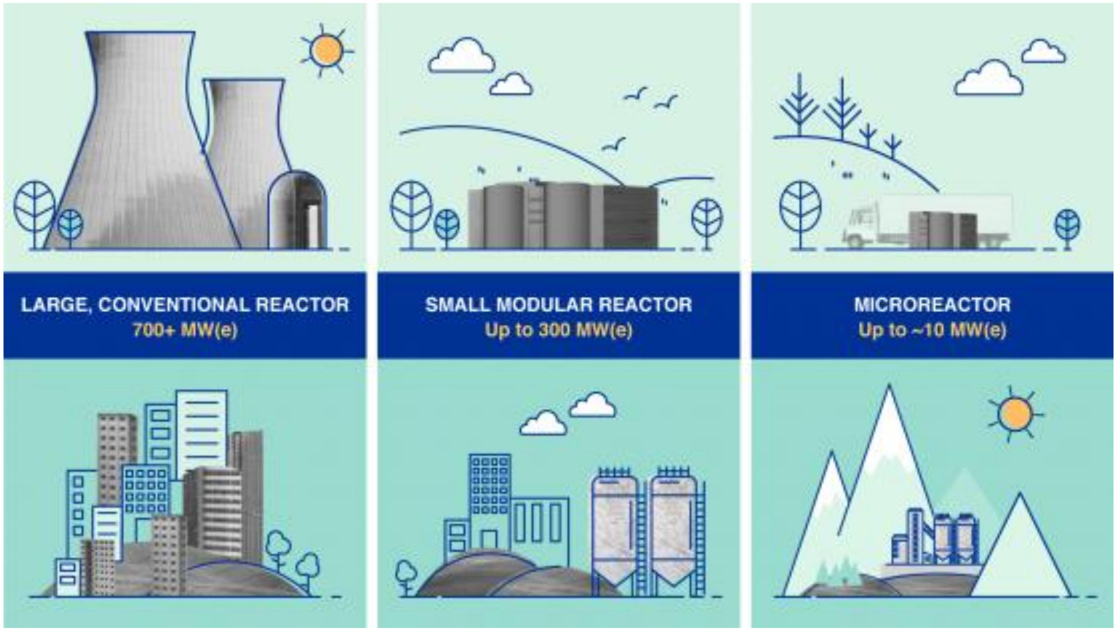
[187] Photo courtesy of the Idaho National Laboratory.
[188] Nuclear Energy Institute. "Advanced Nuclear". https://www.nei.org/fundamentals/advanced-nuclear#:~:text=Advanced%20nuclear%20reactors%20are%20being,temperature%20gas%20and%20liquid%20metal.
[189] Idaho National Laboratory. "GAIN". https://gain.inl.gov/SitePages/Home.aspx

Figure 29: Advanced Nuclear Reactors[190]



3.8 Natural Gas

Natural gas is utilized in Idaho to heat homes, power businesses, move vehicles, and serves as a key component in many industrial processes. More than half of Idaho households use natural gas as their primary energy source to heat their home.[191] Natural gas power plants can adjust generation in real-time in response 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.[192] These discoveries led to Idaho's first commercial production of natural gas and natural gas liquids in 2015.[193] In 2021, Idaho produced over 1,331 million cubic feet of natural gas.[194]

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 to increase the amount of natural gas storage in the vehicle and thus increase 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

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[190] International Atomic Energy Agency. "What are Small Modular Reactors?" https://www.iaea.org/newscenter/news/what-are-small-modular-reactors-smrs

[191] U.S. Energy Information Administration. "Idaho State Profile and Energy Estimates – Profile Analysis." https://www.eia.gov/state/analysis.php?sid=ID

[192] Dunnahoe, Tayvis. "Idaho enters ranks of hydrocarbon producing states." Oil and Gas Journal (February 6, 2017).

[193] 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

[194] 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

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.[195]

Idaho has two public CNG vehicle refueling stations, one in Boise and another in Nampa.[196] Some municipal and commercial fleets utilize natural gas and operate their own CNG refueling stations. There are no commercial RNG facilities in Idaho as of 2022, however, the state expects to see increased interest in RNG development given Idaho's unique resource portfolio and noted success in other biomass industries.

3.9 Propane

Propane is used to heat homes and businesses throughout the state of Idaho, particularly in rural areas. Residential propane prices in Idaho in 2022 fluctuated between $2.50/gallon to $2.85/gallon as of November 2022.[197] Propane consumption is highly seasonal, with peak consumption in fall and winter.

Propane is also used as a transportation fuel, for which there are 10 publicly available stations for refueling in Idaho.[198] As a transportation fuel, propane is most commonly used in specialized medium-duty and heavy-duty vehicles with engines capable of running on liquified petroleum gas. In Idaho, there are several school buses that are on the road as a result of DEQ's Vehicle Replacement Program (VRP).[199]

3.10 Petroleum

There are no petroleum refineries located in Idaho and there is limited storage capacity. Petroleum in Idaho is moved via four major modes of transportation: pipelines, railcars, barges, and truck delivery. Pipeline routes are depicted in Figure 29. Petroleum pipeline infrastructure within Idaho includes the Northwest Products Pipeline, which connects Salt Lake City refineries with Idaho Falls, Pocatello, Burley, and Boise, and continues to Pasco and Spokane in Washington state. This pipeline delivers refined petroleum products predominately to southern Idaho. Much of the refined petroleum products for northern Idaho are sourced from refineries near Billings, Montana, with the product being moved via the Yellowstone Pipeline and terminating in Moses Lake, Washington. Idaho's petroleum products are mostly transported via pipelines, while some are shipped on the Snake River into Lewiston, via barge, and others are transported via truck. End use refined petroleum products are typically delivered via truck.

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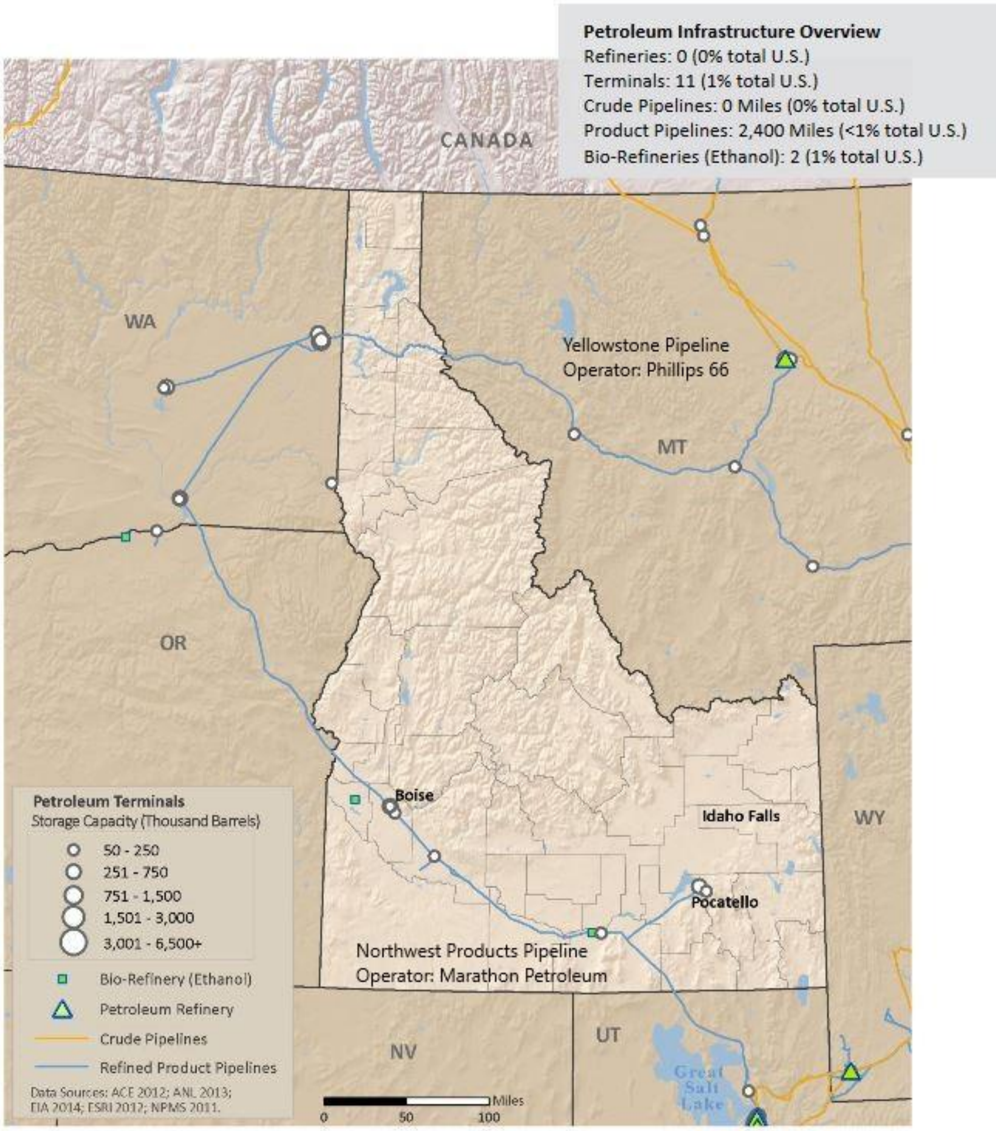
195 U.S. Department of Energy. "Alternative Fuels Data Center." https://afdc.energy.gov/fuels/natural_gas_renewable.html
196 U.S. Department of Energy Alternative Fuels Data Center. "Natural Gas Fueling Station Locations." https://afdc.energy.gov/fuels/natural_gas_locations.html#/find/nearest?fuel=CNG
197 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
198 U.S. Department of Energy. "Alternative Fuels Data Center." https://afdc.energy.gov/fuels/propane_locations.html#/find/nearest?fuel=LPG
199 United States Environmental Protection Agency. "School Bus Rebates: Diesel Emissions Reduction Act (DERA)." https://www.epa.gov/dera/rebates

Figure 30: Transportation Fuel Pipelines and Refineries Serving Idaho[200]



3.11 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.[201] 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 utilize coal at their facilities for power and steam generation (cogeneration) purposes.

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[200] 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

[201] 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

4. Minerals

4.1 Idaho Mineral Uses and the Economy

Minerals play an important role in the development of energy technologies. Idaho is home to a wealth of different minerals that are integral to everyday life and to the advancement of modern science. Idaho's mining legacy has shaped the settlement of the state, brought worldwide recognition to Idaho's natural resources, and continue to provide domestically sourced raw materials to advance modern technology. The essential application of minerals bolsters the economy, innovation for the future, and national security.

Figure 31: The Thompson Creek Mine[202]

In 2021, mining, quarrying and oil/gas extraction contributed $4.3 billion to Idaho's GDP.[203] Currently mining in Idaho supports over 15,000 direct and indirect jobs.[204] Direct mining jobs require highly specialized engineering and skilled labor, in addition to administrative support workers and transportation workers. As demand for domestically sourced raw materials increases, the mining industry will need a skilled and diverse workforce to meet the needs of the country's increased standard of living.

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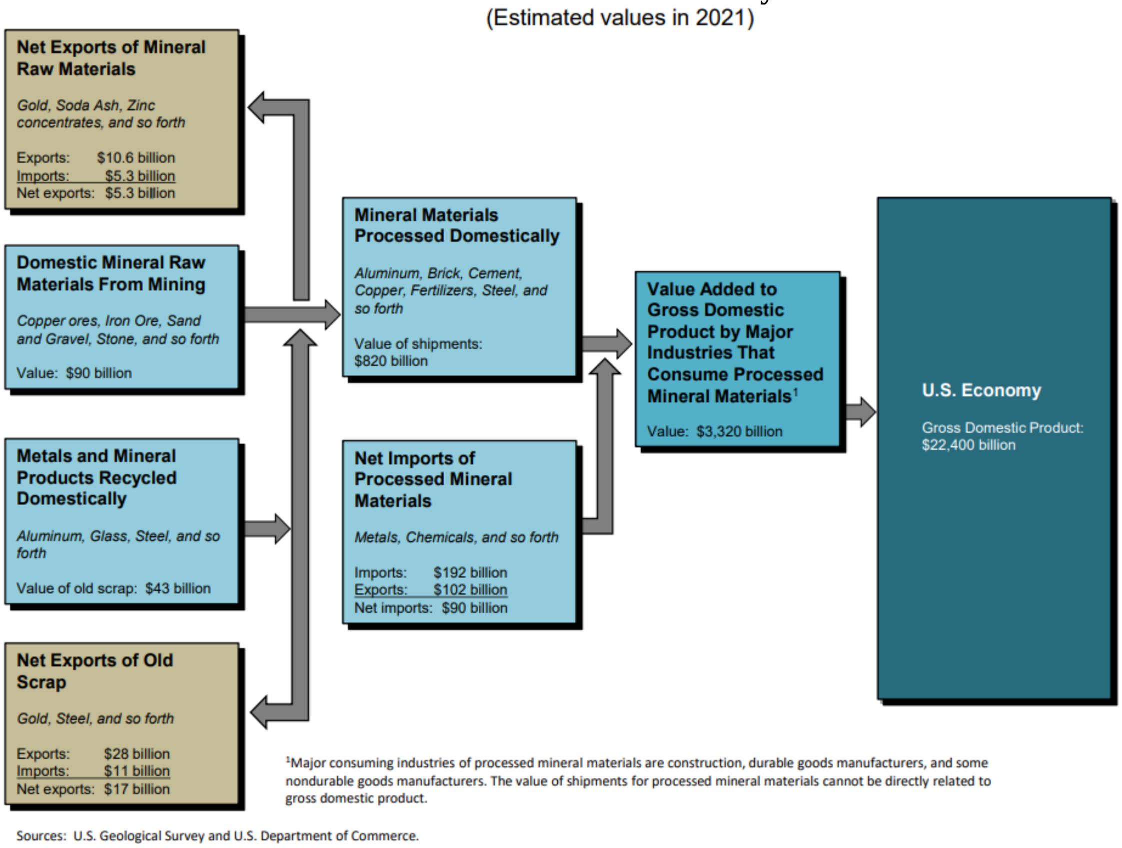
[202] Photo courtesy of Centerra Gold.
[203] U.S. Bureau of Economic Analysis. "GDP By State-Mining." https://apps.bea.gov/iTable/?ReqID=70&step=1#eyJhcHBpZCI6NzAsInN0ZXBzIjpbMSwyNCwyOSwyNSwzMSwyNiwyNywzMF0sImRhdGEiOltbIlRhYmxlSWQiLCI1MjYiXSxbIkNsYXNzaWZpY2F0aW9uIiwiTkFJQ1MiXSxbIk1ham9yX0FyZWEiLCIwIl0sWyJTdGF0ZSIsWyIwIl1dLFsiQXJlYSIsWyIxNjAwMCJdXSxbIlN0YXRpc3RpYyIsWyI2Il1dLFsiVW5pdF9vZl9tZWFzdXJlIiwiTGV2ZWxzIl0sWyJZZWFyIixbIjIwMjEiXV0sWyJZZWFyQmVnaW4iLCItMSJdLFsiWWVhcl9FbmQiLCItMSJdXX0=
[204] National Mining Association. "Economic Impact of Mining – Idaho." https://nma.org/map/idaho/

Figure 32: The Role of Nonfuel Minerals in the U.S. Economy[205]



4.1.1 Minerals in Energy Technology

Conductive metals are used in electronic components for modern technologies. As renewable energy technology advances, demand for minerals is rapidly increasing. For instance, copper is used in the wiring of solar panels and is a critical component to function for wind turbines. Another example is manganese, used as a steel alloy in the power-storing batteries for hybrid and EVs. Rare-earth elements are used in electronics such as smartphones, tablets, and nuclear reactor components.

Idaho has a reserve of naturally occurring raw critical minerals which contributes to the integrity of the national economy and plays an integral role in domestic supply chains, especially in light of federal Buy America requirements. In 2022 the DOI, through the U.S. Geological Survey, released a list of minerals deemed critical to national security for the U.S. This list changes with time as supply and society's needs shift. Idaho is home to many of these critical minerals, notably cobalt. With the 2022 opening of the Jervois Idaho Cobalt mine near Salmon, Idaho is the home of the nation’s only operating cobalt mine. Additionally, deposits of critical minerals, such as antimony are in the permitting and exploration process.[206]

[205] U.S. Geological Survey. “Mineral Commodity Summaries 2022.” https://pubs.usgs.gov/periodicals/mcs2022/mcs2022.pdf
[206] U.S. Geological Survey. “U.S. Geological Survey Releases 2022 List of Critical Minerals”. https://www.usgs.gov/news/national-news-release/us-geological-survey-releases-2022-list-critical-

Minerals are also vital for the development of EVs. Lithium, cobalt, and nickel are used in the lithium-ion batteries and the wiring that power EVs. Automakers are looking towards the Jervois Cobalt mine as a primary source of cobalt for lithium-ion batteries. As EV adoption rapidly increases, policy for the sources and supply chains of minerals will continue to develop.

4.1.2 Minerals in Manufacturing

Minerals are one of the most important raw materials used in manufacturing. For instance, platinum is used in over 20% of manufactured goods. In order to produce more manufactured goods domestically, more minerals and metals are needed to supply that demand. Aluminum, iron ore, steel, and titanium are fundamental components of most metallic manufactured goods. In 2021, mined materials contributed $3.32 trillion in value to the U.S. economy (GDP).[207]

4.1.3 Minerals in Construction

Sand and gravel are the basic building blocks for all construction materials. Aggregate is used to pave roadways, create concrete building foundations, and serves important environmental functions like drainage for stormwater. Natural aggregates (construction sand and gravel and crushed stone) make up the largest component of nonfuel mineral materials consumed in the U.S.[208] Concrete is essential for the construction and long-term reliability of energy projects. Mineral materials used in construction are important to Idaho's construction industry, which employs nearly 79,000 Idahoans each year.[209]

4.1.4 Minerals in Agriculture

Minerals and agriculture share a common interest: fertilizer. Mineral fertilizer is essential to the productivity of farmland as the balance of minerals in soil is required for the growth and development of plant life. Phosphorus, calcium, and sulfur are some of the most common nutrient elements used for plant growth. Southeastern Idaho is home to one of the largest sources of phosphate ore in the U.S., making phosphate mining one of the most important industries in the area.[210] Calcium is mined primarily from limestone deposits in Idaho. Small sulfur deposits throughout the state also contribute to the agricultural industry in Idaho.

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minerals#:~:text=The%202022%20list%20of%20critical%20minerals%20includes%20the,ceramics%2C%20glass%2C%20metallurgy%2C%20and%20polishing%20compounds%20More%20items

[207] U.S. Geological Survey. "Mineral Commodity Summaries 2022." https://pubs.usgs.gov/periodicals/mcs2022/mcs2022.pdf

[208] U.S. Geological Survey. "Materials in Use in U.S. Interstate Highways." https://pubs.usgs.gov/fs/2006/3127/2006-3127.pdf

[209] University of Idaho Extension Indicators. "Idaho: Employment by Industry." http://indicatorsidaho.org/DrawRegion.aspx?RegionID=16000&IndicatorID=17

[210] U.S. Geological Survey. "A History of Phosphate Mining in Southeastern Idaho." https://pubs.usgs.gov/of/2000/of00-425/of00-425.pdf

5. 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. Energy efficiency refers to processes of utilizing technology that consumes a lower amount of electricity while providing sufficient service. A few examples of energy efficiency include switching from incandescent light bulbs to LED, turning a computer off rather than switching it to sleep mode, and unplugging appliances when not in use.[211]

Demand response refers to customers temporarily altering energy consumption during times of higher demand for electricity, usually in response to signals from the utility or grid operator. One example includes authorizing a utility to remotely control heating and ventilation systems during times of high electricity demand.[212]

Collectively, these resources are often referred to as demand-side management (DSM). DSM resources offset future energy loads by reducing energy demand through energy efficiency or demand response. Often conservation or efficiency are terms used to refer to DSM measures.

Idaho utilities have administered cost-effective and sustainable energy efficiency programs for over four decades to conserve both company and consumer resources. Cost-effectiveness is realized when the lifecycle energy, capacity, transmission, distribution, and other quantifiable savings to Idaho residents and businesses exceeds the direct costs of the measure to the utility and participant. Cost-effective energy measures provide economic benefits to Idaho utilities by increasing the capacity for energy within their system to meet future energy demands.

The Idaho PUC directs Idaho's IOUs to conduct cost-effective conservation, energy efficiency, and demand response programs.[213] Each IOU calculates the level of cost-effective efficiency potential in their IRP and offers a suite of efficiency programs for customers.

Idaho Power, BPA, and Avista belong to NEEA, which provides support to regional utilities and groups in the Northwest that implement energy efficiency and conservation programs.

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[211] U.S. Energy Information Administration. "Use of Energy Explained." https://www.eia.gov/energyexplained/index.cfm?page=about_energy_efficiency
[212] U.S. Energy Information Administration. "Demand response saves electricity during times of high demand." https://www.eia.gov/todayinenergy/detail.php?id=24872
[213] 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

5.1 State of Idaho Energy Efficiency Programs

The state of Idaho, through OEMR and DHW, offers a variety of energy efficiency programs that save Idahoans money and reduce taxpayer spending.

5.1.1 Idaho Awards for Leadership in Energy Efficiency

OEMR administers the Idaho Awards for Leadership in Energy Efficiency Program. This program recognizes Idaho businesses and industrial facilities for their achievements in reducing their energy consumption and energy costs. Organizations are recognized for minimizing their energy use through operational processes and behavioral actions and/or upgrading structures within their facilities with more cost-effective and efficient technologies.

Nominations can be made in two categories, “Buildings” and “Industry”. Applicants are evaluated on the previous year’s total electric energy use, gas energy use, and physical and/or programming changes. From the applications received, one application is selected to receive the Governor’s Award for Leadership in Energy Efficiency. This award is given to a single applicant that has demonstrated outstanding efforts to significantly reduce their energy use over the past year.

Figure 33: J.R. Simplot Company Smokey Canyon Mine Energy Efficiency Award

The 2022 Governor’s Award for Leadership in Energy Efficiency was awarded to the J.R. Simplot Company Smokey Canyon Mine. Recently, the J.R. Simplot Company adopted an aggressive energy goal program, 4Sight2030, which aims to achieve 15% reduction in energy consumption, along with waste, water, and carbon, by 2030. To achieve this goal, in 2021 the mine optimized mill, shop heating, and ventilation efficiency which will save 2,542,270 kWh of energy and $86,500 in savings annually.

5.1.2 State Energy Loan Program

The State Energy Loan Program is one of OEMR's longest running and most utilized programs. Since the 1980's, the State Energy Loan Program has offered low-interest loans to develop energy projects for homes and businesses located within Idaho.

Eligible projects under the State Energy Loan Program include:

- HVAC
- Efficient lighting
- Insulation
- Windows
- Weatherization
- Appliances
- Renewable energy projects

Loan amounts range between $1,000-$50,000 for single-family homes and $1,000-$150,000 for commercial/multi-family home/agricultural/industrial buildings. A loan cannot be provided for energy retrofits that have already been performed or to complete new construction.[214] All loans are evaluated by a financial institution for credit worthiness and must be secured by real estate. All loan applicants are charged a credit analysis fee of $100 for single-family home loans and $250 for commercial/multi-family home/agricultural/industrial loans. Consumers may choose to leverage loans by accessing utility incentives and federal and state tax credits and deductions, if available.

The following incentives are available to applicants for various energy efficiency upgrades:

- Deduction for Energy Efficiency Upgrades (Idaho Code 63-3022B): State tax deduction for installation of qualifying energy efficiency upgrades at qualifying residence.
- Residential Alternative Energy Tax Deduction (Idaho Code 63-3022C): State tax deduction for installation of qualifying alternative energy device at qualifying residence.

In 2022, OEMR revised the financing options interest rates available to residential and commercial buildings. By reducing the interest rate and offering more flexible payment options, the State Energy Loan Program has received an increase in applications. Due to the increase in applications, the application period for this program closed December 31, 2022, and will not reopen until Summer 2023.[215]

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[214] Idaho Governor's Office of Energy and Mineral Resources. "State Energy Loan Program." https://oemr.idaho.gov/loan-program/

[215] Idaho Governor's Office of Energy and Mineral Resources. "Press Release." https://oemr.idaho.gov/wp-content/uploads/Release-2022-11_The-State-Energy-Loan-Program-will-Close-Dec.-31-2022.pdf

5.1.3 Government Leading by Example Program

OEMR has offered the Government Leading by Example Program (GLBE) since 2014. GLBE provides financial assistance to rural communities to conduct energy audits to discover potential efficiency upgrades within publicly owned facilities and save taxpayer dollars. OEMR continues to work with The University of Idaho’s Integrated Design Lab. The Integrated Design Lab conducts a Level 1 American Society of Heating, Refrigerating, and Air-Conditioning Engineers energy audit at the applicant’s facility to capture energy saving opportunities within the public facility.

Upon completing the energy audit, the Integrated Design Lab, the applicant, and OEMR meet to discuss energy efficiency upgrades. Depending on the recommendations and the cost, OEMR may offer the applicant cost-share to complete retrofits for the publicly owned building.

Energy upgrades eligible for cost-share include:[216]

- efficient lighting,
- air conditioning units,
- insulation,
- air duct,
- sealing,
- heat pump,
- HVAC system repair, and
- ventilation.

OEMR is committed to expanding outreach to rural partners throughout Idaho. In 2022, OEMR coordinated with the Idaho Department of Commerce and rural economic development professionals throughout the state to share information about GLBE.

[216] Idaho Governor’s Office of Energy and Mineral Resources. “Government Leading by Example.” https://oemr.idaho.gov/financial-information/government-leading-by-example/

Figure 34: Owyhee County Historical Museum GLBE Award

In 2022, the Owyhee County Historical Museum completed a retrofit in their annex building with assistance from OEMR's GLBE Program.

The 6,000 square-foot warehouse-style multi-use building started out with four small fluorescent fixtures in the center of the building which did not produce enough light for the entire building. The county removed the older light fixtures and installed nine new LED fixtures which operate on a sensor that automatically shuts off every fifteen minutes, saving energy and overall utility costs for the museum. Through these energy efficiency measures the museum can put their cost savings towards improvements to provide an enhanced visitor experience.

Eriks Garsvo, Director of the Owyhee County Historical Museum, has been passionate about reducing energy consumption. "Reducing energy saves Owyhee County taxpayers' money," says Garsvo.

5.1.4 State of Idaho Weatherization Assistance Program

DWH administers the State of Idaho Weatherization Assistance Program (WAP). The DHW contracts with local community action agencies and nonprofits to install weatherization improvements in low-income households throughout the state. The analysis helps determine the most appropriate cost-effective measures and identifies health and safety concerns. Low-income households carry a larger burden for energy costs, typically spending 13.9% of total annual income versus 3.0% for other households.[217]

[217] U.S. Department of Energy. "Weatherization Assistance Program Fact Sheet." https://www.energy.gov/eere/wap/articles/weatherization-assistance-program-fact-sheet

Typical weatherization measures include:[218]

- Install programmable thermostats, insulation, efficient light sources, and mechanical ventilation.
- Repair or replace heating or cooling systems, water heaters, windows, doors, and refrigerators.

Between 2010 and 2021, Idaho weatherized an average of 276 homes per year through the WAP.[219] DHW expects to receive additional funding to address the ongoing weatherization needs throughout the state under the BIL.[220] The funds will remain available until expended.

5.2 Northwest Power and Conservation Council's Eighth Power Plan

The Council's Eighth Power Plan, also referred to as the 2021 Power Plan, was published in May 2022 with a six-year action plan period from 2022-2027.[221] The 2021 Power Plan emphasizes that maintaining an adequate and reliable power supply over the action plan period will be challenging due to the region's increased dependence on variable renewable resources. The Council recommends that the region acquire between 750 and 1,000 average megawatts of cost-effective energy efficiency by the end of 2027 and at least 2,400 average megawatts by the end of 2041. The 2021 Power Plan includes less efficiency than past plans, which underscores the high achievements of the last 40 years. Further, the Council recommends utilities examine two demand response products: residential time-of-use (TOU) rates and demand voltage regulation (DVR) to offset the electric system needs during peak periods.[222]

5.3 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 2,505 aMW in electricity savings through energy efficiency.[223] The municipal and cooperative utilities BPA supplies wholesale electric power to typically engage in the Integrated Program Review processes. In 2022, BPA will be updating its Energy Efficiency Action Plan targets to reflect new input from the Council's 2021 Power Plan and its own Resource Program analysis. BPA will continue to offer 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 supports cost-effective efforts of individual public utilities.

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[218] U.S. Department of Energy. "Weatherization Assistance Program Fact Sheet." https://www.energy.gov/eere/wap/articles/weatherization-assistance-program-fact-sheet

[219] U.S. Department of Energy. "Weatherization and Intergovernmental Programs Office Project Map – Idaho." https://www.energy.gov/eere/wipo/articles/weatherization-and-intergovernmental-programs-office-project-map-idaho#:~:text=The%20Idaho%20Department%20of%20Health%20and%20Welfare%20is,weatherization%20improvements%20in%20low-income%20households%20throughout%20the%20state.

[220] U.S. Department of Energy. "Weatherization Assistance Program." https://www.energy.gov/bil/weatherization-assistance-program

[221] National Archives Federal Register. "2021 Northwest Conservation and Electric Power Plan." https://www.federalregister.gov/documents/2022/05/27/2022-11472/2021-northwest-conservation-and-electric-power-plan

[222] Northwest Power and Conservation Council. "The 2021 Northwest Power Plan." https://www.nwcouncil.org/media/filer_public/4b/68/4b681860-f663-4728-987e-7f02cd09ef9c/2021powerplan_2022-3.pdf

[223] Bonneville Power Administration. "Fiscal Year 2020 Red Book https://www.bpa.gov/EE/Utility/researcharchive/Documents/The_Red_Book_FY2020.pdf

Idaho cooperative and municipal utilities through their rates with BPA invested over $5 million in energy efficiency measures through direct payments to customers in 2020 and 2021. Cooperative and municipal utilities in Idaho have been utilizing energy efficiency programs to help meet additional resource needs for over 30 years.

5.4 Idaho Power Energy Efficiency

Since 2002, Idaho Power has achieved a cumulative average annual load reduction of 289 aMW through energy efficiency investments. For the 2023 IRP, Idaho Power analyzed the amount of achievable, cost-effective energy efficiency potential for the period of 2023 – 2042. Idaho Power predicts potential energy efficiency savings to be approximately 107,000 MWh in 2023 and reaches 2,043,000 MWh cumulative achievable savings by 2042.[224]

In 2021, Idaho Power's energy efficiency programs had energy savings of 143,971 MWh, which is enough energy to power more than 12,600 average homes for one year.[225] The 2021 savings from Idaho Power's energy efficiency programs alone, without the estimated savings from NEEA, was 126,102 MWh which is a 27% decrease from the 2020 energy savings of 198,433 MWh.[226] Idaho Power offers educational resources to drive behavior change and create awareness of, and demand for, energy efficiency programs.

Idaho Power operated three demand response programs in 2021. The total demand response capacity was approximately 384 MW with an actual load reduction of 312.8 MW.[227]

Total expenditures from all funding sources of DSM activities were $38.4 million in 2021 ($27.9 million from the Idaho Rider, $8.7 million from Idaho Power base rates, and $1.7 million from the Oregon Rider). DSM program funding comes from the Idaho and Oregon Riders, Idaho Power base rates, and the annual power cost adjustment (PCA).[228]

5.5 PacifiCorp Energy Efficiency

PacifiCorp evaluates new DSM opportunities to include energy efficiency and direct load control programs. PacifiCorp classifies DSM resources into four categories, identified by two primary characteristics: reliability and customer choice. These resources are captured through programmatic efforts that focus on efficient electricity use through load control, price response, energy efficiency and education and behaviors. PacifiCorp has been operating DSM programs since the late 1970's.[229]

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[224] Idaho Power. "Our Plan." https://www.idahopower.com/energy-environment/energy/planning-and-electrical-projects/our-twenty-year-plan/

[225] Idaho Power Company. "Demand-Side Management 2021 Annual Report." https://docs.idahopower.com/pdfs/EnergyEfficiency/Reports/2021DSM.pdf

[226] Idaho Power Company. "Demand-Side Management 2021 Annual Report." https://docs.idahopower.com/pdfs/EnergyEfficiency/Reports/2021DSM.pdf

[227] Idaho Power. "2021 Annual Report." https://docs.idahopower.com/pdfs/energyefficiency/reports/2021dsm.pdf

[228] Idaho Power. "2021 Annual Report." https://docs.idahopower.com/pdfs/energyefficiency/reports/2021dsm.pdf

[229] PacifiCorp. "2021 Integrated Resource Plan." https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2021-irp/Volume I - 9.15.2021 Final.pdf

PacifiCorp plans to increase their DSM resources across their entire service territory over the next twenty years. By the end of 2024, PacifiCorp's preferred portfolio anticipates more than 1,150 MW of energy efficiency and demand response resource capacity. Energy efficiency programs are expected to meet about 64% of that predicted capacity.[230]

5.6 Avista Energy Efficiency

Avista began their demand response program in 2001. This program, along with commercial and residential energy efficiency programs, reduces the need to purchase high-cost wholesale electricity from out-of-state networks. Avista has retained the Applied Energy Group (AEG), a consultant, to study the potential of demand response for the 2022-2045 planning horizon. AEG is focused on developing reliable estimates of the magnitude, timing, and costs of demand response resources, allowing Avista to meet both winter and summer peak loads.

Current demand response programs that are in place include; direct load control and TOU rates; direct load control controls temperatures with a programmable thermostat; firm curtailment programs have customers who agree to reduce demand by a specific amount or to a pre-specified consumption level during the event in exchange for fixed incentive payments; TOU rates provides customers with an incentive to shift consumption out of higher-price-on-peak hours to lower cost off-peak hours.[231]

Avista had 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 14.5%, or by 160 aMW.[232] Avista's 2020 IRP highlighted that, over their 25-year forecast, the company's energy efficiency programs will reduce regional emissions by 4.8 million metric tons between 2021 and 2045. In addition, Avista now predicts that energy efficiency will serve 71% of future load growth, an increase from 53% as stated in the 2017 IRP.[233]

5.7 Intermountain Gas Energy Efficiency

In 2017, IGC was granted authority by the Idaho PUC to implement an energy efficiency program. The IGC Energy Efficiency Program was designed to acquire cost-effective DSM resources in the form of natural gas thermal savings. This program offers rebates for residential customers who purchase and install qualifying high-efficiency natural gas equipment, construct energy efficient homes, and for commercial customers for the installation of high-efficiency natural gas space heating and commercial kitchen equipment.

[230] PacifiCorp. "2021 Integrated Resource Plan." https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2021-irp/Volume I - 9.15.2021 Final.pdf
[231] Avista. "2021 Electric Integrated Resource Plan." https://www.myavista.com/about-us/integrated-resource-planning
[232] Avista. "2021 Electric IRP." https://www.myavista.com/about-us/integrated-resource-planning
[233] Avista. "2020 Electric IRP." https://www.myavista.com/about-us/integrated-resource-planning

In addition, IGC offers free educational resources to assist customers in making energy efficiency decisions. IGC's website provides energy saving tips for home and business,[234] an energy efficiency savings calculator,[235] and a commercial food service equipment savings calculator.[236]

In 2021, 5,553 high-efficiency measures were rebated to IGC customers, a 22% increase from the previous year.[237] In spring 2023, IGC plans to conduct a Conservation Potential Assessment (CPA) to explore additional energy savings opportunities for residential and commercial customers.

5.8 Distributed Energy Resources

Distributed energy resources (DER), also called on-site, dispersed, or decentralized generation, are small power sources that can be combined to provide power to satisfy demand.[238] Typically producing less than 10 MW, such sources can include micro-turbines, small natural gas-fueled generators, CHP plants, battery storage, biomass, wind and solar thermal or PV installations. The use of DERs is becoming common due to the potential for affordable renewable energy, and an increased desire for grid resiliency, largely motivated by increased occurrences of natural disasters such as storms and wildfires.[239] Complex and expensive integration upgrades and power-balancing mechanisms will be required as use of DERs increases.

RTOs/ISOs are required to open their electricity markets to participation by aggregated DERs. To comply, each RTO/ISO must file with FERC tariff provisions that establish market rules addressing specific technical and operational details impacting market participation by DER aggregations.[240]

5.9 Energy Storage Technologies and Approaches

Energy storage technologies provide the ability to store energy for use at later times, adding enhanced control, reliability, and resiliency to the grid. In 2020, the U.S. had 23 GW of installed energy storage. It is projected that installed energy storage will exceed 30 GW by the end of 2025 and 125 GW by 2050.[241] Almost all existing storage is pumped-hydroelectric storage. [242] Energy storage is important as the grid incorporates intermittent energy resources such as wind and solar.

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[234] Intermountain Gas. "Energy Savings Tips." https://www.intgas.com/energy-efficiency_program/energy-saving-tips/
[235] Intermountain Gas. "Energy Efficiency Savings Calculator." https://www.intgas.com/energy-efficiency-savings-calculator/
[236] Intermountain Gas. "Commercial Food Service Equipment Calculator." https://www.intgas.com/energy-efficiency_program/commercial-energy-efficiency/
[237] Intermountain Gas. "2021 Annual Energy Efficiency Report." https://www.intgas.com/energy-efficiency_program/
[238] 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
[239] 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
[240] Advanced Energy Economy. "Opening the Door to DERs." https://info.aee.net/hubfs/Order%202222%20Explainer%20final.pdf
[241] National Renewable Energy Laboratory. "Storage Futures Study: Economic Potential of Diurnal Storage in the U.S. Power Sector." https://www.nrel.gov/docs/fy21osti/77449.pdf and U.S. Energy Information Administration. "U.S. battery storage capacity will increase significantly by 2025". https://www.eia.gov/todayinenergy/detail.php?id=54939
[242] Office of Energy Efficiency and Renewable Energy. "U.S. Hydropower Market Report." https://www.energy.gov/eere/water/events/key-industry-trends-us-hydropower-overview-2021-edition-us-hydropower-market

While there is new research and development in energy storage, some technologies are widely deployed to provide added resilience and reliability to the grid. Common storage technologies include mechanical (pumped-storage hydroelectric power and compressed air), electrochemical (lithium-ion batteries, flow batteries, and hydrogen), and thermal.

Energy storage can play a key role in providing overall grid security and resilience, while allowing critical infrastructure, hospitals, police stations, and essential services to remain operational during emergency situations. There are federal programs that promote the adoption of additional energy storage in the U.S. for resiliency purposes at critical facilities. While the cost of energy storage infrastructure is significant, more affordable utility-scale storage systems are under development.[243]

5.10 Mechanical Storage

Mechanical storage systems use kinetic or gravitational forces to store energy. One example of a mechanical storage system is the flywheel, a device 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.[244]

An example of mechanical storage is 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. Additionally, pumped hydroelectric storage provides added reliability or ancillary services.[245]

Much of the pumped hydroelectric storage infrastructure across the nation emerged during the 1970s. Pumped hydroelectric storage projects range from 10 MWh to 10 GWh. As of 2021, the U.S. electricity system had about 24 GW of energy storage, 23 GW of which is pumped hydroelectric storage.[246]

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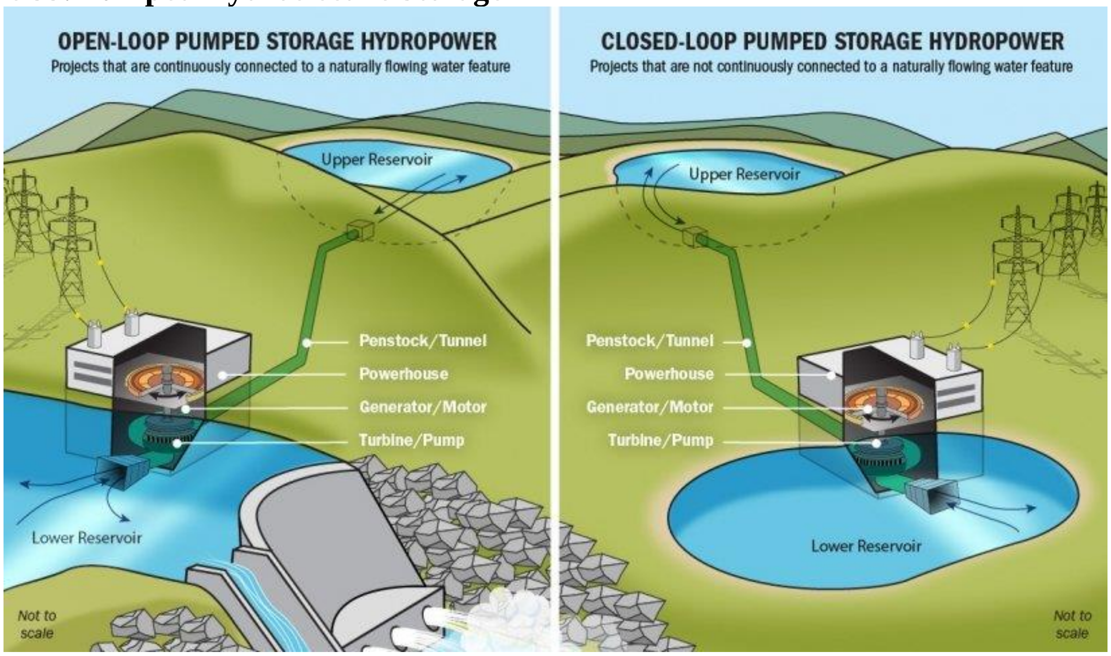
[243] U.S. Department of Energy: Office of Electricity. "Energy Storage." https://www.energy.gov/oe/activities/technology-development/energy-storage

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

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

[246] Office of Energy Efficiency and Renewable Energy. "U.S. Hydropower Market Report." https://www.energy.gov/eere/water/events/key-industry-trends-us-hydropower-overview-2021-edition-us-hydropower-market

Figure 35: Pumped Hydroelectric Storage[247]



5.11 Battery Storage

Battery storage can store excess energy at residential, commercial, and utility scales. Energy storage batteries work similarly to smaller batteries used in our everyday lives but have much greater storage capacities. Battery storage technology is rapidly growing and evolving due to scalability and accessibility. Projections show an estimated 25-35 GW of additional battery storage by 2025.[248] Battery projects typically range from 10 kWh to 10 MWh. Small-scale batteries are being added to residential solar systems by the nation's leading solar installers. A fast-growing trend is utility-scale hybrid generation plants which combine renewable energy with on-site storage, offering increased stability and flexibility to the grid. In 2020, 36% of solar project that connected to the grid were paired with batteries.[249]

Batteries usually have short- to mid-range response times of seconds to hours. There are two categories of batteries used for energy storage, solid-state and flow batteries. Solid-state batteries utilize 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 widely adopted lithium-ion and sodium-ion, but hybrid batteries and flow or redox flow batteries with a wide range of chemistries are becoming increasingly popular. Research continues across all battery storage types.[250]

[247] U.S. Department of Energy. "Pumped Storage Hydropower." https://www.energy.gov/eere/water/pumped-storage-hydropower
[248] 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
[249] Lawrence Berkeley National Lab. "Keep it short: Exploring the impacts of configuration choices on the recent economic of solar-plus-battery and wind-plus-battery hybrid energy plants." https://eta-publications.lbl.gov/sites/default/files/doe_webinar_hybrid_configuration_briefing_final.pdf
[250] Energy Storage Association. "Batteries." https://energystorage.org/why-energy-storage/technologies/solid-electrode-batteries/

5.12 Hydrogen Storage

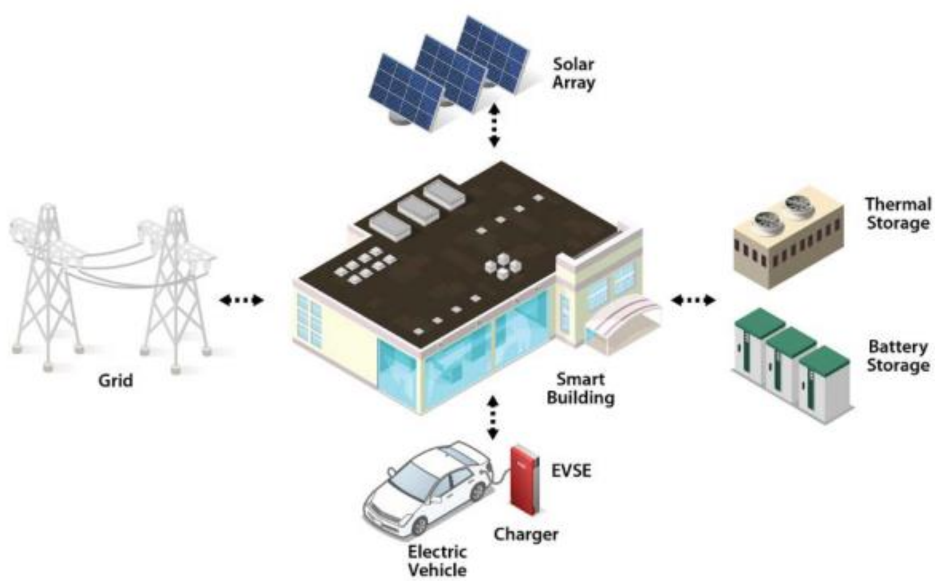
Electricity can be converted into hydrogen, which can be stored and re-electrified. This can occur in fuel cells or through burning in combined cycle gas power plants. Small amounts of hydrogen can be stored in pressurized vessels and large amounts of hydrogen can be stored in constructed underground salt caverns. Electrolysis can mitigate the grid impacts associated with excess wind or solar production, including seasonal-scale variations.[251] Hydrogen projects range in size from 1 GWh to 1 TWh.

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. Hydrogen has a multitude of uses once it is created. Hydrogen can be used in fuel cells, power generation, natural gas blending, or stored as compressed gas. Hydrogen can be stored for long periods of time and in very large quantities.

5.13 Thermal Storage

Thermal storage traps energy temporarily in the form of heat or cold which allows the energy to be turned into electricity later. An example of this at utility-scale includes solar thermal power plants that use molten salt or other heat-retaining substances to store the sun's energy, which can be utilized later in steam generating processes.[252]

Figure 36: Grid-Interactive Integrated Energy Ecosystem Harnessing Energy Storage, Renewable Generation, and EV Charging[253]



[251] Energy Storage Association. "Hydrogen Energy Storage." https://energystorage.org/why-energy-storage/technologies/hydrogen-energy-storage/

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

[253] U.S. Department of Energy. "2021 Thermal Energy Storage Systems for Buildings Workshop." https://www1.eere.energy.gov/buildings/pdfs/80376.pdf

6. Outlook

6.1 Utility Integrated Resource Plans

Idaho's IOUs work with local stakeholders to develop 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 factors. Idaho IOU IRPs are available to the public on the Idaho PUC's website.

6.2 Future Planned Development

Table 1: Planned Investments in Electric Generating Facilities by Idaho IOUs, 2023-2041[254]

Year	Utility	Investment Type	Nameplate Capacity (MW)
2023	Avista	New Wind	100
2023	Idaho Power	New Solar	120
2023	Idaho Power	New Battery Storage	100
2023	Idaho Power	Distributed Storage	15
2024	Avista	New Wind	100
2024	Idaho Power	Distributed Storage	5
2024	Idaho Power	New Wind	700
2024	Idaho Power	New Natural Gas	357
2024	PacifiCorp	New Solar	1,302
2024	PacifiCorp	New Wind	1,920
2024	PacifiCorp	New Battery Storage	700
2025	Idaho Power	Distributed Storage	5
2025	Idaho Power	New Solar	300
2025	Idaho Power	New Battery Storage	105
2026	Avista	Kettle Falls Generating Station Modernization	12
2026	Avista	Post Falls Hydroelectricity Facility Modernization	8
2026	Idaho Power	New Solar	215
2026	PacifiCorp	New Solar+Storage	600
2026	PacifiCorp	New Solar	1,902
2026-2029	Avista	Rathdrum Combustion Turbine (CT) 1&2 Modernization	24

[254] Avista. "2021 Electric IRP." https://www.myavista.com/about-us/integrated-resource-planning; PacifiCorp. "2021 Integrated Resource Plan Update." https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2021_IRP_Update.pdf; and Idaho Power "December 2021 IRP." https://docs.idahopower.com/pdfs/AboutUs/PlanningForFuture/irp/2019/SecondAmended2019IRP.pdf

Year Cont.	Utility Cont.	Investment Type Cont.	Nameplate Capacity (MW) Cont.
2027	Avista	New Natural Gas	211
2027	Idaho Power	Distributed Storage	5
2027	Idaho Power	New Solar	250
2028	Avista	New Wind	100
2028	Idaho Power	New Solar	120
2028	PacifiCorp	Advanced Nuclear	500
2029	Idaho Power	New Solar	100
2031	Avista	Mid-Columbia Hydro Extension	75
2031	Idaho Power	New Natural Gas Peaker	300
2035	Avista	Rathdrum Upgrade	5
2036	Avista	Natural Gas CT	87
2038	Avista	Solar+Storage	150
2038	PacifiCorp	New Non-Emitting Peaker	412
2038	PacifiCorp	New Advanced Nuclear	1000
2041	Avista	New Wind	100
2041	Avista	Natural Gas Peaker	36

Table 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 PURPA or developed as DERs.

Table 2: Major Planned Transmission Projects by Idaho IOUs, 2024-2030[255]

Year	Utility	Investment Type	Capacity (kV)
2024	PacifiCorp	Windstar to Aeolus (Gateway West)	230
2024	PacifiCorp	Aeolus to Mona	500
2024	LS Power	Midpoint to Robinson (SWIP North)	500
2026	PacifiCorp	Oquirrh to Terminal	345
2026	PacifiCorp, BPA, Idaho Power	Boardman to Hemingway	500
2027	PacifiCorp	Bridger/Anticline-Populous (Gateway West)	500

[255] Avista. "2021 Electric IRP." https://www.myavista.com/about-us/integrated-resource-planning; PacifiCorp. "2021 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; LS Power. https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M353/K226/353226801.PDF

2030	PacifiCorp, Idaho Power	Populus to Hemingway (Gateway West)	500

Note: Tables 1 & 2 report the generation and transmission facilities included in the preferred resource strategy from each utility based upon their most recent IRPs or IRP Updates.

IOU planned transmission projects are listed in Table 2. Other organizations are continuing plans on transmission projects in and around Idaho. BPA's Hooper Springs transmission line completed construction in southeast Idaho in Fall 2019.[256]

Figure 37: Figure 5.1 Construction of the Gateway West Transmission Line[257]

Table 3: Announced Coal-fired Generation Facility Exits or Retirements by Idaho IOUs, 2023-2039[258]

Year	Utility	Investment Type	Capacity (MW)
2023	Idaho Power	Jim Bridger 1 & 2	-357
2023	PacifiCorp	Jim Bridger 1 & 2[259]	-354
2025	Idaho Power	Jim Bridger 3[260]	-174
2025	Idaho Power	North Valmy 2[261]	-134
2025	PacifiCorp	Naughton 1 & 2	-375
2025	PacifiCorp	Colstrip 3 & 4	-148

[256] 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
[257] HDR Engineering. "Gateway West Transmission Line, Aeolus to Jim Bridger." https://www.hdrinc.com/portfolio/gateway-west-transmission-line-aeolus-jim-bridger
[258] 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
[259] Jim Bridger Units 1-2, converted to natural gas peakers in 2024. https://docs.idahopower.com/pdfs/AboutUs/PlanningforFuture/irp/2021/2021%20irp_web.pdf
[260] Idaho Power IRP, 2021. https://docs.idahopower.com/pdfs/AboutUs/PlanningforFuture/irp/2021/2021%20irp_web.pdf
[261] Idaho Power is conducting further analysis of North Valmy Unit 2 exit timing. Idaho Power IRP, 2021. https://docs.idahopower.com/pdfs/AboutUs/PlanningforFuture/irp/2021/2021%20irp_web.pdf

2025	Avista	Colstrip 3 & 4[262]	-222
2026	Idaho Power	Jim Bridger 2[263]	-180
2027	PacifiCorp	Dave Johnston 1 – 4	-755
2028	Idaho Power	Jim Bridger 4	-177
2036	PacifiCorp	Huntington 1 & 2	-909
2037	PacifiCorp	Jim Bridger 3 & 4	-702
2039	PacifiCorp	Wyodak	-268

Note: Table 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 3 shows the coal-fired facilities that are owned by Idaho utilities. This table reflects the utilities' exit and retirement dates from coal units as they 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.

6.3 Microgrids

A microgrid is a group of interconnected loads and DER 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 as needed.[264] Microgrids are an emerging resource that optimizes access reliable, clean, and resilient energy through local, interconnected energy systems that incorporate loads, decentralized energy resources, battery storage, and control capabilities.

INL and Idaho Falls Power began studying the benefits of hydroelectric microgrids in 2016. In April 2021, the entities successfully tested and stabilized the hydroelectric microgrid meaning the hydroelectricity produced by the city's Lower, Older Lower, and City hydroelectric plants can provide enough energy to power a variety of essential facilities should they become disconnected from the grid.

[262] Avista has received approval for the 2025 life in Washington but has not received authorization in Idaho to recover all costs through 2027.
[263] 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.
[264] 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

Figure 38: INL and Idaho Falls Power Test Ultracapacitors[265]

6.3.1 Smart Grid

Electric infrastructure in Idaho and the U.S. is aging and reaching capacity. Modernizing the grid to make it "smarter" and more resilient through use of cutting-edge technologies, equipment, and controls that communicate and work together to deliver electricity more reliably and efficiently can greatly reduce the frequency and duration of power outages, reduce storm impacts, and restore service faster when outages occur. Smart grid technologies are made possible by two-way communication technologies, control systems, and computer processing. These advanced technologies include advanced sensors known as Phasor Measurement Units (PMUs) that allow operators to assess grid stability, advanced digital meters that give consumers better information and automatically report outages, relays that sense and recover from faults in the substation automatically, automated feeder switches that re-route power around problems, and batteries that store excess energy and make it available later to the grid to meet customer demand.[266]

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's grid. Smart grid development will help facilitate the deployment of EVs and reduce carbon emissions in the transportation sector.

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[265] Photo courtesy of Idaho National Laboratory. U.S. Department of Energy. "First-of-a-Kind Tests Demonstrate How Small Hydropower Plants and Energy Storage Can Enhance Grid Reliability and Resilience."
https://www.energy.gov/eere/water/articles/first-kind-tests-demonstrate-how-small-hydropower-plants-and-energy-storage-can
[266] U.S. Department of Energy. "Grid Modernization and the Smart Grid." https://www.energy.gov/oe/activities/technology-development/grid-modernization-and-smart-grid

In 2022, the DOE launched the new Grid Deployment Office. The Grid Deployment Office is administering $17 billion in BIL programs such as the Smart Grid Grant Program. The Smart Grid Grant Program will fund a broad suite of grid-enhancing technologies that will increase the capacity of the existing transmission system.[267]

6.4 Electric Vehicles

EVs are vehicles that run on batteries powered by electricity rather than internal combustion engines. EV adoption is increasing rapidly across the country as advancements in technology have improved battery performance and range. Moreover, many Idaho organizations, such as Boise State University, are transitioning to electric fleet vehicles. As of July 2022, Idaho had a total of 4,508 EV registrations statewide.

Figure 39: Boise State University Electric Fleet Vehicle

There are three "levels" of EV charging. EVs can be charged overnight via common 120-volt outlets, also called Level 1 charging. 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).[268] Lastly, direct current fast chargers (DCFC) require a specialized, 480-volt outlet and can provide a full charge after 20-30 minutes (this may vary). Level 1 and 2 chargers are better suited to day-to-day use, but DCFC are the most popular options for long range road trips.[269] As of 2022, Idaho has 153 EV station locations and 381 EVSE ports available to the public.[270] The number of DCFC ports will continue to grow as OEMR administers over $32 million through the EVSE Program and the NEVI Program.

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[267] U.S. Department of Energy. "Grid Deployment Office." https://www.energy.gov/gdo/grid-deployment-office
[268] U.S. Department of Energy. "Electric Vehicles: Charging at Home." https://www.energy.gov/eere/electricvehicles/charging-home
[269] U.S. Department of Energy. "Electric Vehicles: Vehicle Charging." https://energy.gov/eere/electricvehicles/vehicle-charging
[270] U.S. Department of Energy. "Electric Vehicle Charging Station Locations Idaho." https://afdc.energy.gov/fuels/electricity_locations.html#/analyze?fuel=ELEC

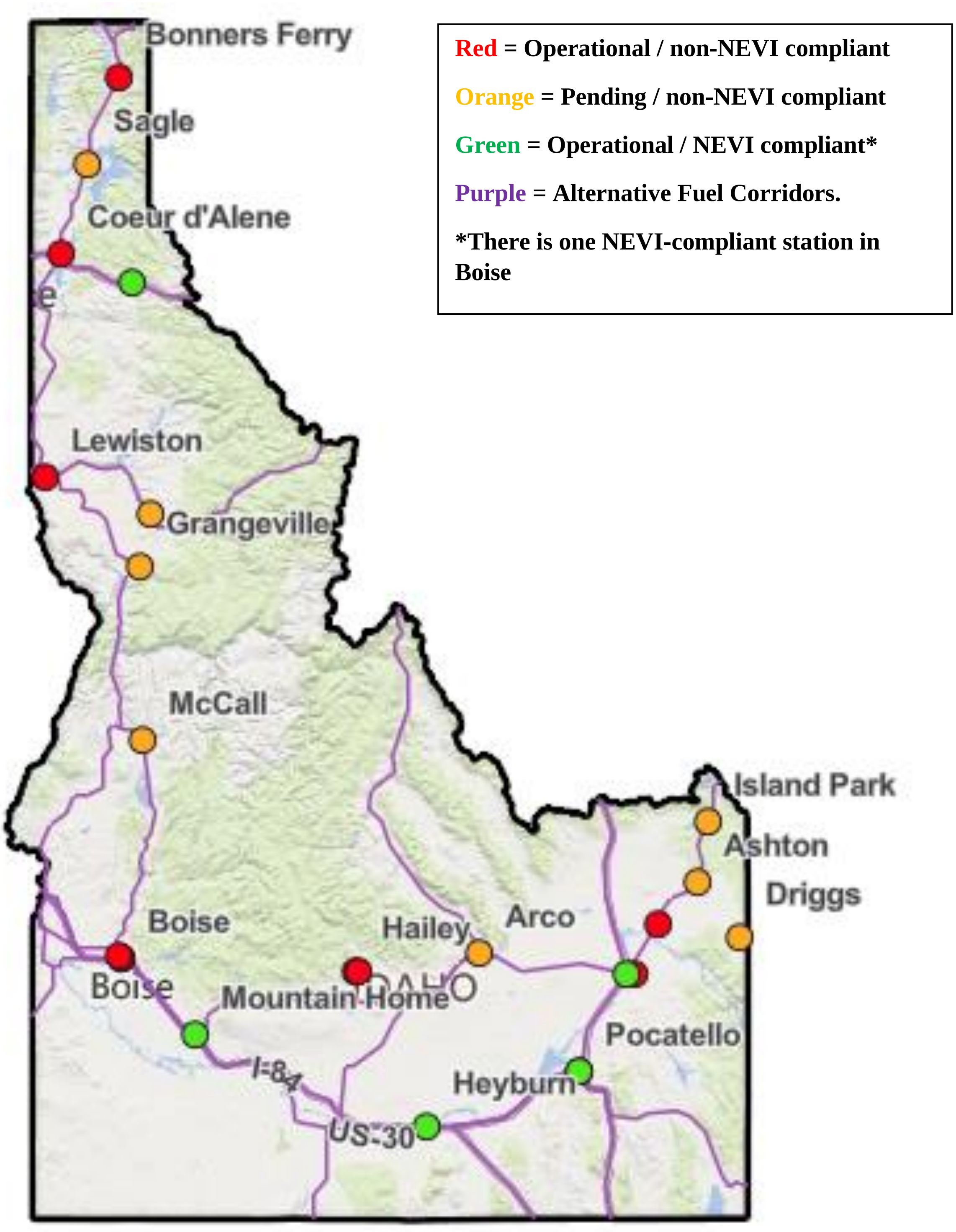
Figure 40: EV Charging Levels[271]

Charging Level	Vehicle Range Added per Charging Time and Power	Supply Power
AC Level 1	4 mi/hour @ 1.4kW 6 mi/hour @ 1.9kW	120VAC/20A *(12-16A continuous)*
AC Level 2	10 mi/hour @ 3.4kW 20 mi/hour @ 6.6kW 60 mi/hour @ 19.2 kW	208/240VAC/20-100A *(16-80A continuous)*
DC Fast Charging	24 mi/20minutes @24kW 50 mi/20minutes @50kW 90 mi/20minutes @90kW	208/480VAC 3-phase *(input current proportional to output power; ~20-400A AC)*

The state of Idaho supports local and regional EV development efforts and has offered grants, such as the EVSE Program, as well as technical assistance to deploy publicly available DCFC infrastructure. Additionally, the state participates in regional efforts such as Regional Electric Vehicle West (REV West) and ChargeWest™, which are partnerships between Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming to educate consumers and fleet owners to raise EV awareness, reduce range anxiety, increase EV adoption, and coordinate EV charging locations.

[271] U.S. Department of Energy. "Costs Associated with Non-Residential Electric Vehicle Supply Equipment." https://afdc.energy.gov/files/u/publications/evse_cost_report_2015.pdf"

Figure 41: EV DCFC Station and Alternative Fuel Corridor Locations in Idaho



6.4.1 State of Idaho Electric Vehicle Supply Equipment Program (2017-2022)

The Volkswagen Clean Air Act Civil Settlement enabled the state of Idaho to allocate $2.6 million to provide incentives for entities to deploy EVSE. Throughout 2017-2022, Idaho's EVSE Program provided cost-share funds for the deployment of public DCFC equipment along Idaho's major travel corridors. In total, twelve sites were selected in the following locations: Lewiston, Hailey, Bonners Ferry, Coeur d'Alene, Sagle, McCall, Ashton, Driggs, Kamiah, Grangeville, Arco, and Island Park.

> **Through the State of Idaho EVSE Program the City of Bonners Ferry installed one DCFC at the Bonners Ferry Visitor Center.**
>
> **<u>What inspired you to apply to the EVSE Program?</u>**
>
> "The City of Bonners Ferry owns and operations its own electric utility and because of this, we felt that we could control the whole process from conception to operations. We also felt that, while some businesses were providing AC charging stations as part of their business model, there were no DCFC within 50 miles of Bonners Ferry. We felt that having the station would allow downtown businesses to benefit from the installation. Additionally, we hoped that by having the station on Highway 95 that we would attract folks from other areas who may have chosen alternate routes but would choose this route to access the station." – Lisa Ailport, Bonners Ferry City Administrator

6.4.2 National Electric Vehicle Formula Program

The NEVI Program was enabled through the BIL and established by the FHWA to provide states with federal funding to strategically deploy DCFC and establish an interconnected network of EV charging across the U.S. Throughout Fiscal Year 2022-2026, Idaho will receive approximately $29 million to install DCFC along designated Alternative Fuel Corridors and in rural and disadvantaged areas. OEMR, ITD, and DEQ are developing a Siting, Feasibility, and Access Study to inform the strategic buildout of DCFC.

Stations built with NEVI formula funds must meet federal guidelines unless exceptions are approved by the FHWA. Stations must be capable of charging at least four cars simultaneously, with each port capable of delivering at least 150 kW of charge. Federal guidance has directed a goal for NEVI-funded charging stations to be available at 50-mile intervals along and no farther than 1 mile from designated Alternative Fuel Corridors. Figure 41 illustrates DCFC locations and Alternative Fuel Corridors throughout Idaho.

6.4.3 Idaho, Montana, Wyoming ChargeWest™ Launch Event

On September 15, 2022, OEMR, in partnership with Montana and Wyoming, launched the ChargeWest™ initiative and celebrated the completion of the EVSE Program. The event was held in Island Park, Idaho, a gateway tourism community where a new DCFC will be installed through the EVSE Program. The event showcased Idaho's ability to adopt EV infrastructure and demonstrated a collaborative effort among intermountain states to support interstate travel.

Figure 42: EVs Showcased at the ChargeWest™ Launch Event[272]

[272] Utah Clean Cities. "ChargeWest™ Launch Event: Idaho, Montana, and Wyoming." https://www.youtube.com/watch?v=Es-lyuecTG4

7. Energy Research and Education Entities in Idaho

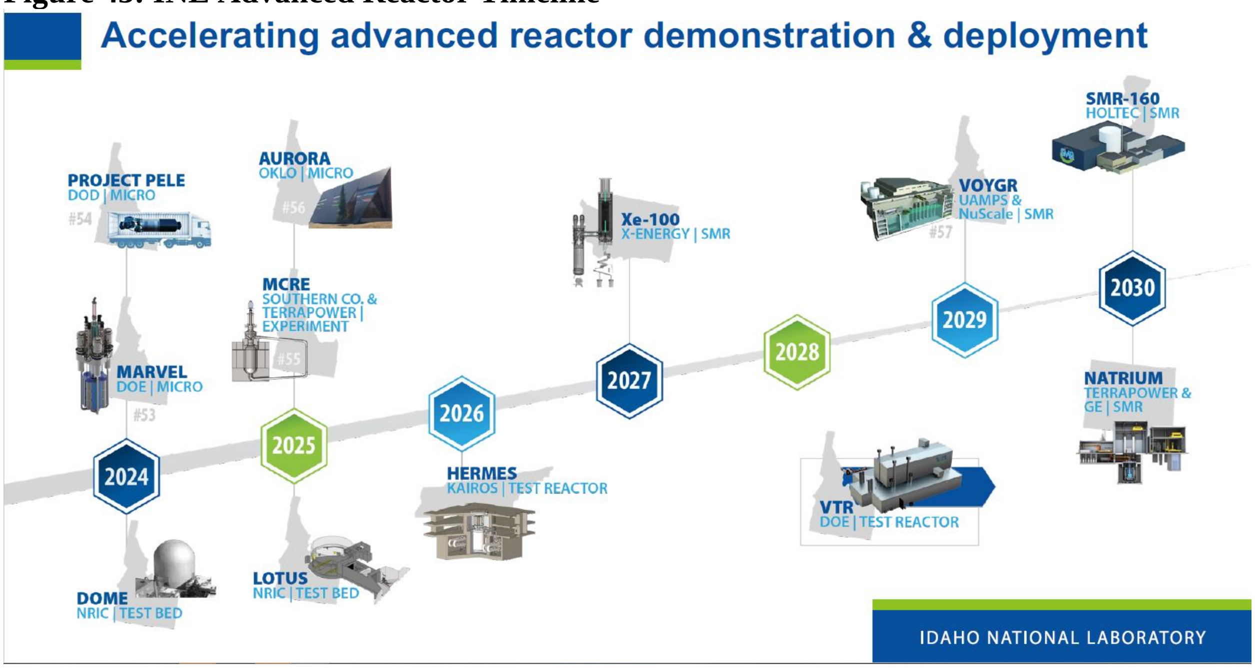
7.1 Research at Idaho National Laboratory

With nearly 5,700 employees, INL is one of the state's largest employers and a major contributor to Idaho's economy. INL is the DOE's nuclear energy research, development, and demonstration center. INL is a major leader in broader clean energy research and a recognized world leader in cybersecurity and critical infrastructure protection. On its 890 square-mile site and growing campus in Idaho Falls, INL has many unique research facilities and capabilities.

Nuclear Science & Technology: INL pioneers many advanced nuclear energy projects being developed around the country to address growing power needs while also reducing carbon emissions. INL leads two national programs focused on commercializing advanced nuclear technologies: GAIN and the National Reactor Innovation Center (NRIC).

Several advanced reactor demonstrations are expected to be located at INL this decade.

Figure 43: INL Advanced Reactor Timeline[273]



Energy Environment Science and Technology: INL's researchers work to accelerate the integration of clean energy sources into the nation's grid. Those sources include nuclear, solar, wind, geothermal, and bio-based energy.

[273] Picture courtesy of INL.

INL is working directly with nuclear power providers to use excess heat at their power plants to produce clean hydrogen, which can be used to decarbonize industrial, manufacturing, and transportation processes.

INL works with the agricultural industry to convert waste products into clean energy. Additionally, INL is a recognized world leader in EV battery research and the development of charging station infrastructure.

National & Homeland Security: INL is recognized for its work in industrial cybersecurity and critical infrastructure protection. INL's 890 square-mile site contains unparalleled assets, such as a wireless test bed, the nation's first security-focused 5G wireless test range. This range allows the Department of Defense and other agencies to address communication challenges, advance 5G security, and improve safety for troops. INL also has a utility-scale grid test bed, complete with hundreds of miles of transmission lines to be utilized for testing real world security scenarios by industry, government, and other partners.

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

7.2 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, University of Idaho, and University of Wyoming. CAES headquarters is a state-owned, energy efficient facility located 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.[274] 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.[275]

Based at Boise State University, the Energy Policy Institute (EPI) is the policy arm of CAES. EPI 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. EPI's team works with policymakers, industry, and communities to advance understanding and decisions about clean, safe, and secure energy systems.

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[274] Center for Advanced Energy Studies. "About Us." https://caesenergy.org/about-us/
[275] Center for Advanced Energy Studies. "Core Capabilities." https://caesenergy.org/research/core-capabilities/

7.3 Universities, Colleges, and Technical Training

Many of Idaho's higher education institutions are engaged in educating tomorrow's energy workforce. These are only a handful of programs offered among higher education institutions. For example, elective and certificate courses are offered in energy generation, energy efficiency and renewable energy at Boise State University.[276] The courses provide both non-science and 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 the energy arena.[277]

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.[278]

The University of Idaho's Integrated Design Lab—located in Boise—performs research, education and outreach supporting energy efficiency in Idaho. Their team performs energy efficiency building audits as part of their service contract with OEMR and have made significant headway with carbon neutral building standards for many participants in their efforts. [279]

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.[280]

University of Idaho will soon offer two new options under its B.S. Geology degree. The Sustainable Mining and Earth Resources option will introduce students to modern mining methods, including "hands-on" experiential work with regional employers to learn mining planning, implementation, restoration, and maintenance of the natural landscapes. The Geology Energy will

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[276] Boise State University. https://www.boisestate.edu/
[277]Boise State University. "Micron School of Materials Science and Engineering." http://coen.boisestate.edu/mse/
[278] University of Idaho. "Biodiesel Education." http://biodieseleducation.org/
[279] University of Idaho "Integrated Design Lab." Integrated Design Lab | University of Idaho (uidaho.edu)
[280]University of Idaho. "National Institute for Advanced Transportation Technology." www.uidaho.edu/engr/research/niatt

introduce students to where and how critical energy resources can be obtained and used in a sustainable and responsible manner.

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.[281]

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. Students 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.[282] New in 2022, NuScale also recently collaborated with Idaho State University to open the Energy Exploration (E2) Center, where students can experience hands-on nuclear learning opportunities similar to the control rooms they might see on the job.[283]

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.[284] 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.[285]

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.[286]

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

[281] Idaho State University. "Programs of Study." http://coursecat.isu.edu/programsofstudy/
[282] Idaho State University. "College of Technology." https://www.isu.edu/estec//
[283]Idaho State University. "NuScale Power, LLC and Idaho State University Open Energy Exploration Center." https://www.isu.edu/news/2022-fall/nuscale-power-llc-and-idaho-state-university-open-energy-exploration-center.html
[284] College of Southern Idaho. "Renewable Energy Systems Technology Program." https://www.csi.edu/programs/renewable-energy-systems-technology/default.aspx
[285] U.S. Economic Development Administration. "CSI Applied Technology & Innovation Center." https://www.eda.gov/success-stories/workforce/stories/college-of-southern-id.htm
[286] 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/

teaches students about electricity, robotics, wireless communication, renewable energy, instrumentation, and computerized control systems.[287]

The Northwest Lineman College**,** based in Meridian, trains lineman apprentices and educates students in construction, maintenance, and operation of the 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 U.S., training over 8,000 individuals annually.[288]

Kootenai Electric Cooperative is constructing a new training facility, scheduled to be completed in October 2023, that will be utilized for new hire orientation and internal safety training initially; with plans to hold training sessions sponsored by other organizations such as Northwest Line Joint Apprenticeship Training Committee (NW/JATC) Northwest Public Power Association (NWPPA) and potentially others.

[287] College of Western Idaho. "Advanced Mechatronics Engineering Technology." https://cwi.edu/program/advanced-mechatronics-engineering-technology
[288] 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. 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.

Cost-Effective: Cost-effectiveness of an energy measure means that the lifecycle energy, capacity, transmission, distribution, and other quantifiable savings to residents and businesses exceed the direct costs of the measure to the utility and participant.

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.

Energy Intensity: Energy intensity is a measure of the energy inefficiency of an economy. It is calculated as units of energy per unit of GDP.

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.

Microgrid: A small network of electricity users with a local source of supply that is usually attached to a centralized national grid but is able to function independently.

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 grids add monitoring, analysis, control and communication capabilities to the national electrical delivery system to maximize the throughput of the system. Consumers have the choice and flexibility to manage electrical use while minimizing bills.

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.