Idaho Energy Landscape 2020

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1. Idaho's Energy Landscape

1.1 ENERGY AND THE ECONOMY

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

Energy costs are affected by the economy, new technology, governmental regulation, and global market trends. For example, advancements in natural gas production technologies have increased the supply of domestically produced natural gas. This has substantially lowered the cost to consumers and increased consumption by over 50% in the past decade.[1]

Historically, economic growth and energy consumption were strongly and positively correlated; however, technological changes and the increased utilization of energy efficiency have weakened this correlation. Idaho's Gross Domestic Product grew 4.7% annually from 1997 to 2017, while Idaho's energy consumption (transportation, heat, and power) only increased 1.1% annually from 1997 to 2017.[2] Today, approximately 13,000 people work in Idaho's energy sector, which pushes the boundaries of technology, launches start-ups, and fuels research, growth, and discovery.[3]

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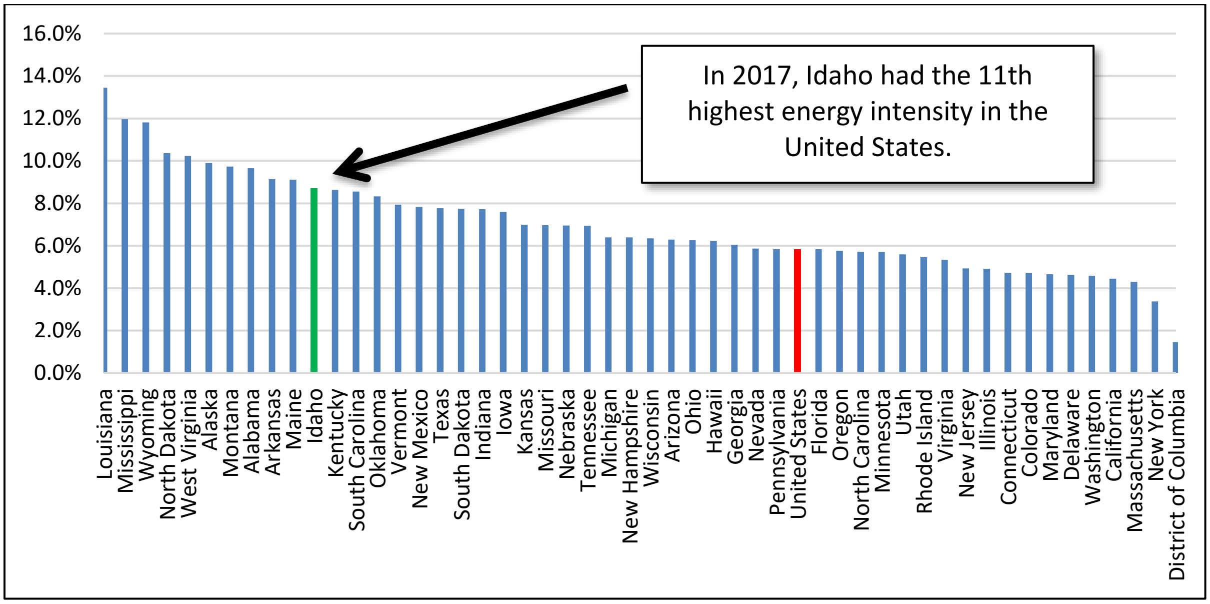
[1] U.S. Energy Information Administration. "U.S. Natural Gas Deliveries to Electric Power Consumers." www.eia.gov/dnav/ng/hist/n3045us2a.htm

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

[3] National Association of State Energy Officials. "2019 U.S. Energy Employment Report: Idaho Report." https://www.usenergyjobs.org/2019-state-reports

1.1.1. Energy Costs

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



Low energy rates have consistently attracted energy-intensive industries to Idaho, including mining, pulp and paper, agriculture, food processing, and computer chip manufacturing. As a result, Idaho's energy expenditures equated to almost 8.7% of the State's Gross Domestic Product (GDP) in 2017, placing Idaho 11th for total energy costs to U.S. states.[5] The total energy costs per GDP illustrated in Figure 1.1 include the cost of gasoline to the State as well. Due to the rural nature of Idaho and the absence of a petroleum refinery in the State, Idahoans frequently spend more on transportation fuel than individuals who live in more densely populated regions of the country.

[4] U.S. Energy Information Administration. "Total Energy Price and Expenditure Estimates, Ranked by State, 2017." https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_sum/html/rank_pr.html&sid=US
[5] U.S. Energy Information Administration. "Total Energy Price and Expenditure Estimates, Ranked by State, 2017." https://www.eia.gov/state/seds/sep_sum/html/pdf/rank_pr.pdf

Table 1.1 Average Energy Bill per Person, 2017[6]

Energy Source	Dollars Per Year	Percentage of Total Cost
Gasoline	$1,845	72%
Electricity	$510	20%
Natural Gas	$128	5%
Propane	$62	2%
Wood	$33	1%
Coal	$0	0%
Total	**$2,578**	**100%**

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

Collectively, Idaho's residential, commercial, industrial, and transportation sectors spent over $6 billion on energy in 2017.[7] When those dollars were adjusted specifically for residential use, the average Idahoan spent about $2,500 on direct energy products in 2017, as demonstrated in Table 1.1. This number was based on Idaho's 2017 residential energy expenditures and population estimate.

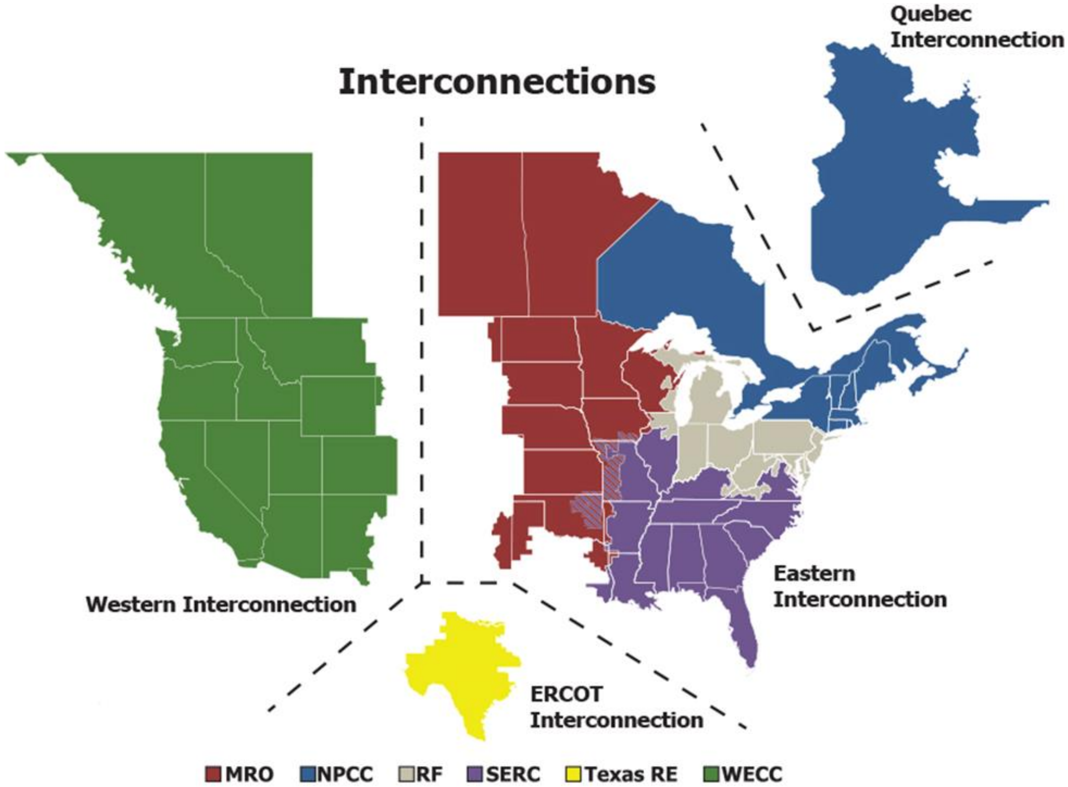
[6] U.S. Energy Information Administration. "Idaho SEDS Data 2017 for Petroleum, Electricity, Coal, Natural Gas, Wood, and Propane." https://www.eia.gov/state/seds/seds-data-complete.php?sid=ID; and U.S. Census Bureau. "Idaho is Nation's Fastest-Growing State, Census Bureau Reports." https://www.census.gov/newsroom/press-releases/2017/estimates-idaho.html

[7] U.S. Energy Information Administration. "Primary Energy, Electricity and Total Energy Expenditure Estimates, 2017." https://www.eia.gov/state/seds/sep_sum/html/pdf/sum_ex_tot.pdf

1.2 IDAHO UTILITIES AND ENERGY SYSTEMS

1.2.1. Electricity

Figure 1.2 North American Electric Reliability Corporation Regional Electric Interconnections[8]



The electrical transmission network in the United States and Canada is made up of four separate interconnections. The Western Interconnection links Idaho with the rest of the western United States and two Canadian provinces as shown in Figure 1.2. Existing 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 in Idaho.[9]

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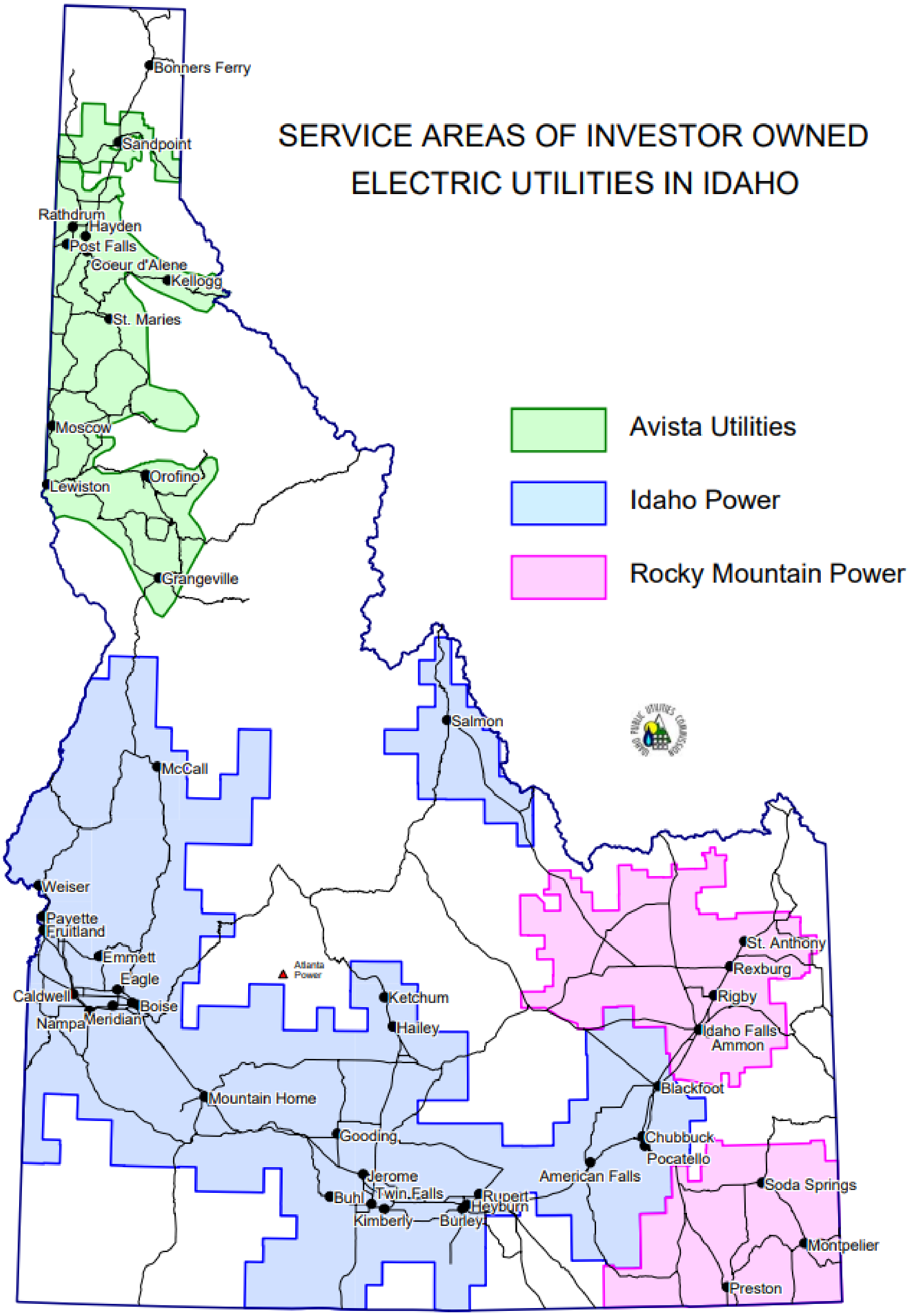
[8] North American Electric Reliability Corporation. "Maps: NERC Interconnections." https://www.nerc.com/AboutNERC/keyplayers/PublishingImages/NERC%20Interconnections.pdf

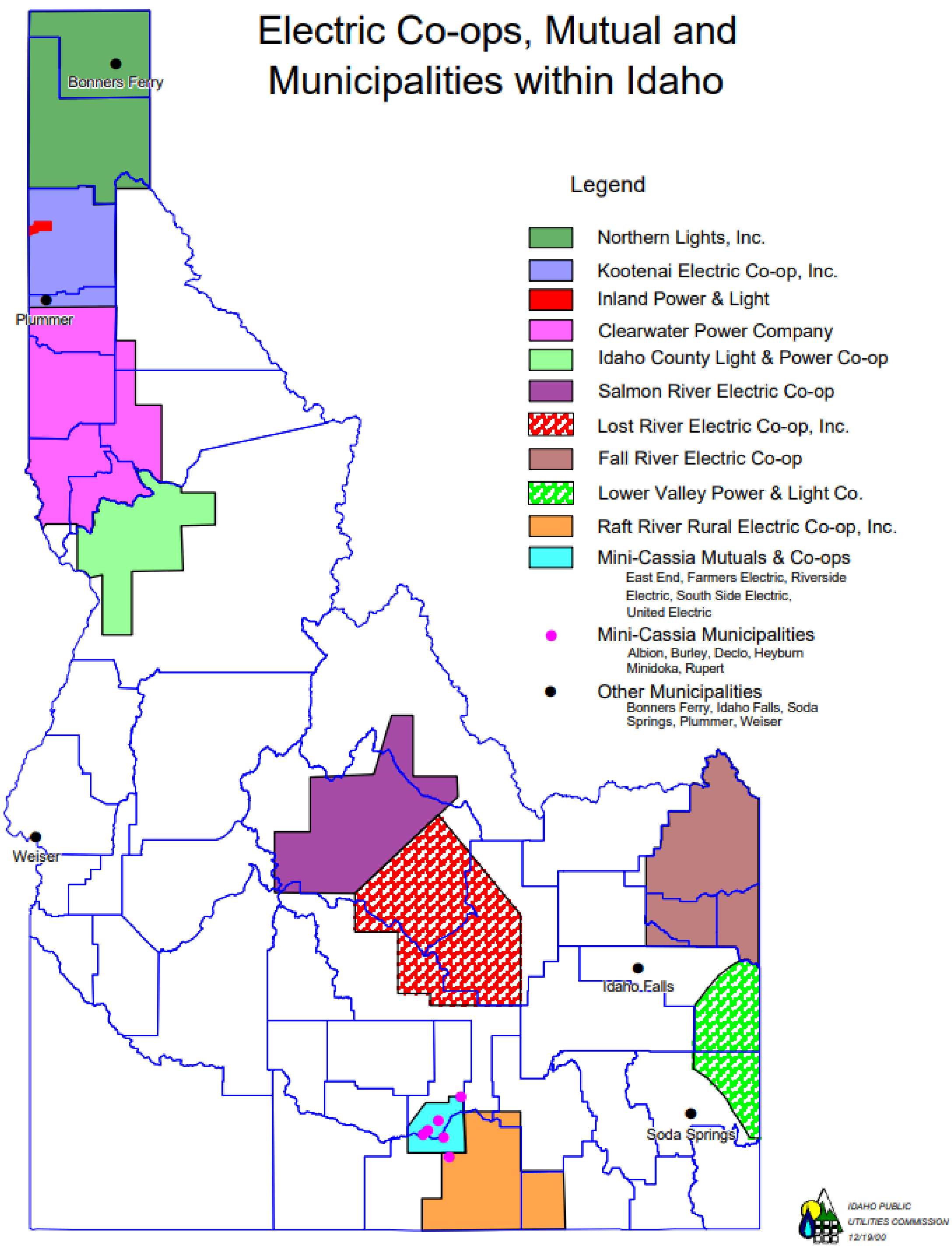
[9] Western Electricity Coordinating Council. "About WECC." https://www.wecc.org/Pages/AboutWECC.aspx

Figure 1.3 Idaho's Investor-Owned Electric Utilities Service Territories[10]



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

Figure 1.4 Idaho's Municipal and Cooperative Utilities Service Territories[11]



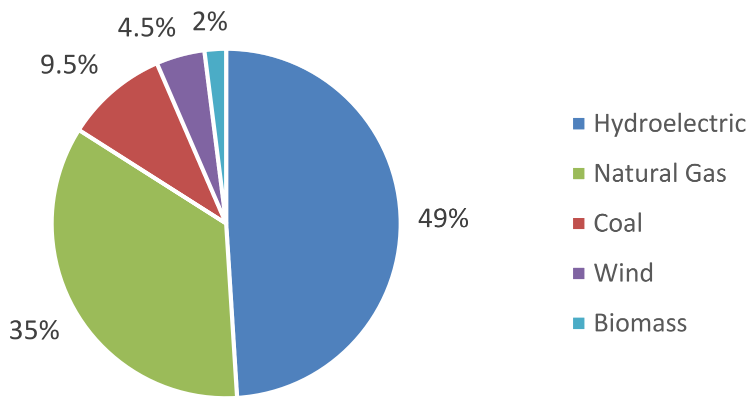
[11] Idaho Public Utilities Commission. "Electric Co-ops, Mutual and Municipalities within Idaho." https://puc.idaho.gov/Fileroom/PublicFiles/maps/elecoop.pdf

Idaho's electrical grid is served by three investor-owned utilities (IOUs), as well as municipal and rural electric cooperative utilities (listed in Appendix A). The three IOUs serve approximately 84% of the State's electricity needs, and municipal and rural electric cooperative utilities serve the remaining 16% as illustrated on the previous pages by Figures 1.3 and 1.4.[12]

1.2.1.1. Avista Corporation

Avista is an investor-owned electric and natural gas utility headquartered in Spokane, Washington. Avista serves over 220,000 electric and natural gas customers in Idaho's northern and central regions. In April 2019, the company signed an agreement with the California Independent System Operator (CAISO) to participate in the Western Energy Imbalance Market (EIM) by the end of April 2022.[13] Additionally, in April 2019, Avista announced its goal to serve its customers with 100% clean electricity by 2045, as required under Washington law, and to have a carbon neutral portfolio by the end of 2027.[14]

Figure 1.5 Avista Energy Production Mix (2017)[15]



Avista generates electricity by utilizing a mix of hydroelectric, natural gas, coal, biomass, and wind generation delivered over 2,750 miles of electrical transmission lines, 19,000 miles of electrical distribution lines, and 7,800 miles of natural gas lines.[16] Avista's 2017 annual energy production mix is shown in Figure 1.5. Hydroelectric generation accounts for nearly half of its electricity mix, which provides a significant price benefit for its customers. Natural gas generation comprises the next-largest source of generation. 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]

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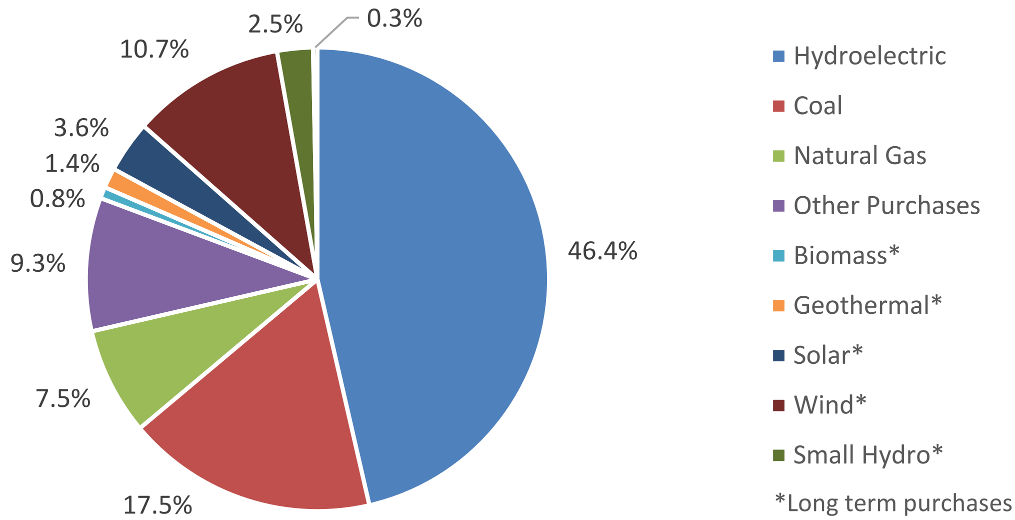
[12] Idaho Consumer-Owned Utilities Association. "About ICUA." https://www.icua.coop/about-icua/
[13] Avista. "Western Energy Imbalance Market." https://www.myavista.com/about-us/our-commitment/western-energy-imbalance-market
[14] Avista. "Our Commitment." https://www.myavista.com/about-us/our-commitment
[15] Avista. "About Our Energy Mix." https://www.myavista.com/about-us/about-our-energy-mix
[16] Avista. "Quick Facts." https://www.myavista.com/about-us/our-company
[17] Avista. "2017 Electric IRP." https://www.myavista.com/about-us/integrated-resource-planning

1.2.1.2. Idaho Power Company

Founded in 1916, Idaho Power Company is the largest electricity provider in the State. Headquartered in Boise, it serves nearly 560,000 customers across a 24,000 square mile service territory in southern Idaho and eastern Oregon.[18] Electricity is supplied through nearly 5,000 miles of transmission line and more than 27,000 miles of distribution line. Idaho Power is one of the nation's few IOUs with a significant hydroelectric generating base, and it has 17 low-cost, emission-free hydroelectric projects at the core of its generation portfolio, including a 1,167 megawatt (MW), three-dam complex in Hells Canyon.[19] Idaho Power entered the Western EIM in April 2018,[20] and announced its goal to provide 100% clean energy by 2045 in March 2019.[21]

Figure 1.6 Idaho Power Energy Mix (2018)[22]



Idaho Power also generates electricity using natural gas at a combined-cycle combustion plant at Langley Gulch, near New Plymouth, Idaho, and two simple-cycle plants near Mountain Home. Additionally, it has partial ownership in baseload coal facilities located in Wyoming, Oregon, and Nevada, the Bridger, Boardman, and Valmy plants, respectively. Idaho Power's resource portfolio fuel mix for 2018 is shown in Figure 1.6. Idaho Power-owned generating capacity was the source for 71.4% of the energy delivered to customers. Purchased power comprised 28.6% of the total energy delivered to customers.[23]

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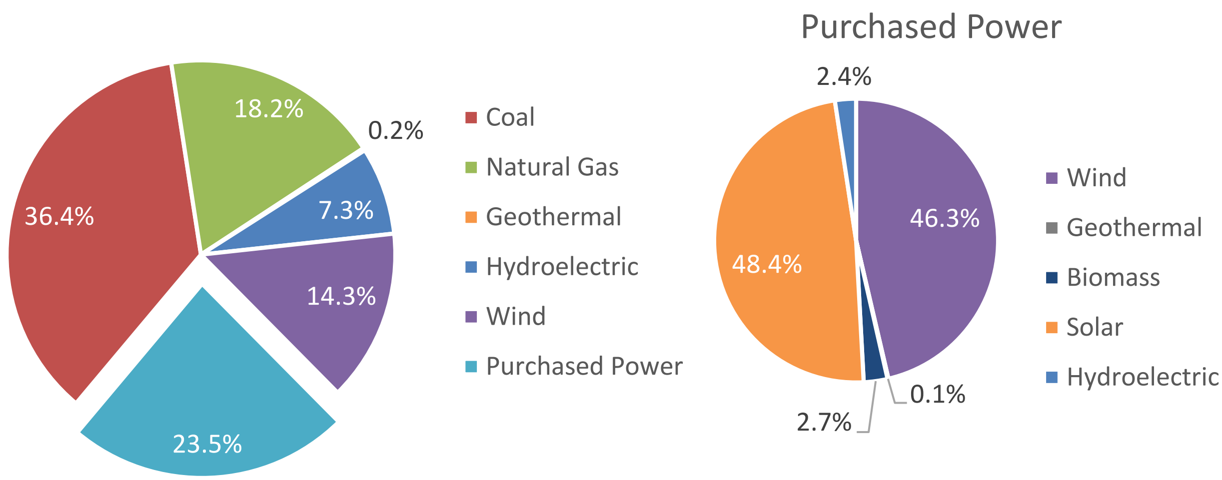
[18] Idaho Power Company. "Energy Sources." https://www.idahopower.com/energy/delivering-power/energy-sources/
[19] Idaho Power Company. "Power Plants." https://www.idahopower.com/energy/delivering-power/power-plants/
[20] Western EIM. "About." https://www.westerneim.com/Pages/About/default.aspx
21 Idaho Power Company. "Clean Today. Cleaner Tomorrow." https://www.idahopower.com/energy/clean-today-cleaner-tomorrow/
22 Idaho Power Company. "Our Energy Sources." https://www.idahopower.com/energy-environment/energy/energy-sources/
[23] Idaho Power Company. "2019 Integrated Resource Plan." https://docs.idahopower.com/pdfs/AboutUs/PlanningForFuture/irp/2019/2019_IRP.pdf

1.2.1.3. PacifiCorp / Rocky Mountain Power

PacifiCorp serves more than 1.9 million retail customers across 141,390 square miles of service territory in California, Idaho, Oregon, Utah, Washington, and Wyoming.[24] PacifiCorp merged in 1989 with Utah Power & Light Company and was purchased by MidAmerican Energy Holdings Company in 2006, which later changed its name to Berkshire Hathaway Energy. In 2014, PacifiCorp and the CAISO launched the Western EIM.[25] PacifiCorp operates under the name Rocky Mountain Power in Idaho, Utah, and Wyoming, and serves 77,000 customers in 14 Idaho counties.[26]

Figure 1.7 PacifiCorp's Energy Production Mix (2019)[27]



PacifiCorp owns 10,880 MW of net generation capacity, including coal, hydroelectric, natural gas, wind, and geothermal resources.[28] PacifiCorp's energy mix is shown in Figure 1.7. Wind, hydro, geothermal, and other non-carbon-emitting resources currently make up about 45% of PacifiCorp's owned and contracted generating capacity. PacifiCorp owns 2,222 MW of wind generation capacity and has long-term power purchase agreements for 1,686 MW from wind projects owned by others.[29] PacifiCorp's customers receive electricity through approximately 16,500 miles of transmission line, 64,000 miles of distribution line, and 900 substations.[30]

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[24] PacifiCorp. "About." https://www.pacificorp.com/about.html
[25] PacifiCorp. "Grid Modernization." https://www.pacificorp.com/energy/grid-modernization.html
[26] Rocky Mountain Power. "Just the Facts." https://www.rockymountainpower.net/content/dam/pcorp/documents/en/rockymountainpower/about/2019_Facts_RockyMountainPower.pdf
[27] PacifiCorp. "2019 Integrated Resource Plan – Volume I." https://www.pacificorp.com/energy/integrated-resource-plan.html
[28] PacifiCorp. "Generation Resources." https://www.pacificorp.com/energy.html
[29] PacifiCorp. "2019 Integrated Resource Plan – Volume I." https://www.pacificorp.com/energy/integrated-resource-plan.html
[30] PacifiCorp. "Transmission." https://www.pacificorp.com/transmission.html

1.2.1.4. Idaho’s Municipal and Cooperative Utilities

Twenty-two electric utility cooperatives and municipalities are members of the Idaho Consumer Owned Utilities Association (ICUA), serving more than 137,000 customers throughout Idaho, accounting for about 16% of Idaho’s electric consumers.[31] Municipal and cooperative utilities are not subject to regulation by the Idaho Public Utilities Commission (PUC).[32] Instead, Idaho’s cooperative electric utilities provide competitively priced energy services to their members and are generally governed by an independently elected Board of Directors. Idaho’s several municipalities provide energy services to their communities and are generally governed by their respective city councils. Most of Idaho’s cooperatives and municipalities purchase the bulk of their electricity, over 96%, from Bonneville Power Administration (BPA); however, many are beginning to acquire their own power generation resources and enter into power purchase agreements with other energy providers.[33] 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.[34] The low-cost, renewable electricity provided by BPA and the lower-four 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

Four of Idaho’s municipal and cooperative utilities 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 47 utilities in six western states. It provides comprehensive wholesale electric-energy services on a nonprofit basis to community-owned power systems throughout the Intermountain West. UAMPS conducts resource planning, evaluation of power resources or services for its members, and develops power-generating facility projects.[35]

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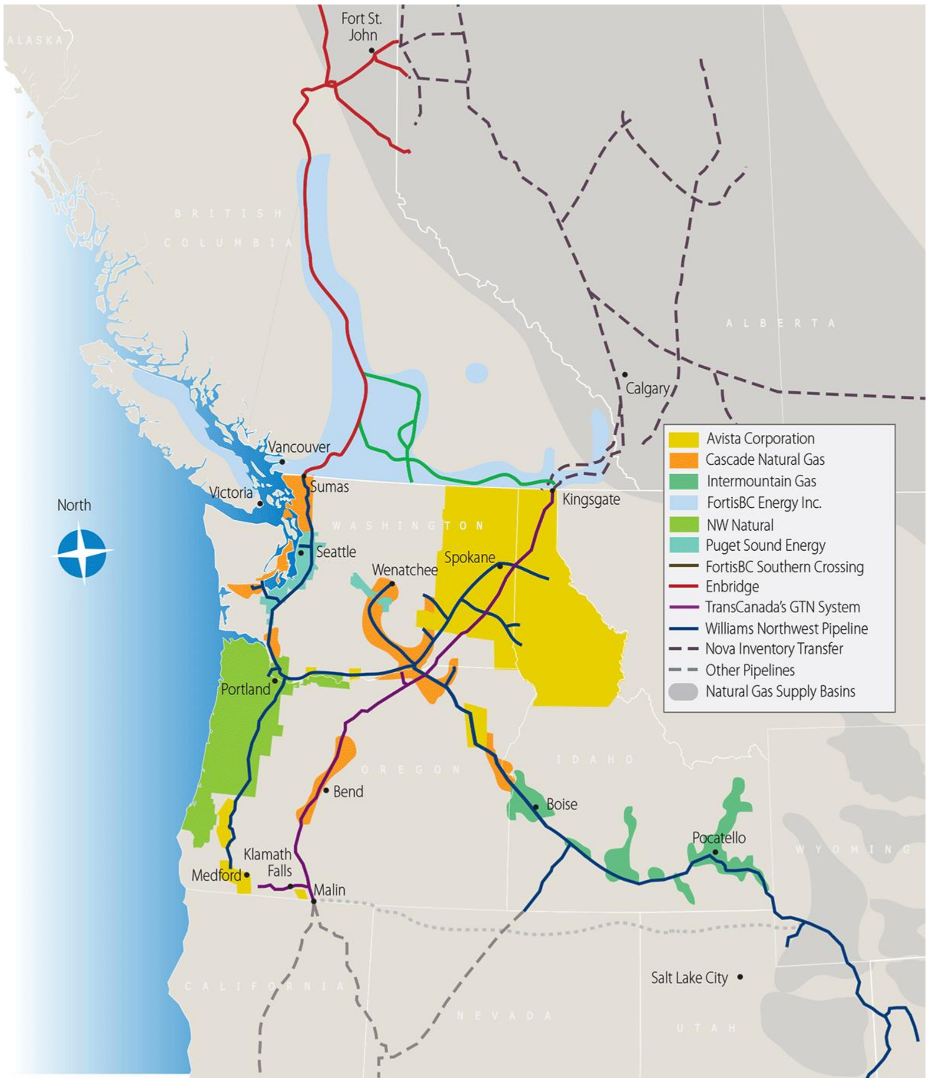
[31] Idaho Consumer-Owned Utilities Association. “About ICUA.” www.icua.coop/about-icua/
[32] Idaho Public Utilities Commission. “About the Commission.” https://puc.idaho.gov/Home/About
[33] Idaho Consumer-Owned Utilities Association. “About ICUA.” http://www.icua.coop/about-icua/
[34] Idaho Falls Power. “Power Portfolio.” https://www.idahofallsidaho.gov/248/Power-Portfolio
[35] UAMPS. “About Us.” http://www.uamps.com/About-Us

1.2.2. Natural Gas

Figure 1.8 Western U.S. Interstate Natural Gas Pipeline System and Natural Gas Service Territories[36]



Two investor-owned natural gas utilities, 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, located in the southeastern part of the state.[37] Figure 1.8 shows the major natural gas infrastructure in Idaho and Idaho utility service territories.

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[36] Northwest Gas Association. "About Us." www.nwga.org/about-us/
[37] Dominion Energy "About Us – Western Gas Operations." https://www.dominionenergy.com/about-us/moving-energy/western-gas-operations

1.2.2.1. Avista Utilities

Avista serves over 85,000 Idahoans in its Washington and northern Idaho natural gas service area, 90% of whom are residential customers.[38] Its north division, which covers about 26,000 square miles primarily in eastern Washington and northern Idaho, is supplied by more than 40 points along interstate pipelines.

Avista holds firm access rights to both Canadian and Rocky Mountain natural gas supplies through the Williams Northwest and Gas Transmission Northwest pipelines. Avista also holds rights to the Jackson Prairie storage facility in Washington. According to Avista's latest Natural Gas Integrated Resource Plan (IRP), the number of customers in Washington and Idaho is projected to increase at an average annual rate of 1.2%.[39]

1.2.2.2. Intermountain Gas Company

Intermountain Gas Company (IGC) was founded in Idaho in 1950, and in 2008 became a wholly-owned subsidiary of MDU Resources Group, headquartered in Bismarck, North Dakota.[40] IGC distributes natural gas to approximately 365,000 residential, commercial, and industrial customers in 75 Idaho communities across 60,000 square miles in southern Idaho through approximately 12,800 miles of pipeline.[41] 125 industrial and transport customers comprise 50% of IGC's annual energy demand while residential and commercial customers comprise 33% and 17% respectively.

Intermountain Gas holds firm capacity rights on William's Northwest Pipeline as well as three upstream pipelines to deliver gas to the distribution system. The upstream systems are: Gas Transmission Northwest, Foothills Pipeline and Nova Gas Transmission. IGC owns and operates the Nampa liquified natural gas (LNG) storage facility and leases storage at the Jackson Prairie underground facility, the Plymouth LNG facility, and leases capacity from Dominion Energy's Clay Basin underground storage field. Residential, commercial, and industrial peak day load growth on IGC's system under design conditions is forecast to grow at an average annual rate of 2.08% over the five-year period of 2019-2023.[42]

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.[43] The Idaho PUC has

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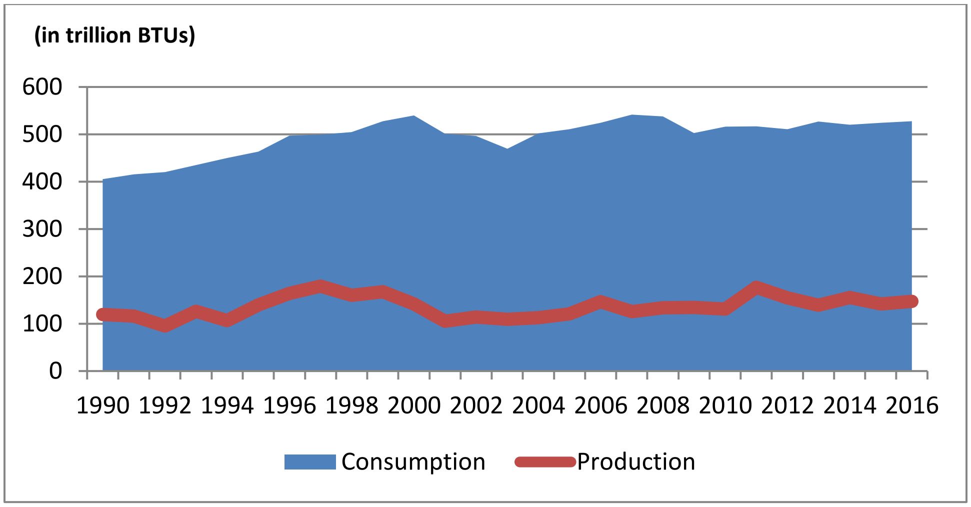
[38] Avista. "2018 Natural Gas Integrated Resource Plan." https://www.myavista.com/about-us/integrated-resource-planning
[39] Avista. "2018 Natural Gas Integrated Resource Plan." https://www.myavista.com/about-us/integrated-resource-planning
[40] Intermountain Gas. "About Us." https://www.intgas.com/in-the-community/about-us/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

elected to allow the Utah Public Service Commission to regulate Dominion Energy's activities in its small Idaho service area.[44]

1.3. ENERGY CONSUMPTION, PRODUCTION, AND PRICES

Figure 1.9 Idaho Energy Production and Consumption[45]

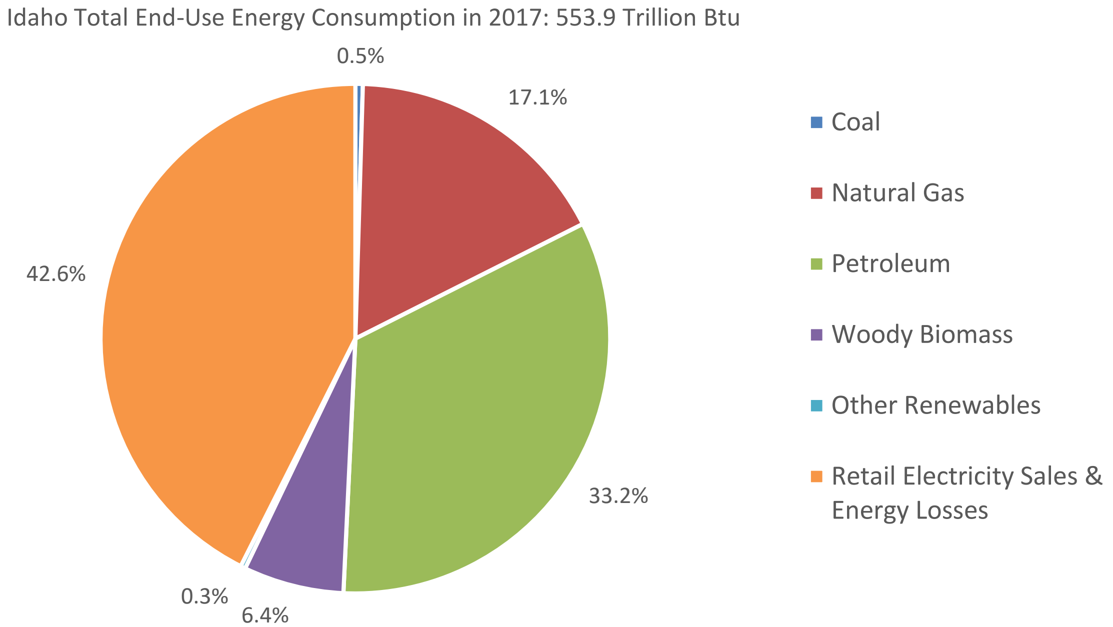


Idaho produces approximately 32% of the total energy it consumes, including electricity, transportation fuels, and heating fuels. This is demonstrated in Figure 1.9. The State's reliance upon imported energy requires a robust and well-maintained infrastructure of highways, railroads, pipelines, and transmission lines to facilitate economic development and maintain Idahoan's high quality of life.

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

1.3.1. Sources of Idaho's Energy

Figure 1.10 Sources of End Use Energy Consumed in Idaho in 2017[46]



As shown in Figure 1.10, petroleum–including those blended with ethanol–used primarily for transportation, accounts for approximately 33% of Idaho's end-use energy consumption. Important energy commodities such as electricity sales and system losses account for 42% and natural gas accounts for 17%, while the remaining 8% is attributable to coal, biomass, and other renewable energy sources.

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

Figure 1.11 Idaho's 2017 Electricity Sources[47]

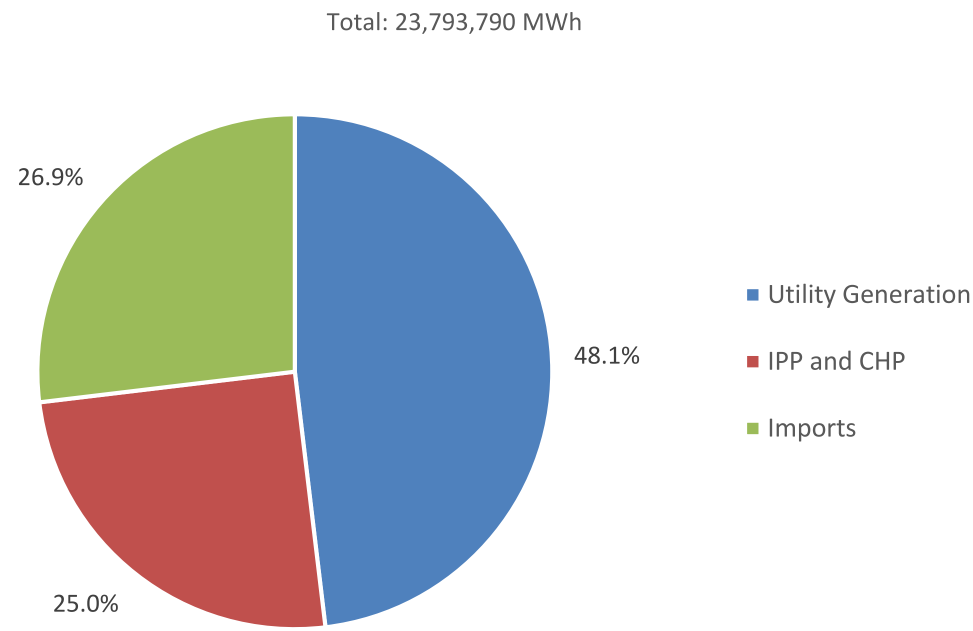
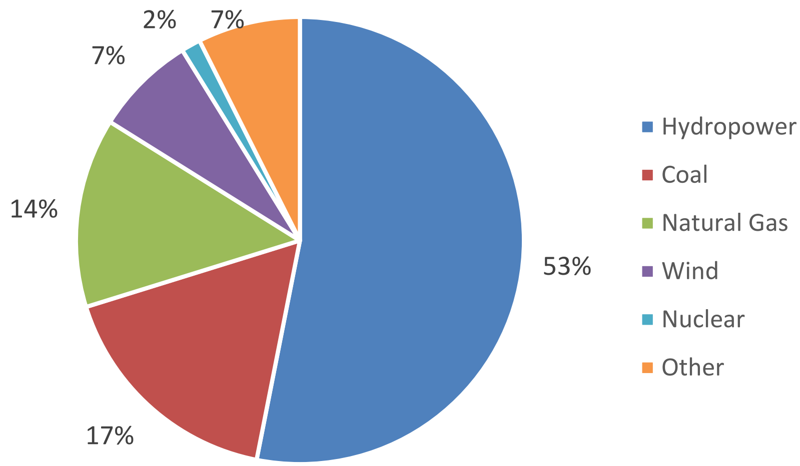


Figure 1.11 illustrates Idaho's dependence upon imported electricity to meet load demands. Idaho's utilities generate approximately 48% of the energy utilized in-state, and 25% is provided by combined heat and power (CHP) or independent power producers (IPP). The remaining 27% is comprised of market purchases and energy imports from out-of-state generating resources owned by Idaho utilities.

[47] U.S. Energy Information Administration. "Idaho Electricity Profile 2017." www.eia.gov/electricity/state/idaho/index.cfm

Figure 1.12 Idaho's 2017 Electricity Fuel Mix[48]



Note: The fuel mix in this figure is based on the percentage of Idaho load served by each utility and not by the generation source of the energy actually delivered to the customer. "Other" refers to solar, geothermal, biomass, and other sources.

Shown in Figure 1.12, hydroelectricity and coal are the dominant sources of Idaho's electricity, comprising approximately 53% and 17%, respectively. Natural gas makes up 14%, and non-hydro renewables, principally wind power, geothermal and biomass, account for approximately 14%. Idaho's municipal and cooperative utilities also receive some output from the Columbia Generating Station nuclear plant in Washington.

While hydroelectric is typically the primary resource utilized for electricity generation in Idaho, its percentage depends upon the quality of the water year. For example, droughts may reduce the hydroelectric share, and non-hydroelectric sources must supply the remainder. All electricity sourced from coal-fired plants is generated in neighboring states.[49]

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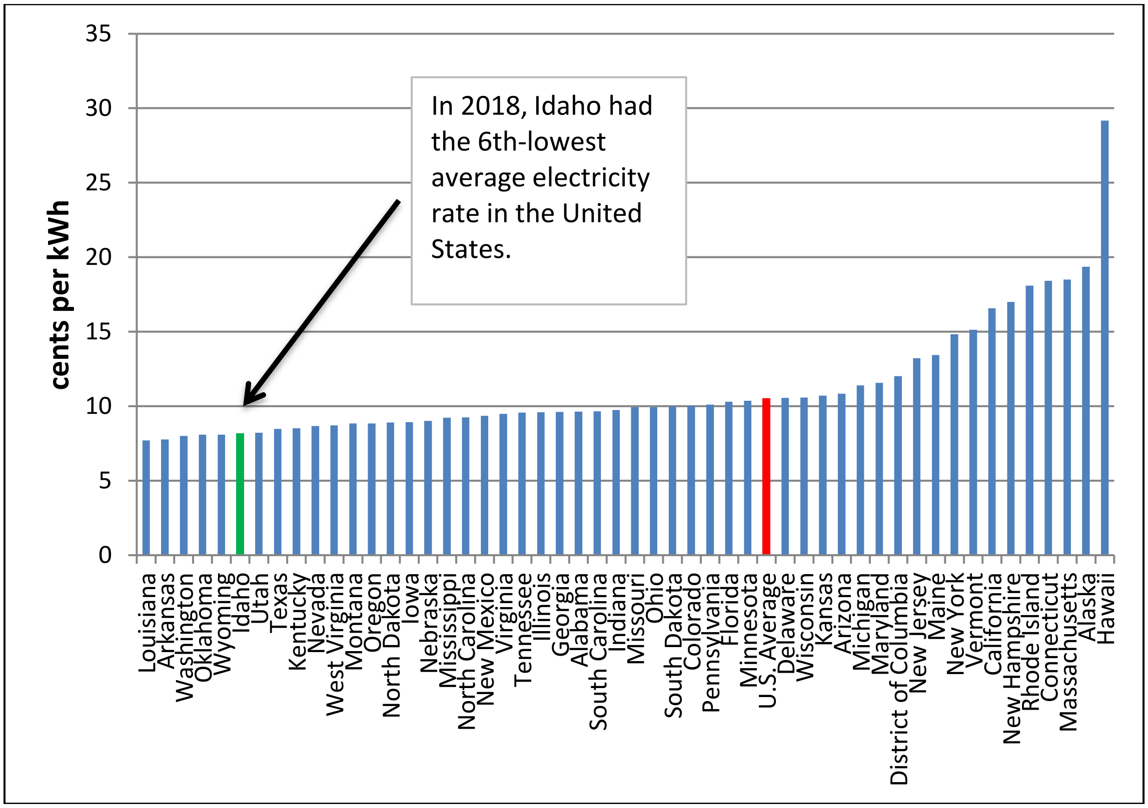
48 Federal Energy Regulatory Commission. "Forms – Form No. 1." https://www.ferc.gov/docs-filing/forms.asp; U.S. Energy Information Administration. "Detailed State Data." https://www.eia.gov/electricity/data/state/; and Bonneville Power Administration. "BPA Fuel Mix Percent Summary." https://www.bpa.gov/p/Generation/Fuel-Mix/FuelMix/BPA-Official-Fuel-Mix-2017.pdf

49 U.S. Energy Information Administration. "Idaho State Profile." https://www.eia.gov/state/analysis.php?sid=ID

1.3.2. Energy Rates Compared to Other States

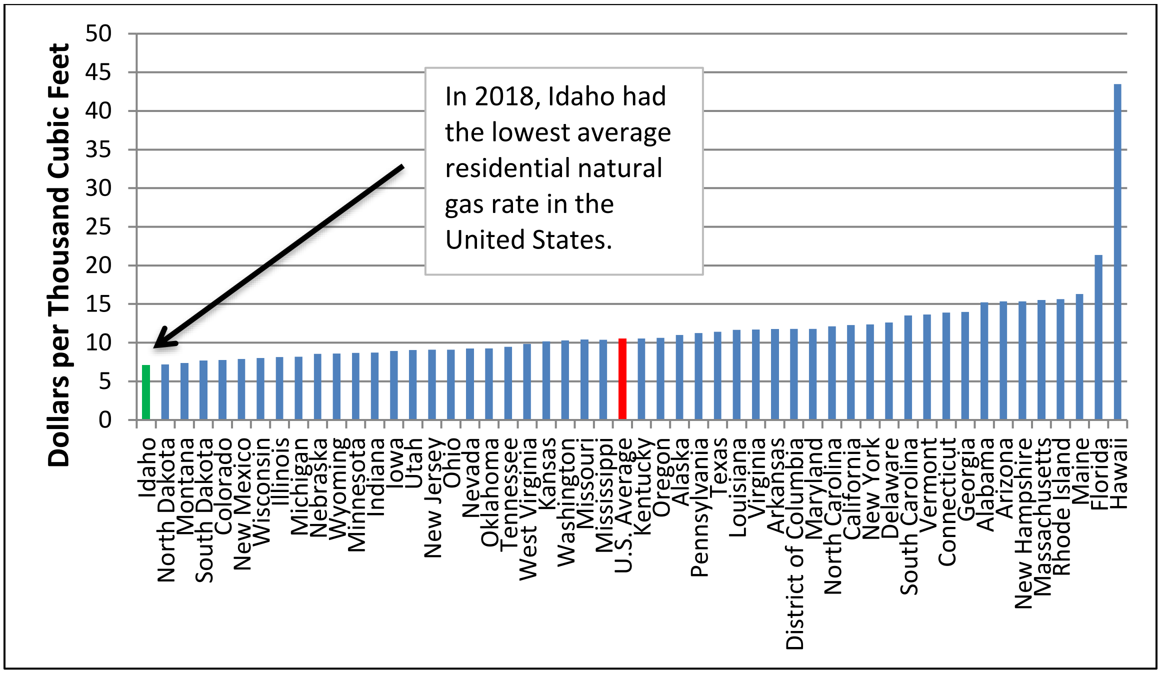
Figure 1.13 Idaho's Average Electricity Rates Compared to Other States for 2018[50]



Large hydroelectric facilities on the Snake River and other tributaries of the Columbia River provide energy and the cost-effective flexibility required to meet the demand peaks of the region. Idaho's baseload resources, including hydro, thermal, and coal resources provide a constant source of reliable, relatively low-cost electricity to Idaho utilities. As a result, Idaho's average electricity rates were the sixth lowest among the fifty states in 2018, shown in Figure 1.13.

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

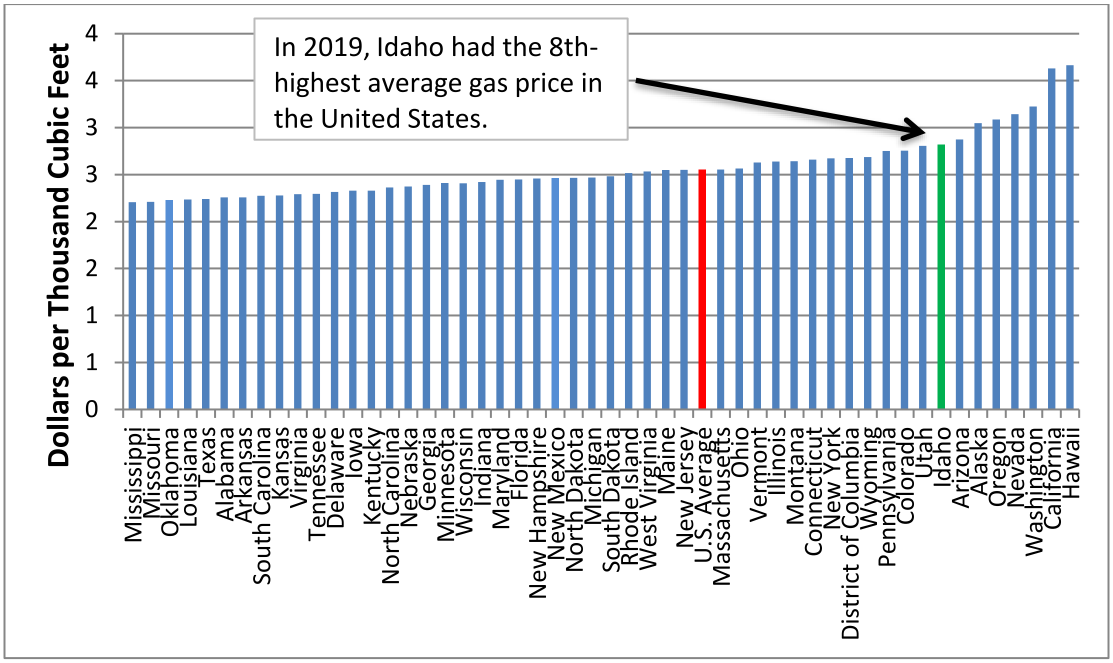
Figure 1.14 Idaho's Residential Natural Gas Prices Compared to Other States[51]



Idaho's average residential natural gas rates also were the lowest in U.S. in 2018, as shown in Figure 1.14.

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

Figure 1.15 Idaho's 2019 Retail Gasoline Prices Compared to Other States[52]



Note: The average combined (local, state and federal) gasoline tax in 2019 was 54.70 cents per gallon. Idaho's combined gasoline tax rate in 2019 was 51.40 cents per gallon.[53]

Idaho relies principally upon refineries in Montana, Utah, and Washington for its supplies of gasoline, diesel, and other petroleum products. Idaho's prices for these products are typically higher than the national average. Idaho had the 8th highest average gasoline price in the United States in 2019, as shown in Figure 1.15.

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

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

1.4. STATE, REGIONAL, AND FEDERAL ENERGY COORDINATORS AND REGULATORS

Policies adopted in neighboring states, regionally or nationally may have an impact on the cost or future rates of energy for citizens located in Idaho. The agencies listed below are involved in coordinating or regulating various aspects of energy policy in Idaho.

1.4.1. Idaho Public Utilities Commission

The Idaho Public Utilities Commission (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 also has authority to promulgate administrative rules under the Idaho Administrative Procedures Act.[54] 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 based upon all the evidence that is presented in the case record. Idaho PUC orders may be appealed directly to the Idaho Supreme Court.

The Idaho PUC holds formal hearings that resemble judicial proceedings in which parties to the case may present testimony and evidence and may conduct cross-examinations. All cases are a matter of public record. The Idaho PUC seeks to increase transparency of its operations and has made information about its functions and means by which citizens can get involved in rate cases available on its website. Information about the Idaho PUC's Consumer Assistance Section, which helps customers with billing and service-related questions, is available on the website. [55]

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 to issue a recommendation. In formal proceedings, the staff is a separate party to the case, and may present its own testimony, evidence, and expert witnesses. Staff recommendations are considered by the Idaho PUC along with those of other parties to each case, which may include utilities, the public, and agricultural, industrial, business, or consumer groups.

1.4.2. Idaho Oil and Gas Conservation Commission

The Idaho Oil and Gas Conservation Commission (OGCC) operates under the authority of section 47-314 of Idaho Code.[56] Administratively housed within the Idaho Department of Lands (IDL), 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 and groundwater.[57]

The IDL reviews applications for drilling, well treatment, pit construction, and other activities in conjunction with the Idaho Department of Water Resources and the Idaho

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[54] Idaho Statutes § 61and § 62.
[55] Idaho Public Utilities Commission. https://puc.idaho.gov/
[56] Idaho Statute §47-314.
[57] Idaho Oil and Gas Conservation Commission. "About the Commission." https://ogcc.idaho.gov/

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

1.4.3. Idaho Energy Resources Authority

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

The IERA provides a vehicle for Idaho utilities to jointly own and finance transmission and generation projects for the benefit of their ratepayers, which often was financially unfeasible for Idaho’s municipal and cooperative electric utilities prior to 2005. 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 and other powers to promote specific projects; it has no appropriation, no full-time staff, and no ability to finance projects that are not backed by ratepayers.[58] The services provided by the IERA help to materially lower the development costs of critical energy projects in the State, providing unique opportunities for Idaho’s municipal and cooperative electric utilities.

1.4.4. 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.[59] DEQ issues permits under the Idaho Pollutant Discharge Elimination System, which began phasing authority from the Environmental Protection Agency to DEQ in 2018. DEQ will have full permitting authority as of July 1, 2021.[60] 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.[61]

1.4.5. Idaho Department of Lands

The Idaho Department of Lands (IDL) leases and issues rights-of-way for energy projects on state endowment lands and provides regulatory oversight of forestry practices in the State and some regulation of Idaho's mining industry.[62] IDL has 16 regional offices

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[58] Idaho Energy Resources Authority. “Statement of Purpose.” http://iera.info/purpose/
[59] Idaho Department of Environmental Quality. “About.” http://www.deq.idaho.gov/about-deq/
[60] Idaho Department of Environmental Quality. “Idaho Pollutant Discharge Elimination System.” https://www.deq.idaho.gov/water-quality/ipdes/
[61] Idaho Department of Environmental Quality. “Regional Offices & Issues.” https://www.deq.idaho.gov/regional-offices-issues/
[62] 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/

throughout the State with staff that provide professional assistance to the citizens of Idaho.

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

The Idaho Governor's Office of Energy and Mineral Resources (OEMR), reestablished by Executive Order 2016-03, coordinates energy and mineral planning and policy development in the State of Idaho.[63] OEMR works to ensure that Idaho energy and mineral resources are developed and utilized in an efficient, effective, and responsible manner, enhance the economy, and sustain the quality of life for its citizens.

OEMR serves as the clearinghouse and first point of contact for the State on energy matters. It oversees the Idaho Strategic Energy Alliance (ISEA), serves as a resource for policy makers, and coordinates efforts with federal and state agencies and local governments. OEMR also administers energy efficiency programs, including Government Leading by Example and the State Energy Loan Program. Information about Idaho's energy and mineral landscape is available to the public on OEMR's website.[64]

1.4.7. Idaho Strategic Energy Alliance

Former Governor C.L. "Butch" Otter established the ISEA in 2009 to enable the development of a sound energy portfolio that emphasizes the importance of diverse, effective, secure, and stable sources of energy. The portfolio includes energy resources available to the State and production methods that provide a high value to Idahoans, thereby ensuring the ongoing good stewardship of our environment. Through its Board of Directors and Task forces, ISEA engages a wide variety of stakeholders to develop effective and long-lasting responses to existing and future energy challenges.[65]

1.4.8. Leadership in Nuclear Energy Commission

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

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

The Bureau of Weights and Measures is responsible for assuring the accuracy of commercial weighing and measuring devices such as petroleum meters, fuel pumps, propane meters, and electric vehicle charging stations. The Bureau monitors gasoline octane levels and is responsible for Idaho's fuel quality and labeling.[66] The Bureau also assures national traceability to Idaho's primary mass and volume standards through a

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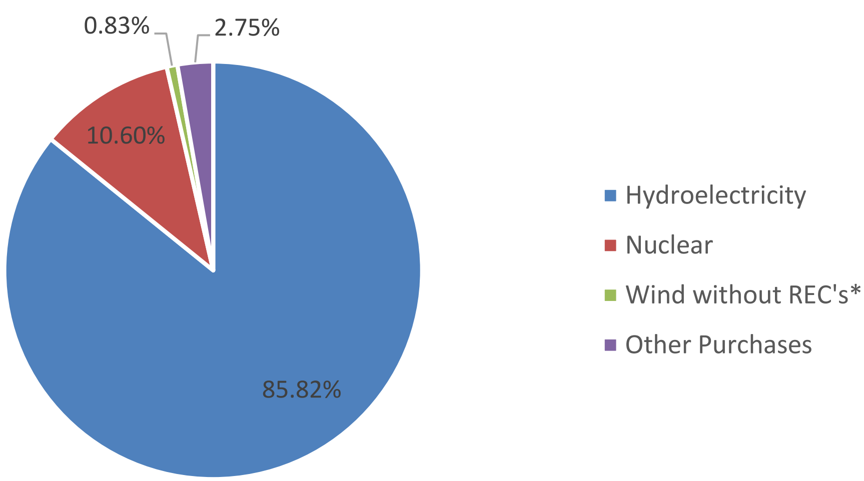
[63] Governor C.L. "Butch" Otter. "Executive Order 2016-03." https://adminrules.idaho.gov/rules/2016%20Archive/EXOs/2016-03_ExOr_16-12.pdf
[64] Idaho Governor's Office of Energy and Mineral Resources. "Welcome." https://oemr.idaho.gov/
[65] Idaho Governor's Office of Energy and Mineral Resources. "Idaho Strategic Energy Alliance." https://oemr.idaho.gov/isea/
[66] Idaho State Department of Agriculture. "About the Division." https://agri.idaho.gov/main/about/about-isda/ag-inspections/

nationally recognized metrology laboratory.

1.4.10. Bonneville Power Administration

The Bonneville Power Administration (BPA) is one of four Power Marketing Administrations (PMAs) under the U.S. Department of Energy (DOE) that supply power throughout their regions.[67] BPA is a separate and distinct entity in the DOE under the DOE Organization Act of 1977.[68] BPA is self-funded and has its own federal borrowing and procurement authorities which it utilizes to serve the northwest. BPA supplies about one-third, or 28%, of regional power.[69] BPA works with cooperatives, municipalities, IOUs, and directly provides electric power to a number of federal installations, industrial, and irrigation customers in a practice known as direct service.[70]

Figure 1.16 BPA Resources (2018)[71]



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

BPA sources power from 31 federal hydroelectric dams that are operated by the U.S. Army Corps of Engineers and the Bureau of Reclamation. These dams are referred to as the Federal Columbia River Power System. It also markets power generated from some non-federal plants in the northwest, as well as additional power from the 1,169 MW Columbia Generating Station nuclear power plant in Richland, Washington.[72] BPA's energy resources are shown in Figure 1.16. BPA operates and maintains approximately three-fourths of the high-voltage transmission lines and 261 substations that serve about 14 million people in its service territory. This territory covers over 300,000 square miles

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[67] 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
[68] Bonneville Power Administration. "BPA Manual." https://www.bpa.gov/news/pubs/Policy%20Library/BPAM_0300_Budgeting.pdf
[69] Bonneville Power Administration. "About Us." https://www.bpa.gov/news/AboutUs/Pages/default.aspx
[70] Bonneville Power Administration. "BPA Facts." www.bpa.gov/news/pubs/GeneralPublications/gi-BPA-Facts.pdf
[71] Bonneville Power Administration. "Fuel Mix." https://www.bpa.gov/p/Generation/Fuel-Mix/Pages/Fuel-Mix.aspx
[72] U.S. NRC. "Columbia Generating Station." https://www.nrc.gov/info-finder/reactors/wash2.html

and includes Idaho, Oregon, Washington, parts of Montana, California, Nevada, Utah and Wyoming.[73]

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 2020 through 2029. 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.[74] Under the Northwest Power Act, BPA is responsible for providing the net load requirements of its requesting customers. This includes IOUs in the Pacific Northwest.

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

1.4.11. 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 Idaho, Montana, Oregon, and Washington to ensure with public participation, an affordable and reliable energy system while enhancing fish and wildlife in the Columbia River Basin.[75]

The Council is an independent entity, controlled by the states, without 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 and implements a fish and wildlife mitigation program, funded by the BPA, for the Columbia River Basin impacted by the federal hydroelectric system.[76]

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.[77]

Additionally, the Council updates the Columbia River Basin Fish and Wildlife Program every five years. The latest update was adopted in October 2014. In 2019, the Council proposed to amend the 2014 Columbia River Basin Fish and Wildlife Program through an

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[73] Bonneville Power Administration. "BPA Facts." www.bpa.gov/news/pubs/GeneralPublications/gi-BPA-Facts.pdf
[74] Bonneville Power Administration. "2018 Pacific Northwest Loads and Resources Study." https://www.bpa.gov/p/Generation/White-Book/wb/2018-WBK-Loads-and-Resources-Summary-20190403.pdf
[75] Northwest Power and Conservation Council. "About." https://www.nwcouncil.org/about
[76] Northwest Power and Conservation Council. "2019 Overview." https://www.nwcouncil.org/sites/default/files/2019Overview.pdf
[77] Northwest Power and Conservation Council. "Seventh Northwest Power Plan Summary Brochure." https://www.nwcouncil.org/sites/default/files/finalplanbrochure.pdf

Addendum. They released draft amendments to the 2014 Program in July for public comment. The Council announced the final amended version of the Program in December 2019. They are hosting workshops in early 2020 to discuss specific sections within the program.[78]

1.4.12. U.S. Department of Energy

The U.S. Department of Energy (DOE) administers national energy, environmental, and nuclear policies through science and technology solutions.[79] DOE oversees the nation's nuclear infrastructure, and operates energy research facilities throughout the nation, including national laboratories like INL.

1.4.13. U.S. Federal Energy Regulatory Commission

The Federal Energy Regulatory Commission (FERC) is an independent regulatory agency within the U.S. DOE. FERC has jurisdiction over interstate electricity sales, wholesale electric rates, hydroelectric licensing, natural gas transmission and related services, pricing, oil pipeline rates and gas pipeline certification.[80]

1.4.14. North American Electric Reliability Corporation

The North American Electric Reliability Corporation (NERC) is a non-profit subject to oversight by the FERC and governmental authorities in Canada whose mission is to ensure the reliability and security of the bulk power system in North America. NERC accomplishes this by developing and enforcing reliability standards and assessing seasonal and long-term reliability.[81] NERC has four interconnection regions and Idaho is located in the Western Interconnection.

1.4.14.1 GridEx

NERC's Grid Security Exercise (GridEx) is an opportunity for utilities to demonstrate how they would respond to and recover from simulated and coordinated cyber and physical security threats and incidents, strengthen their crisis communications relationships, and provide input for lessons learned. The first grid security exercise facilitated by NERC took place in November 2011. The fourth exercise, GridEx IV, was held in November 2017 and had more than 6,500 participants representing 450 organizations. Lessons learned from GridEx V, held in November 2019, are expected to be released in a public report in early 2020.[82]

1.4.15. Western Electricity Coordinating Council

The Western Electricity Coordinating Council (WECC) is the regional entity that monitors and enforces reliability standards in the Western Interconnection subject to oversight by NERC and FERC. These reliability standards apply to electric utilities and other entities that own or operate generation, transmission, or other facilities in the bulk electric system.

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

[79] U.S. Department of Energy. "About Us." https://www.energy.gov/about-us

[80] Federal Energy Regulatory Commission. "About FERC." https://www.ferc.gov/about/about.asp

[81] North American Electric Reliability Corporation. "About NERC." https://www.nerc.com/AboutNERC/Pages/default.aspx

[82] NERC. "GridEx." https://www.nerc.com/pa/CI/CIPOutreach/Pages/GridEx.aspx

WECC also promotes reliability in the Western Interconnection by serving as a central repository of data and other technical metrics about the grid.[83]

1.4.16. Western Interstate Energy Board

The Western Interstate Energy Board (WIEB) is an organization of 11 western states and three western Canadian provinces. The legal basis of the Energy Board is the Western Interstate Nuclear Compact (Public Law 91-461). WIEB provides the instruments and framework for cooperative state efforts to enhance the economy of the west and contribute to the well-being of the region's people. The Board seeks to achieve this purpose by promoting energy policy that is developed cooperatively among member states and provinces and with the federal government.[84] Much of the work of the Board is conducted through its two committees, the Committee on Regional Electric Power Cooperation (CREPC) and the High-Level Radioactive Waste Committee (HLRW).

1.4.16.1 Committee on Regional Electric Power Cooperation

The Committee on Regional Electric Power Cooperation (CREPC) was established in 1984. CREPC is a joint committee of WIEB and the Western Conference of Public Service Commissioners (WCPSC). Membership in CREPC is not formal. CREPC is comprised of the public utility commissions, energy and facility siting agencies, and consumer advocates in the western states and Canadian provinces and works to improve the efficiency of the western electric power system.[85]

1.4.16.2 High-Level Radioactive Waste Committee

The High-Level Radioactive Waste Committee (HLRW) is composed of nuclear waste transportation experts appointed by the Governors of 11 western states. The Committee works with the U.S. Department of Energy to develop a safe and publicly acceptable system for transporting spent nuclear fuel and high-level radioactive waste under the Nuclear Waste Policy Act.[86] 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.[87]

1.4.17. Western Interconnection Regional Advisory Body

The Western Interconnection Regional Advisory Body (WIRAB) was created by Western Governors under Section 215(j) of the Federal Power Act of 2005, which provides for the establishment of a federal regulatory system of mandatory and enforceable electric reliability standards for the nation's bulk power system.[88] WIRAB's membership is composed of member representatives from all states and International provinces that have load within the Western Interconnection. All members are appointed by Governors or Premiers.[89]

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[83] Western Electricity Coordinating Council. "About WECC." https://www.wecc.biz/Pages/AboutWECC.aspx
[84] WIEB. "WIEB Board." https://westernenergyboard.org/wieb-board/who-what/
[85] WIEB. "CREPC." https://westernenergyboard.org/crepc-spsc/what-we-do/
[86] U.S. Department of Energy. "Nuclear Waste Policy Act." https://www.energy.gov/downloads/nuclear-waste-policy-act
[87] WIEB. "High-Level Radioactive Waste." https://westernenergyboard.org/hlrw/who-what/
[88] Federal Power Act. https://legcounsel.house.gov/Comps/Federal%20Power%20Act.pdf
[89] WIEB. "WIRAB." https://westernenergyboard.org/wirab/who-what/

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

1.4.18. 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 41 entities in the Western Interconnection, overseeing 87% of the load in the western United States.[90]

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

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

The Western Energy Imbalance Market (EIM) was first launched in 2014 as an agreement between PacifiCorp and CAISO. In 2019, nine utilities with service territories in the western U.S. and British Columbia, Canada have joined, and 15 confirmed pending participants will enter the EIM before the end of 2022.[91] Idaho Power joined the EIM in April 2018 and Avista will begin participating in April 2022. On September 16, 2019, the BPA signed an implementation agreement with CAISO and a record of decision in a move toward joining the EIM in 2022.[92]

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.[93] The EIM's daily operations are managed by CAISO.[94]

In 2019, CAISO announced an initiative to develop an extended day-ahead market (EDAM) to improve market efficiency by integrating renewable resources using day-ahead unit commitment and scheduling across a larger area.[95] Fifteen EIM entities participated in the EDAM Feasibility Assessment in January 2019, and CAISO plans to

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[90] California ISO. "Reliability Coordinator FAQ." http://www.caiso.com/Documents/ReliabilityCoordinatorFAQ.pdf

[91] Western Energy Imbalance Market. "ISO welcomes BANC and WAPA to the real-time energy market." https://www.westerneim.com/Documents/ISOWelcomesBANCandWAPAtotheReal-TimeEnergyMarket.pdf

[92] BPA. "Energy Imbalance Market." https://www.bpa.gov/Projects/Initiatives/EIM/Pages/Energy-Imbalance-Market.aspx

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

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

[95] California ISO. "Extended day-ahead market." http://www.caiso.com/StakeholderProcesses/Extended-day-ahead-market

request approval to launch the EDAM in 2021.[96]

1.4.20. 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.[97]

1.4.21. U.S. Department of the Interior

The U.S. Department of the Interior (DOI) manages public lands, territories, and tribal matters in the United States through the bureaus and offices it administers, which includes the Bureau of Land Management (BLM), the Bureau of Reclamation (BOR), the National Park Service (NPS), the Fish and Wildlife Service (FWS), and many others. The State and developers must work with DOI and its agencies to secure permitting approval under the National Environmental Policy Act (NEPA), among other federal laws, for energy and mineral projects on federal land.[98]

Some examples of cooperative efforts include the following; the BOR oversees federal water resource management efforts and manages several dams in Idaho including Anderson Ranch, Arrowrock, American Falls, and Palisades. The BLM administers mineral leases throughout Idaho, and is the lead permitting agency for transmission line siting for the Gateway West and Boardman to Hemingway projects. The State and developers also work closely with the FWS on the impact of energy generation and transmission on endangered species and migratory birds.

1.4.22. U.S. Forest Service

The U.S. Forest Service (USFS), administered under the U.S. Department of Agriculture, is responsible for managing and protecting the nation's national forests and grasslands. The State and developers work with USFS on transmission rights-of-way through national forests, energy and mineral development on National Forest System lands, revision of forest land management plans, and woody biomass as a source of energy.[99]

1.4.23. National Marine Fisheries Service

The National Marine Fisheries Service (NMFS), administered under the U.S. Department of Commerce through the National Oceanic and Atmospheric Association, oversees endangered anadromous fish species and ensures compliance with fisheries regulations. The State and Idaho utilities work closely with NMFS on fisheries issues, including those

[96] California ISO. "Extending the Day-Ahead Market to EIM Entities Issue Paper." http://www.caiso.com/InitiativeDocuments/IssuePaper-ExtendedDayAheadMarket.pdf
[97] U.S. Nuclear Regulatory Commission. "The Commission." https://www.nrc.gov/about-nrc/organization/commfuncdesc.html
[98] 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
[99] U.S. Forest Service. "About the Agency." https://www.fs.fed.us/about-agency

related to salmon, steelhead, and hydroelectric facilities in the Snake and Columbia River systems.[100]

1.4.24. 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.[101] EPA administers the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as "Superfund," which allows EPA to clean up contaminated sites.[102] There are currently six sites in Idaho on the Superfund National Priorities List.[103]

1.5 REGIONAL AND NATIONAL ENERGY ISSUES

1.5.1. Transmission Planning

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.[104] Two northwest planning groups, the Northern Tier Transmission Group (NTTG) and the Columbia Grid have been responsible for producing transmission expansion and economic study plans on a periodic basis.[105] 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.

1.5.2. 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.[106]

PURPA categorizes QFs as either small power production facilities, or cogeneration facilities. To qualify for the required purchase at the avoided cost rate, a small power production facility must generate 80 MW or less, with a primary energy source that is renewable, biomass, waste, or geothermal resources.

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[100] NOAA Fisheries. "About Us." https://www.fisheries.noaa.gov/about-us
[101] U.S. Environmental Protection Agency. "About EPA." https://www.epa.gov/aboutepa/our-mission-and-what-we-do
[102] U.S. Environmental Protection Agency. "What is Superfund?" https://www.epa.gov/superfund/what-superfund
[103] U.S. Environmental Protection Agency. "National Priorities List by State." https://www.epa.gov/superfund/national-priorities-list-npl-sites-state#ID
[104] Federal Energy Regulatory Commission. FERC Order Nos. 890 and 1000.
[105] Idaho Power and PacifiCorp are members of NTTG, and Avista and BPA are members of Columbia Grid.
[106] Federal Energy Regulatory Commission. "What is a Qualifying Facility?" https://www.ferc.gov/industries/electric/gen-info/qual-fac/what-is.asp

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.[107]

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

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.[108] 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.[109] The change in contract length does not abrogate or eliminate the utility's mandatory purchase obligation.

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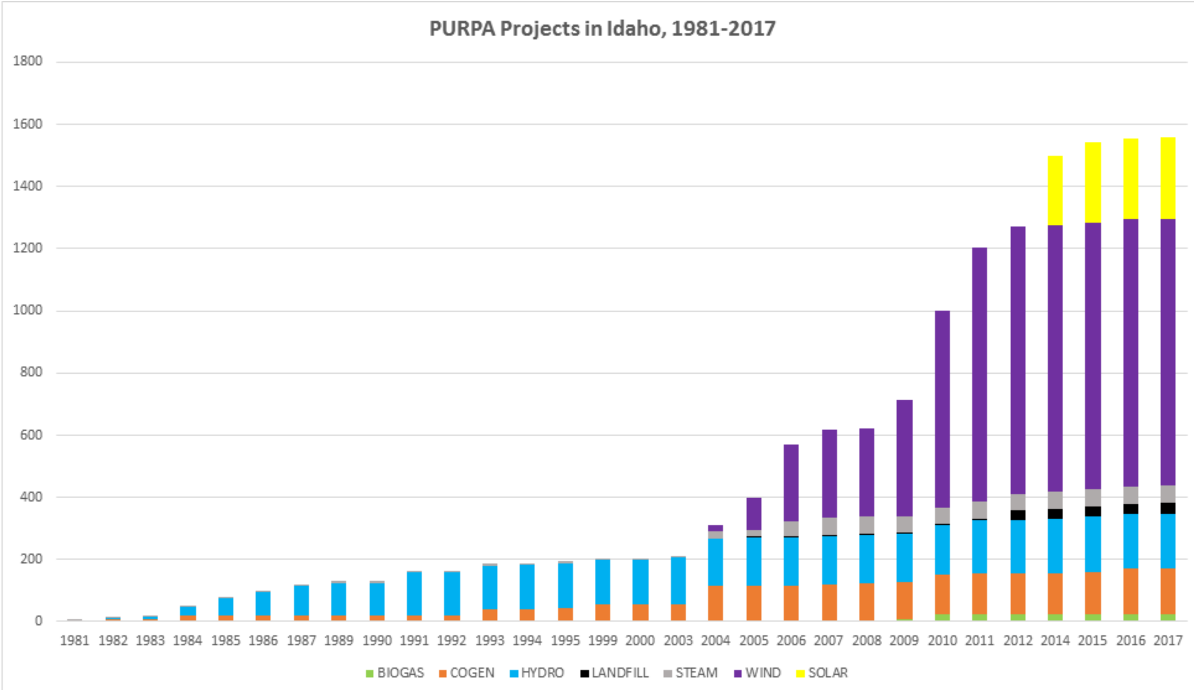
107 Federal Energy Regulatory Commission. "What is a Qualifying Facility?" www.ferc.gov/industries/electric/gen-info/qual-fac/what-is.asp

108 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

109 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 1.17 PURPA Generation in Idaho, 1981-2017[110]



As illustrated in Figure 1.17, as of 2017 almost 1,600 MW of QF resources were online in Idaho, comprised principally of wind and solar projects.

2. Idaho Energy Sources

2.1. HYDROELECTRICITY

Hydroelectricity is a renewable resource. Idaho has more than 140 generating plants with a combined capacity of 2,700 MW, which constitutes some of the most valuable hydroelectric infrastructure in the nation.[111] The flexible nature of hydroelectricity enables it to supply the fluctuating demands on the electric grid, and also allows it to accommodate and compliment the highly-variable and intermittent contributions of local wind and solar generation.

2.2. NATURAL GAS

Natural gas is critical to Idaho's economic health. It heats homes, powers businesses, moves 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 for heating their home.[112] Natural gas power plants can adjust generation in real-time to adapt to load demands. Such responsiveness is critical to supplement the ebbs and flows of electricity

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[110] Idaho Public Utilities Commission. Graph created by Yao Yin, emailed to OEMR by Yao and Kevin Keyt.
[111] U.S. Energy Information Administration. "Idaho Renewable Electricity Profile 2010." https://www.eia.gov/renewable/state/Idaho/
[112] U.S. Energy Information Administration. "Idaho State Profile and Energy Estimates – Profile Analysis." https://www.eia.gov/state/analysis.php?sid=ID

generated by wind and solar projects. 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.[113] These discoveries led to Idaho's first commercial production of natural gas and natural gas liquids in 2015.[114] In 2018, Idaho produced 1.9 billion cubic feet of natural gas.[115]

As a transportation fuel, natural gas is used as compressed natural gas (CNG) or as liquefied natural gas (LNG). Both compression and liquefaction are methods employed to increase the amount of natural gas storage in the vehicle and thus increase its driving range. Renewable natural gas (RNG) is an emerging resource essentially made of biogas, the gaseous product of the decomposition of organic matter, that has been processed to purity standards. Like conventional natural gas, RNG is pipeline-quality gas that is fully interchangeable with conventional natural gas and can be used as a transportation fuel in the form of CNG or LNG. Furthermore, RNG qualifies as an advanced biofuel under the Renewable Fuel Standard.[116]

Idaho has two public CNG vehicle refueling stations, one in Boise and another in Nampa. Some municipal and commercial fleets utilize natural gas and operate their own CNG refueling stations.[117] There are no commercial RNG facilities in Idaho as of 2019, however, the State expects to see increased interest in RNG development given Idaho's unique resource portfolio and noted success in other biomass industries.

2.3. COAL

Idaho has no in-state utility-scale coal-fired power plants. However, Idaho utilities hold ownership shares in coal-fired power plants located in neighboring states that supply a share of Idaho's electricity.[118] In close proximity to Idaho, Wyoming is the nation's largest coal exporter and Montana has the nation's largest identified recoverable coal reserve. Some industrial users in Idaho still utilize coal at their facilities for power and steam generation (cogeneration) purposes.

2.4. NUCLEAR

Nuclear energy is a carbon-free power source. While no commercial-scale nuclear power generation exists in Idaho today, on a national scale, nuclear power generation from 96

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[113] Dunnahoe, Tayvis. "Idaho enters ranks of hydrocarbon producing states." Oil and Gas Journal (February 6, 2017).
[114] 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
[115] 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
[116] U.S. Department of Energy. "Alternative Fuels Data Center." https://afdc.energy.gov/fuels/natural_gas_renewable.html
[117] U.S. Department of Energy. "Boise Buses Running Strong with Clean Cities." https://energy.gov/articles/boise-buses-running-strong-clean-cities; and Intermountain Gas. "Natural Gas Vehicles." https://www.intgas.com/rates-services/naturalgas-vehicles
[118] 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

operating reactors in 26 states accounts for nearly 20% of the electricity, and 55% of carbon-free electricity, produced in the United States.[119]

Between 2010 and 2020, only one new nuclear power plant came online in the United States. Electricity generation from U.S. nuclear power plants totaled 807.1 million megawatt hours (MWh) in 2018, slightly more than the previous peak of 807 million MWh in 2010. Although several nuclear power plants have closed since 2010 without replacement, a combination of added capacity through upgrades and shorter refueling and maintenance cycles allowed the remaining nuclear power plants to produce more electricity.[120]

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

2.4.1. NuScale Small Modular Reactors

In 2013, NuScale Power launched a western state collaboration known as the Western Initiative for Nuclear to study the deployment of a series of NuScale small modular reactor (SMR) power plants at INL, and Washington State, Utah, Wyoming, New Mexico, and Arizona.[121]

NuScale Power's SMR design is a new modular light water reactor nuclear power plant that supplies carbon-free energy for electrical generation, district heating, desalination, and other process heat applications. The SMR design features a fully factory fabricated NuScale Power Module™ capable of generating 60 MW of electricity using a safer, smaller, and scalable version of pressurized water reactor technology.[122]

NuScale Power's technology is the world's first SMR to undergo design certification review by the U.S. NRC. UAMPS will be siting a NuScale 12-module plant at the U.S. DOE INL site in Idaho Falls as part of its Carbon Free Power Project (CFPP) based on the final NRC-approved NuScale design. In December 2018, a memorandum of understanding (MOU) was executed between UAMPS, the U.S. DOE, and the Battelle Energy Alliance (the contractor managing INL). This MOU states that the first two NuScale Power Modules from the Idaho Falls plant will be dedicated for DOE research and design activities in the Joint Use Modular Plant (JUMP) program.[123] On-site

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[119] Nuclear Energy Institute. "Nuclear by the Numbers." https://www.nei.org/CorporateSite/media/filefolder/resources/fact-sheets/nuclear-by-the-numbers.pdf; and U.S. Department of Energy. "5 Fast Facts about Nuclear Energy." https://www.energy.gov/ne/articles/5-fast-facts-about-nuclear-energy

[120] U.S. Energy Information Administration. "Despite closures, U.S. nuclear electricity generation in 2018 surpassed its previous peak." https://www.eia.gov/todayinenergy/detail.php?id=38792

[121] NuScale Power, LLC. "Western Initiative for Nuclear." https://www.NuScalepower.com/projects/western-initiative-for-nuclear

[122] NuScale Power, LLC. "About Us." http://www.NuScalepower.com/about-us/history

[123] U.S. Department of Energy, Office of Nuclear Energy. "Agreement supporting power generated from small modular reactors." https://www.energy.gov/ne/articles/doe-office-nuclear-energy-announces-agreement-supporting-power-generated-small-modular

construction of the NuScale power plant at INL is expected to begin in 2021, with the first module beginning commercial operation in 2026, and full commercial operation in 2027.[124]

2.5. WIND

Wind is a renewable resource. Idaho's wind production grew from 207,000 MWh at the end of 2008 to a total of more than 2,655,000 MWh in 2018 (or 1,000 MW). Wind power generated about 15% of Idaho's net electricity in 2018, provided by nearly 550 wind turbines at utility-scale wind facilities.[125] Wind mapping studies estimate that Idaho has almost 212,830 MW of potential wind generation.[126]

Idaho's most promising wind resources are located in and around the Snake River Plain, particularly on its eastern end.[127] To supplement wind's intermittent nature, dispatchable resources, including hydroelectric, nuclear power, and natural gas-fired generators, must be ready to meet and/or supplement load requirements when wind generation is not available.

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[124] Idaho National Laboratory. "What is the carbon free power project?" https://inl.gov/article/frequently-asked-questions/

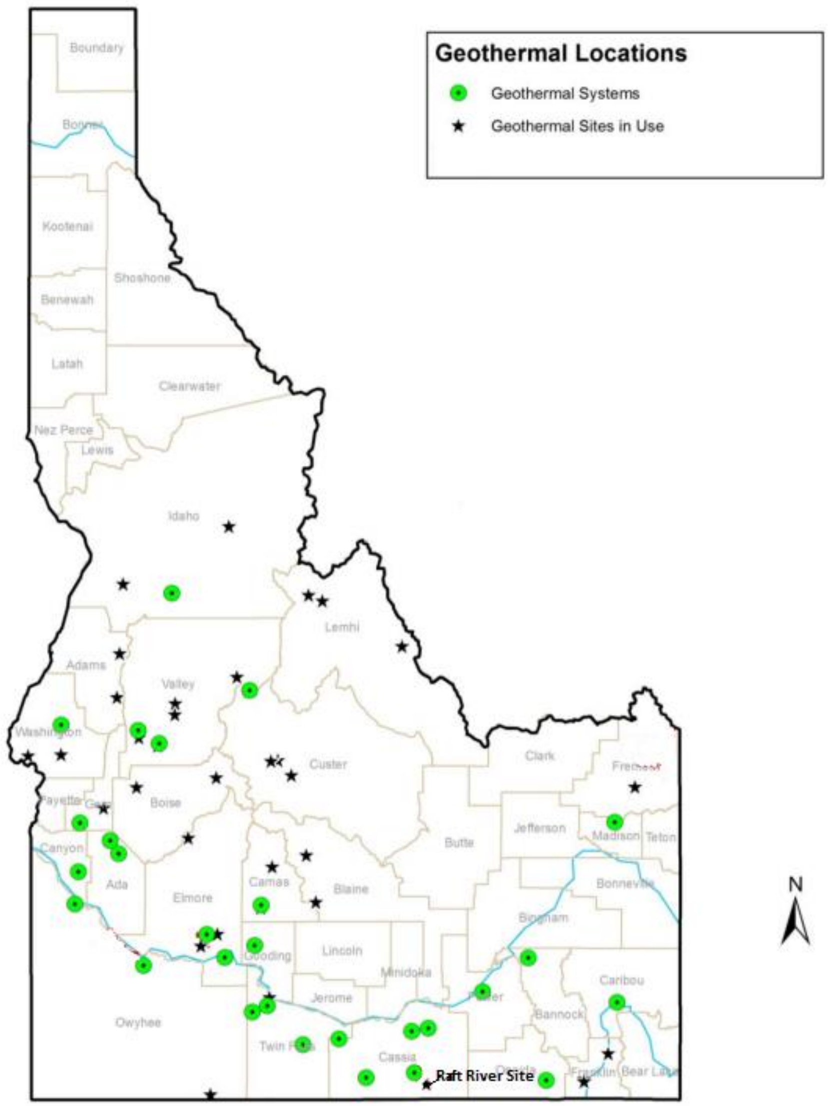
[125] U.S. Energy Information Administration. "Electricity Data Browser."." https://www.eia.gov/electricity/data/browser/#/topic/0?agg=1,0,2&fuel=008&geo=vvvvvvvvvvvvo&sec=o3g&linechart=ELEC.GEN.WND-US-99.A~ELEC.GEN.WND-IA-99.A~ELEC.GEN.WND-TX-99.A&columnchart=ELEC.GEN.WND-US-99.A~ELEC.GEN.WND-IA-99.A~ELEC.GEN.WND-TX-99.A&map=ELEC.GEN.WND-US-99.A&freq=A&ctype=li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

[126] AWEA. "Wind Energy in Idaho." https://www.awea.org/Awea/media/Resources/StateFactSheets/Idaho.pdf

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

2.6. GEOTHERMAL

Figure 2.1 Geothermal Locations in Idaho[128]



Geothermal energy is a renewable resource. Unlike intermittent resources, geothermal energy provides reliable baseload power generation. An estimated 17,000 GWh of geothermal power potential exists in Idaho, much of it in the southern portions of the State as depicted in Figure 2.1.[129] Ormat manages Idaho's only operating commercial geothermal power plant, the Raft River Enhanced Geothermal System Project, located in

[128] Idaho Governor's Office of Energy and Mineral Resources. "Direct Use." https://oemr.idaho.gov/sources/re/geothermal/
[129] Geothermal Resources Council. "Geothermal Energy Potential: State of Idaho." https://geothermal.org/PDFs/Final_Idaho.pdf

Cassia County. The Raft River plant provides about 11 MW of net capacity.[130] Idaho is one of seven states with utility scale electricity generation from geothermal energy.[131]

In addition to electric generation, direct use of geothermal waters is the oldest, most versatile, and most prevalent utilization of geothermal energy.[132] Idaho has over 1,000 wells and 200 springs. Wells that have a bottom hole temperature more than 85 degrees Fahrenheit and less than 212 degrees Fahrenheit are designated as low-temperature geothermal (LTG) resource wells.[133] These low-temperature geothermal resources are used for space heating, aquaculture, greenhouses, and recreation throughout the State.

Geothermal heating of buildings has a long and rich history in Idaho. 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.[134] The City of Boise's geothermal heating utility delivers naturally heated water to more than 6 million square feet of building space. The Idaho Statehouse is the only geothermally heated capitol building in the nation. District heating is also currently being used for space heating at several of the Boise State University campus buildings.[135]

2.7. BIOENERGY

Bioenergy is renewable and derived from biological sources for uses associated with heating, electricity, or vehicle fuel. Bioenergy is produced primarily from wood, wastes, ethanol from corn fermentation, and biodiesel from oil seeds and animal fats. It can be produced from agricultural wastes and dedicated energy crops that are used to make advanced biofuels, which include switchgrass, miscanthus, and poplar.

Idaho had 84 MW of installed capacity of biomass electricity generation in 2017 which produced approximately 465,402 MWh, or 2.7% of Idaho's electricity production for that year.[136] As of 2019, Idaho has one operating ethanol plant capable of producing 60 million gallons per year.[137] There is no commercial production of biodiesel in Idaho.

2.8. SOLAR

Solar power is a renewable resource. Electricity is produced either through photovoltaic (PV) solar cells, or concentrated solar power (CSP). PV solar cells convert sunlight directly into electricity using solar plates stationed on an array angled towards the sun.

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130 Ormat. "Global Projects." https://www.ormat.com/en/projects/all/main/

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

132 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

133 Idaho Department of Water Resources. "Geothermal Resource Wells." https://idwr.idaho.gov/wells/geothermal-wells.html

134 Boise Warm Springs Water District. "About." https://bwswd.com/about-the-district/

135 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/

136 U.S. Energy Information Administration. "Idaho Electricity Profile 2017, Table 5." https://www.eia.gov/electricity/state/Idaho/state_tables.php

137 Official Nebraska Government Website. "Ethanol Facilities Capacity by State and Plant." www.neo.ne.gov/statshtml/122.htm

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.[138]

Utility-scale solar power generation in Idaho began in August 2016 and produced 0.2% of the total power generated in Idaho that year. By June 2019, the total installed solar power generation had grown to 488.3 MW. There are now 51 companies, six manufacturers, 21 installers, and 16 other solar industry companies in Idaho, and enough installed solar to power 64,000 homes.[139] Among the largest installed solar projects in Idaho, Grand View PV Solar Two, completed in 2016, has a generating capacity of 108 MW, enough to power nearly 18,000 homes. Additionally, American Falls Solar I and II, completed in 2017, have a combined generating capacity of 52 MW, enough to power over 7,000 homes.[140]

Solar energy can also be used for domestic applications which help to generate hot water and heat residential homes. There are two types of solar water heating systems, active and passive. Active solar water heating systems circulate liquid, either water or an anti-freezing heat-transfer fluid, through a series of pumps and controls located in pipes throughout a home. Passive solar water heating systems use the movement of hot water rising and cool water sinking to push water through a pipe system in the home without the use of pumps. Both types of systems need a storage tank for the water and solar panels to collect the needed heat.[141]

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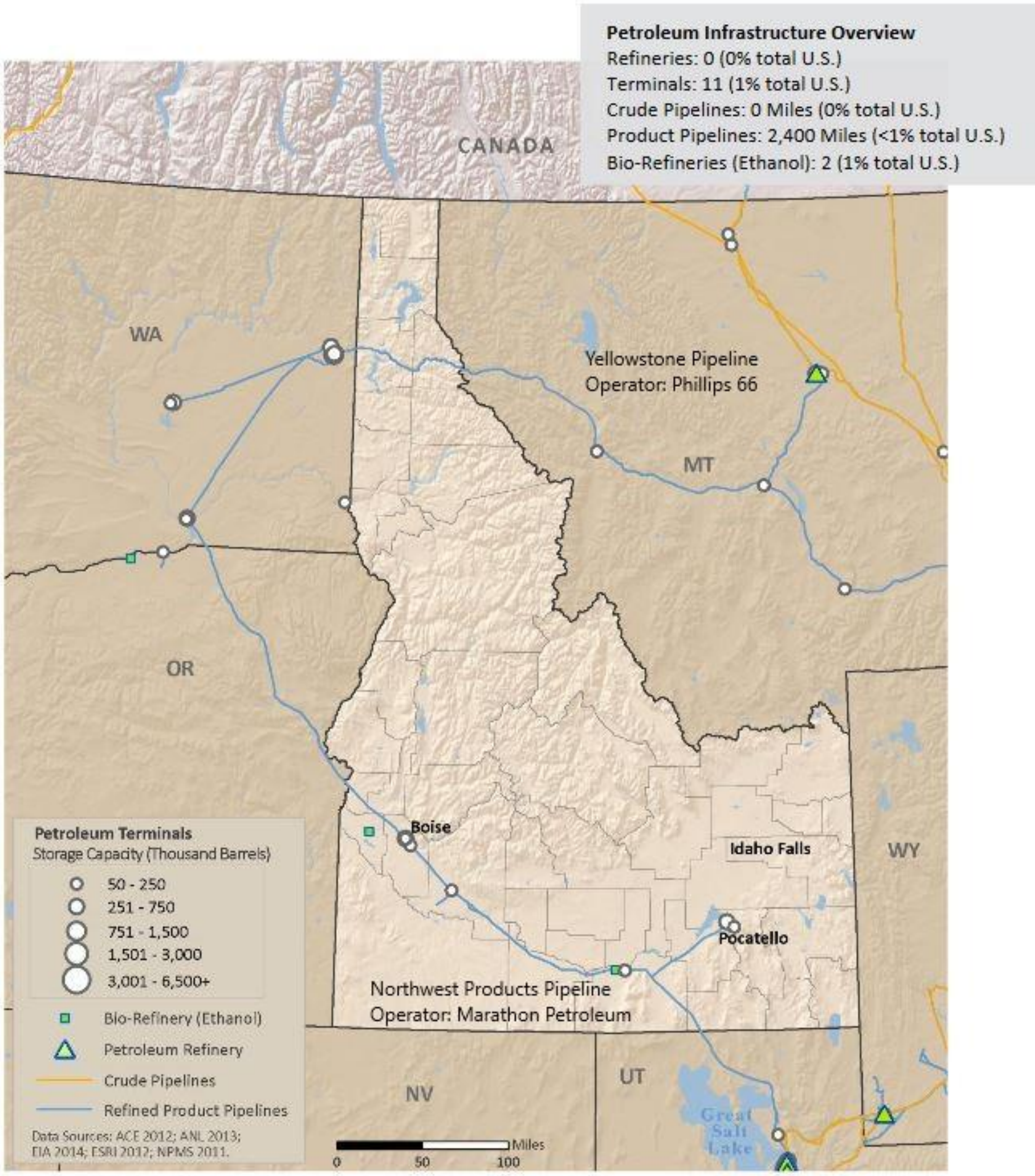
[138] U.S. Department of Energy. “Solar Energy Technology Basics.” https://energy.gov/eere/energybasics/articles/solar-energy-technology-basics
[139] Solar Energy Industries Association. “Solar Spotlight – Idaho.” https://www.seia.org/sites/default/files/2019-09/Factsheet_Idaho.pdf
[140] Solar Energy Industries Association. “Idaho Solar.” https://www.seia.org/state-solar-policy/idaho-solar
[141] U.S. Department of Energy. “Solar Water Heaters.” https://energy.gov/energysaver/solar-water-heaters

2.9. PETROLEUM

Figure 2.2 Transportation Fuel Pipelines and Refineries Serving Idaho[142]



There are no petroleum refineries located in Idaho and there is limited storage capacity. Pipeline routes are depicted in Figure 2.2. The State's petroleum pipeline infrastructure includes the Northwest Products Pipeline, which connects Salt Lake City refineries with Pocatello, Burley, and Boise, and continues to Spokane. This pipeline delivers refined petroleum products predominantly to southern Idaho. Refineries near Billings, Montana also transport refined petroleum products to northern Idaho via the Yellowstone Pipeline.

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[142] 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

2.10. PROPANE

Propane is used to heat homes and businesses throughout the State of Idaho, particularly in rural areas. Residential propane prices in Idaho fluctuated between $1.62/gallon to $2.53/gallon in 2019.[143] Since March 2019, propane prices have fallen approximately 35%. As of December 2019, propane prices were $1.82/gallon. Propane consumption is highly seasonal, with peak consumption in fall and winter. Propane is also used as a transportation fuel.

2.11. COMBINED HEAT AND POWER

Several Idaho facilities and industrial users have incorporated systems that generate on-site electricity and thermal energy in a process known as combined heat and power (CHP). CHP is typically deployed at sites, such as industrial operators and university or corporate campuses, which have high demand for electricity and hot water or steam. There are approximately 22 CHP systems in Idaho, and most are utilized by wood product facilities, dairies, hotels, and large industrial users.[144]

2.12. CONSERVATION, ENERGY EFFICIENCY, DISTRIBUTED ENERGY RESOURCES, AND DEMAND RESPONSE

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.[145]
- "Energy efficiency" refers to processes of utilizing technology that consumes a lower amount of electricity while providing sufficient service. For example, switching from incandescent lights bulbs to LED light bulbs.[146]
- "Demand response" refers to customers temporarily altering their energy-consuming behavior during times of higher demand for electricity, usually in response to signals from the utility or grid operator. For example, authorizing a utility to remotely control heating and ventilation systems during times of high electricity demand.[147]

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

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[143] 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

[144] U.S. Department of Energy. "Combined Heat and Power Installations in Idaho." https://doe.icfwebservices.com/chpdb/state/ID

[145] U.S. Energy Information Administration. "Use of Energy Explained." https://www.eia.gov/energyexplained/index.cfm?page=about_energy_efficiency

[146] U.S. Energy Information Administration. "Use of Energy Explained." https://www.eia.gov/energyexplained/index.cfm?page=about_energy_efficiency

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

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

The Idaho PUC directs Idaho investor-owned electric utilities to continue to place an emphasis on cost-effective conservation, energy efficiency, and demand response.[148] Each IOU calculates the level of cost-effective efficiency potential in their IRP and offers a suite of efficiency programs for customers to achieve energy efficiency goals.

Idaho Power, BPA and Avista belong to the Northwest Energy Efficiency Alliance (NEEA), which provides support to regional utilities and groups in the northwest that implement energy efficiency and conservation programs. NEEA provides funding for initiatives such as increasing compliance of energy codes, and also provides a vehicle through which collective industry consensus can be achieved on market acceptance of energy efficient products, like LED light bulbs.[149]

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

The Northwest Power Planning Council's Seventh Power Plan identifies the potential of cost-effective energy measures for the region. It estimates that approximately 4,300 aMW of cost-effective energy efficiency can be developed in the Pacific northwest region of Washington, Oregon, Idaho and Montana by 2035.[150] However, an important finding of the plan is that future electricity needs can no longer be adequately addressed by only evaluating average annual energy requirements. Planning for capacity to meet peak loads, and the flexibility to provide within hour load following and regulation services will also need to be considered.

2.12.2. Bonneville Power Administration Energy Efficiency

BPA works with its public utility customers to fund and implement energy-efficiency programs. They have tracked savings produced through those programs over the last four decades, acquiring more than 1,700 aMW of energy saved.[151] The municipal and cooperative utilities BPA supplies wholesale electric power typically engage in the Integrated Program Review processes. In its 2016 Energy Efficiency Action Plan, BPA set goals for achieving energy-efficiency savings from 2016 to 2021. BPA also sets an energy efficiency incentive budget every two-year rate period and monitors cost-effective efforts of individual public utilities. BPA is investigating efforts to achieve a goal of saving

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[148] 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
[149] Northwest Energy Efficiency Alliance. "About NEEA." http://neea.org/about-neea
[150] The Northwest Power and Conservation Council. "About the Seventh Power Plan." www.nwcouncil.org/energy/powerplan
[151] Bonneville Power Administration. "2016-2021 Energy Efficiency Action Plan." https://www.bpa.gov/EE/Policy/EEPlan/Documents/2016-2021_BPA_EE_Action_Plan.pdf

approximately 580 aMW from 2016 through 2021.[152] To accomplish this, BPA offers its municipal and cooperative customers an extensive energy-efficiency program, which includes many qualifying improvements and rebates that are passed on to the retail customer.

2.12.3. Idaho Power Energy Efficiency

Since 2002, Idaho Power has achieved a cumulative average annual load reduction of 242 aMW due to their energy efficiency investments. In its 2019 IRP, Idaho Power analyzed the amount of achievable, cost-effective energy efficiency potential for the period of 2019 – 2038. Due to a reduction in lighting measures within energy efficiency programming, Idaho Power predicts their potential energy efficiency savings to be approximately 234 aMW. This is a decline from the 273 aMW that was reported in the 2017 IRP.[153]

In 2018, Idaho Power's energy efficiency programs had energy savings of 158,412 MWh; this is enough energy to power more than 16,000 average homes a year.[154] This is a 5.6% decrease from the 2017 energy savings of 167,819 MWh.[155]

2.12.4. PacifiCorp Energy Efficiency

PacifiCorp plans to increase their demand side management resources across their entire service territory in the next twenty years. By the end of 2023, PacifiCorp's preferred portfolio plans to include over 700 MW of energy efficiency and direct load control resource capacity. By the end of their 2019 IRP's 20-year cycle, PacifiCorp expects to have more than 2,700 MW of energy efficiency and direct load control resource capacity. Energy efficiency programs are expected to meet 84% of that predicted capacity.[156]

2.12.5. Avista Energy Efficiency

Avista has acquired 219 aMW of electricity savings since it began offering energy efficiency measures to consumers in 1978. Of that total, the company currently has 145 aMW of active demand side resources for all of its customers. This reduced Avista's overall electric load by approximately 12.3% in 2016. This amounts to approximately 48 aMW in Idaho customer savings.[157]

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

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[152] Bonneville Power Administration. "2016-2021 Energy Efficiency Action Plan." https://www.bpa.gov/EE/Policy/EEPlan/Documents/2016-2021_BPA_EE_Action_Plan.pdf
[153] Idaho Power Company. "2019 IRP." https://docs.idahopower.com/pdfs/AboutUs/PlanningForFuture/irp/2019/2019_IRP.pdf
[154] Idaho Power Company. "2017 IRP Appendix B: DSM Annual Report." https://docs.idahopower.com/pdfs/AboutUs/PlanningForFuture/irp/AppendixB_DSM.pdf
[155] Idaho Power Company. "2019 IRP Appendix B: DSM Annual Report." https://docs.idahopower.com/pdfs/AboutUs/PlanningForFuture/irp/2019/2018_DSM.pdf
[156] PacifiCorp. "2019 Integrated Resource Plan." https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2019_IRP_Volume_I.pdf
[157] Avista. "2017 Electric IRP." https://www.myavista.com/about-us/integrated-resource-planning

achievable conservation potential. In its most recent IRP, Avista indicates that it has an achievable potential of demand savings of up to 173.1 aMW.[158] The CPA process was used to develop Avista's IRP for 2017.

2.12.6. Intermountain Gas Energy Efficiency

Intermountain Gas was granted authority by the Idaho PUC to implement an energy efficiency program effective October 1, 2017. The residential energy efficiency program was designed to acquire cost-effective demand side management (DSM) resources in the form of natural gas therm savings. The initial program includes rebates for residential customers that purchase and install qualifying high-efficient natural gas equipment in their homes. In addition, Intermountain Gas offers a rebate for the completion of new ENERGY STAR® qualified homes that have a Home Energy Rating Score (HERS) of 75 or less.[159]

The 2018 Energy Efficiency Annual Report states that Intermountain Gas exceeded the pilot year savings goal of 65,000 therms and achieved a savings of over 283,000 therms during the first program year. That is enough natural gas to serve 368 homes.[160] In 2018, Intermountain Gas commissioned the first Conservation Potential Assessment (CPA) to support both short term energy-efficiency planning and long-term resource planning activities. The CPA will be used for resource planning, identifying achievable, cost-effective energy efficiency opportunities and program design taking into consideration factors like funding levels and market readiness.

2.12.7. Distributed Energy Resources

Distributed energy resources (DER), also called on-site generation, dispersed or decentralized generation, are small power sources that can be combined to provide power to satisfy demand.[161] Such sources can include micro-turbines, small natural gas-fueled generators, combined heat and power plants, battery storage, biomass, wind and solar thermal or photovoltaic installations. Use of DERs is becoming more common due to potential for more affordable renewable energy, and an increased desire for grid resiliency, especially during disasters. The intermittent nature of DERs remains a challenge for utilities, and complex and expensive integration upgrades and power-balancing mechanisms will be required as use of DER increases.[162]

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[158] Avista. "2017 Electric IRP." https://www.myavista.com/about-us/integrated-resource-planning
[159] Intermountain Gas. "Energy Efficiency Program." https://www.intgas.com/energy-efficiency/rebate-program
[160] Intermountain Gas. "Energy Efficiency Annual Report." https://www.intgas.com/energy-efficiency/
[161] 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
[162] 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

3. Outlook

3.1. 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 concerns. Idaho IOU IRPs are available to the public on the Idaho PUC's website and via the utility's websites listed below:

- Avista: https://www.myavista.com/about-us/our-company/integrated-resource-planning
- Idaho Power: https://www.idahopower.com/energy/planning/integrated-resource-plan/
- PacifiCorp/Rocky Mountain Power: https://www.pacificorp.com/energy/integrated-resource-plan.html
- Idaho PUC: http://www.puc.idaho.gov
- Intermountain Gas: https://www.intgas.com/wp-content/uploads/PDFs/commission_filings/IRP-Write-Up-Book-2019.pdf

3.2. FUTURE PLANNED DEVELOPMENT

Table 3.1 Planned Investments in Electric Generating Facilities by Idaho Investor-Owned Utilities, 2020-2027[163]

Year	Investment Type	Nameplate Capacity (MW)	Utility
2026	Natural Gas-Fired Peaker	192	Avista
2026-2029	Thermal Upgrades	34	Avista
2027	Natural Gas-Fired Peaker	96	Avista
2023	New Wind	3500	PacifiCorp
2020	New Solar	3000	PacifiCorp
2020	New Battery Storage	600	PacifiCorp
2022-2023	Jackpot Solar	220	Idaho Power

Table 3.2 Major Planned Transmission Projects by Idaho Investor-Owned Utilities, 2020-2027[164]

Year	Investment Type	Capacity (kV)	Utility
2024	Oquirrh to Terminal	345	PacifiCorp
2023	Windstar to Aeolus (Gateway West)	230	PacifiCorp
2020	Aeolus to Bridger/Anticline (Gateway West)	500	PacifiCorp
2024	Bridger/Anticline-Populus (Gateway West)	500	PacifiCorp
TBD[165]	Populus to Hemingway (Gateway West)	500	PacifiCorp, Idaho Power
2025 or beyond	Boardman to Hemingway	500	PacifiCorp, BPA, Idaho Power
2023	Aeolus to Mona	500	PacifiCorp

Note: Tables 3.1 & 3.2 report the generation and transmission facilities included in the preferred resource strategy from each utility based upon their 2017 IRPs or IRP Updates.

Table 3.1 shows planned generation projects listed by Idaho's three electric IOUs in their most recent IRPs or IRP updates. These resources may be physically located outside of Idaho. Additional renewable generation may be developed by independent power producers under Public Utility Regulatory Policies Act (PURPA) or developed as net metering projects. IOU planned transmission projects are listed in Table 3.2.

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[163] Avista. "2017 Electric IRP." https://www.myavista.com/about-us/integrated-resource-planning; PacifiCorp "2019 IRP Volume I." https://www.pacificorp.com/energy/integrated-resource-plan.html; and Idaho Power. "2019 IRP." https://docs.idahopower.com/pdfs/AboutUs/PlanningForFuture/irp/2019/2019_IRP.pdf

[164] Avista. "2017 Electric IRP." https://www.myavista.com/about-us/integrated-resource-planning; PacifiCorp. "2019 IRP Volume I." https://www.pacificorp.com/energy/integrated-resource-plan.html; and Idaho Power. "2019 IRP." https://docs.idahopower.com/pdfs/AboutUs/PlanningForFuture/irp/2019/2019_IRP.pdf

[165] Idaho Power and PacifiCorp continue to coordinate the timing of next steps to best meet customer and system needs.

Other organizations are continuing plans on transmission projects around Idaho. BPA's Hooper Springs transmission line completed construction in southeast Idaho in Fall 2019.[166] Idaho Falls Power, a municipal electric utility serving the city of Idaho Falls, continues to work on the 161 kV North Loop transmission expansion proposal, while LS Power, a commercial energy developer, is exploring development of the Southwest Intertie Project, Northern Section through southern Idaho.

3.3. MICROGRIDS

A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. This means a microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode.[167] The development of microgrids as an emerging resource provides practical answers to the energy challenges of the 21st century by creating an optimized way to access reliable, clean, and resilient energy through local, interconnected energy systems that incorporate loads, decentralized energy resources, battery storage, and control capabilities.

3.3.1 "Smart Grid"

Technologies that not only allow for two-way communication between a utility and its customers but sensing capabilities along transmission lines that respond to needed load in real time describes "smart grid" technologies. Emerging "smart grid" technologies could make it possible for consumers to individually balance their energy supply and demand. Allowing consumers to adjust electricity use in response to available supplies and costs could enhance the capacity and flexibility of the power system and may have a significant impact on Idaho energy networks. Smart grid development may facilitate the deployment of electric vehicles and help reduce carbon emissions in the transportation sector. The development of new energy storage technologies will impact both the feasibility of fuel-switching in the transportation sector (gas to electric) as well as grid stability through grid-scale energy storage.[168]

3.4. ENERGY STORAGE TECHNOLOGIES AND APPROACHES

Energy storage is the capture of energy produced at one time for use at a later time. These technologies could extend and optimize the operating capabilities of the grid. Energy is stored in numerous ways, using technologies such as: batteries, including advanced chemistry batteries, flow batteries, and capacitors; thermal, which captures heat and cold; mechanical, which harnesses kinetic or gravitational energy; hydrogen, which can be converted from excess electricity generation via electrolysis; and pumped hydroelectric, created by large-scale water reservoirs.[169]

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[166] 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

[167] 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

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

[169] Energy Storage Association. "Technologies of Energy Storage." http://energystorage.org/energy-storage/energy-storage-technologies

Energy storage also can play a key role in providing overall grid security and resilience, while allowing critical infrastructure such as hospitals, police stations and other key services to remain operational during emergency situations. The federal government has a number of programs promoting the adoption of more energy storage in the United States, particularly for resiliency purposes at military bases. The cost of energy storage infrastructure is a significant hurdle; however, more affordable utility-scale storage systems are currently under development.[170]

3.4.1. Battery Storage

Batteries for grid scale energy storage are attracting significant interest across the nation, which has resulted in a gradual reduction of price. Batteries for energy storage usually have a short to mid-range response time (seconds to a few hours). There are two types of batteries used for energy storage, solid state and flow batteries. Solid state batteries utilize different solid chemical compounds for varying grid service applications, the most common chemical pairing is lithium-ion. Flow batteries use different chemical compounds that are dissolved in liquid and are forced through a membrane within the battery to create a reaction that produces electricity. Research studies are being conducted on both types of batteries to discover more effective ways to use battery storage.[171]

3.4.2. 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 on a utility scale includes solar thermal power plants that use molten salt or other heat-retaining substance to store the sun’s energy, which can be utilized later in steam generating processes.[172]

3.4.3 Mechanical Storage

Mechanical storage systems utilize kinetic or gravitational forces to store inputted energy. One example of a mechanical storage system is the flywheel, a mechanism in which rotational energy is stabilized and maintained through movement of an accelerating wheel that can then store the energy kinetically for future use. A generator is then applied to easily convert the stored energy from mechanical to electrical energy.[173]

3.4.4 Hydrogen Storage

Electricity can be converted into hydrogen by electrolysis. The hydrogen can then be stored and eventually re-electrified. Hydrogen can be re-electrified in fuel cells or burned in combined cycle gas power plants. Small amounts of hydrogen can be stored in pressurized vessels, or very large amounts of hydrogen can be stored in constructed underground salt caverns. This method of storage can level excess wind or PV production, including seasonal variations. Hydrogen energy storage is growing due to a much higher

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

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

[172] Energy Storage Association. “Thermal Energy Storage.” https://energystorage.org/why-energy-storage/technologies/thermal-energy-storage/

[173] Energy Storage Association. “Mechanical Energy Storage.” https://energystorage.org/why-energy-storage/technologies/mechanical-energy-storage/

storage capacity compared to small scale batteries, large scale compressed air energy storage (CAES), or pumped hydroelectric.[174]

3.4.5 Pumped Hydroelectric Storage

Pumped hydroelectric storage facilities store energy by utilizing excess electricity when energy demand is low to pump water from a lower to a higher reservoir to be released through turbines when energy demand is high. Both pumped hydroelectric storage and compressed air systems are best suited for response times of hours or longer.[175]

3.5. ELECTRIC VEHICLES

Electric vehicles (EV) are vehicles that run off of batteries charged by electricity rather than fossil fuels and a combustion engine. The rate of electric vehicle ownership is rising due to affordability and advances in battery technology performance. The costs of charging an EV in Idaho are reflective of Idaho's affordable electricity rates and can cost significantly less than the price of an equivalent amount of gasoline.[176] However, the typical range that many EVs are able to travel on a single charge and a limited EV charging station infrastructure can restrict where an Idahoan can travel in an EV, given the State's rural geography.

EV owners have a variety of charging options to recharge their battery that require differing types of infrastructure. For example, EVs can be charged overnight via common 120-volt outlets, also called Level 1 chargers. Level 2 charging stations have a 240-volt capacity, which can be installed at residences, businesses or fleet locations to charge at a faster rate (about 3-5 hours for a full charge).[177] Direct charge or DC "fast chargers" require a specialized, 480-volt outlet and can provide a full charge after 20-30 minutes. Level 1 and 2 chargers are likely to be more frequently used day-to-day, but DC fast chargers are the most popular options for long range road trips.[178]

4. Energy Research and Education Entities in Idaho

4.1. RESEARCH AT IDAHO NATIONAL LABORATORY

INL is one of the State's largest employers, and the U.S. Department of Energy's (DOE) nuclear energy research, development, and demonstration laboratory. INL is also a leading contributor to a variety of non-nuclear clean energy technologies research on cybersecurity and protecting critical infrastructure.[179] Within its 890 square miles of research space, INL has numerous unique research facilities and capabilities.

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

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

[176] Idaho Strategic Energy Alliance. "Transportation Task Force Report 2015." https://oemr.idaho.gov/wp-content/uploads/2016/06/2015_Transportation_TF_Report.pdf

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

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

[179] Idaho National Laboratory. "INL Research Areas." https://www.inl.gov/research-programs/

Nuclear Science and Technology: In addition to the Gateway for Accelerated Innovation in Nuclear (GAIN) initiative,[180] which was created to provide technical, regulatory, and financial support to move reactor technologies toward commercialization, INL was recently named home to the National Reactor Innovation Center (NRIC). NRIC is the next step toward commercialization. It provides private sector technology developers access to facilities and expertise within the national laboratory system. Through NRIC, new reactor demonstrations will be able to accelerate technology readiness from proof of concept to proof of operations. This includes demonstration of the first of its kind small modular reactors and microreactors.[181]

Energy Environment Science and Technology: INL is working to help accelerate cost effective integration of clean energy sources, including geothermal, wind, nuclear and solar power into the grid. Additionally, INL leads research into electric vehicle (EV) charging technologies and the charging habits of EV owners, hoping to discover safer, faster, and more efficient means of dispatching energy on smart grids, charging, and utilizing battery technologies.[182] Effective charging will enhance EV owner security, while increasing domestic energy independence. INL's extensive research can help inform decisions on how to most effectively deploy EV charging opportunities.

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

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

4.2. CENTER FOR ADVANCED ENERGY STUDIES

The Center for Advanced Energy Studies (CAES) is a research, education, and innovation consortium that brings together INL, Boise State University, Idaho State University, the University of Idaho, and the University of Wyoming. CAES headquarters is a state-owned, energy-efficient facility located near INL and University Place campus in Idaho Falls. With complimentary capabilities and research programs at each of the participating universities, CAES works to solve regional energy challenges that have national impact.[183] CAES utilizes the expertise, facilities, and capabilities from all five member organizations allowing for a collaborative approach to solve challenges in the following core areas: nuclear science and engineering; materials science and engineering; geological systems

[180] Gateway for Accelerated Innovation in Nuclear. "What is GAIN?" https://gain.inl.gov/SitePages/What%20is%20GAIN.aspx
[181] U.S. Department of Energy "National Reactor Innovation Center Fact Sheet." https://www.energy.gov/sites/prod/files/2019/08/f65/NRIC_Fact_Sheet.pdf
[182] Idaho National Laboratory. "Clean Energy & Transportation." https://at.inl.gov/SitePages/Evaluation%20of%20Conductive%20and%20Wireless%20Charging%20Systems.aspx
[183] CAES. "About Us." https://caesenergy.org/about-us/

and applications; energy systems design, analysis, and testing; environmental and resource sustainability; energy policy; and fossil carbon conversion.[184]

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

4.3. UNIVERSITIES, COLLEGES, AND TECHNICAL TRAINING

Many of Idaho's higher education institutions are engaged in educating tomorrow's energy workforce. For example, elective courses are offered in energy efficiency and renewable energy at **Boise State University**. The courses provide non-science or engineering students with a solid grounding in energy fundamentals, which is helping Boise State educate a knowledgeable generation of energy consumers, policymakers, teachers and business leaders.

The **Micron School of Materials Science and Engineering (MSE)** at Boise State University is home to one of the most productive materials science and engineering programs in the Pacific northwest. MSE is currently investigating a broad range of materials issues in areas such as nuclear fuels, biomaterials, glasses, semiconductors, electronic memories, computational modeling and magnetic materials.[185]

The Department of Biological and Agricultural Engineering at the **University of Idaho** houses the **Biodiesel Fuel Education Program** which provides unbiased, 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.[186]

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.[187]
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.[188]

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[184] CAES. "Core Capabilities." https://caesenergy.org/research/core-capabilities/
[185] Boise State University. "Micron School of Materials Science and Engineering." http://coen.boisestate.edu/mse/
[186] University of Idaho. "Biodiesel Education." http://biodieseleducation.org/
[187] University of Idaho. "National Institute for Advanced Transportation Technology." www.uidaho.edu/engr/research/niatt
[188] Idaho State University. "Programs of Study." http://coursecat.isu.edu/programsofstudy/

Idaho State University established the **Energy Systems Technology and Education Center** (ESTEC) in its College of Technology. ESTEC integrates the education and training required for graduates to maintain existing plants. They also learn to install and test components in new plants in various key areas of technology, including electrical engineering, instrumentation and control, mechanical engineering, wind engineering, instrumentation and automation, nuclear operations, and renewable energy.[189]

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 its **Renewable Energy Systems Technology Program.**[190] CSI received a $4.4 million Economic Development Administration federal grant in 2011 to help build a nearly $7 million **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.[191]

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.[192]

The **College of Western Idaho** (CWI) is looking to the future of managing a diverse energy sector with its Advanced Mechatronics Engineering Technology program. This one-to-two-year program teaches students about electricity, robotics, wireless communication, renewable energy, instrumentation and computerized control systems.[193]

The **Northwest Lineman College,** based in Meridian, trains lineman apprentices and educates students in construction, maintenance, and operation of the electrical grid. It provides lineman certification for individuals already working in the trade and develops customized training services for power and construction companies worldwide. Founded in 1993, the college educates more trade professionals in the Power Delivery Industry than any other educational institution in the United States, training 4,000 individuals annually.[194]

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[189] Idaho State University. "College of Technology." https://www.isu.edu/estec//
[190] College of Southern Idaho. "Renewable Energy Systems Technology Program." https://www.csi.edu/programs/renewable-energy-systems-technology/default.aspx
[191] Lochsa Engineering. "CSI Applied Technology & Innovation Center." www.lochsa.com/csi-applied-technology-innovation-center
[192] College of Eastern Idaho. "Energy Systems Technician." http://www.eitc.edu/programs-of-study/trades-industry/energy-systems-technician; and Idaho State University. "Energy Systems Technology and Education Center." https://www.isu.edu/estec/
[193] College of Western Idaho. "Advanced Mechatronics Engineering Technology." https://cwi.edu/program/advanced-mechatronics-engineering-technology
[194] Northwest Lineman College. "Northwest Lineman College." https://lineman.edu/

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

Rural Electric Cooperatives

Bonneville Power Administration	800-282-3713
Clearwater Power	888-743-1501
East End Mutual Electric	208-436-9357
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

Municipal Electric Utilities

Albion Light and Water Plant	208-673-5352
Bonners Ferry Light and Water	800-626-4950
Burley Electric Department	208-878-2538
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	208-431-6598
Soda Springs Electric Light and Power	208-547-2600
City of Weiser Electric Department	208-414-1964

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.

Bonneville Power Administration (BPA): A power marketing and electric transmission agency of the U.S. government with headquarters in Portland, Oregon.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Demand: The amount of power consumers require at a particular time. Demand is synonymous with load. It is also 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.

Federal Energy Regulatory Commission (FERC): A quasi-independent regulatory agency within the U.S. Department of Energy having jurisdiction over interstate electricity sales, wholesale electric rates, hydroelectric licensing, natural gas transmission and related services, pricing, oil pipeline rates and gas pipeline certification.

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

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

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

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

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

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

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

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

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

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

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

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

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

Integrated Resource Plan (IRP): A plan that IOUs produce periodically for regulators and customers to share their vision of how to meet the growing need for energy. These plans contain a preferred portfolio of resource types and an action plan for acquiring specific resources to meet the needs of customers including conservation measures.

Specific resources will be acquired as individual projects or purchases and, when appropriate, through a formal request for proposals (RFP) process.

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

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

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

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

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

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

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

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

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

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

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

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

NERC (North American Electric Reliability Corporation): An organization subject to oversight by the Federal Energy Regulatory Commission and governmental authorities in Canada whose mission is to ensure the reliability of the bulk power system in North America. To achieve that, NERC develops and enforces reliability standards; assesses power adequacy annually via 10 year and seasonal forecasts; monitors the bulk power system; evaluates users, owners and operators for preparedness; and educates, trains and certifies electric industry personnel.

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 also 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 also 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.

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 also Obligation to serve.)*

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

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

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

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

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

Rural electric cooperative: *See Cooperative electric utility*.

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

Smart grid: Smart grid is a concept. At the moment that concept is undeveloped. The basic concept of smart grid is to add monitoring, analysis, control and communication capabilities to the national electrical delivery system to maximize the throughput of the system. In theory, the smart grid concept might allow utilities to move electricity around the system as efficiently and economically as possible. It might also allow the homeowner and business to use electricity as economically as possible. Consumers will have the choice and flexibility to manage electrical use while minimizing bills. Smart grid hopes to build on many of the technologies already used by electric utilities. It also adds communication and control capabilities with the idea of optimizing the operation of the entire electrical grid. To reduce this concept to a single sentence, one might describe smart grid as overlaying a communication network on top of the power grid.

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

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

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

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

Transmission: The network of high-voltage lines, transformers and switches used to move electrical power from generators to the distribution system (loads). This network is also 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.

Western Electricity Coordinating Council (WECC): A group of utilities banded together to promote reliability by coordinating the power supply and transmission in the West.

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.