FINAL REPORT

Supply Side Non-Energy Impacts

Avista

Date: April 8, 2022

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DNV

1 INTRODUCTION

The goal of this project is to provide Avista with quantitative ($/MWh, $/kW) estimates of non-energy impacts (NEIs) for a variety of generation technologies and scenarios. Washington's Clean Energy Transition Act (CETA; https://www.commerce.wa.gov/growing-the-economy/energy/ceta/) requires investor-owned utilities to consider equity-related NEIs in integrated resource plans (IRPs). To accomplish this, DNV is building and applying a supply-side NEI database. As part of a previous project, DNV provided Avista with demand-side NEIs for measures included in energy efficiency programs. With the addition of supply-side NEIs, Avista, its advisory groups, and the Utilities and Transportation Commission (UTC) will be able to assess the full societal costs and benefits of all possible permutations of generation and efficiency options in future IRPs.

2 METHODOLOGY OVERVIEW

To compare the sustainability of different generator types, academic researchers use a method known as multi-criteria decision analysis (MCDA).[1,2] This process is conceptually similar to the preferred resource strategy (PRS) used in Avista's 2021 IRP to consider the different effects of each generator type on a variety of factors. Academic MCDA tends to include a wider range of sustainability effects than the PRS, specifically additional health, environmental, and economic effects; these are exactly the types of effects that Avista wants to quantify. These additional effects will help Avista factor into the PRS calculations more of these hidden costs and benefits that go beyond levelized cost of delivered energy to its customers (LCOE). DNV will add a monetization step to the MCDA methods to align the data into units that make it easier to integrate into the PRS.

Estimating NEIs can be a very complicated and nuanced endeavor. Specific documentation guidelines for investor-owned utilities are still being developed and will likely vary by state once completed.

DNV's approach is designed to produce defensible, levelized costs and benefits per MWh or kW, in such a way that they can be added directly to Avista's existing LCOE by generator type, for a variety of additional sustainability effects not yet considered in Avista's 2021 IRP. The approach follows four stages:

1. Conduct a jurisdictional scan to identify additional NEIs being used elsewhere and not listed in the RFP
2. Identify NEIs available through federal and regulatory publications
3. Where necessary, convert NEI units to $/MWh and/or $/kW values and apply discount rates
4. Conduct a gap analysis to provide recommendations to prioritize future research based on the necessary level of effort and anticipated value to Avista

Where available, DNV leveraged existing metanalytic data published by regulatory and government institutions such as the Environmental Protection Agency (EPA) and the National Renewable Energy Laboratory (NREL). Such official values should be readily defensible. In cases where institutional studies were not available, DNV conducted secondary research to identify data sources. Cases in which DNV was unable to identify a published data source are part of the gap analysis.

After compiling a database of NEI types (e.g., health) and values ($/MW or $/MWh) by generation technology, DNV applied the information in the database to the specific generation technologies and scenarios identified in the RFP and Avista's current generation assets.

[1] Klein, S.J. and Whalley, S. (2015). Comparing the sustainability of U.S. electricity options through multi-criteria decision analysis. Energy Policy79(2015)127–149. http://dx.doi.org/10.1016/j.enpol.2015.01.007

[2] Nock, D. and Baker, E. (2019). Holistic multi-criteria decision analysis evaluation of sustainable electric generation portfolios: New England case study. Applied Energy 242 (2019) 655–673. https://doi.org/10.1016/j.apenergy.2019.03.019

3 DATABASE COMPILATION

Database compilation involves conducting secondary research to identify and catalog the NEI values in terms of native units (e.g., tons of pollution per MWh) and to monetize those units ($/MWh or $/MW) for each level in the database. Once prepared, the database is a single location that DNV and Avista can apply to specific scenarios and generation assets.

3.1 Database structure

The database includes NEI impacts disaggregated by resource type, location, and lifecycle phase whenever possible. The resource types are shown in Table 3-1. These resources include both current and potential resource types. The abbreviations in the table are used in the tables and figures throughout the report. The database application is explained in Section 3.4.

Table 3-1. Database resource types

Group	Technology	
	Abbreviation	Generator Types
Biomass	Biomass	Biomass
Coal	Coal	Coal
	Coal CCS	Coal with Carbon Capture
Hydro	Hydro-PB	Pumped hydro - brownfield
	Hydro-GF	Pumped hydro - greenfield
	Hydro-Res	Reservoir hydro
	Hydro-RR	Run-of-river hydro
	Hydro-RRS	Run-of-river hydro with storage
Hydrogen electrolyzer	HE-LG	Hydrogen electrolyzer - large
	HE-SM	Hydrogen electrolyzer - small
Lithium-ion storage	Batt-LG	Lithium-ion Storage - Large
	Batt-SM	Lithium-ion Storage - Small
Natural gas	NG-Aero	Natural gas Aero Turbine
	NG-CCCT	Natural gas CCCT
	NG-CT	Natural gas CT
	NG-ICE	Natural gas internal combustion engine
Non-natural gas	NNG-Bio	Non-natural gas (Bio-fuel)
	NNG-CF	Clean Fuel Turbine
	NNG-Hyd	Non-natural gas (Hydrogen)
	NNG-LAir	Non-natural gas (Liquid air)
	NNG-Ren	Renewable natural gas storage tank
Nuclear	Nuclear	Nuclear
Solar	Solar-Com	Community solar
	Solar-Rft	Rooftop solar
	Solar-Utl	Utility-scale solar
Wind	Wind-LG	Large wind
	Wind-Off	Off-shore wind
	Wind-SM	Small Wind

Near/Away: For some NEI metrics, the database also includes values disaggregated into near and away from the resource site. Near-resource site impacts occur at the operations facility or nearby communities whereas impacts away from the resource site may occur in a different county, state, or country. This distinction provides the flexibility to assign near-facility impacts within or without Avista's territory depending on the location of the resource.

Generation Resource Phase: When possible, NEI metrics are also disaggregated by generation resource phase, including construction, operations, mining, and decommissioning, which are further described in Table 3-2.

Table 3-2. Generation resource phase

Phase	Description
Construction	Impacts specific to construction or manufacturing of the generation resource
Operation	Impacts associated with the operations of the generation resource
Mining	Impacts associated with fuel mining
Decommissioning	Impacts associated with decommissioning and disposing of the generation resource

3.2 Non-energy impact metrics

This section describes DNV's methods for determining values for each of the NEI types.

3.2.1 Public health

Electricity-generating technologies can cause a variety of public health impacts across their life cycles, from construction and manufacturing of components to operations and mining to decommissioning. Operational impacts due to particulate matter 2.5 ($PM_{2.5}$), sulfur dioxide (SO_2), and nitrogen oxide (NO_x) emissions are readily available across many electricity-generating technologies.[3] These emissions values can be used to estimate monetized health impacts across different counties in the US by utilizing readily available tools from the EPA. Table 3-3 summarizes the metrics used to quantify operational public health impacts.

Table 3-3. Public health metric descriptions

Metric	Description	Sources
$PM_{2.5}$ Health Effects	Particulate matter 2.5 ($PM_{2.5}$) emissions are produced through fossil fuel, biomass, and other combustion to generate electricity. Increased $PM_{2.5}$ emissions are associated with increased mortality rates, respiratory and cardiovascular illnesses, and other impacts which the COBRA model monetizes. DNV used information from eGRID and the EPA to estimate $PM_{2.5}$ emissions and COBRA to monetize them, resulting in a dollar per MWh value.	COBRA[4]; eGRID[5]; EPA[6]
SO_2 Heath Effects	Sulfur dioxide (SO_2) emissions are also emitted through combustion to produce electricity. Increased SO_2 emissions are associated with increased respiratory diseases and breathing difficulty.[7] DNV used the eGRID emissions estimates and the COBRA model to produce a dollar per MWh health impact metric.	COBRA[8]; eGRID[9]
NO_x Health Effects	Nitrogen oxides (NOx) are also produced through combustion to generate electricity. Increased NO_x emissions are associated with increased respiratory diseases, particularly asthma, hospital admissions, and emergency room visits.[10] DNV used the eGRID emissions estimate and the COBRA model to produce a dollar per MWh health impact for NO_x.	COBRA[11]; eGRID[12]

[33] These emissions and health impacts do not include health impacts from upstream or downstream activities including mining, drilling, manufacturing, or disposal. Additionally, they do not include operational health impacts from soil or water contamination.

[4] User's Manual for the Co-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA). 2021. US EPA. November 2021. https://www.epa.gov/cobra.

[5] United States Environmental Protection Agency (EPA). 2022. "Emissions & Generation Resource Integrated Database (eGRID), 2020" Washington, DC: Office of Atmospheric Programs, Clean Air Markets Division. Available from EPA's eGRID web site: https://www.epa.gov/egrid.

[6] Estimating Particulate Matter Emissions for EGRID. 2020. US EPA. July 2020. https://www.epa.gov/sites/default/files/2020-07/documents/draft_egrid_pm_white_paper_7-20-20.pdf.

[7] United States Environmental Protection Agency (EPA). (n.d.). "Sulfur Dioxide Basics" EPA. Retrieved February 1, 2022, from https://www.epa.gov/so2-pollution/sulfur-dioxide-basics#effects

[8] Ibid

[9] Ibid

[10] United States Environmental Protection Agency (EPA). (n.d.). "Basic Information about NO2" EPA. Retrieved February 1, 2022, from https://www.epa.gov/no2-pollution/basic-information-about-no2#Effects

[11] Ibid

[12] Ibid

3.2.1.1 Emissions values

The EPA has a comprehensive database of environmental characteristics of almost all electric power generated in the US. The Emissions and Generation Resource Integrated Database (eGRID) contains data on emissions, emissions rates, generation, heat input, and many other characteristics.[13] Values from eGRID were used to supplement data provided directly by Avista for existing and proposed generation resources. DNV combined information from the two sources for plant annual heat input from combustion (MMBtu), total emissions from NO_x (tons), total emissions from SO_2 (tons), and plant annual net generation (MWh). Total emissions from $PM_{2.5}$ are not available in eGRID, however, the EPA provides $PM_{2.5}$ estimates for most electric generating units in a separate database based on the EPA's National Emissions Inventory (NEI).[14] Total emissions for $PM_{2.5}$, NO_x, and SO_2 were converted into tons/MWh based on the annual net generation from each electric generating unit.

Figure 3-1 through Figure 3-3 present the $PM_{2.5}$, SO_2, and NO_x emissions per MWh for both existing and proposed generation types. Both the existing and proposed biomass plants have the highest $PM_{2.5}$ emissions rates, followed by the existing and proposed coal plants. It is important to note that while for most technologies, the assumed counterfactual would be producing no emissions or similar emissions if the fuel were burned in a different power plant, the biomass counterfactual is less well defined. The Kettle Falls biomass facility burns sawmill or chip mill biomass residuals. In the absence of the Kettle Falls facility, it is difficult to say how the waste material would have been used and what the likely emissions would have been. The existing and proposed coal plants also had the highest SO_2 emissions, while the Northeast natural gas plant had the highest NO_x emissions. Hydro, wind, and solar had no $PM_{2.5}$, SO_2, or NO_x emissions. For SO_2 and NO_x, the coal with carbon capture and storage resource is assumed to have the same emissions rate as the current Coal Strip facility, as this is the best available data. In practice, the SO_2 and NO_x emissions rate for the coal with carbon capture and storage may be lower.

[13] United States Environmental Protection Agency (EPA). 2022. "Emissions & Generation Resource Integrated Database (eGRID), 2020" Washington, DC: Office of Atmospheric Programs, Clean Air Markets Division. Available from EPA's eGRID web site: https://www.epa.gov/egrid.

[14] US EPA. 2020. Review of Estimating Particulate Matter Emissions for EGRID: Draft White Paper. https://www.epa.gov/sites/default/files/2020-07/documents/draft_egrid_pm_white_paper_7-20-20.pdf.

Figure 3-1. Operational $PM_{2.5}$ emissions per MWh by generation type

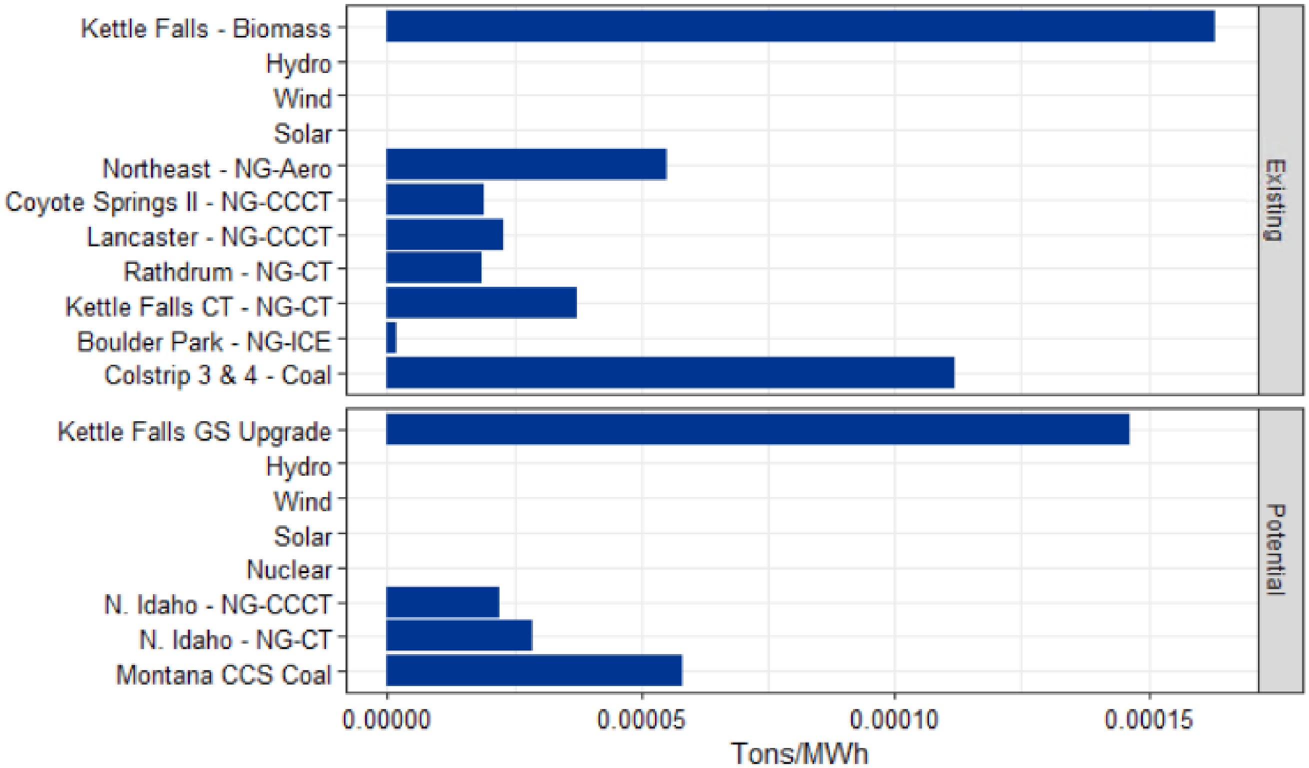


Figure 3-2. Operational SO_2 emissions per MWh by generation type

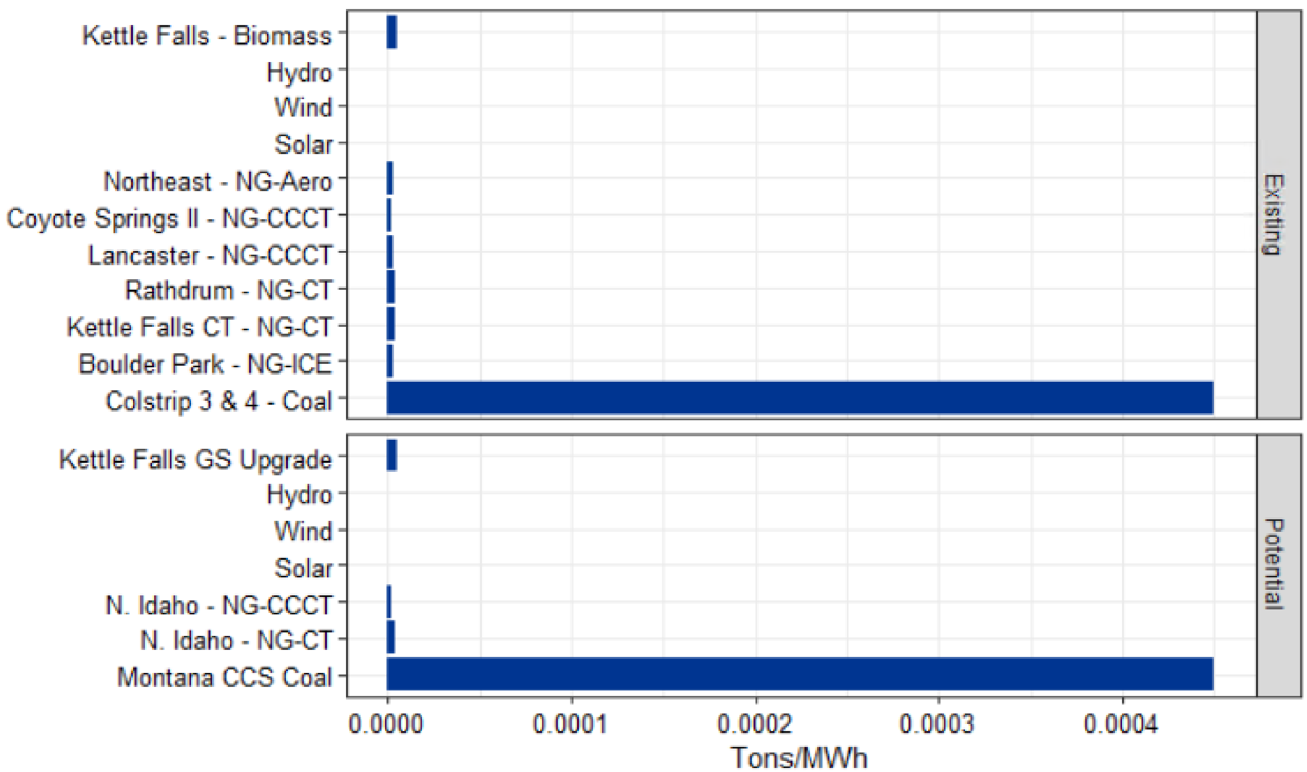
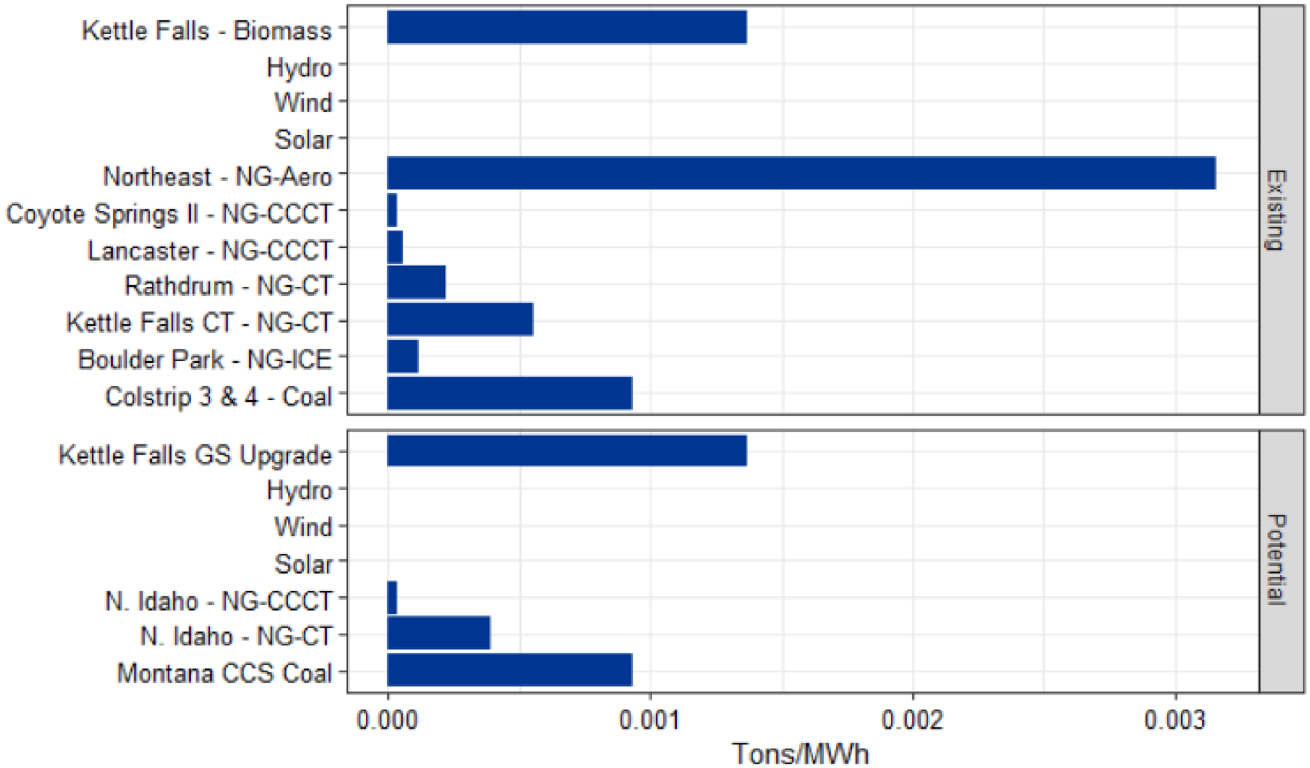


Figure 3-3. Operational NO_X emissions per MWh by generation type



3.2.1.2 Monetized impacts

Co-Benefits Risk Assessment (COBRA) is a screening and modeling tool provided by the EPA that can be used to explore how changes in air pollution can affect human health in different areas of the country and estimate the economic value of the health benefits associated with those changes.[15] [16] Emissions changes are entered at the county, state, or national level, and COBRA uses an air quality model to estimate the effects of those emissions changes across the country. The model then estimates the number of health incidences avoided and the economic value for health impacts such as mortality, non-fatal heart attacks, and respiratory admissions. The monetization for these health conditions is based on values such as the willingness to pay, the cost of illness, and the value of a statistical life that were collected from various literature reviews. DNV modeled the impacts of $PM_{2.5}$, SO_2, and NO_X emissions in the counties where combustion generation technologies, including coal, natural gas, and biomass, either exist or are proposed. When emissions are changed in one county, the COBRA model produces the monetized impacts for every county in the United States. DNV categorized those impacts in the following way:

- **Site county**: The monetized health costs in the county where the generation resource is located. Resources may be located within or outside Avista's territory.
- **Avista territory**: The monetized health costs in Avista's territory. If the site county is within Avista's service territory, those costs are not included in this estimate; in this case, total cumulative effects within Avista territory will equal the sum of the site county and Avista territory effects.

[15] User's Manual for the Co-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA). 2021. US EPA. November 2021. https://www.epa.gov/cobra.

[16] It should be noted that this study assumes Avista complies with existing permitting laws that establish maximum levels of pollution that utilities are allowed to produce. While legally acceptable, these allowances do not imply that only pollution over those thresholds results in harm. Instead, they essentially establish a maximum amount of harm that a utility is legally allowed to cause.

- **Other US**: The monetized health costs for the rest of the United States

DNV combined emissions information from eGRID and Avista with the monetized health impacts from COBRA to estimate the economic impact on health from a one-ton increase in $PM_{2.5}$, SO_2, NO_x (Equation 1).

Equation 1. Monetized health impacts

$$Monetized\ Health\ impacts\left[\frac{\$}{MWh}\right] = Emissions\left[\frac{tons}{MWh}\right] \times Health\ Impacts\ from\ pollutant\left[\frac{\$}{ton}\right]$$

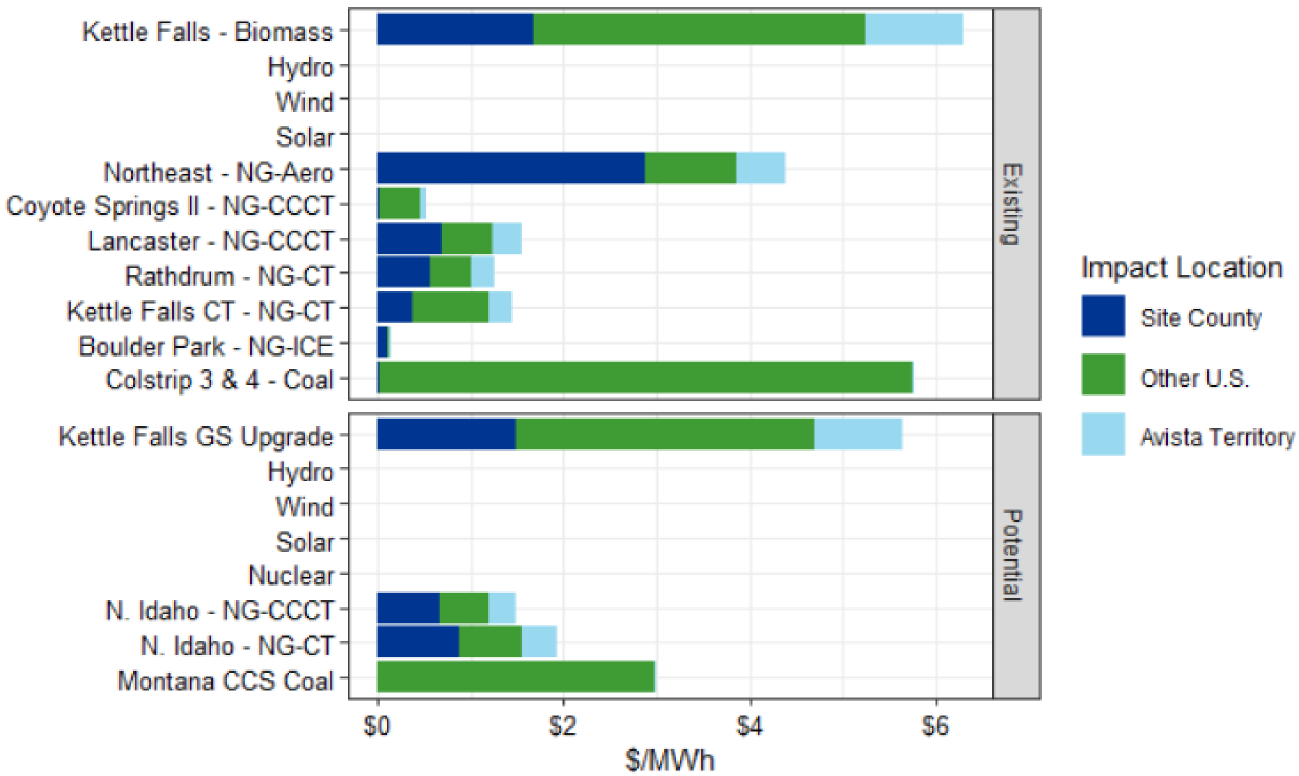
Table 3-4 displays dollars per ton of $PM_{2.5}$, NO_x, and SO_2 for each of the counties where an existing plant is located. COBRA estimates the public health costs of a change in pollutant levels by county. Estimates were only available for combustion generation technologies such as coal, gas, or biomass. The counties included in the table above are where existing plants are currently located.

Table 3-4. Dollars per ton by County

Plant County	PM2.5 ($/ton)			NOx ($/ton)			SO2 ($/ton)		
	Site County	Avista Territory	US-Other	Site County	Avista Territory	US-Other	Site County	Avista Territory	US-Other
Rosebud, MT	118.81	172.40	51,361.34	7.88	33.59	9,973.72	12.22	75.28	22,473.09
Kootenai, ID	30,724.75	13,558.21	23,330.00	1,508.19	761.88	4,304.93	2,060.74	1,071.30	10,101.90
Spokane, WA	52,237.59	9,523.47	17,869.91	2,678.17	489.07	3,266.53	3,749.00	713.52	7,578.78
Morrow, OR	1,268.66	2,891.67	23,471.96	65.68	290.51	3,038.00	253.43	1,192.13	13,335.49
Stevens, WA	10,222.35	6,399.56	21,922.87	609.91	566.63	3,954.48	867.26	866.72	9,184.79

Figure 3-4 presents the operational health costs per MWh for $PM_{2.5}$ emissions for each existing and proposed combustion resource. Renewable resources including solar, wind, and hydro do not have any reported operational $PM_{2.5}$, SO_2, or NO_x emissions. For existing resources, Colstrip and Kettle Falls have the largest impact on the US as a whole. This is expected, as biomass and coal produce more $PM_{2.5}$ than natural gas. Since Colstrip is in Montana, which is not in Avista territory, there are fewer Avista impacts. The population for Stevens county, where Kettle Falls is located, is much larger than the county where Colstrip is located, which would explain why Kettle Falls has a much larger site county impact than Colstrip.

Figure 3-4. Operational $PM_{2.5}$ health costs per MWh by generation type



In Figure 3-5, the operational SO_2 health costs per MWh are shown for existing and proposed resources and by impact location. Coal has the largest impact compared to the other resources. These impacts are nearly all outside of Avista's territory.

Figure 3-5. Operational SO_2 health costs per MWh by generation type

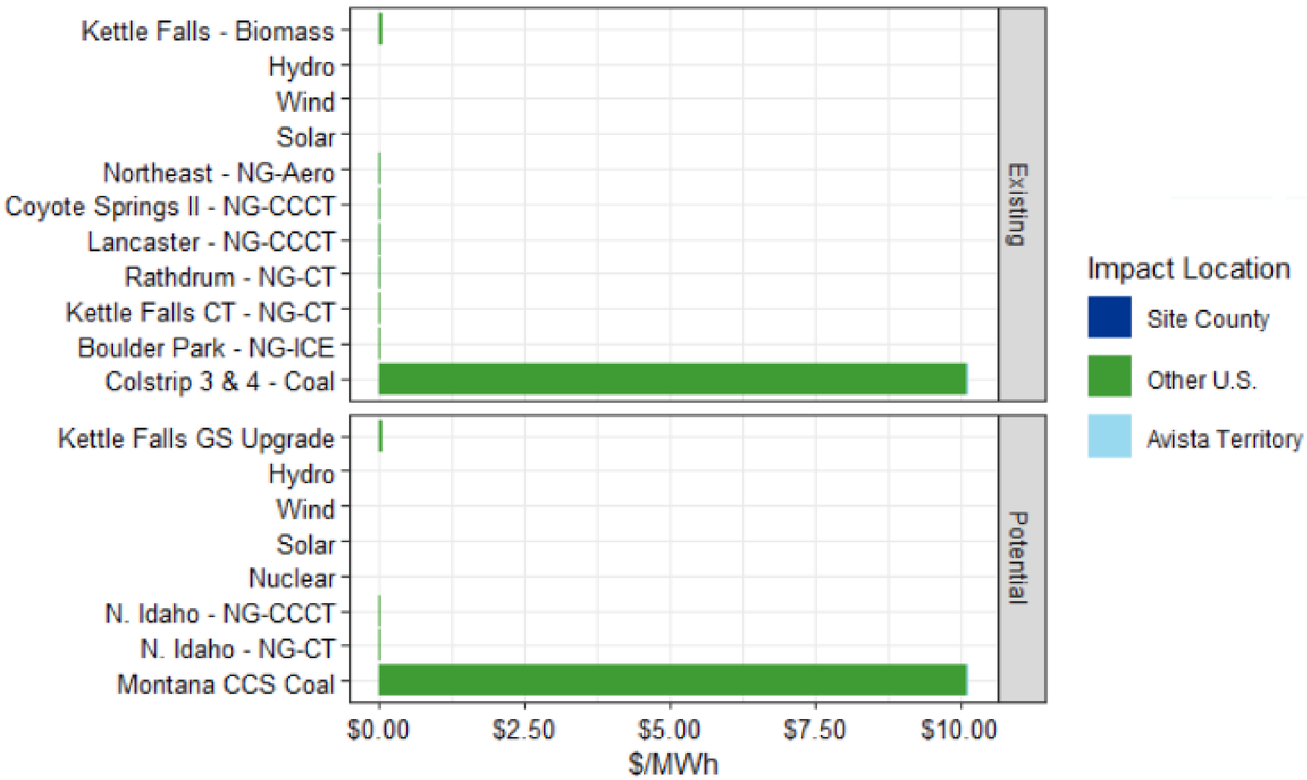
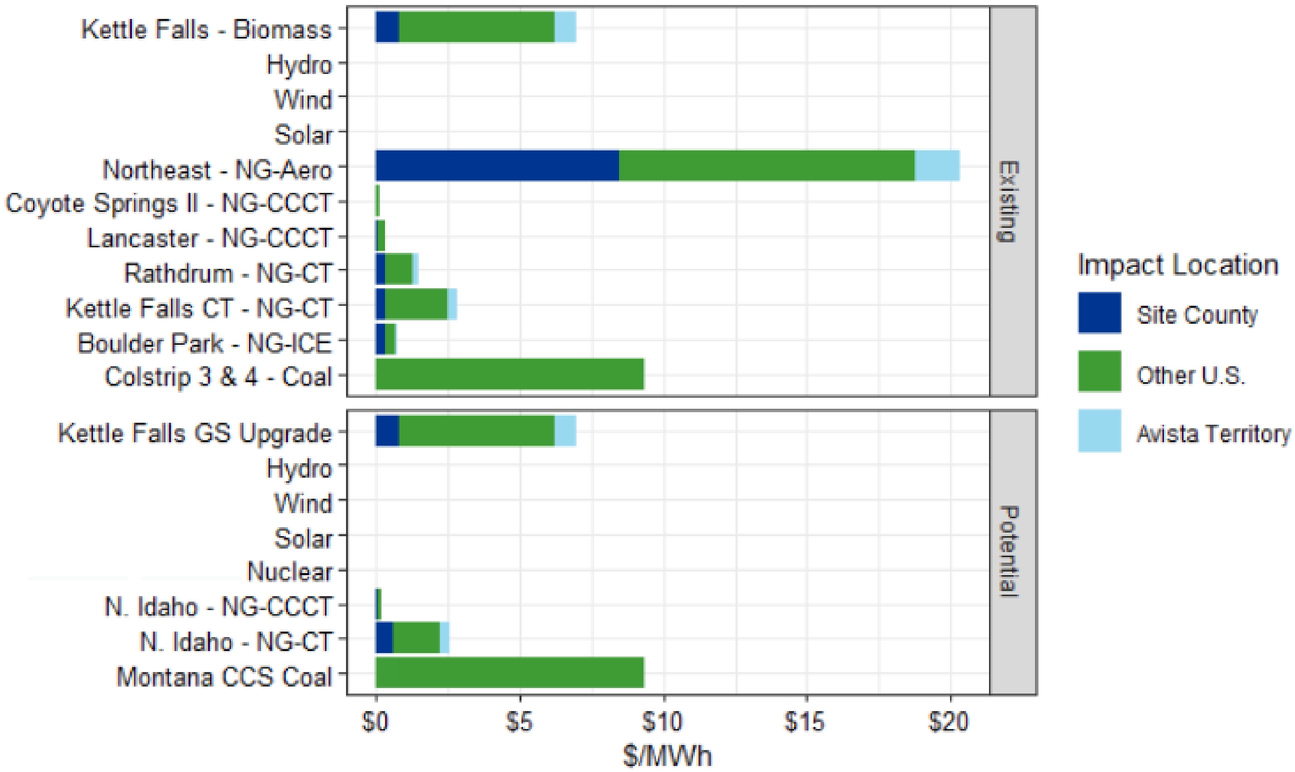


Figure 3-6 shows the operational NOx health costs per MWh for existing and proposed resources by impact location. For existing resources, Northeast natural gas has the highest NOx health costs per MWh throughout the US and in Avista's territory. Additionally, Colstrip had the next highest health costs per MWh throughout the US, and Kettle Falls had the second-highest NOx health costs in Avista's territory. For proposed facilities, the Colstrip resources had the highest national NOx health costs and Kettle Falls had the highest health costs within Avista's territory.

Figure 3-6. Operational NO_X health costs per MWh by generation type



3.2.2 Safety

Electricity generating facilities have safety impacts associated with all supply-chain phases. These impacts can include injuries or fatalities related to mining, construction, operation, maintenance, or decommissioning of the facility. Because the monetary cost of injuries is not easily transferable across regions, and because of limited data regarding injuries, DNV used only fatalities as the benchmark for resources safety. [17]Table 3-5 presents an overview of the safety metrics and sources. Available safety information is not always disaggregated by supply-chain activity, so this report specifies when safety estimates apply to the whole supply chain or whether estimates apply to certain aspects of the supply chain.

Table 3-5. Safety metric descriptions

Metric	Description	Sources
Direct fatalities from construction and operation	Direct fatalities that occur during the construction and operation of an energy resource. These fatalities could be from normal workplace accidents, catastrophic failures, and public interaction.	Balancing safety with sustainability[18]; BLS[19]; BTS[20]; MSHA[21]; CDC[22]; DOT[23]
Indirect fatalities due to supply-chain activities	Indirect fatalities occur from accidents related to the production and transportation of materials used in either construction, operation, or decommissioning. This can include mining for fuel or base materials and accidents related to the processing and transportation of these raw materials.	

[17] DNV recognizes fatalities and injuries might already be contained within insurance costs for specific facilities. A significant portion of fatalities comes from indirect supply-chain activities, though, and might therefore fall out of insurance costs for the generating facility. Further research would be needed to identify what proportion of these fatalities are already being quantified by insurance.

[18] Sovacool, Benjamin K., Rasmus Andersen, Steven Sorensen, Kenneth Sorensen, Victor Tienda, Arturas Vainorius, Oliver Marc Schirach, and Frans Bjørn-Thygesen. 2016. "Balancing Safety with Sustainability: Assessing the Risk of Accidents for Modern Low-Carbon Energy Systems." Journal of Cleaner Production 112 (January): 3952–65.

[19] "Census of Fatal Occupational Injuries (CFOI) - Current and Revised Data." 2018. Bls.gov. December 18, 2018. https://www.bls.gov/iif/oshcfoi1.htm.

[20] "Train Fatalities, Injuries, and Accidents by Type of Accident | Bureau of Transportation Statistics." n.d. Www.bts.gov. https://www.bts.gov/content/train-fatalities-injuries-and-accidents-type-accidenta.

[21] "Coal Mining Fatality Statistics: 1900-2013." 2013. Msha.gov. 2013. https://arlweb.msha.gov/stats/centurystats/coalstats.asp.

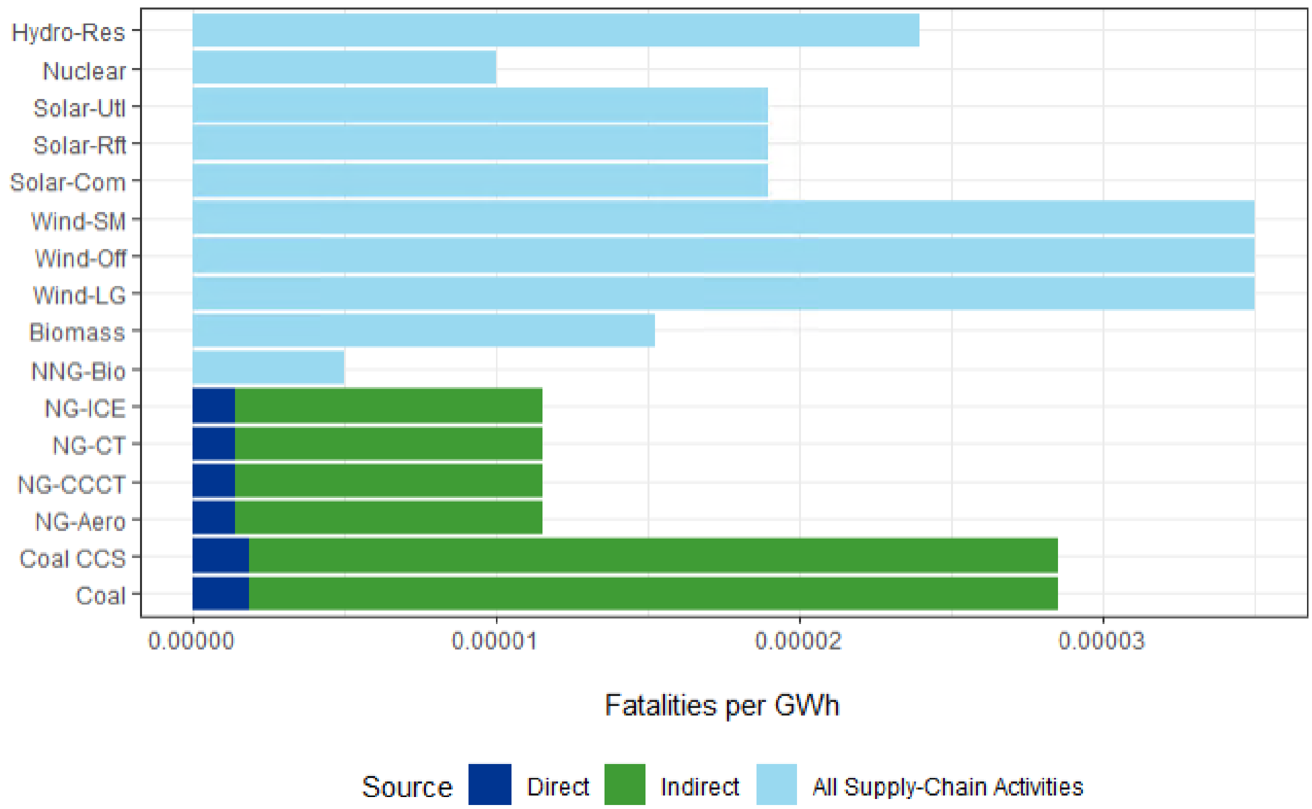
[22] "CDC - Fatalities in the Oil and Gas Extraction Industry (FOG) - NIOSH Workplace Safety & Health Topic." 2021. Www.cdc.gov. June 24, 2021. https://www.cdc.gov/niosh/topics/fog/default.html.

[23] 2022. Dot.gov. 2022. https://portal.phmsa.dot.gov/analytics/saw.dll?Portalpages&PortalPath=%2Fshared%2FPDM%20Public%20Website%2F_portal%2FSC%20Incident%20Trend&Page=Significant%20Incidents%20Consequences.

3.2.2.1 Fatality values

Fatality estimates for biomass, biofuels, hydro, nuclear, solar, and wind include reported fatalities from all aspects of the supply chain in aggregate. These values were calculated from a proprietary database to which DNV does not have access and come from accidents happening in many different countries.[24] The source data for these resources does not disaggregate fatalities by specific supply chain activity. For coal and natural gas, DNV developed fatality estimates using publicly available data for US production,[25,26] transportation,[27,28] and generation[29] (See Appendix A for more details). Fatality values are shown in Figure 3-7 and are reported in fatalities per GWh because fatalities are closely tied to fuel inputs for fossil fuel generation, and the amount of fossil fuel inputs is more dependent on output than capacity.

Figure 3-7. Fatalities by generation type[30]



Fatalities per GWh were highest for wind, followed by coal, and hydro. Wind fatalities may be higher due to the relatively high frequency of small aircraft collisions with wind turbines, dangerous maintenance work on top of turbines, and potential increased documentation due to active monitoring of operations by critics and advocates. Coal has the second-highest level

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[24] Sovacool, Benjamin K., Rasmus Andersen, Steven Sorensen, Kenneth Sorensen, Victor Tienda, Arturas Vainorius, Oliver Marc Schirach, and Frans Bjørn-Thygesen. 2016. "Balancing Safety with Sustainability: Assessing the Risk of Accidents for Modern Low-Carbon Energy Systems." Journal of Cleaner Production 112 (January): 3952–65.

[25] "CDC - Fatalities in the Oil and Gas Extraction Industry (FOG) - NIOSH Workplace Safety & Health Topic." 2021. Www.cdc.gov. June 24, 2021. https://www.cdc.gov/niosh/topics/fog/default.html.

[26] "Coal Mining Fatality Statistics: 1900-2013." 2013. Msha.gov. 2013. https://arlweb.msha.gov/stats/centurystats/coalstats.asp.

[27] 2022. Dot.gov. 2022. https://portal.phmsa.dot.gov/analytics/saw.dll?Portalpages&PortalPath=%2Fshared%2FPDM%20Public%20Website%2F_portal%2FSC%20Incident%20Trend&Page=Significant%20Incidents%20Consequences.

[28] "Train Fatalities, Injuries, and Accidents by Type of Accident | Bureau of Transportation Statistics." n.d. Www.bts.gov. https://www.bts.gov/content/train-fatalities-injuries-and-accidents-type-accidenta.

[29] "Census of Fatal Occupational Injuries (CFOI) - Current and Revised Data." 2018. Bls.gov. December 18, 2018. https://www.bls.gov/iif/oshcfoi1.htm.

[30] Fatality rates are not sub-technology specific, meaning the same estimate is applied for coal and coal with carbon capture, all natural gas sub-technologies, and solar.

of fatalities likely because mining is a dangerous job. When compared to a similar resource like natural gas, it is important to note that electricity production accounts for the vast majority of coal use (91.5%).[31] For natural gas, the extraction and transportation values, while high for the entire industry, are being multiplied by the percentage of natural gas that goes for electricity production (38%).[32]

When further comparing coal against the resource with the third-highest fatalities per GWh (Reservoir Hydro), the values are not perfectly relatable because they come from different sources. Reservoir Hydro comes from a proprietary database. While DNV cannot look at all incidences in the database, the top eight are shown to be catastrophic dam failure accidents.[33] It is unknown if this database accounts for accidents during construction or mining of raw material, which would create a more even comparison with coal.

3.2.2.2 Monetized Impacts

Figure 3-8 presents the monetized impacts from fatalities by generation type. DNV monetized fatalities using the EPA's value of a statistical life,[34] adjusted to 2021 dollars using the Federal Reserves' Consumer Price Index.[35] This conversion is seen in Equation 2. This analysis treats fatalities consistently across all generation types and supply chain activities, so the proportional difference between resource sites is the same in Figure 3-8 as it is in Figure 3-7.

Equation 2. Monetized safety

$$Monetized\ safety\ \left[\frac{\$}{MWh}\right] = Safety\ \left[\frac{Fatalities}{MWh}\right] x\ Value\ of\ a\ Statistical\ Life \left[\frac{\$10,742,916.67}{Fatality}\right]$$

31 Use of coal - U.S. Energy Information Administration (EIA)

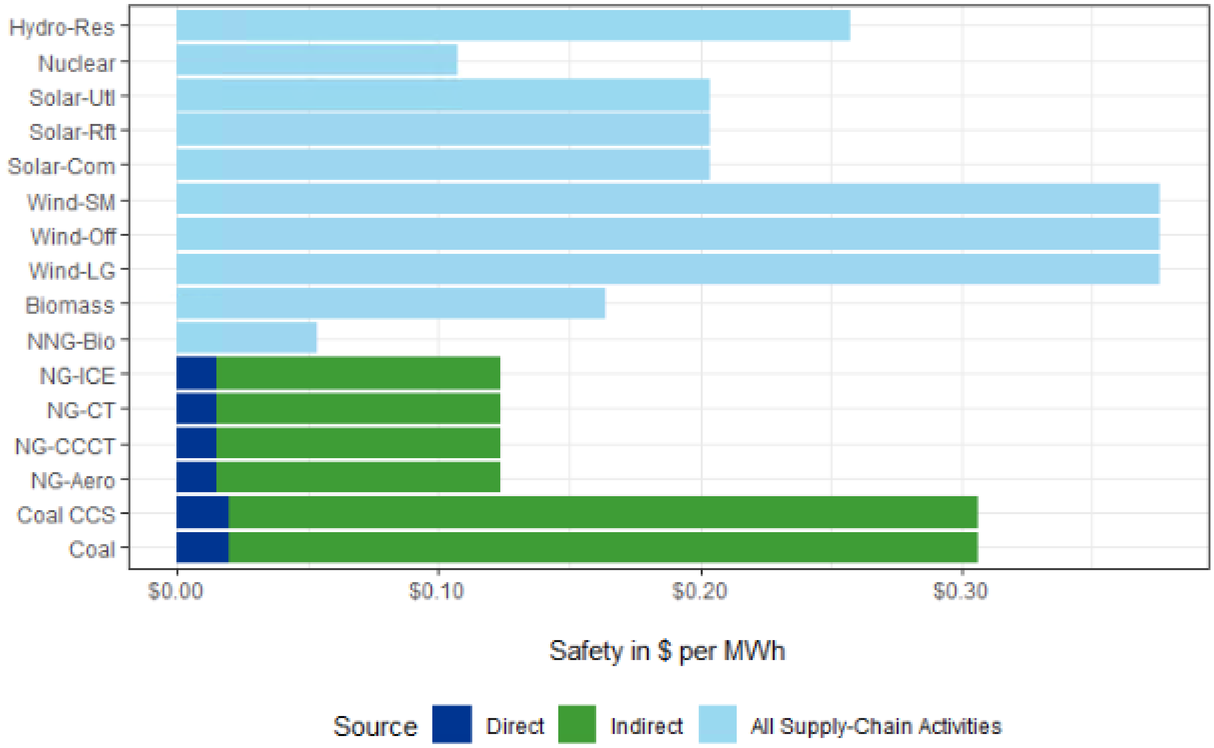
32 https://www.eia.gov/energyexplained/natural-gas/use-of-natural-gas.php#:~:text=The%20commercial%20sector%20uses%20natural,combined%20heat%20and%20power%20systems.

33 Sovacool, Benjamin K., Rasmus Andersen, Steven Sorensen, Kenneth Sorensen, Victor Tienda, Arturas Vainorius, Oliver Marc Schirach, and Frans Bjørn-Thygesen. 2016. "Balancing Safety with Sustainability: Assessing the Risk of Accidents for Modern Low-Carbon Energy Systems." Journal of Cleaner Production 112 (January): 3952–65.

34 US EPA. n.d. "Mortality Risk Valuation." Accessed February 23, 2022. https://www.epa.gov/environmental-economics/mortality-risk-valuation.

35 Federal Reserve Bank of Minneapolis. n.d. Review of Consume Price Index, 1800-. https://www.minneapolisfed.org/about-us/monetary-policy/inflation-calculator/consumer-price-index-1800-.

Figure 3-8. Monetized fatalities by generation type



3.2.3 Reliability and resiliency

The reliability and resiliency impact of generation resources could be negative or positive to Avista's customers. While some types of resources may be able to increase reliability and resiliency in certain circumstances, there are no generalizable reliability and resiliency impacts by generation resource. Detailed modeling would be necessary to assess the reliability and resiliency impacts of the existing and proposed resources as these benefits are based on the location of the resource and its interaction in the larger transmission and distribution grid. Further, any benefits may not be societal impacts, but rather impacts only to specific customers.

3.2.4 Energy security

The IEA[36] defines energy security as "the uninterrupted availability of energy sources at an affordable price." This definition has broad implications. National energy policy plays a role in the availability of fuel and other imports necessary to generate energy. At a more local scale, the uninterrupted availability component can be considered via distribution system reliability and resiliency metrics. DNV recommends using energy burden as a metric for the affordability component of the definition. Energy burden is often a component of housing burden, which is directly factored into the Washington Health Disparities score. Additionally, energy burden is also an often-considered equity-related metric.

Energy burden is calculated as the proportion of household income spent on electricity and heating. As such, the effects of different generation resources on household income and the cost of electricity are the necessary components for estimating energy burden effects. While some of these aspects are addressed by the Economic NEIs, DNV suggests addressing this metric qualitatively by assessing whether a resource is expected to increase or decrease customer's energy costs through

36 https://www.iea.org/topics/energy-security

the IRP's revenue requirement or energy rate calculation of future energy costs. This serves as an indicator of how expensive energy will be to the end user to maintain affordability of energy.

3.2.5 Environment

Electricity-generating technologies have a variety of environmental impacts throughout their life cycles. DNV considered land use, water use, wildfire risk, and wildlife impacts. These metrics vary substantially in data availability across technologies and project phases.

3.2.5.1 Land use

Land use represents the indirect and on-site operational costs of a power plant during its operation. Land use affects all generation technologies via fuel extraction for fossil fuels and nuclear and use of land for energy generation rather than food production for renewables. Table 3-6 presents the descriptions of the types of land uses included in the values for each phase.

Table 3-6. Land use phase descriptions

Land Use Phase	Description	Sources
Construction	Land used during manufacturing, construction, and for key construction inputs such as gravel.	NREL[37]; DNV subject matter experts; Stevens et al[38]
Mining	Land used for fuel mining and production.	
Operations	Land used for resource operations.	
Decommissioning	Land used to store, dispose of, or recycle the components of the resource following operations.	

[37] National Renewable Energy Laboratory (NREL). Review of Land Use by System Technology. Energy Analysis. https://www.nrel.gov/analysis/tech-size.html.

[38] Stevens, Landon, Barrett Anderson, Colton Cowan, Katie Colton, and Dallin Johnson. 2017. Review of The Footprint of Energy: Land Use of U.S. Electricity Production. Strata Policy. https://docs.wind-watch.org/US-footprints-Strata-2017.pdf.

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Land use values

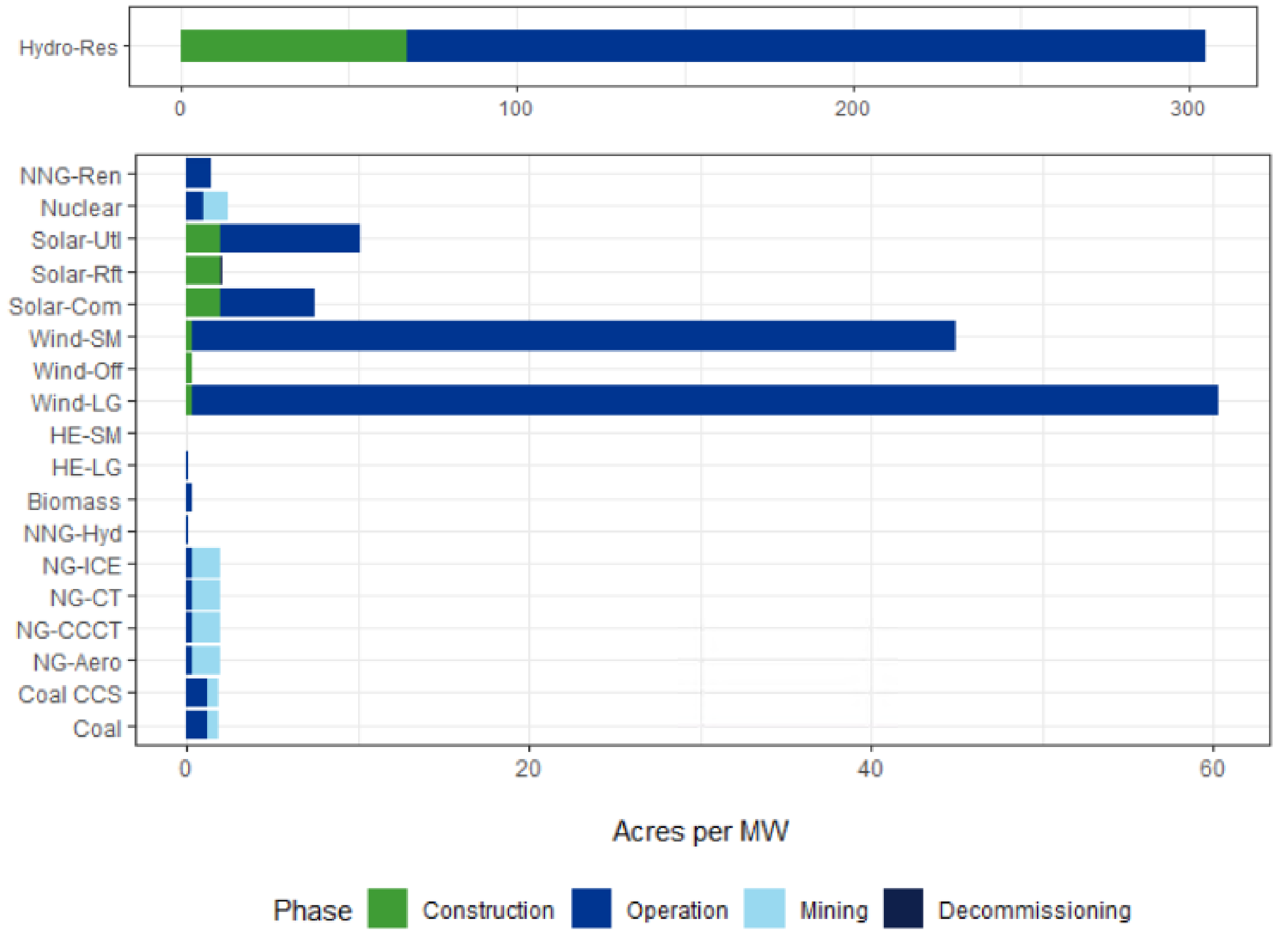
DNV compiled land use values from NREL, Stevens et al, and internal subject matter experts. Table 3-7 summarizes the land use value coverage by generator type and phase. Checks indicate identified values, circles indicate missing values, and blank cells indicate phases where no value is expected (fuel mining for renewables). While DNV was able to identify values for most phases that are expected to have the largest land use, most generator types are missing construction and manufacturing land use as well as decommissioning.

Table 3-7. Land use value coverage by phase

Group	Technology		Phase			
	Abbreviation	Generator Types	Construction	Operation	Mining	Decommissioning
Biomass	Biomass	Biomass	○	✓	○	○
Coal	Coal	Coal	○	✓	✓	○
	Coal CCS	Coal with Carbon Capture	○	✓	✓	○
Hydro	Hydro-PB	Pumped hydro - brownfield	○	○		○
	Hydro-GF	Pumped hydro - greenfield	○	○		○
	Hydro-Res	Reservoir hydro	✓	✓		○
	Hydro-RR	Run-of-river hydro	○	○		○
	Hydro-RRS	Run-of-river hydro with storage	○	○		○
Hydrogen electrolyzer	HE-LG	Hydrogen electrolyzer - large	○	✓		○
	HE-SM	Hydrogen electrolyzer - small	○	✓		○
Lithium-ion Storage	Batt-LG	Lithium-ion Storage - Large	○	○		○
	Batt-SM	Lithium-ion Storage - Small	○	○		○
Natural gas	NG-Aero	Natural gas Aero Turbine	○	✓	✓	○
	NG-CCCT	Natural gas CCCT	○	✓	✓	○
	NG-CT	Natural gas CT	○	✓	✓	○
	NG-ICE	Natural gas internal combustion engine	○	✓	✓	○
Non-natural gas	NNG-Bio	Non-natural gas (Bio-fuel)	○	○		○
	NNG-CF	Clean Fuel Turbine	○	○		○
	NNG-Hyd	Non-natural gas (Hydrogen)	○	○		○
	NNG-LAir	Non-natural gas (Liquid air)	○	○		○
	NNG-Ren	Renewable natural gas storage tank	○	✓		○
Nuclear	Nuclear	Nuclear	○	✓	✓	○
Solar	Solar-Com	Community solar	✓	✓		✓
	Solar-Rft	Rooftop solar	✓	✓		✓
	Solar-Utl	Utility-scale solar	✓	✓		✓
Wind	Wind-LG	Large wind	✓	✓		○
	Wind-Off	Off-shore wind	✓	✓		○
	Wind-SM	Small Wind	✓	✓		○

The assembled land use values are reported in acres per MW in Figure 3-9. Reservoir hydro had the highest land use per per MW. It is important to note that actual land use for the reservoir and operational building may be greater or smaller depending on the local topography. The next highest land use was for onshore wind, which includes both direct and indirect land use. Actual land use for a project may vary, depending on how much of the land can be used for other activities such as farming. Offshore wind land use is limited to the land needed onshore to connect the resource to the grid and does not account for the ocean surface area occupied. Construction land use for hydro, solar, and wind includes the land needed for mining raw materials needed to manufacture or construct the resources. Natural gas mining includes the land needed for frac sand mining as well as fracking. Coal mining assumes that surface mining accounts for two-thirds of the mining while underground mining accounts for the remaining third.

Figure 3-9. Land use by generation type by MW



Monetized impacts

Given the cost of the land is part of capital cost or the cost of the products Avista acquires, DNV does not propose to include these land impacts as a non-energy impact. There could be additional land use impacts considered such as the effect of property values on neighboring lands. These impacts could be both positive (i.e. hydro reservoir) or negative in the case of power production facilities. DNV recommends further study on this topic as part of its study gaps section.

3.2.5.2 Water use

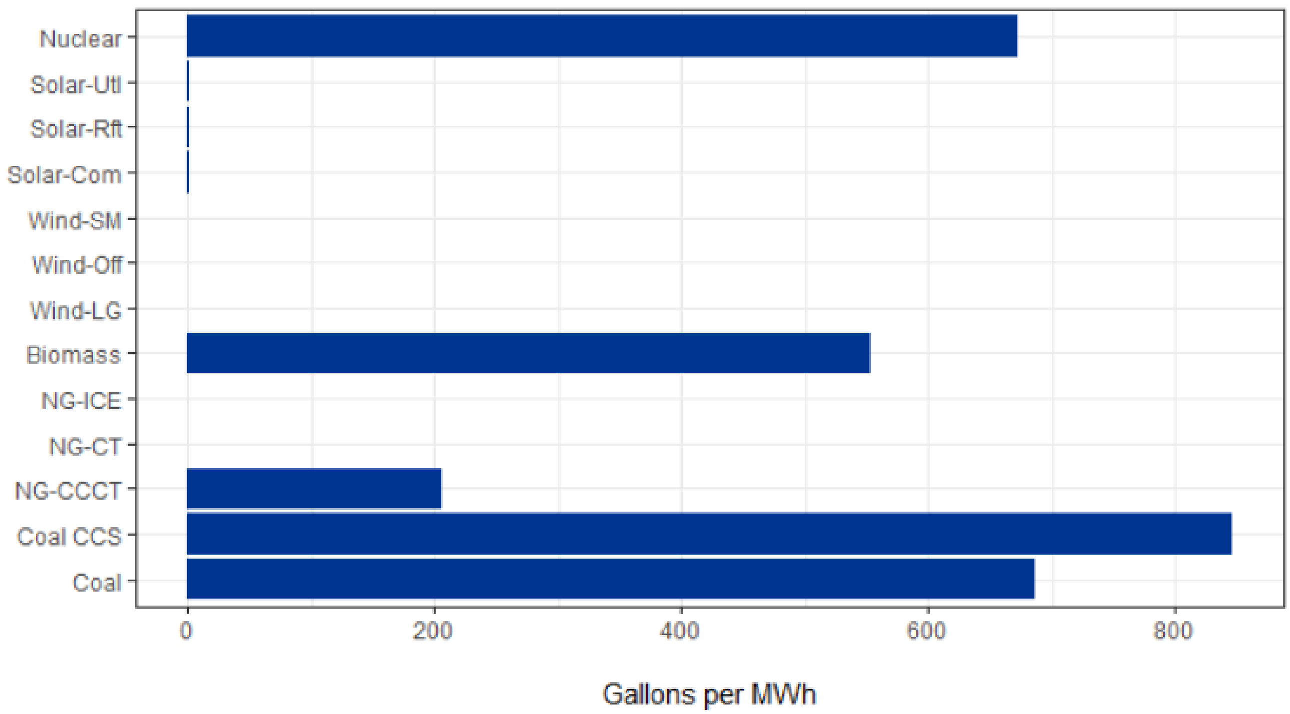
Water is often used throughout the lifecycle phases of electricity generation. It is commonly used in sustainability models and can vary substantially across generation resources.

Water use values

Water consumption during operations is a readily available metric for most generation resources. Water consumption is the water that is withdrawn and lost through evaporation, transpiration, or other causes. As water consumption is typically associated with the amount of electricity generated, this analysis compares water consumption in gallons per MWh. All water consumption values are from Macknick et al.[39]

Figure 3-10 shows the operational water use by generation type. Reservoir hydro has the highest operational water consumption based on evaporative water losses from the reservoir. The United State Geological Survey (USGS) estimates there is 21 inches of evaporation in Lake Couer d Alene which is centrally located relative to Avista hydro resources. [40] With an approximate surface area of 5,600 acres, water loss from the Noxon reservoir is approximately 2,000 gallons/MWh. This value could vary dramatically based on the surface area of the reservoir as well as the weather. The water consumption for coal, biomass, natural gas, and nuclear assume a cooling tower is used. Solar uses minimal water, assuming that the panels are washed periodically.

Figure 3-10. Operational water consumption by generation type by MWh



[39] Macknick, J, R Newmark, G Heath, and K C Hallett. 2012. "Operational Water Consumption and Withdrawal Factors for Electricity Generating Technologies: A Review of Existing Literature." Environmental Research Letters 7 (4): 045802.

[40] Maupin, M.A., and Weakland, R.J., 2009, Water budgets for Coeur d'Alene Lake, Idaho, water years 2000–2005: U.S. Geological Survey Scientific Investigations Report 2009-5184, 16 p.

Monetized impacts

DNV recommends only monetizing water consumption for resources that do not have the cost of water included as part of the resource’s cost. In this event, Avista could use the Spokane, WA commercial water utility rates for water use greater than 1,000 cubic feet[41] as an approximation for this non-energy impact.

[41] Spokane City. 2022 Commercial Utilities Rates. Spokane City Public Works & Utilities. Accessed February 16, 2022. https://my.spokanecity.org/publicworks/utility-billing/commercial-rates/.

3.2.5.3 Wildfire risk

Fossil fuels contribute to wildfires through climate change effects, and as of 2014, wildfires were not included in the EPA's social cost of carbon calculations.[42] [43] DNV was unable to identify a readily identifiable monetized wildfire metric. Because climate change has increased the severity and timing of wildfires,[44] greenhouse gas (GHG) emissions per MWh could serve as a proxy for wildfire risk. Avista currently factors this risk using the Social Cost of Carbon in its IRP's Washington Preferred Resource Strategy Analysis. Further research to develop a wildfire risk assessment could consider fire risk by technology which could result in a wildfire, length of long-range transmission lines by existing or proposed resource, or the wildfire risks associated with specific locations.

[42] Environmental Defense Fund, Institute for Policy Integrity, and NRDC. 2014. Review of Flammable Planet: Wildfires and the Social Cost of Carbon. https://costofcarbon.org/files/Flammable_Planet__Wildfires_and_Social_Cost_of_Carbon.pdf.

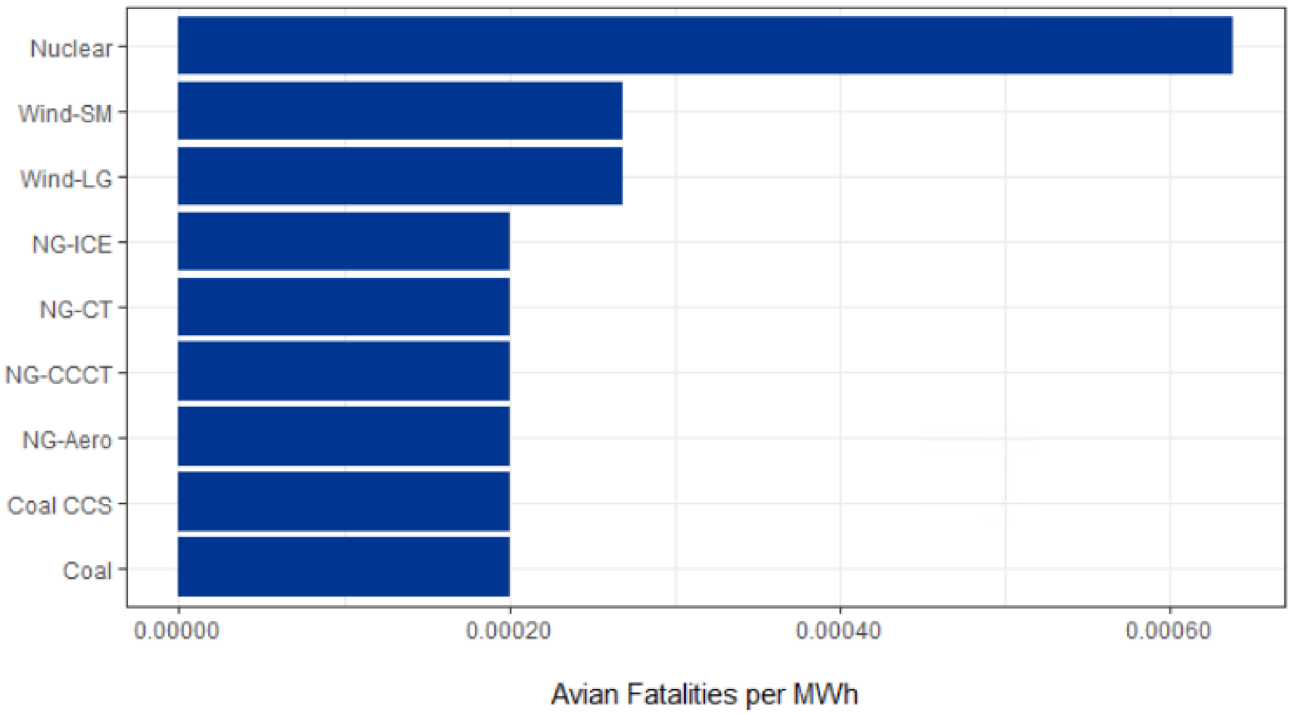
[43] Avista uses the social cost of carbon as set in Executive Order 12866. This executive order cites that its estimates come from The DICE (2010), FUND (2012), and PAGE (2009) models, all versions of which were prior to the 2014 Environmental Defense Fund analysis of the EPA social cost of carbon. Additional research into available documentation of those three models failed to identify wildfire costs as included in them. The closest, specific cost cited was for the FUND model (http://www.fund-model.org/files/documentation/Fund-3-9-Scientific-Documentation.pdf), which considers timber production. However, that document makes no reference to the effects of fires either on timber production or independent of it. DICE documentation lists similar, high-level cost factors as FUND, and the HOPE model documentation does not list any specific cost factors.

[44] US EPA. 2016. "Climate Change Indicators: Wildfires | US EPA." US EPA. July 2016. https://www.epa.gov/climate-indicators/climate-change-indicators-wildfires.

3.2.5.4 Wildlife impacts

Different generation technologies can adversely affect wildlife through climate change effects or direct contact with native species. Impacts can occur throughout the lifecycle of generation resources and can be highly variable depending on the location of the resource. One commonly cited metric for wildlife impacts is avian fatalities from direct and indirect operations of electricity generation. These fatalities include birds crashing into generators as well as the impacts of mining on avian populations. Figure 3-11 presents the avian fatality rates for combustion technologies, wind, and nuclear. Nuclear had the highest fatality rate, followed by wind, and fossil fuels. DNV did not monetize these impacts, as there was no readily available monetary value to use.

Figure 3-11. Avian fatalities per MWh



In addition to a dearth of monetized values of wildlife impacts, it should be noted that wildlife impacts are often included in environmental impact studies that are required as part of the permitting and relicensing process for specific generation assets. This often results in remediation costs being embedded in the cost of that generation resource. For example, to mitigate fish impacts, a hydro plant might be required to build and maintain fish hatcheries or dissolved gas might be rectified through improvements to spillway processes.

3.2.6 Economic

Jobs are the economic impact most directly affected by adding or retiring new generation, and there are readily available data on these effects. The NREL Jobs and Economic Development Impact (JEDI) models include job effects for a variety of generation technologies, including multiplier effects that take into account direct, indirect, and induced jobs. These multiplicative effects represent the full GDP effects of the jobs split into construction and operation phases. Table 3-8 describes the economic metrics produced by the JEDI model. When applying the economic metrics to the generation resources, DNV used the value added metric.

Table 3-8. Economic metric descriptions

Metric	Description	Sources
Jobs	Construction period jobs refer to full-time equivalent jobs for a year during construction period. Operating year jobs refers to the ongoing or permanent full-time equivalent jobs for each year of operation.	JEDI[45]
Earnings	Refers to the wage and salary compensation paid to workers. This monetizes the job impacts.	
Output	This covers all costs associated with the resource.	
Value Added	The difference between total gross output and the cost of intermediate inputs. It is comprised of payments made to workers (wages and salaries and benefits), proprietary income, other property type income (payments from interest, rents, royalties, dividends, and profits), indirect business taxes (excise and sales taxes paid by individuals to businesses, and taxes on production and imports less subsidies. It is equivalent to gross domestic product.	

Each of the metrics is further disaggregated into the following types of impacts:

- **Direct**: Labor directly related to onsite development, construction, and operations
- **Indirect**: Supporting industry impacts
- **Induced**: Impacts due to reinvestment and spending driven by the direct and indirect impacts

It should be noted that Avista already accounts for direct impacts in the cost to commission and run facilities and indirect costs would be assumed to be included in the costs of materials and other supporting services. Therefore, only induced impacts represent NEIs.

There are 6 JEDI models that applied to Avista's existing and proposed resources, wind (large and small), off-shore wind, pumped hydro (greenfield and brownfield), coal, biomass, and natural gas (CT and CCCT). The JEDI models include default values but also allow users to specify many inputs. For the purposes of this study, DNV specified location, year of construction, resource size, and percent local for each existing and proposed resource. More detailed methods can be found in appendix A on model versions and assumptions.

45 Jobs and Economic Development Impact Models (JEDI). Biofuels, Coal, Conventional Hydropower, Marine and Hydrokinetic Power, Natural Gas, and Wind. NREL.

Exceptions

DNV used slightly different methods for some of the resources as described here.

Offshore wind: The JEDI model for offshore wind is in beta. The direct economic impacts reported by the model were reasonable and in-line with expected values. However, DNV observed that the indirect and induced economic impacts from the JEDI model were much higher than for any other model and implied an unreasonably high multiplier (approximately 12:1 and 9000:1, respectively). To compensate, DNV used the direct impacts produced by the JEDI model and applied indirect and induced job multipliers from The Economic Policy Institute[46] (EPI) to estimate indirect and induced job impacts. The EPI study reports multipliers by major industries and sub-industries that corresponds with a two-digit code. DNV used the multipliers reported for the major industry, utilities, and sub-industry, electric power generation, transmission, and distribution, that corresponds with the two-digit code 12 in this source.

Solar PV: NREL does not provide JEDI models for solar PV. DNV could not identify any unbiased, third-party reports of the job impacts for solar PV installations. Organizations representing the solar PV installation industry publish reports, but DNV did not have confidence in the impartiality of these sources. To provide job values, DNV estimated direct, indirect, and induced jobs using capital cost assumptions from Avista's 2021 IRP and jobs per capital outlay ratios from EPI[47] for the Construction industry type (code 15). DNV assumed capital costs of $1000 per kW for large scale solar projects and $2000 per kW for small scale solar projects based on information from Avista. These numbers were used alongside the EPI Construction jobs per million dollars in final demand to calculate direct, indirect, and induced jobs per MW.

Coal with carbon capture: Carbon capture technology is too new for there to be reliable information or models related to construction or operations costs. However, there are established models for coal plants without carbon capture. To reflect the additional equipment needed for carbon capture, DNV multiplied the economic impacts for standard coal plants by 1.2 the ratio of the LCOE of coal with carbon capture to standard coal.

For **clean fuel non-natural gas**, DNV estimated operations economic benefits by using the proposed N. Idaho CCCT values but scaled to the MW and MWh values associated with this resource

3.2.6.2 Construction impacts

Benefits from construction are valued on a per MW basis because size is the main driver of how much a project will cost. Avista already accounts for the direct and indirect impacts as part of the cost of commissioning a facility. Therefore, only the induced impacts represent NEIs.

[46] Bivens, Josh. 2019. Updated Employment Multipliers for the U.S. Economy. Economic Policy Institute. January 23, 2019. https://www.epi.org/publication/updated-employment-multipliers-for-the-u-s-economy/.

[47] Bivens, Josh. 2019. Updated Employment Multipliers for the U.S. Economy. Economic Policy Institute. January 23, 2019. https://www.epi.org/publication/updated-employment-multipliers-for-the-u-s-economy/.

Figure 3-12 shows the direct, indirect, and induced construction jobs for proposed generation resources. The figure does not include the construction economic impacts for existing generation resources, as those impacts were already realized. While the direct and indirect jobs are not considered to be NEIs, they do provide useful context for interpreting the induced jobs. Rooftop solar is expected to produce the most jobs overall, although pumped hydro projects would produce more direct jobs. Greenfield and brownfield hydro projects are likely to be large, capital-intensive projects. In contrast, while any, single rooftop solar project would be very small, a very large number of these projects could be completed. It should also be noted that DNV utilized a different method to estimate Solar PV job impacts, so these values should be interpreted with caution.

Figure 3-12. Construction jobs by proposed generation type

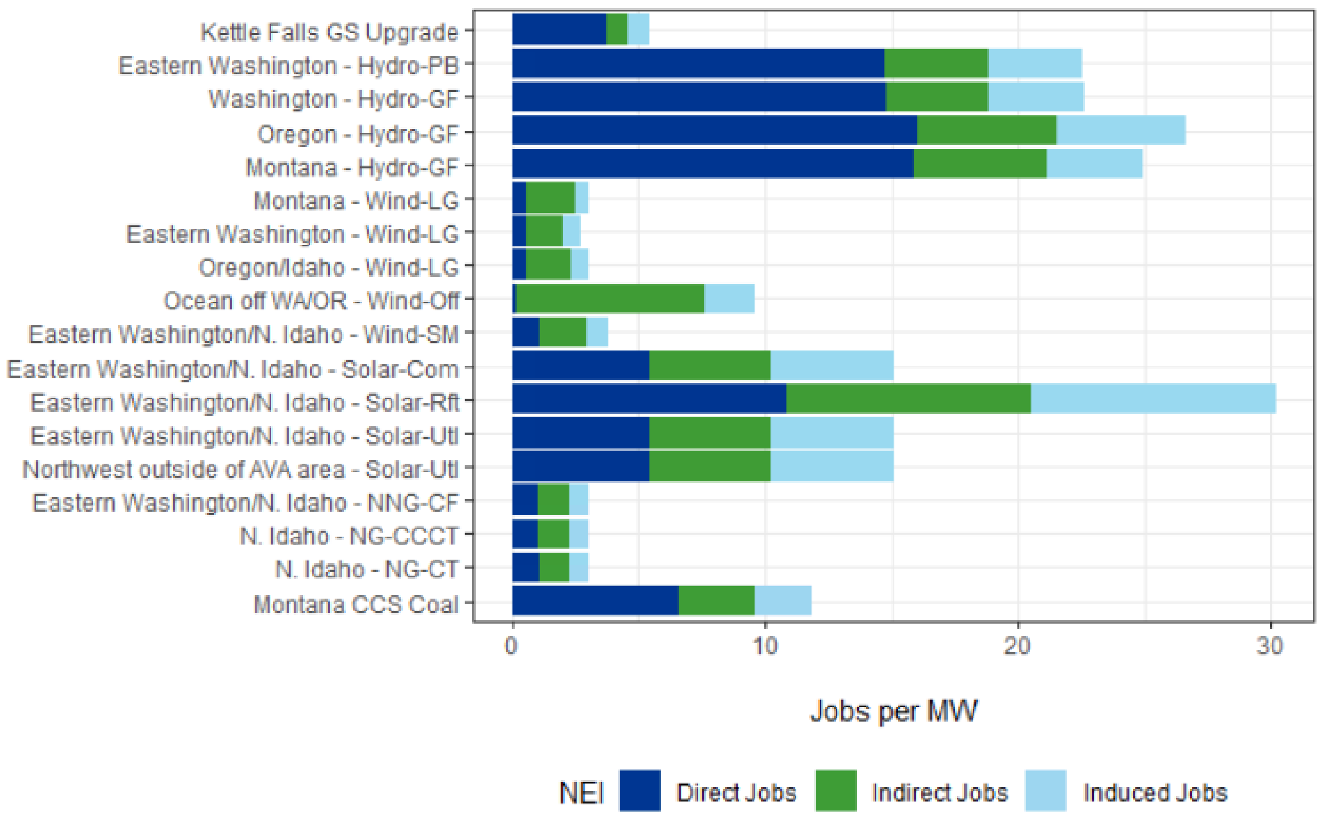


Figure 3-13 and Table 3-9 show the construction economic impacts (local impacts, value-add) by proposed generation type. DNV could not identify a trustworthy value for solar PV wages, so those generation types are left off the figure. Across the remaining generation types, wages are similar, so the relative levels of monetized values are similar to those for jobs.

Figure 3-13. Construction economic induced impact by proposed generation type

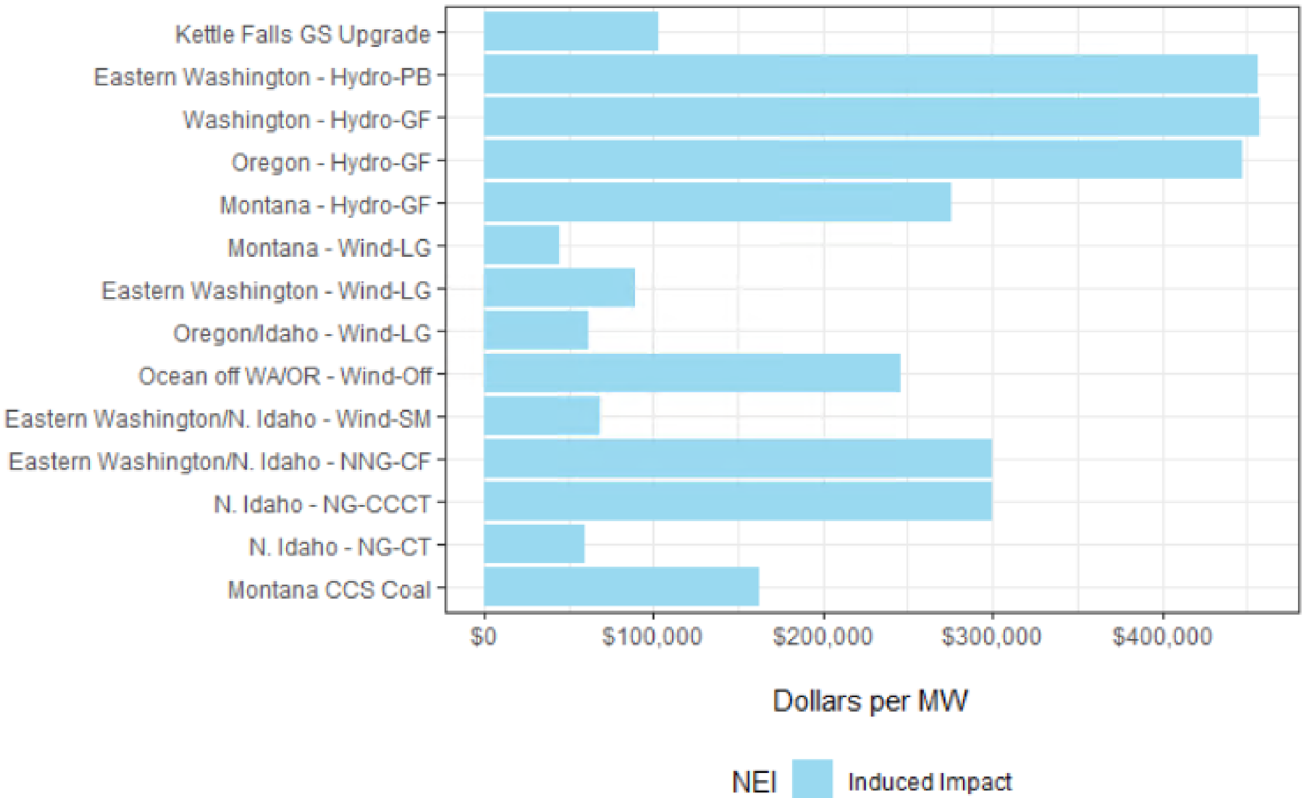


Table 3-9. Summary of Construction Induced Value Add

Fuel Type	Resource Name	Economic Construction ($/MW)
Batt-LG	Eastern Washington/N. Idaho	Gap
Batt-SM	Eastern Washington/N. Idaho	Gap
Biomass	Kettle Falls GS Upgrade	102,800
Coal CCS	Montana CCS Coal	162,822
HE-LG	Eastern Washington	Gap
HE-SM	Eastern Washington	Gap
Hydro-GF	Montana	275,500
Hydro-GF	Oregon	448,000
Hydro-GF	Washington	458,000
Hydro-PB	Eastern Washington	456,600
NG-CCCT	N. Idaho	300,280
NG-CT	N. Idaho	59,000
NNG-Bio	Eastern Washington/N. Idaho	Gap
NNG-CF	Eastern Washington/N. Idaho	300,280
NNG-Hyd	Eastern Washington/N. Idaho	Gap
NNG-LAir	Eastern Washington/N. Idaho	Gap
NNG-Ren	Eastern Washington/N. Idaho	Gap
Nuclear	Eastern Washington/N. Idaho	Gap
Solar-Com	Eastern Washington/N. Idaho	Gap
Solar-Rft	Eastern Washington/N. Idaho	Gap
Solar-Utl	Eastern Washington/N. Idaho	Gap
Solar-Utl	Northwest outside of AVA area	Gap
Wind-LG	Eastern Washington	89,600
Wind-LG	Montana	44,267
Wind-LG	Oregon/Idaho	62,267
Wind-Off	Ocean off WA/OR	245,978
Wind-SM	Eastern Washington/N. Idaho	68,600

3.2.6.3 Operations impacts

Operational economic impacts affect those directly employed by the generation resource, those supporting the project, and communities and businesses that benefit from the greater economic potential this project provides. Figure 3-14 shows the direct, indirect, and induced construction jobs for existing and proposed generation resources per MWh. DNV could not identify a trustworthy source for solar PV operations jobs. Almost all of the costs for solar PV are incurred during the construction phase, so DNV expects solar PV operations jobs to be very low per GWh. Hydro resources generate the most jobs during the operations phase as well. The most common types of indirect jobs created by the hydro resources are "professional services", "wholesale trade", and "retail trade".

Figure 3-14. Operations jobs by generation type

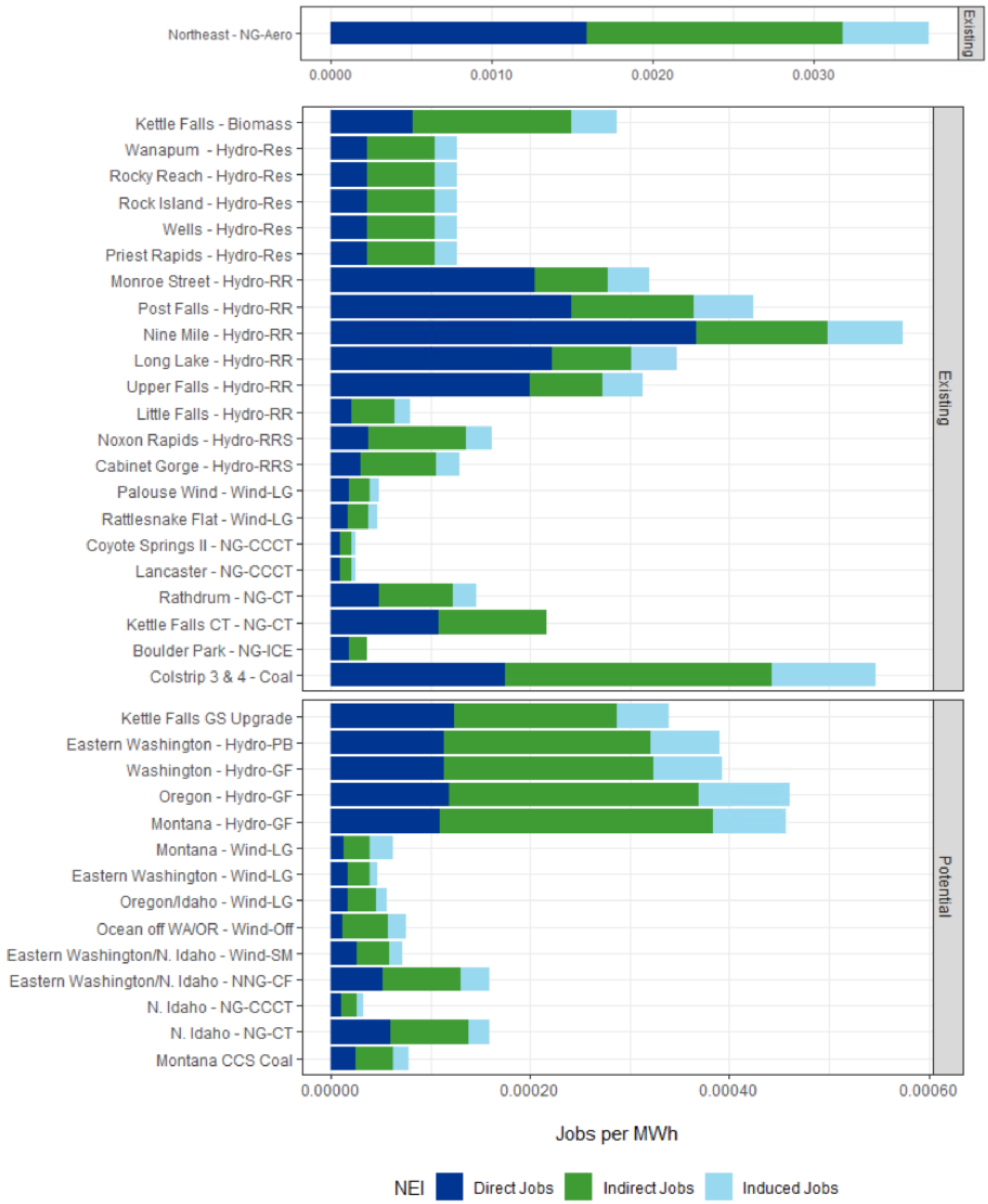


Figure 3-15 and Table 3-10 shows the operations economic impacts (local impacts, value-add) by generation type. Hydro resources generate the most economic value during operations phases, driven by the job impacts.

Figure 3-15. Operations Economic Impact by Generation Type

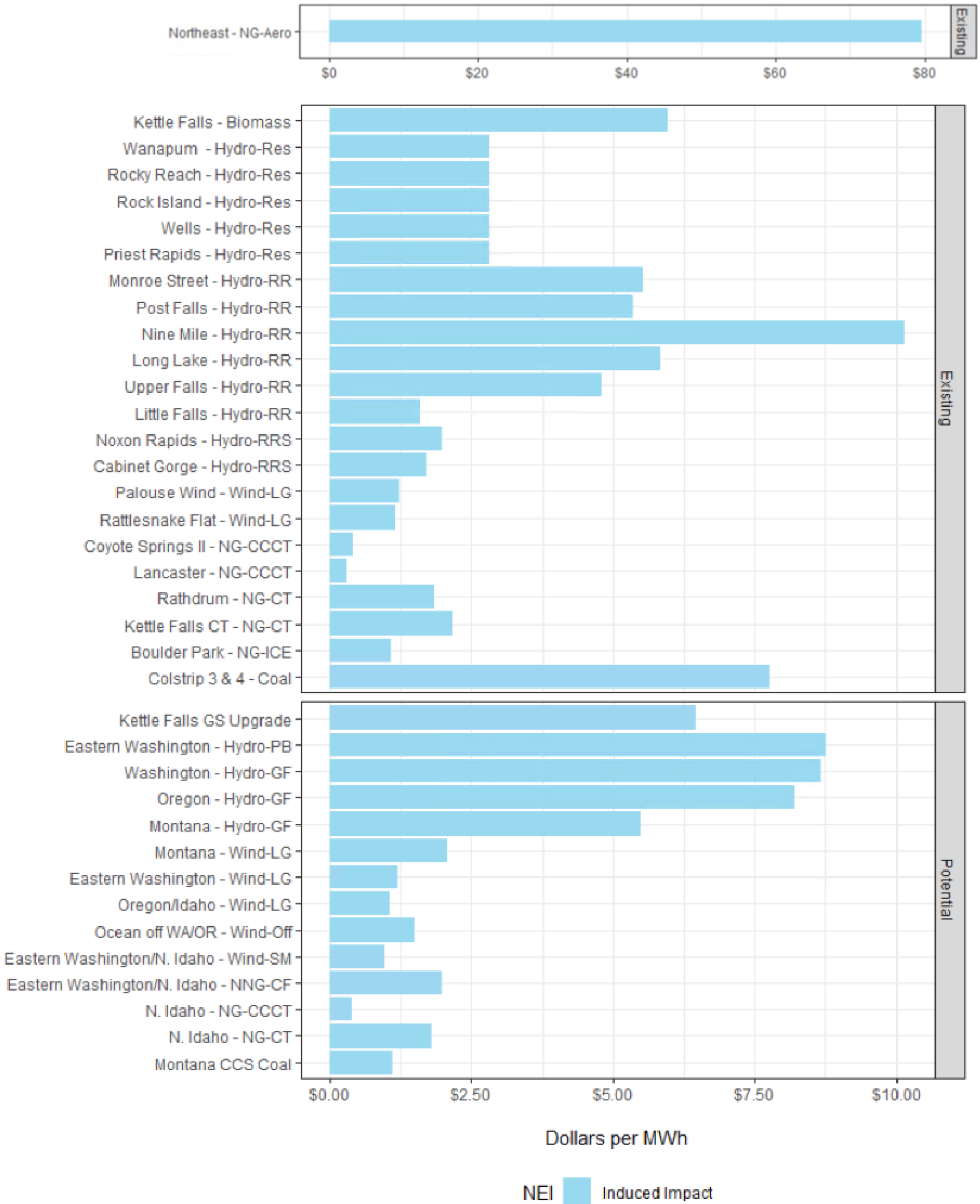


Table 3-10: Summary of Operations Induced Value Add

Existing/ Potential	Fuel Type	Resource Name	Economic Operations ($/MWh)
Existing	Biomass	Kettle Falls	5.98
	Coal	Colstrip 3 & 4	7.77
	Hydro-Res	Priest Rapids	2.82
		Rock Island	2.82
		Rocky Reach	2.82
		Wanapum	2.82
		Wells	2.82
	Hydro-RR	Little Falls	1.59
		Long Lake	5.84
		Monroe Street	5.54
		Nine Mile	10.16
		Post Falls	5.34
		Upper Falls	4.80
	Hydro-RRS	Cabinet Gorge	1.70
		Noxon Rapids	1.98
	NG-Aero	Northeast	79.53
	NG-CCCT	Coyote Springs II	0.42
		Lancaster	0.30
	NG-CT	Kettle Falls CT	2.17
		Rathdrum	1.83
	NG-ICE	Boulder Park	1.09
	Solar-Utl	Adams Neilson	Gap
	Wind-LG	Palouse Wind	1.21
		Rattlesnake Flat	1.15
Potential	Batt-LG	Eastern Washington/N. Idaho	Gap
	Batt-SM	Eastern Washington/N. Idaho	Gap
	Biomass	Kettle Falls GS Upgrade	6.46
	Coal CCS	Montana CCS Coal	1.11
	HE-LG	Eastern Washington	Gap
	HE-SM	Eastern Washington	Gap
	Hydro-GF	Montana	5.48
		Oregon	8.22
		Washington	8.68
	Hydro-PB	Eastern Washington	8.77
	NG-CCCT	N. Idaho	0.40
	NG-CT	N. Idaho	1.79
	NNG-Bio	Eastern Washington/N. Idaho	Gap
	NNG-CF	Eastern Washington/N. Idaho	1.99
	NNG-Hyd	Eastern Washington/N. Idaho	Gap
	NNG-LAir	Eastern Washington/N. Idaho	Gap
	NNG-Ren	Eastern Washington/N. Idaho	Gap
	Nuclear	Eastern Washington/N. Idaho	Gap
	Solar-Com	Eastern Washington/N. Idaho	Gap
	Solar-Rft	Eastern Washington/N. Idaho	Gap
	Solar-Utl	Eastern Washington/N. Idaho	Gap
		Northwest outside of AVA area	Gap
	Wind-LG	Eastern Washington	1.21
		Montana	2.08
		Oregon/Idaho	1.06
	Wind-Off	Ocean off WA/OR	1.50
	Wind-SM	Eastern Washington/N. Idaho	0.97

3.3 Summary of compiled data

Table 3-11 summarizes the NEI value coverage by generator type. In general, older generator types tended to have more readily available information than newer resource types.

Table 3-11. Summary of data completeness

Group	Generator Types	Public Health	Safety	Environment			Economic
				Land Use	Water Use	Wildlife	
Biomass	Biomass	✓	✓	✓	✓		✓
Coal	Coal	✓	✓	✓	✓	✓	✓
	Coal CCS	✓	✓	✓	✓	✓	✓
Hydro	Hydro-PB						✓
	Hydro-GF						✓
	Hydro-Res		✓	✓			✓
	Hydro-RR						✓
	Hydro-RRS						✓
Hydrogen Electrolyzer	HE-LG			✓			
	HE-SM			✓			
Lithium-ion Storage	Batt-LG						
	Batt-SM						
Natural gas	NG-Aero	✓	✓	✓	✓	✓	✓
	NG-CCCT	✓	✓	✓	✓	✓	✓
	NG-CT	✓	✓	✓	✓	✓	✓
	NG-ICE	✓	✓	✓	✓	✓	✓
Non-natural gas	NNG-Bio		✓				
	NNG-CF						
	NNG-Hyd			✓			
	NNG-LAir						
	NNG-Ren			✓			
Nuclear	Nuclear		✓	✓	✓	✓	
Solar	Solar-Com		✓	✓	✓		✓
	Solar-Rft		✓	✓	✓		✓
	Solar-Utl		✓	✓	✓		✓
Wind	Wind-LG		✓	✓	✓	✓	✓
	Wind-Off		✓	✓	✓		✓
	Wind-SM		✓	✓	✓	✓	✓

3.4 Database application

DNV applied the values in the database to existing and proposed Avista generation resources. The first step in this process was to obtain information about each generation resource from Avista, including technology type, capacity, and operating output over the past 3 years.

The next step was to match each generation resource to the resource type in the database. Then DNV could assign NEIs based on the per MWh or per MW values for each NEI type to new generation resources and resources already operated by Avista. Benefits appear as positive values and costs appear as negative values. The values are then summed to produce a final, total NEI value for each resource.

3.5 Issues and data gaps

This section documents the areas where there was insufficient information to provide an estimated NEI value for any specific NEI types for specific resources. In addition to documenting the NEIs for which values are not readily available, DNV estimates the research value and research effort that it would take to fill each gap using a high, medium, low designation on each dimension. Table 3-12 summarizes the NEIs, the gaps, and the value and effort of addressing each one. Finer-grained gaps are also identified in the database.

Table 3-12. Gap analysis

NEI	Resource	Description	Additional Research Description	Value	Effort
Public Health	All	Emissions data only available for operation phase	Locate emissions for mining, construction, decommissioning then monetize	Medium	High
	All	Soil and water contamination effects not included	Locate emissions data for these effects, including for supply-chain, plant operations, and decommissioning. Locate monetary costs of those types of contamination and multiply	Low	High
	Nuclear	Public health risks of transport and long-term storage of radioactive wastes as well as risks of catastrophic failures was not included	Identify risk analysis data for nuclear operations and waste management	Low	Medium
	Biomass	Counterfactual emissions for the biomass if not used in the power plants was not modeled	Identify likely alternative treatment of the biomass material and the resulting emissions	Low	Medium
Safety	Hydro, Nuclear, Solar, Wind, Biomass, Biogas	Fatalities data are reported in aggregate across the supply chain and within proprietary databases	Locate original data or conduct original research to disaggregate fatalities. Low effort approach could develop reasonable ratios for fatalities in each phase of supply chain and apply those ratios to the overall aggregate number.	Low	High/ Low
Reliability & Resiliency	All	Specific metrics on reliability and grid resiliency could not be calculated for this study. Monetizing these metrics is an additional challenge	An analysis of how different IRP scenarios are likely to affect grid reliability, especially in named communities would help address CETA concerns	Medium	High
Energy Security	All	This study considered LCOE values as proxies for the cost of energy	An analysis of how different IRP scenarios are likely to affect energy burdens, especially for named communities would help address CETA concerns	High	High

NEI	Resource	Description	Additional Research Description	Value	Effort
Environment: Wildfires	All	Comparative data for wildfire risks for different generation technologies is not readily available. Monetizing these risks is an additional challenge	Investigate the California wildfire risk assessment system and consider adapting for use in Washington. This assessment is done at the state level in California, so a statewide, rather than utility specific effort would be reasonable.	High	High
Environment: Land use, Water use monetization	All	The current study used publicly available, but somewhat arbitrary sources to monetize land and water values	Establish a more robust source(s) for these values, possibly applying more site-specific values or possibly blending values from multiple sources	Low	Medium
Environment: Wildlife monetization	All	Estimates of the monetary value of wildlife are not readily available.	Conduct additional secondary research with the EPA and conservation groups for data. Primary research would be very difficult and expensive.	Low	High
Environment: Surface air effects	Wind	Potential surface air effects of wind turbines was not considered	Obtain recent data, if available, on surface air downwind of wind turbines. Monetize those impacts.	Low	High
Economic	Hydrogen Electrolyzer	These technologies are too new to have robust, publicly available economic impact models. LCOEs for HE are based on compression, transportation, and storage costs, assuming a source of hydrogen is already accessible. The cost to produce the hydrogen is not included.	Conduct additional primary and secondary research into the costs to produce the storage tanks and facilities for these resources. Conduct additional research to price hydrogen generation and add to the LCOEs Create an economics impacts model similar to JEDI	Medium	High
All	Non-natural gas	Publicly available data for this technology were not readily available	Additional research on the facilities that produce this fuel are needed to estimate the NEIs associated with it, including economic modeling. Combustion pollutants are likely to be similar to geologic natural gas, so public health impacts likely to be similar to gas turbine plants	Medium	High
Economic	Solar PV,	NREL does not publish a JEDI model for these resources, and no equivalent models are publicly available	Identify a reasonable number for wage earnings for solar PV installation and operations Develop economic models for indirect and induced jobs	High	Medium

NEI	Resource	Description	Additional Research Description	Value	Effort
All	Battery Storage	Publicly available data for this technology were not readily available	Additional research on the facilities that produce this fuel are needed to estimate the NEIs associated with it, including economic modeling	High	High
Economic	Nuclear	NREL does not publish a JEDI model for these resources, and no equivalent models are publicly available	Nuclear plants are established technology so information on operational costs should be available.	Low	Low
Decommis-sioning	All	Data on decommissioning costs was not readily available	Locate data on these costs for established technologies. Survey permitting requirements for decommissioning financing for newer technologies	Medium	High

4 OVERALL IMPACTS

The NEI database can be applied to Avista's specific existing and proposed resources to estimate the overall NEIs for each resource. The impacts are aggregated by NEI metric. Some metrics are reported per MWh while others are reported by MW, depending on whether the impact is fixed or variable with electricity production.

The aggregated impacts per MWh include the following components:

- **Economic - Operations**: Induced value-added economic impacts of operations. Avista already accounts for the direct impacts as part of the cost of energy production. Therefore, only the induced impacts represent NEIs. These impacts are reported as benefits.
- **Public Health**: Health impacts occurring throughout the United States due to operations. These impacts are reported as costs.
- **Safety**: Direct and indirect fatalities occurring during construction, operations, and mining. These impacts are reported as costs.

The aggregated impacts per MW include the following components:

- **Economic - Construction**: Induced value-added economic impacts of resource operations. These impacts are reported as benefits for proposed facilities only.

Table 4-1. Net Resource Benefits for Existing Avista Resources

Fuel Type	Resource Name	Economic Operations ($/MWh)	Safety ($/MWh)	Public Health ($/MWh)	Net ($/MWh)
Biomass	Kettle Falls	5.98	-0.16	-13.36	-7.54
Coal	Colstrip 3 & 4	7.77	-0.31	-25.26	-17.80
Hydro-Res	Priest Rapids	2.82	-0.26	0.00	2.56
Hydro-Res	Rock Island	2.82	-0.26	0.00	2.56
Hydro-Res	Rocky Reach	2.82	-0.26	0.00	2.56
Hydro-Res	Wanapum	2.82	-0.26	0.00	2.56
Hydro-Res	Wells	2.82	-0.26	0.00	2.56
Hydro-RR	Little Falls	1.59	Gap	0.00	1.59
Hydro-RR	Long Lake	5.84	Gap	0.00	5.84
Hydro-RR	Monroe Street	5.54	Gap	0.00	5.54
Hydro-RR	Nine Mile	10.16	Gap	0.00	10.16
Hydro-RR	Post Falls	5.34	Gap	0.00	5.34
Hydro-RR	Upper Falls	4.80	Gap	0.00	4.80
Hydro-RRS	Cabinet Gorge	1.70	Gap	0.00	1.70
Hydro-RRS	Noxon Rapids	1.98	Gap	0.00	1.98
NG-Aero	Northeast	79.53	-0.12	-24.73	54.67
NG-CCCT	Coyote Springs II	0.42	-0.12	-0.67	-0.37
NG-CCCT	Lancaster	0.30	-0.12	-1.94	-1.76
NG-CT	Kettle Falls CT	2.17	-0.12	-4.30	-2.26
NG-CT	Rathdrum	1.83	-0.12	-2.79	-1.08
NG-ICE	Boulder Park	1.09	-0.12	-0.92	0.04
Solar-Utl	Adams Neilson	Gap	-0.20	0.00	-0.20
Wind-LG	Palouse Wind	1.21	-0.38	0.00	0.83
Wind-LG	Rattlesnake Flat	1.15	-0.38	0.00	0.78

Table 4-2: Net Resource Benefits for Potential Resource Alternatives

Fuel Type	Resource Name	$/MWh				$/MW
		Economic Operations	Safety	Public Health	Net	Economic Construction
Batt-LG	**Eastern Washington/N. Idaho**	Gap	Gap	0.00	0.00	Gap
Batt-SM	**Eastern Washington/N. Idaho**	Gap	Gap	0.00	0.00	Gap
Biomass	**Kettle Falls GS Upgrade**	6.46	-0.16	-12.71	-6.41	102,800
Coal CCS	**Montana CCS Coal**	1.11	-0.31	-22.49	-21.69	162,822
HE-LG	**Eastern Washington**	Gap	Gap	0.00	0.00	Gap
HE-SM	**Eastern Washington**	Gap	Gap	0.00	0.00	Gap
Hydro-GF	**Montana**	5.48	Gap	0.00	5.48	275,500
Hydro-GF	**Oregon**	8.22	Gap	0.00	8.22	448,000
Hydro-GF	**Washington**	8.68	Gap	0.00	8.68	458,000
Hydro-PB	**Eastern Washington**	8.77	Gap	0.00	8.77	456,600
NG-CCCT	**N. Idaho**	0.40	-0.12	-1.75	-1.48	300,280
NG-CT	**N. Idaho**	1.79	-0.12	-4.52	-2.86	59,000
NNG-Bio	**Eastern Washington/N. Idaho**	Gap	-0.05	0.00	-0.05	Gap
NNG-CF	**Eastern Washington/N. Idaho**	1.99	Gap	0.00	1.99	300,280
NNG-Hyd	**Eastern Washington/N. Idaho**	Gap	Gap	0.00	0.00	Gap
NNG-LAir	**Eastern Washington/N. Idaho**	Gap	Gap	0.00	0.00	Gap
NNG-Ren	**Eastern Washington/N. Idaho**	Gap	Gap	0.00	0.00	Gap
Nuclear	**Eastern Washington/N. Idaho**	Gap	-0.11	0.00	-0.11	Gap
Solar-Com	**Eastern Washington/N. Idaho**	Gap	-0.20	0.00	-0.20	Gap
Solar-Rft	**Eastern Washington/N. Idaho**	Gap	-0.20	0.00	-0.20	Gap
Solar-Utl	**Eastern Washington/N. Idaho**	Gap	-0.20	0.00	-0.20	Gap
Solar-Utl	**Northwest outside of AVA area**	Gap	-0.20	0.00	-0.20	Gap
Wind-LG	**Eastern Washington**	1.21	-0.38	0.00	0.83	89,600
Wind-LG	**Montana**	2.08	-0.38	0.00	1.70	44,267
Wind-LG	**Oregon/Idaho**	1.06	-0.38	0.00	0.68	62,267
Wind-Off	**Ocean off WA/OR**	1.50	-0.38	0.00	1.12	245,978
Wind-SM	**Eastern Washington/N. Idaho**	0.97	-0.38	0.00	0.59	68,600

5 APPENDICES

5.1 Appendix A: Detailed Methods

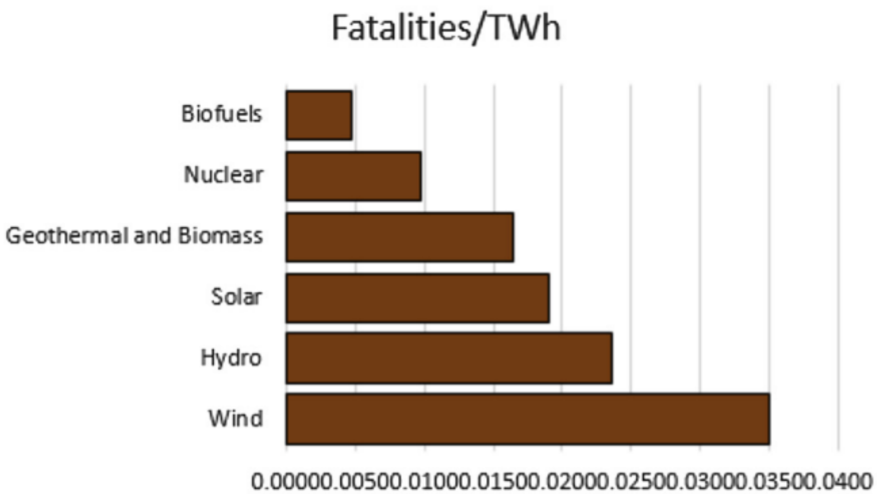
5.1.1 Safety

5.1.1.1 Biomass, bio-fuel, hydro, nuclear, solar, wind

Fatality estimates for electricity generation from biomass, bio-fuels, hydro, nuclear, solar, and wind come from a 2015 paper titled *Balancing safety with sustainability: assessing the risk of accidents for modern low-carbon energy systems*[48]. The authors of this paper develop their own dataset of energy value chain accidents. They explain the requirements for being included in the dataset as, "this means it must have occurred at a nuclear, renewable, hydrogen, or hydroelectric energy facility, its associated infrastructure, or within its fuel cycle (mine, transportation by truck or pipeline, enrichment facility, manufacturing plant, etc.)." The authors provide examples from this research such as a 2013 accident in Noxen, Pennsylvania where 5 people died when a helicopter crashed into a wind farm during bad weather, or a 2013 accident in Catanzaro, Italy, where 2 welders are killed in an explosion while working at a biofuel plant.

The authors further go on to normalize fatalities by energy use and describe using a subset of incidences ranging from 1990 – 2013. Because DNV does not have access to this full database, values cannot be disaggregated into direct and indirect fatalities. Figure 5-1 shows the graphical results of this study in fatalities/TWh:

Figure 5-1. Fatalities per TWh from original paper



5.1.1.2 Fossil fuels (natural gas and coal)

Fatality estimates for natural gas and coal are developed using publicly available data regarding US production, transportation, and generation. It is necessary to calculate new numbers because most of the value chain for these generation types takes place in the US and estimates from secondary research is not available for current, US-only values. DNV aggregates values from multiple sources to produce values for coal and natural gas.

[48] Sovacool, Benjamin K., Rasmus Andersen, Steven Sorensen, Kenneth Sorensen, Victor Tienda, Arturas Vainorius, Oliver Marc Schirach, and Frans Bjørn-Thygesen. 2016. "Balancing Safety with Sustainability: Assessing the Risk of Accidents for Modern Low-Carbon Energy Systems." Journal of Cleaner Production 112 (January): 3952–65.

Natural gas

Extraction

DNV developed numbers for natural gas using industry statistics related to extraction, transportation, and generation. For extraction, DNV used the National Institute for Occupational Safety and Health (NIOSH) database of Fatalities in the Oil and Gas Extraction Industry (FOG)[49]. This database includes land-based and offshore worker fatalities related to the U.S. oil and gas extraction industry only.

Table 5-1. Fatalities from the U.S. natural gas and oil extraction industry by state, 2015-2017

State	fatalities in 2015-2016	fatalities in 2017
Texas	45	44
North Dakota	13	3
Oklahoma	8	6
Louisiana	4	4
New Mexico	5	3
Colorado	<3	<3
Illinois	<3	<3
Ohio	<3	<3
West Virginia	<3	<3
Wyoming	<3	<3
California	<3	0
Kansas	<3	0
Kentucky	<3	0
Pennsylvania	<3	0
Virginia	<3	0
Total	**92**	**69**

Source: NIOSHA FOG database

The FOG data does not separate out which fatalities occurred from oil or natural gas extraction. DNV used the ratio between U.S. oil and natural gas production, which was 59% natural gas and 41% oil in 2019,[50] to disaggregate fatalities by fuel. This ratio makes the simplifying assumption that the risks from oil extraction and natural gas extraction are equal. DNV was unable to find any studies comparing the safety of oil vs. gas extraction and so this ratio approach could be applied absent newer evidence. Multiplying the average total fatalities from 2015-2017 by 59% produces a value of 31.7 fatalities per year from natural gas extraction.

Transportation

Besides fatalities from oil and gas extraction, there are also fatalities from the operation of gas pipelines. The federal Pipeline and Hazardous Material Safety Administration (PHMSA)[51] publishes records of "significant" pipeline incidents which involve either an injury or a fatality to either industry employees or members of the public.

[49] "CDC - Fatalities in the Oil and Gas Extraction Industry (FOG) - NIOSH Workplace Safety & Health Topic." 2021. Www.cdc.gov. June 24, 2021. https://www.cdc.gov/niosh/topics/fog/default.html.

[50] According to the EIA the U.S. produced an average of 111.5 billion cubic feet per day and 12.8 million barrels of oil in 2019. Because one barrel of oil has the energy equivalent of 6,000 cubic feet of gas, this works out to a ratio of 59% natural gas and 41% oil on an equivalent basis.

[51] 2022. Dot.gov. 2022. https://portal.phmsa.dot.gov/analytics/saw.dll?Portalpages&PortalPath=%2Fshared%2FPDM%20Public%20Website%2F_portal%2FSC%20Incident%20Trend&Page=Significant%20Incidents%20Consequences.

Table 5-2. U.S. pipeline fatalities and injuries to industry employees and members of the public, 2005-2020

Calendar year	Total fatalities	Total injuries
2005	16	46
2006	19	34
2007	15	46
2008	8	54
2009	13	62
2010	19	103
2011	11	50
2012	10	54
2013	8	42
2014	19	93
2015	9	48
2016	16	86
2017	7	30
2018	6	78
2019	11	35
2020	15	43
Total	**202**	**904**

Source: PHMSA

This source shows that over the 2005-2020 period there have been 202 fatalities and 686 injuries from these significant incidents.[52] While these data are for all types of pipelines, other studies have shown that 91% of these incidents were related to gas pipelines in general and 78% were related to gas distribution lines in particular.[53] By taking the average of this 16 year period, multiplying by 91% for the share of fatalities from natural gas pipeline operation, the yearly fatality rate from operation of natural gas pipelines is 11.5.

While most natural gas is delivered via pipelines, there has been increasing interest in the transportation of liquified natural gas (LNG) due to the challenges of building new pipeline capacity. LNG is primarily delivered by truck due to severe restrictions on LNG transport by rail.[54] One case study of LNG transport in New England indicated that this method of transportation is very safe.[55]

Generation

Lastly, DNV used the Census of Fatal Occupational Injuries (CFOI)[56] from the U.S. Bureau of Labor Statistics to develop fatality estimates from natural gas electricity generation. This source claims there were 5 fatalities in fossil fuel electric power generation (NAICS code 221112) for 2019. According to the EIA[57], 2019 energy production from natural gas was 46.7% of US energy production from fossil fuels, meaning there were 2.3 fatalities per year from natural gas generation.

Total

The last thing to consider with fatalities of natural gas extraction and transportation is the proportion of gas that goes to electricity generation compared with the proportion of gas that goes to other end uses. EIA's 2020 numbers for natural gas consumption by sector[58] calculates 38% of this is for electric power. Using this, the final value for fatalities per year associated with natural gas electricity generation is:

Equation 3

$$Fatalities\ per\ year = (31.7_{extraction} + 11.5_{transportation}) * 0.38_{electricity\ generation} + 2.3_{generation} = 18.7$$

52 Oracle BI Interactive Dashboards - SC Incident Trend (dot.gov)

53 State Gas Pipelines - Pipeline Accidents (ncsl.org)

54 Risk Assessment of Surface Transport of Liquid Natural Gas (dot.gov)

55 "Over the past 45 years, Engie has contracted with motor carriers to transport LNG to 42 storage facilities in New England. During this time, these carriers have completed over 300,000 truck trips up to 150 miles with only two incidents. One was a truck rollover and the other was a truck engine fire. In both examples the LNG product in the cargo tank was not released." (Source: Risk Assessment of Surface Transport of Liquid Natural Gas (dot.gov)

56 "Census of Fatal Occupational Injuries (CFOI) - Current and Revised Data." 2018. Bls.gov. December 18, 2018. https://www.bls.gov/iif/oshcfoi1.htm.

57 https://www.eia.gov/energyexplained/electricity/electricity-in-the-us.php#:~:text=Most%20electricity%20is%20generated%20with,wind%20turbines%2C%20and%20solar%20photovoltaics.

58 https://www.eia.gov/energyexplained/natural-gas/use-of-natural-gas.php#:~:text=The%20commercial%20sector%20uses%20natural,combined%20heat%20and%20power%20systems.

To convert this number into fatalities per unit of energy, DNV used the 2020 EIA U.S. electricity generated by major source[59]. For natural gas, this was 1.624×10^{9} MWh, resulting in a per MWh value of 1.152×10^{-8} fatalities.

Coal

Extraction

Estimates for coal extraction come from the U.S. Department of Labor's Mine Safety and Health Administration (MSHA)[60]. DNV chose to average total fatalities from 2005 to 2020 to match the process used for natural gas. This comes to an average of 21.25 fatalities per year from coal extraction. These fatality values are shown in Table 5-3.

Table 5-3. US coal mining fatalities

Calendar year	Total fatalities
2005	23
2006	47
2007	34
2008	30
2009	18
2010	48
2011	20
2012	20
2013	20
2014	16
2015	12
2016	8
2017	15
2018	12
2019	12
2020	5
Total	**340**

Transportation

For valuing coal transportation DNV calculated the average number of US train fatalities[61] from 2005 to 2020 and came up with 9.94 fatalities per year. These yearly values are shown in Table 5-4.

[59] https://www.eia.gov/tools/faqs/faq.php?id=427&t=3,%20multiply%20by%20share%20of%20natural%20gas%20going%20to%20electricity%20https://www.eia.gov/tools/faqs/faq.php?id=50&t=8

[60] "Coal Mining Fatality Statistics: 1900-2013." 2013. Msha.gov. 2013. https://arlweb.msha.gov/stats/centurystats/coalstats.asp.

[61] "Train Fatalities, Injuries, and Accidents by Type of Accident | Bureau of Transportation Statistics." n.d. Www.bts.gov. https://www.bts.gov/content/train-fatalities-injuries-and-accidents-type-accidenta.

Table 5-4. US rail fatalities

Calendar year	Total fatalities
2005	33
2006	6
2007	9
2008	27
2009	4
2010	8
2011	6
2012	9
2013	11
2014	5
2015	11
2016	7
2017	7
2018	7
2019	3
2020	6
Total	**159**

According to the National Railway Labor Conference's latest estimate[62], coal accounted for 13% of carloads in the US.

Generation

Lastly, DNV used the Census of Fatal Occupational Injuries (CFOI)[63] from the U.S. Bureau of Labor Statistics to develop fatality estimates from natural gas electricity generation. This source claims there were 5 fatalities in fossil fuel electric power generation (NAICS code 221112) for 2019. According to the EIA[64], 2019 energy production from natural gas was 28.4% of US energy production from fossil fuels, meaning there were 1.42 fatalities per year from natural gas generation.

Total

The last thing to consider for coal is the proportion of coal used for electricity generation. According to EIA[65], this is 91.5%. When factoring this into all the steps above, the safety value of coal is shown in

62 Coal In Decline: The Impact on Railroads - NRLC (raillaborfacts.org)

63 "Census of Fatal Occupational Injuries (CFOI) - Current and Revised Data." 2018. Bls.gov. December 18, 2018. https://www.bls.gov/iif/oshcfoi1.htm.

64 https://www.eia.gov/energyexplained/electricity/electricity-in-the-us.php#:~:text=Most%20electricity%20is%20generated%20with,wind%20turbines%2C%20and%20solar%20photovoltaics.

65 https://www.eia.gov/energyexplained/coal/use-of-coal.php

Equation 4

$$Fatalities\ per\ year = (21.25\ _{extraction} + (9.94_{US\ rail} * 0.13_{coal\ rail})) * 0.915_{electricity\ generation} + 1.42_{generation} = 22.04$$

To convert this number into fatalities per unit of energy, DNV used the 2020 EIA U.S. electricity generated by major source[66]. For coal, this was 773 x 10^8 MWh, resulting in a per MWh value of 2.851 x 10^{-8} fatalities.

5.1.2 Economic

To produce job, output, earnings, and value added estimates DNV used applicable JEDI models downloaded from NREL's website. These models and model versions can be found below in Table 5-5.

Table 5-5. Specific JEDI models

Categorization	Model Version
Biopower	JEDI Biopower Model rel. B12.23.16
Coal	JEDI Coal Model rel. C12.23.16
Conventional hydro	JEDI CHydro Model rel.CH12.23.16
Marine and hydrokinetic	JEDI MHydro Model rel. MH12.23.16
Natural gas	JEDI NGas Model rel. NG4.17.17
Land based wind	JEDI Land Based Wind Model Beta rel. W10.30.20
Offshore wind	JEDI OffShore Wind Model rel.2021-2

The main inputs for the models are specified location, year of construction, resource size, and percent local, DNV used the information for existing and proposed resource given from Avista (Table 5-6). JEDI models have additional default values for local content that are derived from industry norms. DNV used the default values for biopower, coal, marine and hydrokinetic, natural gas, and land-based wind.

Table 5-6. JEDI imputes for specific plants

Plant Name	Categorization	Location	MW	Start Date	Capacity Factor
Colstrip 3 & 4	Coal	Colstrip, MT	1,480	1984/1986	
Rathdrum	Natural gas CT	Rathdrum, ID	166	1995	11.7%
Northeast	Natural gas Aero Turbine	Spokane, WA	62	1978	0.1%
Boulder Park	Natural gas ICE	Spokane Valley, WA	25	2002	
Coyote Springs II	Natural gas CCCT	Boardman, OR	306	2003	70.3%
Lancaster	Natural gas CCCT	Rathdrum, ID	256	2001	63.9%
Kettle Falls CT	Natural gas CT	Kettle Falls, WA	7	2002	2.0%
Kettle Falls	Biomass	Kettle Falls, WA	51	1983	59.6%
Noxon Rapids	Storage Hydro	Noxon, MT	555	1959	37.4%
Cabinet Gorge	Storage Hydro	Cabinet, ID	260	1952	43.2%
Monroe Street	Run-of-river hydro	Spokane, WA	15	1890	64.1%
Post Falls	Run-of-river hydro	Post Falls, ID	15	1906	60.6%
Nine Mile	Run-of-river hydro	Nine Mile Falls, WA	38	1908	35.8%
Little Falls	Run-of-river hydro	Ford, WA	35	1910	56.2%
Long Lake	Run-of-river hydro	Ford, WA	88	1915	82.0%
Upper Falls	Run-of-river hydro	Spokane, WA	10	1922	66.4%
Palouse Wind	Large Wind	Approx Oaksdale, WA	105	2010	39.9%
Rattlesnake Flat	Large Wind	Approx Lind, WA	144	2020	0.3%
Adams Neilson	Large Solar	Lind, WA	20	2019	27.0%
Wanapum	Reservoir hydro	Grant County, WA	2,258	1950s	25.9%
Rocky Reach	Reservoir hydro	Chelan County, WA	1,300	1950s	51.8%
Rock Island	Reservoir hydro	Chelan County, WA	629	1950s	45.4%

[66] https://www.eia.gov/tools/faqs/faq.php?id=427&t=3,%20multiply%20by%20share%20of%20natural%20gas%20going%20to%20electricity%20https://www.eia.gov/tools/faqs/faq.php?id=50&t=8

Plant Name	Categorization	Location	MW	Start Date	Capacity Factor
Wells	Reservoir hydro	Douglas County, WA	774	1950s	64.6%
Priest Rapids	Reservoir hydro	Grant County, WA	956	1950s	57.1%
Potential Resource	Large wind	MT	150	Post 2025	45.0%
Potential Resource	Large wind	Eastern WA	150	Post 2025	35.3%
Potential Resource	Large wind	Oregon/ID	150	Post 2025	35.3%
Potential Resource	Off-shore wind	Ocean off WA/OR	150	Post 2030	50.0%
Potential Resource	Small wind	Eastern WA/N. ID	50	Post 2025	35.3%
Potential Resource	Utility-scale solar	Eastern WA/N. ID	100	Post 2025	24.2%
Potential Resource	Community solar	Eastern WA/N. ID	5	Post 2025	20.0%
Potential Resource	Rooftop solar	Eastern WA/N. ID	0	Post 2025	15.0%
Potential Resource	Utility-scale solar	Northwest outside of AVA area	100	Post 2025	24.2%
Potential Resource	Natural gas CT	N. ID	50	Post 2025	11.5%
Potential Resource	Natural gas CCCT	N. ID	250	Post 2025	57.0%
Potential Resource	Pumped hydro - greenfield	WA	200	Post 2027	12.5%
Potential Resource	Pumped hydro - greenfield	OR	200	Post 2027	12.5%
Potential Resource	Pumped hydro - greenfield	MT	200	Post 2027	12.5%
Potential Resource	Pumped hydro - brownfield	Eastern WA	500	Post 2027	12.5%
Potential Resource	Hydrogen electrolyzer - small	Eastern WA	5	Post 2025	n/a
Potential Resource	Hydrogen electrolyzer - large	Eastern WA	50	Post 2025	n/a
Potential Resource	Clean Fuel Turbine	Eastern WA/N. ID	50	Post 2035	11.5%
Potential Resource	Non-natural gas (Hydrogen)	Eastern WA/N. ID		Post 2035	n/a
Potential Resource	Renewable natural gas storage tank	Eastern WA/N. ID		Post 2035	n/a
Potential Resource	Non-natural gas (Bio-fuel)	Eastern WA/N. ID		Post 2035	n/a
Potential Resource	Non-natural gas (Liquid air)	Eastern WA/N. ID		Post 2025	n/a
Potential Resource	Nuclear	Eastern WA/N. ID	200	Post 2030	92.4%
Potential Resource	Biomass	Kettle Falls GS Upgrade	25	Post 2025	70.0%
Potential Resource	Coal with Carbon Capture	Montana CCS Coal	200	Post 2030	80.0%
Potential Resource	Lithium Ion Distribution scale	Eastern WA/N. ID	1	Post 2025	n/a
Potential Resource	Lithium Ion Utility scale	Eastern WA/N. ID	1	Post 2025	n/a

Exceptions

Mentioned previously in section 3.2.6, offshore wind used JEDI estimates from direct impacts and used multipliers from EPI to estimate indirect and induced job impacts. The EPI study reports multipliers by major industries and sub-industries that corresponds with a two-digit code. DNV used the multipliers reported for the major industry, utilities, and sub-industry, electric power generation, transmission, and distribution, that corresponds with the two-digit code 12 in this source. These multipliers were 3.99 for indirect impacts and 1.65 for induced impacts.

The JEDI model for run-of-the-river hydropower requires project cost inputs in order to reflect jobs, earning, output, and value added according to the project specifications. In the absence of project specific project costs, these inputs were scaled in reference to the default MW project size of 5 MW. Therefore, any project costs are multiplied by the proportion of the project MW size to 5 MW.

5.2 Appendix B: Detailed Non-Energy Impacts Values

This appendix includes the applied NEI values and monetized values for each NEI category.

5.2.1 Public health

Table 5-7 shows the applied operational emissions values and Table 5-8 shows the monetized health impacts from the emissions.

Table 5-7. Operational Emissions in Tons per GWh

Type	Technology Abbreviation	Generator Name/ Location	NOx	SOx	PM2.5
Existing	Biomass	Kettle Falls	1.37	0.01	0.16
	Coal	Colstrip 3 & 4	0.93	0.45	0.11
	Hydro-Res	Wanapum	0.00	0.00	0.00
		Rocky Reach	0.00	0.00	0.00
		Rock Island	0.00	0.00	0.00
		Wells	0.00	0.00	0.00
		Priest Rapids	0.00	0.00	0.00
	Hydro-RR	Monroe Street	0.00	0.00	0.00
		Post Falls	0.00	0.00	0.00
		Nine Mile	0.00	0.00	0.00
		Long Lake	0.00	0.00	0.00
		Upper Falls	0.00	0.00	0.00
		Little Falls	0.00	0.00	0.00
	Hydro-RRS	Noxon Rapids	0.00	0.00	0.00
		Cabinet Gorge	0.00	0.00	0.00
	NG-Aero	Northeast	3.16	0.00	0.05
	NG-CCCT	Coyote Springs II	0.03	0.00	0.02
		Lancaster	0.06	0.00	0.02
	NG-CT	Rathdrum	0.22	0.00	0.02
		Kettle Falls CT	0.55	0.00	0.04
	NG-ICE	Boulder Park	0.11	0.00	0.00
	Solar-Utl	Adams Neilson	0.00	0.00	0.00
	Wind-LG	Palouse Wind	0.00	0.00	0.00
		Rattlesnake Flat	0.00	0.00	0.00
Potential	Biomass	Kettle Falls GS Upgrade	1.37	0.01	0.15
	Coal CCS	Montana CCS Coal	0.93	0.45	0.06
	Hydro-PB	Eastern Washington	0.00	0.00	0.00
	Hydro-GF	Washington	0.00	0.00	0.00
		Oregon	0.00	0.00	0.00
		Montana	0.00	0.00	0.00
	HE-LG	Eastern Washington	-	-	-
	HE-SM	Eastern Washington	-	-	-

Type	Technology Abbreviation	Generator Name/ Location	NOx	SOx	PM2.5
	Batt-LG	Eastern Washington/N. Idaho	-	-	-
	Batt-SM	Eastern Washington/N. Idaho	-	-	-
	NG-CCCT	N. Idaho	0.03	0.00	0.02
	NG-CT	N. Idaho	0.39	0.00	0.03
	NNG-Bio	Eastern Washington/N. Idaho	-	-	-
	NNG-Hyd	Eastern Washington/N. Idaho	-	-	-
	NNG-LAir	Eastern Washington/N. Idaho	-	-	-
	NNG-CF	Eastern Washington/N. Idaho	-	-	-
	NNG-Ren	Eastern Washington/N. Idaho	-	-	-
	Nuclear	Eastern Washington/N. Idaho	-	-	0.00
	Solar-Com	Eastern Washington/N. Idaho	0.00	0.00	0.00
	Solar-Rft	Eastern Washington/N. Idaho	0.00	0.00	0.00
	Solar-Utl	Eastern Washington/N. Idaho	0.00	0.00	0.00
		Northwest outside of AVA area	0.00	0.00	0.00
	Wind-LG	Montana	0.00	0.00	0.00
		Eastern Washington	0.00	0.00	0.00
		Oregon/Idaho	0.00	0.00	0.00
	Wind-Off	Ocean off WA/OR	0.00	0.00	0.00
	Wind-SM	Eastern Washington/N. Idaho	0.00	0.00	0.00

Table 5-8. Operational Public Health Costs in Dollars per MWh

Type	Technology Abbreviation	Generator Name/ Location	NOx			SOx			PM2.5			Total Impact, All Regions
			Site County	Avista Territory	Other U.S.	Site County	Avista Territory	Other U.S.	Site County	Avista Territory	Other U.S.	
Existing	Biomass	Kettle Falls	$ 0.83	$ 0.77	$ 5.40	$ 0.00	$ 0.00	$ 0.05	$ 1.67	$ 1.04	$ 3.58	$ 13.36
	Coal	Colstrip 3 & 4	$ 0.01	$ 0.03	$ 9.31	$ 0.01	$ 0.03	$ 10.11	$ 0.01	$ 0.02	$ 5.73	$ 25.26
	Hydro-Res	Wanapum	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Rocky Reach	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Rock Island	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Wells	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Priest Rapids	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Hydro-RR	Monroe Street	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Post Falls	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Nine Mile	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Long Lake	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Upper Falls	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Little Falls	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Hydro-RRS	Noxon Rapids	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Cabinet Gorge	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	NG-Aero	Northeast	$ 8.46	$ 1.54	$10.32	$ 0.01	$ 0.00	$ 0.02	$ 2.87	$ 0.52	$ 0.98	$ 24.73
	NG-CCCT	Coyote Springs II	$ 0.00	$ 0.01	$ 0.11	$ 0.00	$ 0.00	$ 0.03	$ 0.02	$ 0.05	$ 0.44	$ 0.67
		Lancaster	$ 0.08	$ 0.04	$ 0.24	$ 0.00	$ 0.00	$ 0.02	$ 0.70	$ 0.31	$ 0.53	$ 1.94
	NG-CT	Rathdrum	$ 0.34	$ 0.17	$ 0.96	$ 0.01	$ 0.00	$ 0.04	$ 0.58	$ 0.25	$ 0.44	$ 2.79
		Kettle Falls CT	$ 0.34	$ 0.31	$ 2.18	$ 0.00	$ 0.00	$ 0.03	$ 0.38	$ 0.24	$ 0.82	$ 4.30
	NG-ICE	Boulder Park	$ 0.31	$ 0.06	$ 0.37	$ 0.01	$ 0.00	$ 0.02	$ 0.10	$ 0.02	$ 0.03	$ 0.92
	Solar-Utl	Adams Neilson	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Wind-LG	Palouse Wind	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Rattlesnake Flat	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Potential	Biomass	Kettle Falls GS Upgrade	$ 0.83	$ 0.77	$ 5.40	$ 0.00	$ 0.00	$ 0.05	$ 1.50	$ 0.94	$ 3.21	$ 12.71
	Coal CCS	Montana CCS Coal	$ 0.01	$ 0.03	$ 9.31	$ 0.01	$ 0.03	$ 10.11	$ 0.01	$ 0.01	$ 2.98	$ 22.49
	Hydro-PB	E. WA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Hydro-GF	WA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Oregon	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Montana	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	HE-LG	E. WA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	HE-SM	E. WA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Batt-LG	E. WA/N. ID	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Batt-SM	E. WA/N. ID	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	NG-CCCT	N. ID	$ 0.05	$ 0.03	$ 0.15	$ 0.00	$ 0.00	$ 0.02	$ 0.68	$ 0.30	$ 0.52	$ 1.75

Type	Technology Abbreviation	Generator Name/ Location	NOx			SOx			PM2.5			Total Impact, All Regions
			Site County	Avista Territory	Other U.S.	Site County	Avista Territory	Other U.S.	Site County	Avista Territory	Other U.S.	
	NG-CT	N. ID	$ 0.58	$ 0.29	$ 1.67	$ 0.01	$ 0.00	$ 0.04	$ 0.88	$ 0.39	$ 0.67	$ 4.52
	NNG-Bio	E. WA/N. ID	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	NNG-Hyd	E. WA/N. ID	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	NNG-LAir	E. WA/N. ID	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	NNG-CF	E. WA/N. ID	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	NNG-Ren	E. WA/N. ID	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Nuclear	E. WA/N. ID	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Solar-Com	E. WA/N. ID	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Solar-Rft	E. WA/N. ID	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Solar-Utl	E. WA/N. ID	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Northwest outside of AVA area	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Wind-LG	Montana	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		E. WA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Oregon/ID	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Wind-Off	Ocean off WA/OR	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Wind-SM	E. WA/N. ID	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

5.2.2 Safety

Table 5-9 shows the applied fatalities per TWh and Table 5-10 shows the monetized impacts.

Table 5-9. Fatalities per TWh

Type	Technology Abbreviation	Generator Name/ Location	Direct Fatalities	Indirect Fatalities		Total Fatalities
			Construction and Operation	Mining	Operation	All Value Chain
Existing	Biomass	Kettle Falls	0.0153	-	-	0.0153
	Coal	Colstrip 3 & 4	0.0018	0.0251	0.0015	0.0285
	Hydro-Res	Wanapum	0.0240	-	-	0.0240
		Rocky Reach	0.0240	-	-	0.0240
		Rock Island	0.0240	-	-	0.0240
		Wells	0.0240	-	-	0.0240
		Priest Rapids	0.0240	-	-	0.0240
	Hydro-RR	Monroe Street	-	-	-	-
		Post Falls	-	-	-	-
		Nine Mile	-	-	-	-
		Long Lake	-	-	-	-
		Upper Falls	-	-	-	-
		Little Falls	-	-	-	-
	Hydro-RRS	Noxon Rapids	-	-	-	-
		Cabinet Gorge	-	-	-	-
	NG-Aero	Northeast	0.0014	0.0074	0.0027	0.0115
	NG-CCCT	Coyote Springs II	0.0014	0.0074	0.0027	0.0115
		Lancaster	0.0014	0.0074	0.0027	0.0115
	NG-CT	Rathdrum	0.0014	0.0074	0.0027	0.0115
		Kettle Falls CT	0.0014	0.0074	0.0027	0.0115
	NG-ICE	Boulder Park	0.0014	0.0074	0.0027	0.0115
	Solar-Utl	Adams Neilson	0.0190	-	-	0.0190
	Wind-LG	Palouse Wind	0.0350	-	-	0.0350
		Rattlesnake Flat	0.0350	-	-	0.0350
Potential	Biomass	Kettle Falls GS Upgrade	0.0153	-	-	0.0153
	Coal CCS	Montana CCS Coal	0.0018	0.0251	0.0015	0.0285
	Hydro-PB	Eastern Washington	-	-	-	-
	Hydro-GF	Washington	-	-	-	-
		Oregon	-	-	-	-

Type	Technology Abbreviation	Generator Name/ Location	Direct Fatalities	Indirect Fatalities		Total Fatalities
			Construction and Operation	Mining	Operation	All Value Chain
		Montana	-	-	-	-
	HE-LG	Eastern Washington	-	-	-	-
	HE-SM	Eastern Washington	-	-	-	-
	Batt-LG	Eastern Washington/N. Idaho	-	-	-	-
	Batt-SM	Eastern Washington/N. Idaho	-	-	-	-
	NG-CCCT	N. Idaho	0.0014	0.0074	0.0027	0.0115
	NG-CT	N. Idaho	0.0014	0.0074	0.0027	0.0115
	NNG-Bio	Eastern Washington/N. Idaho	0.0050	-	-	0.0050
	NNG-Hyd	Eastern Washington/N. Idaho	-	-	-	-
	NNG-LAir	Eastern Washington/N. Idaho	-	-	-	-
	NNG-CF	Eastern Washington/N. Idaho	-	-	-	-
	NNG-Ren	Eastern Washington/N. Idaho	-	-	-	-
	Nuclear	Eastern Washington/N. Idaho	0.0100	-	-	0.0100
	Solar-Com	Eastern Washington/N. Idaho	0.0190	-	-	0.0190
	Solar-Rft	Eastern Washington/N. Idaho	0.0190	-	-	0.0190
	Solar-Utl	Eastern Washington/N. Idaho	0.0190	-	-	0.0190
		Northwest outside of AVA area	0.0190	-	-	0.0190
	Wind-LG	Montana	0.0350	-	-	0.0350
		Eastern Washington	0.0350	-	-	0.0350
		Oregon/Idaho	0.0350	-	-	0.0350
	Wind-Off	Ocean off WA/OR	0.0350	-	-	0.0350
	Wind-SM	Eastern Washington/N. Idaho	0.0350	-	-	0.0350

Table 5-10. Monetized Fatalities per MWh

Type	Technology Abbreviation	Generator Name/ Location	Direct Fatalities	Indirect Fatalities		Total Fatalities
			Construction and Operation	Mining	Operation	All Value Chain
Existing	Biomass	Kettle Falls	$0.16	-	-	$ 0.16
	Coal	Colstrip 3 & 4	$0.02	$0.27	$0.02	$ 0.31
	Hydro-Res	Wanapum	$0.26	-	-	$ 0.26
		Rocky Reach	$0.26	-	-	$ 0.26
		Rock Island	$0.26	-	-	$ 0.26
		Wells	$0.26	-	-	$ 0.26
		Priest Rapids	$0.26	-	-	$ 0.26
	Hydro-RR	Monroe Street	-	-	-	-
		Post Falls	-	-	-	-
		Nine Mile	-	-	-	-
		Long Lake	-	-	-	-
		Upper Falls	-	-	-	-
		Little Falls	-	-	-	-
	Hydro-RRS	Noxon Rapids	-	-	-	-
		Cabinet Gorge	-	-	-	-
	NG-Aero	Northeast	$0.02	$0.08	$0.03	$ 0.12
	NG-CCCT	Coyote Springs II	$0.02	$0.08	$0.03	$ 0.12
		Lancaster	$0.02	$0.08	$0.03	$ 0.12
	NG-CT	Rathdrum	$0.02	$0.08	$0.03	$ 0.12
		Kettle Falls CT	$0.02	$0.08	$0.03	$ 0.12
	NG-ICE	Boulder Park	$0.02	$0.08	$0.03	$ 0.12
	Solar-Utl	Adams Neilson	$0.20	-	-	$ 0.20
	Wind-LG	Palouse Wind	$0.38	-	-	$ 0.38
		Rattlesnake Flat	$0.38	-	-	$ 0.38
Potential	Biomass	Kettle Falls GS Upgrade	$0.16	-	-	$ 0.16
	Coal CCS	Montana CCS Coal	$0.02	$0.27	$0.02	$ 0.31
	Hydro-PB	Eastern Washington	-	-	-	-
	Hydro-GF	Washington	-	-	-	-
		Oregon	-	-	-	-
		Montana	-	-	-	-
	HE-LG	Eastern Washington	-	-	-	-
	HE-SM	Eastern Washington	-	-	-	-
	Batt-LG	Eastern Washington/N. Idaho	-	-	-	-

Type	Technology Abbreviation	Generator Name/ Location	Direct Fatalities	Indirect Fatalities		Total Fatalities
			Construction and Operation	Mining	Operation	All Value Chain
	Batt-SM	Eastern Washington/N. Idaho	-	-	-	-
	NG-CCCT	N. Idaho	$0.02	$0.08	$0.03	$ 0.12
	NG-CT	N. Idaho	$0.02	$0.08	$0.03	$ 0.12
	NNG-Bio	Eastern Washington/N. Idaho	$0.05	-	-	$ 0.05
	NNG-Hyd	Eastern Washington/N. Idaho	-	-	-	-
	NNG-LAir	Eastern Washington/N. Idaho	-	-	-	-
	NNG-CF	Eastern Washington/N. Idaho	-	-	-	-
	NNG-Ren	Eastern Washington/N. Idaho	-	-	-	-
	Nuclear	Eastern Washington/N. Idaho	$0.11	-	-	$ 0.11
	Solar-Com	Eastern Washington/N. Idaho	$0.20	-	-	$ 0.20
	Solar-Rft	Eastern Washington/N. Idaho	$0.20	-	-	$ 0.20
	Solar-Utl	Eastern Washington/N. Idaho	$0.20	-	-	$ 0.20
		Northwest outside of AVA area	$0.20	-	-	$ 0.20
	Wind-LG	Montana	$0.38	-	-	$ 0.38
		Eastern Washington	$0.38	-	-	$ 0.38
		Oregon/Idaho	$0.38	-	-	$ 0.38
	Wind-Off	Ocean off WA/OR	$0.38	-	-	$ 0.38
	Wind-SM	Eastern Washington/N. Idaho	$0.38	-	-	$ 0.38

5.2.3 Environment

5.2.3.1 Land Use

Table 5-11 presents the applied land use in acres per MW.

Table 5-11. Land Use in Acres per MW

Type	Technology Abbreviation	Generator Name/ Location	Land Use (Acres/ MW)				
			Construction	Mining	Operation	Decommissioning	Total
Existing	Biomass	Kettle Falls	-	-	0.30	-	0.30
	Coal	Colstrip 3 & 4	-	0.72	1.18	-	1.90
	Hydro-Res	Wanapum	67.36	-	237.55	-	304.91
		Rocky Reach	67.36	-	237.55	-	304.91
		Rock Island	67.36	-	237.55	-	304.91
		Wells	67.36	-	237.55	-	304.91
		Priest Rapids	67.36	-	237.55	-	304.91
	Hydro-RR	Monroe Street	-	-	-	-	-
		Post Falls	-	-	-	-	-
		Nine Mile	-	-	-	-	-
		Long Lake	-	-	-	-	-
		Upper Falls	-	-	-	-	-
		Little Falls	-	-	-	-	-
	Hydro-RRS	Noxon Rapids	-	-	-	-	-
		Cabinet Gorge	-	-	-	-	-
	NG-Aero	Northeast	-	1.66	0.34	-	2.00
	NG-CCCT	Coyote Springs II	-	1.66	0.34	-	2.00
		Lancaster	-	1.66	0.34	-	2.00
	NG-CT	Rathdrum	-	1.66	0.34	-	2.00
		Kettle Falls CT	-	1.66	0.34	-	2.00
	NG-ICE	Boulder Park	-	1.66	0.34	-	2.00
	Solar-Utl	Adams Neilson	1.98	-	8.10	0.04	10.12
	Wind-LG	Palouse Wind	0.28	-	60.00	-	60.28
		Rattlesnake Flat	0.28	-	60.00	-	60.28
Po	Biomass	Kettle Falls GS Upgrade	-	-	0.30	-	0.30

Type	Technology Abbreviation	Generator Name/ Location	Land Use (Acres/ MW)				
			Construction	Mining	Operation	Decommissioning	Total
	Coal CCS	Montana CCS Coal	-	0.72	1.18	-	1.90
	Hydro-PB	Eastern Washington	-	-	-	-	-
	Hydro-GF	Washington	-	-	-	-	-
		Oregon	-	-	-	-	-
		Montana	-	-	-	-	-
	HE-LG	Eastern Washington	-	-	0.03	-	0.03
	HE-SM	Eastern Washington	-	-	0.01	-	0.01
	Batt-LG	Eastern Washington/N. Idaho	-	-	-	-	-
	Batt-SM	Eastern Washington/N. Idaho	-	-	-	-	-
	NG-CCCT	N. Idaho	-	1.66	0.34	-	2.00
	NG-CT	N. Idaho	-	1.66	0.34	-	2.00
	NNG-Bio	Eastern Washington/N. Idaho	-	-	-	-	-
	NNG-Hyd	Eastern Washington/N. Idaho	-	-	0.10	-	0.10
	NNG-LAir	Eastern Washington/N. Idaho	-	-	-	-	-
	NNG-CF	Eastern Washington/N. Idaho	-	-	-	-	-
	NNG-Ren	Eastern Washington/N. Idaho	-	-	1.36	-	1.36
	Nuclear	Eastern Washington/N. Idaho	-	1.42	0.97	-	2.39
	Solar-Com	Eastern Washington/N. Idaho	1.98	-	8.10	0.04	10.12
	Solar-Rft	Eastern Washington/N. Idaho	1.98	-	0.00	0.04	2.02
	Solar-Utl	Eastern Washington/N. Idaho	1.98	-	8.10	0.04	10.12
		Northwest outside of AVA area	1.98	-	8.10	0.04	10.12
	Wind-LG	Montana	0.28	-	60.00	-	60.28
		Eastern Washington	0.28	-	60.00	-	60.28
		Oregon/Idaho	0.28	-	60.00	-	60.28
	Wind-Off	Ocean off WA/OR	0.28	-	-	-	0.28
	Wind-SM	Eastern Washington/N. Idaho	0.28	-	44.70	-	44.98

5.2.3.2 Water Use

Table 5-12 presents the applied water use in gallons per MWh.

Table 5-12. Water Use in Gallons per MWh

Type	Technology Abbreviation	Generator Name/ Location	Water Use (Gallons/ MWh)
Existing	Biomass	Kettle Falls	553
	Coal	Colstrip 3 & 4	687
	Hydro-Res	Wanapum	4491
		Rocky Reach	4491
		Rock Island	4491
		Wells	4491
		Priest Rapids	4491
	Hydro-RR	Monroe Street	-
		Post Falls	-
		Nine Mile	-
		Long Lake	-
		Upper Falls	-
		Little Falls	-
	Hydro-RRS	Noxon Rapids	-
		Cabinet Gorge	-
	NG-Aero	Northeast	-
	NG-CCCT	Coyote Springs II	205
		Lancaster	205
	NG-CT	Rathdrum	0
		Kettle Falls CT	0
	NG-ICE	Boulder Park	0
	Solar-Utl	Adams Neilson	1
	Wind-LG	Palouse Wind	0
		Rattlesnake Flat	0
Potential	Biomass	Kettle Falls GS Upgrade	553
	Coal CCS	Montana CCS Coal	846
	Hydro-PB	Eastern Washington	-
		Washington	-
	Hydro-GF	Oregon	-
	HE-LG	Montana	-
	HE-LG	Eastern Washington	-
	HE-SM	Eastern Washington	-
	Batt-LG	Eastern Washington/N. Idaho	-
	Batt-SM	Eastern Washington/N. Idaho	-
	NG-CCCT	N. Idaho	205
	NG-CT	N. Idaho	0

Type	Technology Abbreviation	Generator Name/ Location	Water Use (Gallons/ MWh)
	NNG-Bio	Eastern Washington/N. Idaho	-
	NNG-Hyd	Eastern Washington/N. Idaho	-
	NNG-LAir	Eastern Washington/N. Idaho	-
	NNG-CF	Eastern Washington/N. Idaho	-
	NNG-Ren	Eastern Washington/N. Idaho	-
	Nuclear	Eastern Washington/N. Idaho	672
	Solar-Com	Eastern Washington/N. Idaho	1
	Solar-Rft	Eastern Washington/N. Idaho	1
	Solar-Utl	Eastern Washington/N. Idaho	1
	Wind-LG	Northwest outside of AVA area	1
	Wind-LG	Montana	0
		Eastern Washington	0
	Wind-Off	Oregon/Idaho	0
	Wind-Off	Ocean off WA/OR	0

5.2.3.3 Wildlife Impacts

Table 5-13 presents the applied values for avian fatalities per GWh.

Table 5-13. Avian fatalities per GWh

Type	Technology Abbreviation	Generator Name/ Location	Wildlife Impacts (Avian Fatalities/GWh)
Existing	Biomass	Kettle Falls	-
	Coal	Colstrip 3 & 4	0.20
	Hydro-Res	Wanapum	-
		Rocky Reach	-
		Rock Island	-
		Wells	-
		Priest Rapids	-
	Hydro-RR	Monroe Street	-
		Post Falls	-
		Nine Mile	-
		Long Lake	-
		Upper Falls	-
		Little Falls	-
	Hydro-RRS	Noxon Rapids	-
		Cabinet Gorge	-
	NG-Aero	Northeast	0.20
	NG-CCCT	Coyote Springs II	0.20
		Lancaster	0.20
	NG-CT	Rathdrum	0.20
		Kettle Falls CT	0.20
	NG-ICE	Boulder Park	0.20
	Solar-Utl	Adams Neilson	-
	Wind-LG	Palouse Wind	0.27
		Rattlesnake Flat	0.27
Potential	Biomass	Kettle Falls GS Upgrade	-
	Coal CCS	Montana CCS Coal	0.20
	Hydro-PB	Eastern Washington	-
	Hydro-GF	Washington	-
		Oregon	-
		Montana	-
	HE-LG	Eastern Washington	-
	HE-SM	Eastern Washington	-
	Batt-LG	Eastern Washington/N. Idaho	-
	Batt-SM	Eastern Washington/N. Idaho	-
	NG-CCCT	N. Idaho	0.20
	NG-CT	N. Idaho	0.20

Type	Technology Abbreviation	Generator Name/ Location	Wildlife Impacts (Avian Fatalities/GWh)
	NNG-Bio	Eastern Washington/N. Idaho	-
	NNG-Hyd	Eastern Washington/N. Idaho	-
	NNG-LAir	Eastern Washington/N. Idaho	-
	NNG-CF	Eastern Washington/N. Idaho	-
	NNG-Ren	Eastern Washington/N. Idaho	-
	Nuclear	Eastern Washington/N. Idaho	0.64
	Solar-Com	Eastern Washington/N. Idaho	-
	Solar-Rft	Eastern Washington/N. Idaho	-
	Solar-Utl	Eastern Washington/N. Idaho	-
		Northwest outside of AVA area	-
	Wind-LG	Montana	0.27
		Eastern Washington	0.27
		Oregon/Idaho	0.27
	Wind-Off	Ocean off WA/OR	-
	Wind-SM	Eastern Washington/N. Idaho	0.27

5.2.4 Economic

Table 5-14 shows the applied construction jobs and economic impacts.Table 5-15 shows the applied operations jobs and economic impacts.

Table 5-14. Construction Jobs and Economic Impacts

Type	Technology Abbreviation	Generator Name/ Location	Direct Impact				Indirect Impact				Induced Impact			
			Jobs/MW	Earnings in 2021$/MW	Output in 2021$/MW	Value Added in 2021$/MW	Jobs/MW	Earnings in 2021$/MW	Output in 2021$/MW	Value Added in 2021$/MW	Jobs/MW	Earnings in 2021$/MW	Output in 2021$/MW	Value Added in 2021$/MW
Existing	Biomass	Kettle Falls	3.00	$300,603	$372,189	$330,178	0.71	$47,638	$147,929	$86,588	0.69	$45,105	$136,686	$83,037
	Coal	Colstrip 3 & 4	5.44	$466,653	$902,905	$597,432	2.44	$110,203	$345,878	$176,486	1.82	$79,865	$250,743	$133,446
	Hydro-Res	Wanapum	15.51	$1,106,541	$2,034,243	$1,335,911	4.25	$285,630	$901,729	$517,882	3.92	$260,677	$789,639	$480,274
		Rocky Reach	15.51	$1,106,541	$2,034,243	$1,335,911	4.25	$285,630	$901,729	$517,882	3.92	$260,677	$789,639	$480,274
		Rock Island	15.51	$1,106,541	$2,034,243	$1,335,911	4.25	$285,630	$901,729	$517,882	3.92	$260,677	$789,639	$480,274
		Wells	15.51	$1,106,541	$2,034,243	$1,335,911	4.25	$285,630	$901,729	$517,882	3.92	$260,677	$789,639	$480,274
		Priest Rapids	15.51	$1,106,541	$2,034,243	$1,335,911	4.25	$285,630	$901,729	$517,882	3.92	$260,677	$789,639	$480,274
	Hydro-RR	Monroe Street	1.07	$87,838	$202,703	$128,378	4.26	$358,108	$1,317,568	$621,622	2.16	$148,649	$452,703	$277,027
		Post Falls	1.55	$82,759	$200,000	$117,241	5.28	$317,241	$1,296,552	$496,552	2.57	$117,241	$379,310	$200,000
		Nine Mile	1.07	$85,106	$202,128	$130,319	4.26	$61,170	$1,319,149	$622,340	2.15	$148,936	$454,787	$276,596
		Long Lake	1.07	$85,227	$201,136	$131,818	4.26	$354,545	$1,318,182	$621,591	2.15	$150,000	$453,409	$276,136
		Upper Falls	1.07	$90,000	$200,000	$130,000	4.26	$350,000	$1,320,000	$620,000	2.15	$150,000	$450,000	$280,000
		Little Falls	15.20	$1,085,714	$1,965,714	$1,302,857	4.11	$277,143	$874,286	$502,857	3.83	$254,286	$771,429	$468,571
	Hydro-RRS	Noxon Rapids	15.86	$925,045	$1,817,838	$1,087,027	5.22	$240,000	$771,351	$382,703	3.74	$164,505	$516,216	$274,775
		Cabinet Gorge	16.29	$932,692	$1,858,462	$1,083,077	5.63	$261,923	$851,154	$435,000	4.03	$177,692	$570,000	$302,308
	NG-Aero	Northeast	0.92	$141,129	$196,129	$150,968	0.85	$54,677	$199,516	$114,839	0.65	$44,677	$135,323	$82,258
	NG-CCCT	Coyote Springs II	0.98	$139,608	$196,699	$147,712	1.03	$52,255	$190,359	$104,281	0.71	$38,137	$109,902	$63,595
		Lancaster	1.07	$134,727	$196,680	$141,211	1.19	$51,914	$206,328	$100,039	0.76	$34,648	$111,211	$58,984
	NG-CT	Rathdrum	1.07	$135,060	$197,169	$141,566	1.19	$52,048	$206,867	$100,301	0.76	$34,699	$111,506	$59,157
		Kettle Falls CT	0.97	$141,667	$197,222	$151,389	0.83	$54,167	$200,000	$115,278	0.69	$44,444	$136,111	$81,944
	NG-ICE	Boulder Park	0.92	$139,200	$179,200	$149,200	0.84	$54,000	$196,800	$113,200	0.64	$44,000	$133,600	$81,200
	Solar-Utl	Adams Neilson	5.45	$293,973	-	-	4.80	$258,912	-	-	4.88	$263,227	-	-
	Wind-LG	Palouse Wind	0.63	$45,810	$50,000	$47,143	1.50	$109,143	$316,095	$173,048	0.67	$46,857	$144,952	$90,381
		Rattlesnake Flat	0.56	$41,319	$45,486	$42,569	1.50	$41,319	$316,042	$172,986	0.66	$46,528	$143,819	$89,653
Potential	Biomass	Kettle Falls GS Upgrade	3.72	$371,600	$460,400	$408,000	0.88	$58,800	$182,800	$107,200	0.84	$55,600	$168,800	$102,800
	Coal CCS	Montana CCS Coal	6.63	$569,380	$1,101,667	$728,948	2.97	$134,462	$422,018	$215,337	2.22	$97,446	$305,941	$162,822
	Hydro-PB	E. WA	14.75	$1,052,400	$1,933,000	$1,270,200	4.04	$271,400	$856,800	$492,200	3.73	$247,800	$750,800	$456,600
	Hydro-GF	WA	14.81	$1,056,500	$1,937,000	$1,274,000	4.05	$272,350	$858,500	$493,000	3.74	$248,500	$753,000	$458,000
		OR	16.04	$1,076,500	$1,994,500	$1,254,000	5.50	$290,000	$861,500	$477,500	5.11	$269,000	$775,000	$448,000
		MT	15.91	$929,000	$1,821,500	$1,091,000	5.24	$240,500	$773,000	$383,500	3.76	$165,000	$518,000	$275,500
	HE-LG	E. WA	-	-	-	-	-	-	-	-	-	-	-	-
	HE-SM	E. WA	-	-	-	-	-	-	-	-	-	-	-	-

Type	Technology Abbreviation	Generator Name/ Location	Direct Impact				Indirect Impact				Induced Impact			
			Jobs/MW	Earnings in 2021$/MW	Output in 2021$/MW	Value Added in 2021$/MW	Jobs/MW	Earnings in 2021$/MW	Output in 2021$/MW	Value Added in 2021$/MW	Jobs/MW	Earnings in 2021$/MW	Output in 2021$/MW	Value Added in 2021$/MW
	Batt-LG	E. WA/N. ID	-	-	-	-	-	-	-	-	-	-	-	-
	Batt-SM	E. WA/N. ID	-	-	-	-	-	-	-	-	-	-	-	-
	NG-CCCT	N. ID	1.07	$134,720	$196,680	$141,200	1.19	$51,920	$206,360	$100,040	0.76	$34,640	$111,240	$300,280
	NG-CT	N. ID	1.08	$134,800	$196,600	$141,200	1.20	$52,000	$206,400	$100,000	0.76	$34,600	$111,200	$59,000
	NNG-Bio	E. WA/N. ID	-	-	-	-	-	-	-	-	-	-	-	-
	NNG-Hyd	E. WA/N. ID	-	-	-	-	-	-	-	-	-	-	-	-
	NNG-LAir	E. WA/N. ID	-	-	-	-	-	-	-	-	-	-	-	-
	NNG-CF	E. WA/N. ID	1.07	$134,720	$196,680	$141,200	1.19	$51,920	$206,360	$100,040	0.76	$34,640	$111,240	$300,280
	NNG-Ren	E. WA/N. ID	-	-	-	-	-	-	-	-	-	-	-	-
	Nuclear	E. WA/N. ID	-	-	-	-	-	-	-	-	-	-	-	-
	Solar-Com	E. WA/N. ID	5.45	$293,973	-	-	4.80	$258,912	-	-	4.88	$263,227	-	-
	Solar-Rft	E. WA/N. ID	10.90	$587,946	-	-	9.60	$517,824	-	-	9.67	$526,454	-	-
	Solar-Utl	E. WA/N. ID	5.45	$293,973	-	-	4.80	$258,912	-	-	4.88	$263,227	-	-
		Northwest outside of AVA area	5.45	$293,973	-	-	4.80	$258,912	-	-	4.88	$263,227	-	-
	Wind-LG	MT	0.57	$31,733	$36,067	$32,267	1.91	$96,000	$306,867	$136,867	0.59	$25,267	$80,800	$44,267
		E. WA	0.56	$40,667	$44,867	$41,933	1.50	$109,200	$316,000	$172,933	0.66	$46,467	$143,667	$89,600
		OR/ID	0.56	$35,933	$40,400	$37,467	1.83	$108,000	$308,867	$154,400	0.68	$35,800	$104,933	$62,267
	Wind-Off	Ocean off WA/OR	0.15	$11,227	$11,227	$11,227	7.49	$770,052	$1,816,213	$991,067	1.96	$120,076	$412,474	$245,978
	Wind-SM	E. WA/N. ID	1.08	$54,400	$59,000	$55,200	1.92	$94,600	$314,800	$144,200	0.84	$38,200	$125,200	$68,600

Table 5-15. Operations Jobs and Economic Impacts

Type	Technology Abbreviation	Generator Name/ Location	Direct Impact				Indirect Impact				Induced Impact			
			Jobs/MWh	Earnings in 2021 $/MWh	Output in 2021 $/MWh	Value Added in 2021 $/MWh	Jobs/MWh	Earnings in 2021 $/MWh	Output in 2021 $/MWh	Value Added in 2021 $/MWh	Jobs/MWh	Earnings in 2021 $/MWh	Output in 2021 $/MWh	Value Added in 2021 $/MWh
Existing	Biomass	Kettle Falls	<0.0001	$3.40	$3.40	$3.40	0.0002	$11.26	$35.23	$19.87	<0.0001	$3.25	$9.87	$5.98
	Coal	Colstrip 3 & 4	0.0002	$15.71	$15.71	$15.71	0.0003	$15.71	$64.08	$30.18	0.0001	$4.63	$14.64	$7.77
	Hydro-Res	Wanapum	<0.0001	$2.81	$2.81	$2.81	<0.0001	$4.73	$17.54	$10.15	<0.0001	$1.53	$4.64	$2.82
		Rocky Reach	<0.0001	$2.81	$2.81	$2.81	<0.0001	$4.73	$17.54	$10.15	<0.0001	$1.53	$4.64	$2.82
		Rock Island	<0.0001	$2.81	$2.81	$2.81	<0.0001	$4.73	$17.54	$10.15	<0.0001	$1.53	$4.64	$2.82
		Wells	<0.0001	$2.81	$2.81	$2.81	<0.0001	$4.73	$17.54	$10.15	<0.0001	$1.53	$4.64	$2.82
		Priest Rapids	<0.0001	$2.81	$2.81	$2.81	<0.0001	$4.73	$17.54	$10.15	<0.0001	$1.53	$4.64	$2.82
	Hydro-RR	Monroe Street	0.0002	$15.51	$15.51	$15.51	<0.0001	$5.54	$22.15	$12.18	<0.0001	$3.32	$8.86	$5.54
		Post Falls	0.0002	$17.37	$17.37	$17.37	0.0001	$6.68	$28.06	$12.03	<0.0001	$2.67	$9.35	$5.34
		Nine Mile	0.0004	$27.35	$27.35	$27.35	0.0001	$10.16	$39.06	$21.09	<0.0001	$5.47	$16.41	$10.16
		Long Lake	0.0002	$16.52	$16.52	$16.52	<0.0001	$6.24	$23.56	$12.69	<0.0001	$3.22	$9.67	$5.84
		Upper Falls	0.0002	$14.41	$14.41	$14.41	<0.0001	$6.40	$20.81	$11.21	<0.0001	$3.20	$8.01	$4.80
		Little Falls	<0.0001	$1.59	$1.59	$1.59	<0.0001	$3.18	$11.14	$6.36	<0.0001	$1.06	$2.65	$1.59
	Hydro-RRS	Noxon Rapids	<0.0001	$2.74	$2.74	$2.74	<0.0001	$4.60	$18.87	$9.26	<0.0001	$1.17	$3.73	$1.98
		Cabinet Gorge	<0.0001	$2.18	$2.18	$2.18	<0.0001	$3.79	$15.15	$7.38	<0.0001	$1.04	$3.31	$1.70
	NG-Aero	Northeast	0.0016	$106.04	$106.04	$106.04	0.0016	$121.95	$413.56	$243.89	0.0005	$42.42	$132.55	$79.53
	NG-CCCT	Coyote Springs II	<0.0001	$0.57	$0.57	$0.57	<0.0001	$0.68	$2.22	$1.24	<0.0001	$0.25	$0.73	$0.42
		Lancaster	<0.0001	$0.53	$0.53	$0.53	<0.0001	$0.59	$2.16	$1.10	<0.0001	$0.18	$0.57	$0.30
	NG-CT	Rathdrum	<0.0001	$3.24	$3.24	$3.24	<0.0001	$3.60	$13.26	$6.72	<0.0001	$1.10	$3.48	$1.83
		Kettle Falls CT	0.0001	$2.17	$2.17	$2.17	0.0001	$3.26	$9.77	$5.43	0.0000	$1.09	$3.26	$2.17
	NG-ICE	Boulder Park	<0.0001	$1.45	$1.45	$1.45	<0.0001	$1.63	$5.61	$3.26	0.0000	$0.54	$1.81	$1.09
	Solar-Utl	Adams Neilson	-	$-	$-	$-	-	$-	$-	$-	-	$-	$-	$-
	Wind-LG	Palouse Wind	<0.0001	$1.48	$1.48	$1.48	<0.0001	$1.54	$5.48	$3.60	<0.0001	$0.64	$1.97	$1.21
		Rattlesnake Flat	<0.0001	$1.28	$1.28	$1.28	<0.0001	$1.47	$5.21	$3.44	<0.0001	$0.60	$1.84	$1.15
Potential	Biomass	Kettle Falls GS Upgrade	0.0001	$5.22	$5.22	$5.22	0.0002	$11.48	$36.14	$20.48	<0.0001	$3.52	$10.57	$6.46
	Coal CCS	Montana CCS Coal	<0.0001	$2.24	$2.24	$2.24	<0.0001	$2.24	$9.12	$4.29	<0.0001	$0.66	$2.08	$1.11
	Hydro-PB	E. WA	0.0001	$8.58	$8.58	$8.58	0.0002	$14.61	$54.06	$31.23	<0.0001	$4.75	$14.25	$8.77
	Hydro-GF	WA	0.0001	$8.68	$8.68	$8.68	0.0002	$14.61	$53.88	$31.51	<0.0001	$4.57	$14.16	$8.68
		OR	0.0001	$9.13	$9.13	$9.13	0.0003	$14.61	$54.34	$31.51	<0.0001	$5.02	$14.16	$8.22
		MT	0.0001	$7.76	$7.76	$7.76	0.0003	$12.79	$53.42	$26.03	<0.0001	$3.20	$10.50	$5.48
	HE-LG	E. WA	-	-	-	-	-	-	-	-	-	-	-	-
	HE-SM	E. WA	-	-	-	-	-	-	-	-	-	-	-	-
	Batt-LG	E. WA/N. ID	-	-	-	-	-	-	-	-	-	-	-	-
	Batt-SM	E. WA/N. ID	-	-	-	-	-	-	-	-	-	-	-	-
	NG-CCCT	N. ID	<0.0001	$0.64	$0.64	$0.64	<0.0001	$0.80	$2.95	$1.47	<0.0001	$0.23	$0.76	$0.40
	NG-CT	N. ID	<0.0001	$3.18	$3.18	$3.18	<0.0001	$3.57	$12.90	$6.55	<0.0001	$0.99	$3.38	$1.79

Type	Technology Abbreviation	Generator Name/ Location	Direct Impact				Indirect Impact				Induced Impact			
			Jobs/MWh	Earnings in 2021 $/MWh	Output in 2021 $/MWh	Value Added in 2021 $/MWh	Jobs/MWh	Earnings in 2021 $/MWh	Output in 2021 $/MWh	Value Added in 2021 $/MWh	Jobs/MWh	Earnings in 2021 $/MWh	Output in 2021 $/MWh	Value Added in 2021 $/MWh
	NNG-Bio	E. WA/N. ID	-	-	-	-	-	-	-	-	-	-	-	-
	NNG-Hyd	E. WA/N. ID	-	-	-	-	-	-	-	-	-	-	-	-
	NNG-LAir	E. WA/N. ID	-	-	-	-	-	-	-	-	-	-	-	-
	NNG-CF	E. WA/N. ID	<0.0001	$3.18	$3.18	$3.18	<0.0001	$3.97	$14.61	$7.31	<0.0001	$1.15	$3.77	$1.99
	NNG-Ren	E. WA/N. ID	-	-	-	-	-	-	-	-	-	-	-	-
	Nuclear	E. WA/N. ID	-	$-	$-	$-	-	$-	$-	$-	-	$-	$-	$-
	Solar-Com	E. WA/N. ID	-	$-	$-	$-	-	$-	$-	$-	-	$-	$-	$-
	Solar-Rft	E. WA/N. ID	-	$-	$-	$-	-	$-	$-	$-	-	$-	$-	$-
	Solar-Utl	E. WA/N. ID	-	$-	$-	$-	-	$-	$-	$-	-	$-	$-	$-
		Northwest outside of AVA area	-	$-	$-	$-	-	$-	$-	$-	-	$-	$-	$-
	Wind-LG	MT	<0.0001	$0.79	$0.79	$0.79	<0.0001	$1.29	$9.01	$5.73	<0.0001	$1.18	$3.79	$2.08
		E. WA	<0.0001	$1.34	$1.34	$1.34	<0.0001	$1.55	$5.48	$3.60	<0.0001	$0.63	$1.94	$1.21
		OR/ID	<0.0001	$1.19	$1.19	$1.19	<0.0001	$1.64	$4.96	$2.98	<0.0001	$0.60	$1.79	$1.06
	Wind-Off	Ocean off WA/OR	<0.0001	$0.91	$0.91	$0.91	<0.0001	$3.63	$3.63	$3.63	<0.0001	$1.50	$1.50	$1.50
	Wind-SM	E. WA/N. ID	<0.0001	$1.36	$1.36	$1.36	<0.0001	$1.49	$5.63	$3.30	<0.0001	$0.52	$1.81	$0.97

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