Clean Energy in the Bonneville Power Administration Area

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EXECUTIVE SUMMARY

The devastating consequences of climate change demand urgent actions from policymakers, polluting industries, and society in general. Electricity production and distribution have a significant environmental footprint. Utilities in Washington, Oregon and Idaho states rely on hydroelectric power for the majority of the sector's power generation, and hydropower has no greenhouse gas emissions. Utilities now must replace the remaining quarter of the state's power that comes from coal-fired (by 2025) and natural gas-fired power plants (by 2045). This report is a scan of the landscape of the current and future workforce needed by utilities to achieve Washington state's clean energy goals.

Current Workforce and Clean Energy Efforts

- Most utilities rely on a core set of occupations: electricians, engineers, hydro-operators, linemen, power plant operators, and mechanics.
- Community-scale solar installations, wind farms, building out electric vehicle (E.V.) charging infrastructure, pilot power storage capacity projects, and smart grid projects to improve grid resiliency are the most common clean energy efforts initiated in the Bonneville Power Administration (BPA) service area in the last three years.
- Utilities face ongoing workforce challenges, particularly related to a chronic labor shortage of hydro-operators, competing with large technology companies for highly qualified candidates, and recruiting and developing a diverse workforce.
- The COVID-19 pandemic did not significantly impact clean energy efforts though it caused a short-lived pause in utilities' recruitment and hiring. Managerial and hiring tasks were moved online, requiring stringent security protocols but allowing organizations to resume activities as usual.

Future Workforce and Clean Energy Efforts

- Utilities are generally confident in their ability to meet early Clean Energy Transformation Act (CETA) benchmarks and anticipate federal funds to stimulate investment in their shovel-ready clean energy projects, particularly transportation electrification and energy storage capacity. Still, some utility representatives expressed uncertainty regarding technical feasibility, particularly for later CETA benchmarks.
- The occupation mix needed to support these future efforts will remain the same as the current workforce. However, many, if not all, roles will evolve and incorporate the new

technical skills required to operate increasingly electrical and integrated systems. Training programs should adapt their curricula to integrate more technology skills, various communication protocols among multiple systems, cybersecurity awareness, and electrical safety.

- The evolution of legacy occupations (i.e., skilled trades) to meet the demands of the clean energy utility industry is a core strategy for maintaining strong labor standards in the utility sector and ensuring that clean energy jobs are good jobs. New job titles are emerging related to clean energy and race and equity, but only at the director and program manager level. They are not new occupations.

Impact of Public Policy

- Recent state-level legislation and proposed federal legislation aim to curb greenhouse gas emissions and quickly transition to carbon-free electricity production.
- Examples include the Clean Energy Transformation Act (CETA), the American Jobs Plan, and Governor Inslee's Climate Commitment. Specifically, CETA mandates that utilities eliminate coal power by 2025, be carbon-neutral by 2030, and carbon-free by 2045.
- Even though hydroelectric power is already the primary power source of many utilities in the Bonneville Power Administration region, organizations are investing in renewable energy sources (e.g., solar, wind) and storage solutions.
- Some expressed concern over whether there was adequate labor supply to implement these plans (e.g., electrician apprenticeship programs' capacity is traditionally limited). The financial burden to utilities, consumers, and communities is another concern.

Industry Challenges

- Industry leaders are aware of the grid’s vulnerabilities to extreme weather events like that in Texas. They place a high priority on improving the grid’s resiliency.
- Industry leaders are also aware of the grid’s vulnerability to cyberattacks. They acknowledge the need to expand cybersercuity workforce and training to meet that challenge.

Recommendations

The Center of Excellence for Clean Energy can support the clean energy industry by:

- Continuing to provide a valuable connection between industry and training programs.

- Engage current and potential students and expose them to the industry.
- Promote clean technology training programs.
- Provide high-quality labor forecasts and workforce data on job skills and clean energy specific occupations.
- Support and inform the industry on recruitment, hiring, and retention best practices.

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Energy Market Structure

Two distinct market frameworks co-exist in the United States' utility market: unregulated and regulated markets.[1] Washington state has a regulated market with investor-owned utilities, municipal utilities, rural electrical cooperatives, Public Utility Districts (PUDs), a tribal utility, and one federal utility.[2,3] Each type of utility has a regulatory entity that controls the quality and rates of the services provided to consumers.

The municipal utilities, rural electrical cooperatives, PUDs, and the tribal utility may generate their power and purchase power wholesale from the Bonneville Power Administration (BPA), which covers Washington, Oregon, and Idaho. The investor-owned utilities operate in every step of the process from generation to distribution and billing, with oversight from a state public utility commission, the Washington Utilities and Transportation Commission (WUTC), which has the mission of ensuring that investor-owned utilities are safe, reliable, and fairly priced.[4,5]

Washington state has long enjoyed clean, cheap energy thanks to the federal investment in hydropower. The Grand Coulee Dam is the largest hydropower plant in the United States It and the other hydropower plants in the state produce nearly a quarter of the U.S. hydroelectric power. This has helped keep Washington's energy prices very low, the fourth lowest in the country. As of 2019, hydropower accounted for 54% of the power generated in Washington state. However, hydropower has fallen both as a percentage of power produced and in total megawatt-hours in recent years.[6]

The next two largest energy sources are natural gas (12%) and coal (11%). These two energy sources account for 98% of the sector's carbon dioxide (CO_2) emissions, with coal accounting for more than two-thirds of the 22 million metric tons the Washington state power sector generates annually.[7]

Other sources account for a much smaller percentage of the sector's total megawatt-hours. Nuclear is fourth, at just under 5%, and wind power is fifth at 4.4%. Renewables, particularly non-CO_2-emitting renewables like wind and solar, have increased dramatically in the past several years, with wind doubling between 2017 and 2019 and solar increasing 8,800% in the same two years. Still, these non-hydro, non-emitting sources collectively account for less than 10% of the power generated in Washington state.[7]

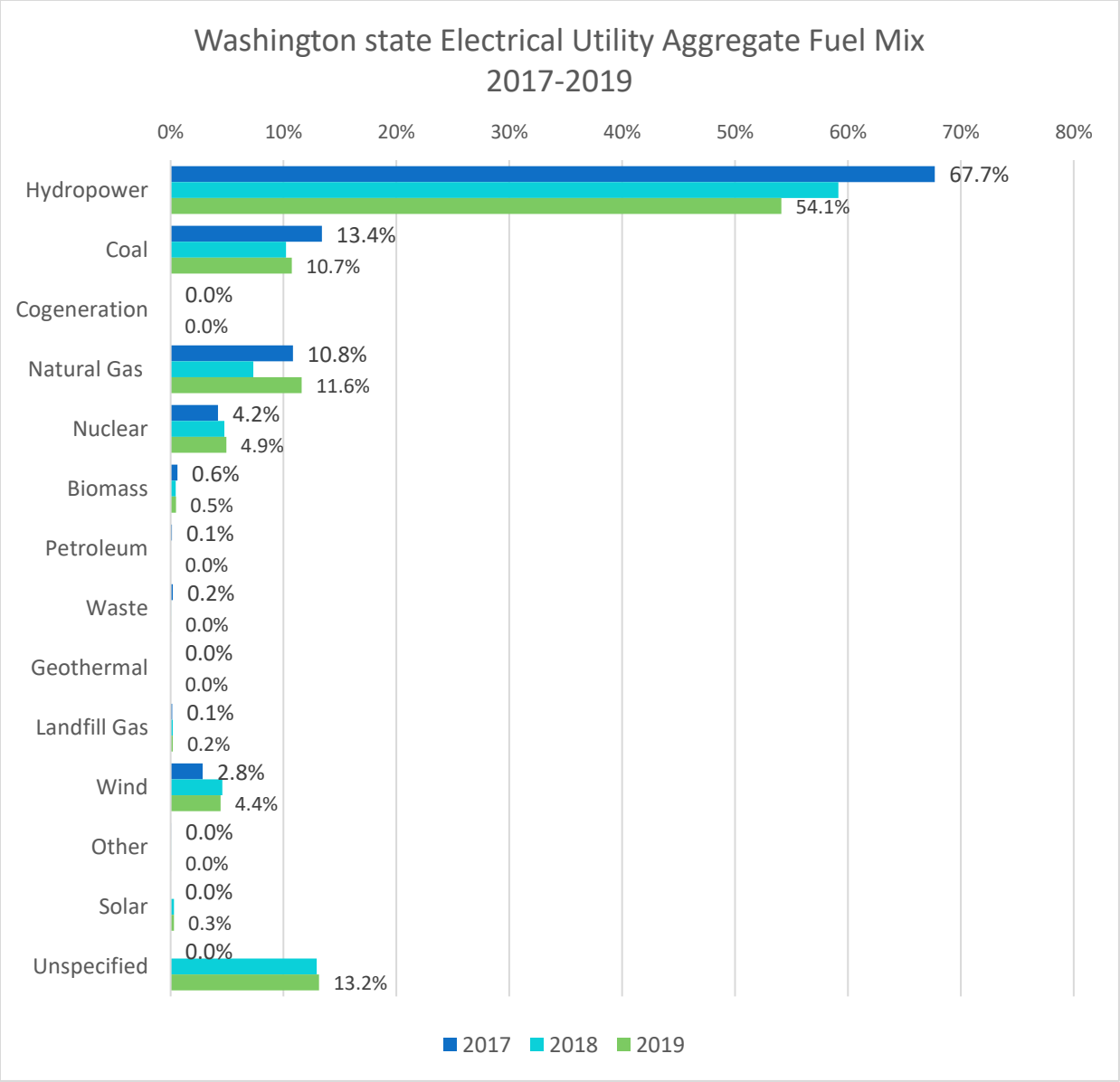


Figure 1. Fuel Sources for Electrical Power Generation in Washington state, 2017-2019[7]

CLEAN ENERGY IN THE MARKET

For clean energy to gain market share in either regulated or unregulated markets, the marginal production costs of clean energy must be low enough compared to the market or regulated consumption prices to ensure that utilities make a sufficient profit for financial solvency. And the prices utilities charge consumers must be affordable for low-income households. Technological advances and decreased production costs for clean energy sources have encouraged providers to invest in these sources and ramp up production capacity. For instance, onshore and offshore wind costs are expected to decline by 37-49% by 2050.[8]

In the past two decades, there have been efforts at both the federal and state levels to drive down the cost of clean energy and push utilities to shift power generation to greener sources and away from coal-fired and natural gas-fired power plants. One key element of these efforts is Renewable Energy Certificates (REC). RECs are a market instrument that represents the property rights to the non-power attributes of renewable electricity generation.[9] These certificates may support utilities' efforts to meet state requirements and substantiate consumers' clean energy rebates claims. Companies may finance clean energy use using various approaches:

- **Compliance REC procurement**: utilities buy certificates to meet the minimum percentage of electricity generated or sold from clean energy sources required by their state's renewable portfolio standards (RPS) requirements. In Washington state, utilities serving 25,000 customers or more must generate at least 15% of their electricity from renewable sources.[10]
- **Voluntary REC procurement**: individuals or organizations seeking to increase their renewable energy consumption and decrease their environmental footprint buy certificates.
- **Green Pricing Programs**: utilities offer consumers the option to pay a premium on their electric bill to have some or all of their electricity generated by renewable sources.[10]
- **Integrated Financing**: investments in grid technologies greatly facilitate the integration of renewable energy in operations planning, mainly thanks to energy storage. Thermally activated technologies are incorporated with capacity planning, grid operations, and load management. Specifically, energy generation and transmission siting allow for electricity production and consumption on a piece of land owned by an individual or company. Thanks to advances in energy storage, any surplus capacity can be sold to an energy marketer by the landowner.[11,12]
- **Community Solar Programs**: Utilities and third-party solar developers may sell a share of a local solar system to local communities and businesses. Since the community members share the cost of energy purchases, economies of scale make this option financially advantageous.[13]

State Policies

While long enjoying a reputation as an environmentally-friendly state, Washington state has become a leader in U.S. climate and energy policy in the last three years, leading the way with ambitious emission targets and legislation and public investments to reach those targets. While much of this work reaches far beyond electrical power generation and distribution, understandably, power utilities and their workforce implications are profound. The following state policies are changing the state's energy landscape:

- Clean Energy Transformation Act (CETA, SB 5116[14])

- Amendment of State Greenhouse Gas Emission Limits (HB 2311[15])
- Clean Buildings (HB 1257[16])
- Advancing Green Transportation Adoption (HB 2042[17])
- Zero-Emission Vehicles (ZEV) Mandate (SB 5811)[18]
- Governor's Climate Commitment[19]
- Climate Commitment Act (CCA, SB 5126[20])
- Clean Fuels Standard (CFS, HB 1091[21])
- Healthy Environment for All Act (HEAL Act, SB 5141[22])

CLEAN ENERGY TRANSFORMATION ACT (CETA)

The most central policy to the utility industry is the Clean Energy Transformation Act (CETA).[14] CETA was passed in 2019 and is currently in rulemaking.[23] The act has four landmark dates for utilities in Washington:

- Utilities publish a clean energy implementation play by 2022
- Eliminate coal power by 2025 (14% in 2017[24])
- Reach 100% carbon-neutral power generation by 2030 from "non-emitting electric generation and electricity from renewable resources" by 2030
- Carbon-free electric generation by 2045

The first landmark, eliminating coal power, primarily involves the state's only coal-fired power plant, TransAlta Centralia, which produced 7 million[6] of the 10 coal-fired megawatt-hours[7] distributed in 2019.

The second landmark, 100% carbon-neutral power, is more wide reaching regarding how it will impact the industry. By 2030, 80% of utilities' power must come from non-emitting sources. Non-emitting is broader than renewables and includes nuclear and natural gas with carbon capture and storage. The remaining 20% of the carbon neutrality obligation can be fulfilled by purchasing RECs, paying an administrative penalty (starts at $100/ton and increases over time), or investing in Energy Transformation Projects (ETPs).

ETPs "provide energy-related goods and services other than electricity generation and result in a reduction of fossil fuel consumption and a reduction of GHG emissions, while providing benefits to the customers of a utility." This component of the legislation incentivizes utilities making investments in infrastructure that reduces consumers' consumption of fossil fuels and even energy.

The 80/20 balance will shift so that by 2045, the state will require utilities to generate all power from non-emitting sources, meeting the fourth landmark. CETA caps the cost of compliance at 2% of each utility's prior year's revenue. Utilities can also apply for waivers to allow for a slower transition. While the state may grant utilities extensions and the annual cost of compliance is capped, all utilities will be required to meet the fourth landmark eventually.

Changes to the Regulatory Structure

In addition to the clean-energy requirements, CETA changes electricity generation regulation in five key ways:

- Authorizes the UTC to move investor-owned utilities from a return-on-capital model to a performance-based model
- Requires utilities to incorporate the social cost of carbon into their accounting
- Requires utilities to distribute benefits equitably and reduce the burden on the highly-impacted and vulnerable communities
- Requires utilities to improve their low-income energy assistance programs
- Incentivizes utilities to create high-quality jobs through ETPs

Change Investor-Owned Utilities Profit Model

The current investor-owned utility (IOU) profit model is return-on-investment. This model incentivizes IOUs to invest in generation capacity *and* maximize consumption. It disincentivizes IOUs from investing in consumer-side energy efficiency and distributed energy projects. As improvements in energy efficiency remain one of the best ways to reduce emissions, this structure is a significant impediment to reaching emission targets. The UTC can move IOUs to a performance-based model in which investors' profit is based on metrics set by the UTC. These metrics may include energy efficiency, carbon reduction, and how the utility improves equity in its service provision and environmental impact.

Social Cost of Carbon

CETA's requirement that utilities incorporate the social cost of carbon changes the baseline calculations for the cost of implementation for the transition to clean energy, thus making the transition more cost-effective because the cost of energy production is more fully accounted for. The federal government set the social cost of carbon at $68/ton, and this will go up to $116/ton by 2050. The discount rate is a low 2.5%, which weights future damages more heavily.[25]

Equity

CETA requires a Cumulative Impact Analysis that identifies communities bearing a disproportionate pollution burden from electricity generation and who are particularly vulnerable to its effects and the effects of climate change. Utilities are required to use this analysis to inform their planning and must prioritize highly-impacted and vulnerable communities' short and long-term public and environmental health when making investments. In practice, this means that ETPs must be equitably distributed throughout the community and not concentrated in more affluent areas. Therefore, when prioritizing ETPs, impact on equity should be a primary consideration.

Low-Income Energy Assistance

Closely aligned with the equity requirement, all utilities are required to improve their low-income energy assistance programs to ensure that clean energy is affordable for low-income households. The programs may include energy subsidies to eligible households and investments in energy efficiency and distributed energy resources for them. Like other components of CETA, this has a coverage requirement that ratchets up over time, starting at programs reaching 60% of eligible households in 2030 and reaching 90% by 2050.

High-Quality Jobs

Also closely related to the equity requirements, CETA includes a graduated incentive structure for utilities to create high-quality jobs through the ETPs:

- 50% tax exemption for projects in which the utility makes a good-faith effort to procure from and contract with women, minority, and veteran-owned businesses, businesses with a track record of complying with wage and hour regulations, businesses that use apprenticeships, and businesses that prioritize hiring local workers
- 75% tax exemption for projects that do the above and pay "prevailing wage rates determined by local collective bargaining"
- 100% tax exemption for projects "developed under a community workforce agreement or project labor agreement" certified by the Department of Labor and Industry[18,26]

GREENHOUSE GAS LIMITS

The Greenhouse Gas Limiting legislation[15] simply updated the limits of the state's emissions initially passed in 2008. It also includes carbon sequestration as necessary to meet emission targets. The change is as follows:

Year	2008 Limits	2020 Updated Limits
2020	1990 levels	1990 levels
2030		45% below 1990
2035	25% below 1990	
2040		70% below 1990
2050	50% below 1990	95% below 1990 and net-zero greenhouse gas emissions

CLEAN BUILDINGS

Also passed in 2019 is the Clean Buildings Act.[14] The primary focus of this act does not have immediate implications for the utility industry, though it will impact energy consumption overall and electricity consumption specifically. This is because the built environment is responsible for more than a quarter of emissions in Washington state and has increased 50% since 1990.[27] The legislation seeks to meet the 70% reduction in energy usage for buildings built between 2013 and 2031 through four components:

- Washington state building code will include electric vehicle infrastructure requirements for all buildings that provide on-site parking
- Utilities must maintain use Energy Star-compatible records about the energy usage in all nonresidential and some public buildings served by the utility
- The Department of Commerce must develop plans to improve energy efficiency and reduce emissions from homes and communities
- Owners of commercial buildings 50,000 square feet and larger must continually improve their buildings' efficiency and provide $75 million in incentives to encourage these investments
- This act increases energy efficiency standards for natural gas and encourages the transition to renewable natural gas (e.g., landfill gas, dairy digester).

ADVANCING GREEN TRANSPORTATION ADOPTION ACT AND ZERO-EMISSION VEHICLES (ZEV) MANDATE

The Advancing Green Transportation Adoption Act and Zero-Emission Vehicles (ZEV) Mandate are a bundle of tax incentives, state funds, and programs aimed at incentivizing the adoption of non-internal combustion engine (ICE) vehicles. Many of these tax incentives and programs have been piloted or were in place before the passage. The renewal and, in some cases, restructuring

and expansion, particularly for charging infrastructure, will support the continued adoption of E.V.s, which expands the role of utilities in consumers' daily lives.[28]

GOVERNOR'S CLIMATE COMMITMENT

Governor Jay Inslee made a Climate Commitment[19] to reduce emissions in Washington state by 30 million metric tons by 2030 to open the 2021-2023 biennium. Inslee laid out several legislative and budget priorities in the commitment, including capping greenhouse gases, investing in community and climate resiliency, advancing environmental justice, transitioning to clean transportation, improving the efficiency of buildings, and investing in clean energy. During the 2021 session, the legislature passed three landmark bills:

- Climate Commitment Act[20]
- Clean Fuels Standard [21]
- Healthy Environment for All Act (HEAL Act)[22]

Governor Inslee's commitment has three major categories of efforts:

- Clean Energy
- Clean Transportation
- Healthy Homes and Buildings

While clean energy is the most immediately relevant to the supply side of the utility sector, particularly the commitment to grid modernization, both clean transportation and healthy homes and buildings directly affect the demand for power from utilities. Clean transportation both increases demand and makes distribution more complicated and dynamic because nearly all of the commitment is focused on the electrification of transportation. Healthy homes and buildings aim to reduce demand through energy efficiency and complicate distribution through distributed generation.[28]

Below are the governor's priorities and proposed 2021-2023 budget and the budget enacted by the state legislature:

Category	Expenditure	Proposed (in millions)	Enacted (in millions)
Clean Energy	Clean-energy loans	$20.0	$2.5
	Grid modernization	$15.0	$17.6
	Clean energy tech research and development	$15.0	$10.8
	Rural clean energy innovation grants (Dairy digester bioenergy projects)	$5.0	$5.0
Clean Transportation	Ferry Electrification	$190.2	$6.8
	Transportation electrification	$35.0	$15.4
	Decarbonize the maritime sector	$5.0	
	Electric vehicle promotion	$1.5	
Healthy Homes & Buildings	Public building retrofits	$66.0	$10.0
	Low-income weatherization/Housing rehabilitation/WSU Community Energy Efficiency	$55.0	$14.9
	Next-generation clean buildings	$20.0	$10.0
Total		$427.7	$93.3

CLIMATE COMMITMENT ACT

The Climate Commitment Act, a cornerstone of Inslee's Climate Commitment, is a cap-and-invest carbon-pricing program. It covers approximately 80% of the state's greenhouse gas emissions and applies to most entities that emit 25,000 tons or more per year. This includes the utility industry, transportation industry, and oil and gas industry.

Under this act, the Department of Ecology will sell emission allowances to covered entities. Utilities are already covered under CETA and will not have to purchase theirs, but if they reduce emissions ahead of schedule, they can auction off any unused allowances. The priority use for those proceeds is to improve their low-income energy assistance programs.

The number of allowances will shrink over time, but their price has a floor and a ceiling to increase predictability. The Department of Ecology can issue additional permits if the price ceiling is hit and may withdraw permits if emission targets are not met.

The revenue from the sale of allowances will go to climate change mitigation and adaptation through four funding mechanisms:

- Transportation projects that reduce emissions (transit and electrification)
- Air Quality and Health Disparities Improvement Account
- Climate Investment Account
- Natural Climate Solutions Account

The standards and investments will have equity at their core, prioritizing highly-impacted communities for pollution reduction and investment for climate mitigation and resilience.

CLEAN FUELS

Clean Fuels Act's primary objective is to reduce the carbon intensity of the state's transportation fuel. The regulation of transportation fuel's carbon intensity does not directly affect utilities, but entities covered by the act may purchase credits from utilities for residential electric vehicle charging to meet carbon-reduction targets. In addition, the act explicitly states that credits should be used to invest in smart charging technology to charge vehicles when the grid has comparatively low carbon intensity.

HEALTHY ENVIRONMENT FOR ALL ACT

Finally, the Health Environment for All Act defines environmental justice objectives woven through the preceding legislation. It requires that a racial justice lens be used for planning, metric setting, program implementation, and enforcement. Specifically, it funds the Washington Environmental Health Disparities (WA-EHD) map to be used in community engagement, planning, and evaluation.

It clarifies how the various funds, particularly the Climate Investment Account, will prioritize highly-impacted and vulnerable communities. Finally, it creates a structure to ensure community representation when projects are selected, and funds are distributed.

Federal Policies

Despite the strong state policies implemented to support decarbonization and curb greenhouse gas emissions, efficient strategies to ramp up clean energy production should consider pollution best tackled at a broad geographic scope. Regional coordination among states is crucial to address these issues, particularly for utilities where energy sources are shared across administrative borders. The federal government has the power to centralize efforts and coordinate decisions at the national level. The new administration has voiced its dedication to the clean energy agenda, earmarking massive amounts to fund greenhouse (GHG) emissions reduction initiatives.

The Biden-Harris administration and their allies in Congress have proposed several large-scale pieces of legislation and administration action to make up ground on addressing climate change and ensure that the United States is a leader in developing and producing clean energy. The pandemic response has been the primary focus of the first four months of the administration,

but the administration is pivoting more on infrastructure and energy in recent weeks. The following pieces of legislation, if passed, have the most direct impact on the utility industry:

- Clean Energy and Sustainability Accelerator Act
- American Jobs Plan
- The 21st Century Energy Workforce Act

CLEAN ENERGY AND SUSTAINABILITY ACCELERATOR ACT

The Clean Energy and Sustainability Accelerator Act, introduced to Congress on February 4, 2021, aims at leveraging private and public funding sources to invest in clean energy technologies.[29] Specifically, the Act advocates for creating the Clean Energy and Sustainability Accelerator, a non-profit endowed with $50 billion from the Secretary of Energy at its creation date, plus an additional $10 billion on each of the following five years. This non-profit will support the following three primary axes:

- Funding regional, state, and local green banks
- Supporting climate impacted communities, particularly low-income, and disadvantaged individuals
- Supporting the creation of new green banks nationwide

Funding regional, state, and local green banks

According to the National Renewable Energy Laboratory,[30] green banks leverage innovative financing solutions to fund and advance low-carbon projects, renewable energy production, and climate-resilient ventures. Their ability to secure low-cost capital helps decrease production costs of more expensive clean-energy sources such as solar energy. Green banks' capital may come from various sources, including state public funding, pension funds, climate funds, or electricity price surcharges like Connecticut.[31] Lower production costs are critical to ensure proper market penetration of new technologies. Cost reduction also means that gas emission goals are reached within the target timeframe and that everyone, regardless of income status, has access to clean energy. In the Clean Energy and Sustainability Accelerator Act, qualifying green banks are defined as:

> *Dedicated public or non-profit specialized finance entities that are designed to drive private capital into market gaps for low- and zero-emission goods and services; uses finance tools to mitigate climate change; do not take deposits; and are funded by government, public, private, or charitable contributions.*

The Clean Energy and Sustainability Accelerator is a non-profit that will support the creation of green banks in places where they do not already exist, which is the case in Washington state. The proposed Accelerator could be the only investor of a project or partner with other public and private capital providers. Investments should help ramp up renewable clean energy generation, including solar, wind, geothermal, hydropower, ocean and hydrokinetic, or fuel cell. The Act also targets energy efficiency, industrial decarbonization, smart-grid applications, net-emissions agriculture and forestry projects, electric and hydrogen transportation, and climate-resilient infrastructure. For example, the Accelerator will provide low- and zero-interest loans to public or non-profit organizations seeking to finance the acquisition of a zero-emission vehicles fleet.

Support climate change-impacted communities, particularly low-income, and disadvantaged individuals

The Act also seeks to address equity and income concerns regarding the population's access to sometimes-expensive clean energy products. Investment decisions shall prioritize projects (at least 40% of investments within 30 years) that serve climate-impacted communities. Besides, within one year of the Accelerator's creation, its board of directors is mandated to consider establishing an "accelerated clean energy transition program." This program will support zero-emissions power facilities and assets. It will also finance economic development projects in communities disproportionally impacted by disinvestment in carbon-intensive activities.

Support the creation of new green banks nationwide

A dedicated Start-Up division will provide technical assistance and seed funding to states and other political subdivisions to support the creation of green banks. To the best of our knowledge, such establishments do not yet exist in Washington state. Cost-reduction initiatives have so far been left to energy providers and private companies. Many utilities in the state currently provide financial incentives to encourage energy-efficient product uptake by households to reduce their carbon footprint and energy consumption.

For example, homeowning customers of Seattle City Light may benefit from discounts to purchase energy-efficient heat pumps or credits through net metering programs. Similarly, new energy-efficient construction projects may be eligible for energy price rebates. However, no financial institution is dedicated to helping homeowners purchase energy-efficient home solutions or residential contractors retrofit their building portfolio. A green bank could complement local utilities' financial incentives by providing low-interest loans to finance private,

clean energy generation or energy-efficient solutions. This financing could give the necessary push to achieve the state's GHG emission goals.

AMERICAN JOBS PLAN ($3T INFRASTRUCTURE BILL)

President Joe Biden introduced the American Jobs Plan on March 31, 2021. It is an ambitious plan to bolster public domestic investments nationwide. For decades, public infrastructure has been neglected, resulting in an enormous backlog of deferred maintenance and unmet infrastructure needs. As a result, nearly every aspect of our physical infrastructure, from bridges and roads, water systems, electric grids to energy-efficiency construction and high-speed telecommunication networks, receives a grade of C- or less.[32–35] More to the point, electricity generation and distribution innovation have been underinvested in.[28] The American Jobs Plan provides $3 trillion to update public infrastructure and support highly-impacted communities in dealing with climate change and adopting clean energy sources. The president's plan also seeks to modernize the clean energy infrastructure through the following:

- Supporting public and private transportation electrification
- Expanding the electrical grid
- Retrofitting more than two million homes, commercial buildings, and schools
- Increasing investment in research and development spending
- Investing in clean energy manufacturing
- Expanding the clean energy workforce

Supporting Public and Private Transport Electrification

First, the president's plan will enhance grants and loans for passenger and freight rail efficiency and electrification. Second, it allocates $174 billion to boost the national electric vehicles (E.V.s) market. This amount will help improve the working of those building E.V.s and their batteries. In addition, it will fund the installation of a nationwide 500,000 E.V.-charger network by 2030 and the electrification of 50,000 transit buses and at least 20% of yellow school buses.

Expanding the Electric Grid

The President's plan also outlines the strategies to support 100% carbon-free electricity by 2035, thanks to a $100 billion investment. It will help improve the national electric grid's resilience and harness public and private capital to finance the buildout of at least 20 gigawatts of high-voltage capacity power lines. A newly established Grid Deployment Authority at the Department of Energy will oversee the deployment of high-voltage transmission lines. These efforts are

expected to produce many good-paying jobs for union laborers, line workers, electricians, and supply chain sectors.

The plan also announces the creation of an expanded direct-pay investment tax credit and production tax credit to support clean energy generation and storage efforts. A newly created Energy Efficiency and Clean Electricity Standard (EECES) will help consumers decrease their electricity bills and pollution and create more competition in the utility market. A staple of the Pacific Northwest, hydropower and other carbon-free energy sources will still be used extensively.

Retrofitting Homes, Commercial Buildings, and Schools

The President's plan allocates $213 billion to bolster energy efficiency efforts in the construction industry to reduce home energy costs for Americans. This section contains three pillars:

- Building energy-efficient or retrofitting affordable housing units
- Phasing out detrimental zoning and land-use policies
- Improving the public housing system

The plan leverages union trade workers to spur this effort and invests $40 billion in public housing and $27 billion in the Clean Energy and Sustainability Accelerator described above. In addition, a Civilian Climate Corps would ensure the availability of the workforce needed to carry out these changes.

Increasing Research and Development Spending

The President's plan calls for a $35 billion investment in related research and development spending to stay ahead of worldwide competition and back national climate and clean energy efforts. This announcement is expected to spur technological innovations in critical clean-energy infrastructure such as carbon capture, utility-scale energy storage, or the development of new energy sources (e.g., nuclear, hydrogen, offshore wind). A new working group, the ARPA-C (Advanced Research Projects Agency-Climate), shall spearhead these efforts. Participating researchers will focus on carbon-neutral construction materials, low-cost energy storage solutions and electric vehicles, affordable building efficiency tools, and management systems for grids powered by carbon-free power plants.

Investing in clean energy manufacturing

Investing in clean energy sources and related new technologies could ideally be produced by American manufacturing and American suppliers. For example, the president's plan announces a

$46 billion investment in federal purchasing power to be spent on electric vehicles and charging station manufacturing, as well as electric heat pumps for residential and commercial buildings heating. This investment plan also targets advanced critical technologies like nuclear reactors and fuels.

Expanding the clean energy workforce

To ensure the preparedness of the future workforce for clean energy endeavors, the president's plan allocated $40 billion to a new Dislocated Worker Program and sector-based training. In particular, sector-based training will focus on programs in high-demand careers, including clean energy. In addition, the 21st Century Energy Workforce Act described below will be a powerful tool to build a productive and educated energy labor force.

THE 21ST CENTURY ENERGY WORKFORCE ACT

In addition to supporting clean energy technologies adoption and renewable energy source generation, the federal government also must make sure that the labor workforce of tomorrow will be ready to operate these technologies and serve the energy industry's needs. The latter increasingly relies on electricians and engineers, an assertion corroborated by our interviews with industry stakeholders. A new bill introduced to Congress in January 2021 aims to strengthen the pipeline between training programs and energy employers.

To ensure that there is adequate supply to meet the demand for 1,500,000 additional workers in the energy sector over the next 15 years,[36] 21st Century Energy Workforce Act seeks to expand workforce supply to meet the industry's needs. First, the Act calls for creating a so-called "National Center of Excellence for the 21st Century Workforce Advisory Board" to steer strategic workforce efforts. This board shall be comprised of industry stakeholders, economics and labor experts, state and local government representatives, education representatives (elementary, secondary, and post-secondary institutions), and labor organization representatives. The board will have similar responsibilities to the Center of Excellence for Clean Energy (CECE):

- Support training programs that meet industry needs and standards
- Align apprenticeship programs and industry certifications
- Coordinate educational standards and foundational skills taught in the K-12 system and at post-secondary institutions
- Support the replication of existing model energy curricula

The Act also advocates for creating financial grants awarded to eligible training programs seeking to earn an industry-recognized credential. Among other considerations, eligible training

institutions should have the capacity to support students who plan to work in the energy industry. Criteria are varied, but applications shall prioritize post-secondary and apprenticeship programs, including the following:

- Community colleges whose curriculum includes basic math and science education
- Registered apprenticeship programs
- Institutions that apply as a state consortium to leverage geographically relevant best practices
- Institutions that have an apprenticeship to complement educational activities
- Institutions that provide basic energy workforce development training
- Industry-affiliated pre-apprenticeships

With an annual budget of $20,000,000 between 2021 and 2025, winning institutions may receive up to $1 million in individual awards, significantly increasing their ability to invest in capacity.

WORKFORCE

It is important to understand the current state of the workforce to understand what the utility industry's workforce needs will be to meet the rapidly changing power landscape. Following is a brief overview of the current state of the utility sector workforce in Washington state.

By Utility

The top five electricity retailers in Washington state are: Puget Sound Energy (23% of the state's retail sales), the City of Seattle (10%), PUD 1 of Snohomish County (7%), Avista Corp (6%), and PUD 2 of Grant County (6%).[37] In Oregon, the top five retailers are Portland General Electric (34% of the state's retail sales), PacifiCorp (26%), Umatilla Electric Coop (6%), the City of Eugene (5%), and Calpine Energy Solutions (3%). Finally, Idaho top retailers include Idaho Power (58% of the state's retail sales), PacifiCorp (15%), Avista Corp (14%), the City of Idaho Falls (3%), and Kootenai Electric Cooperative (2%). Among the three states, Puget Sound Energy is the largest retailer, with 20,833,230 megawatt hours sold in 2019.

Operators in the Bonneville Power Administration area generate electricity through a diverse fuel mix that primarily relies on hydroelectricity (83%), and nuclear (83%). Natural gas is also an important source of electricity for utilities (up to 23% of electricity generation in Oregon).

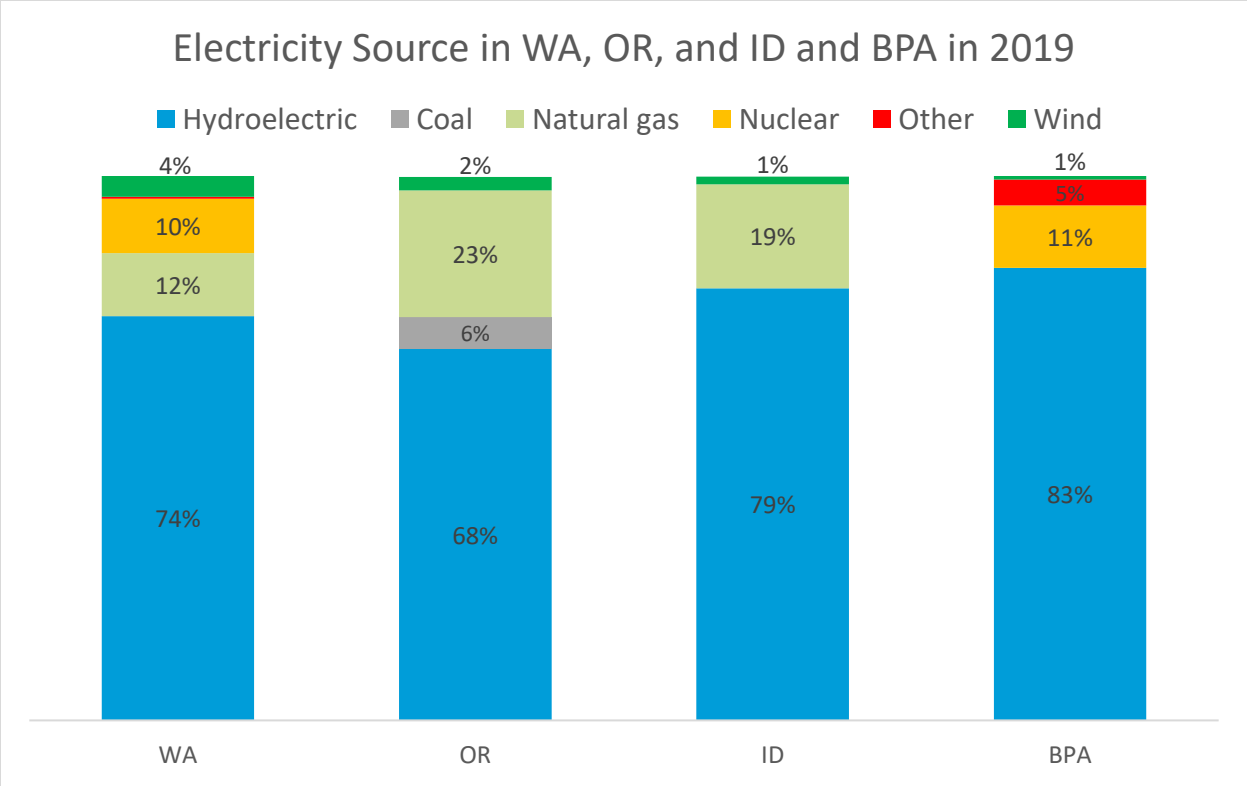


Figure 2. BPA, WA, OR, and ID Fuel Mix in 2019[7]. Source: BPA and EIA, 2021.

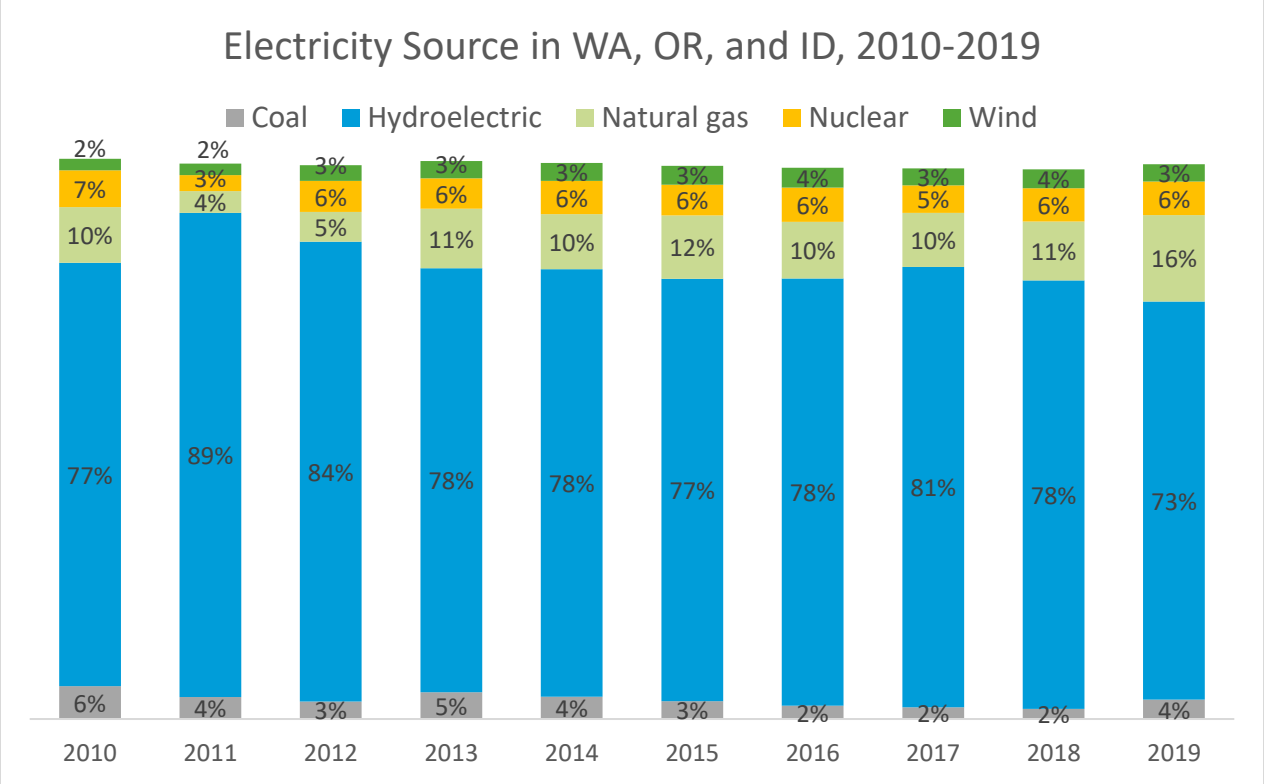


Figure 3. WA, OR, and ID Fuel Mix, 2010-2019. Source: BPA and EIA, 2021.

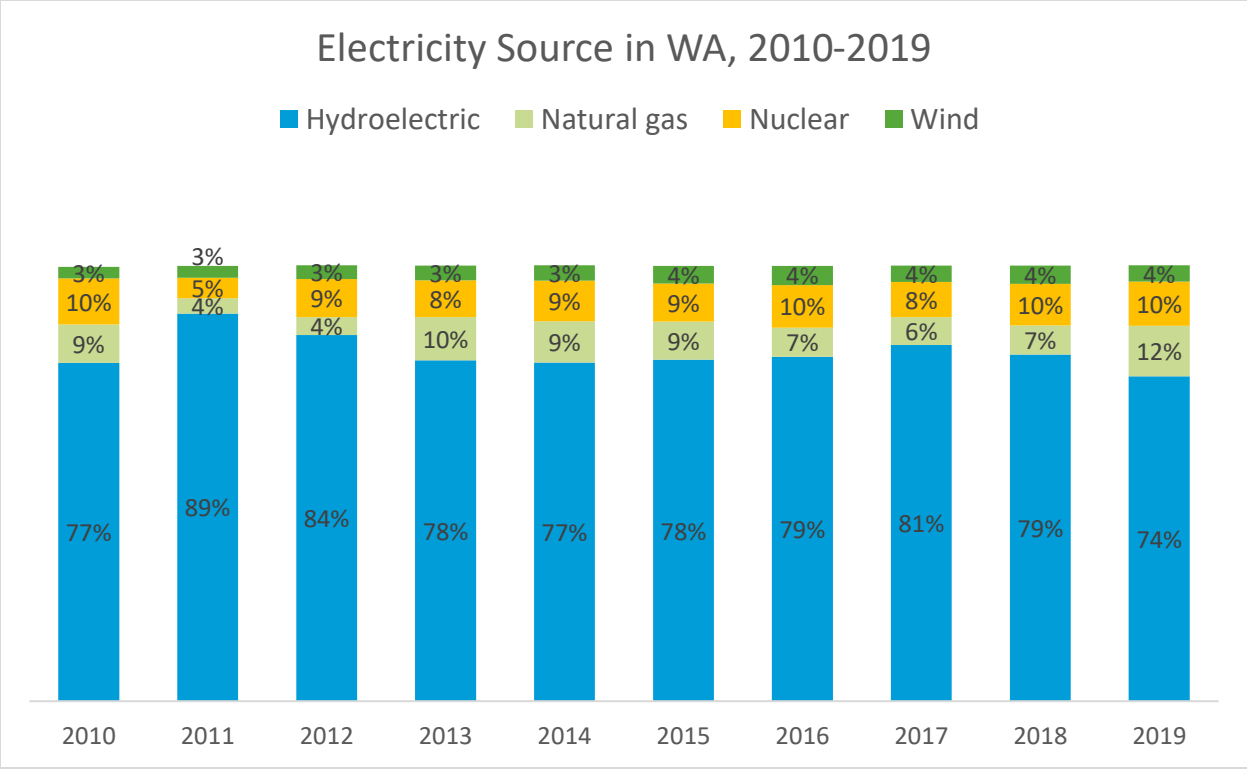


Figure 4. WA Fuel Mix, 2010-2019. Source: EIA, 2021.

Electric Utilities play an essential role in the economy, powering millions of consumers and firms and providing a wage to thousands of workers in all specialties, from crafts to engineering. The North American Industry Classification System (NAICS) breaks down utilities in the following manner:

- Hydroelectric Power Generation
- Fossil Fuel Electric Power Generation
- Nuclear Electric Power Generation
- Solar Electric Power Generation
- Wind Electric Power Generation
- Geothermal Electric Power Generation
- Biomass Electric Power Generation
- Other Electric Power Generation
- Electric Bulk Power Transmission and Control
- Electric Power Distribution

In 2019, entities that contributed the most to the state's gross regional product (the market value of all goods and services produced in Washington, Oregon, and Idaho) were electric power distributors, electric bulk power transmission and control, followed by hydroelectric power generation utilities.

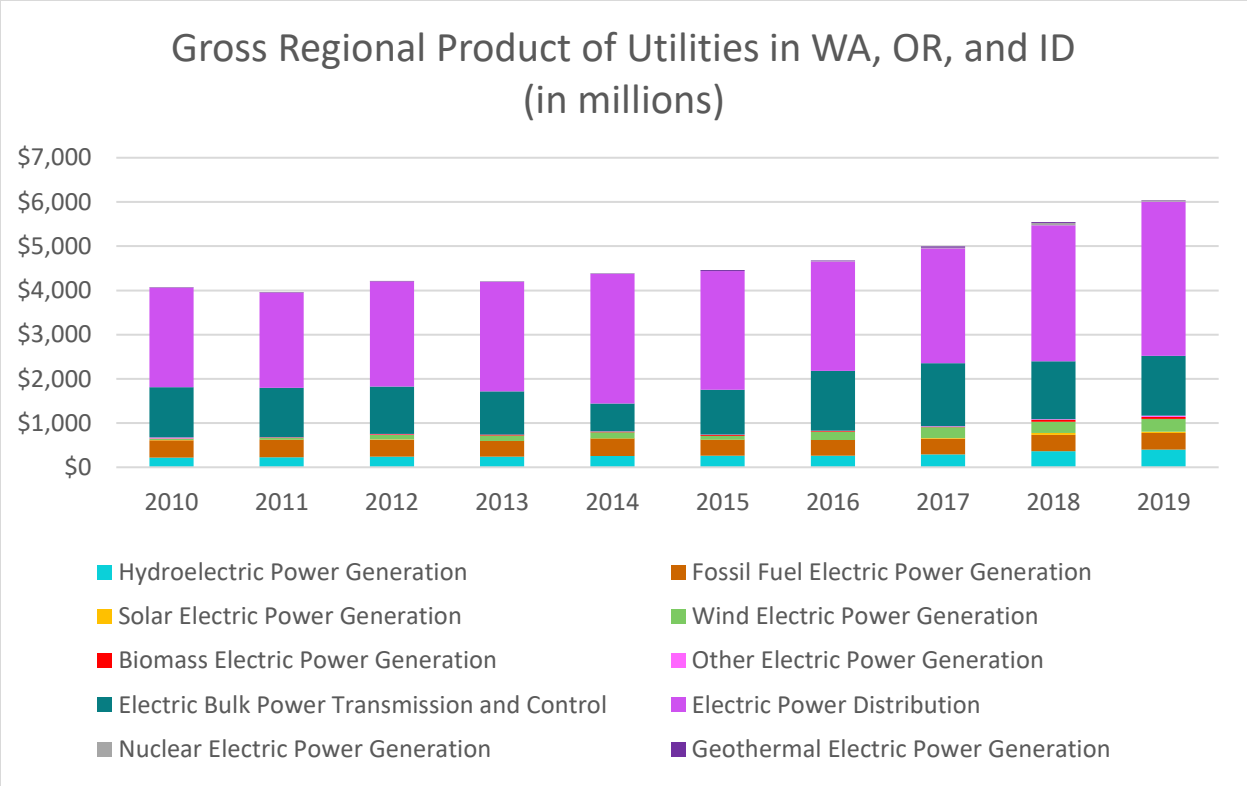


Figure 5. Gross Regional Product of Utilities in WA, OR, and ID. Source: EMSI, 2021.[38]

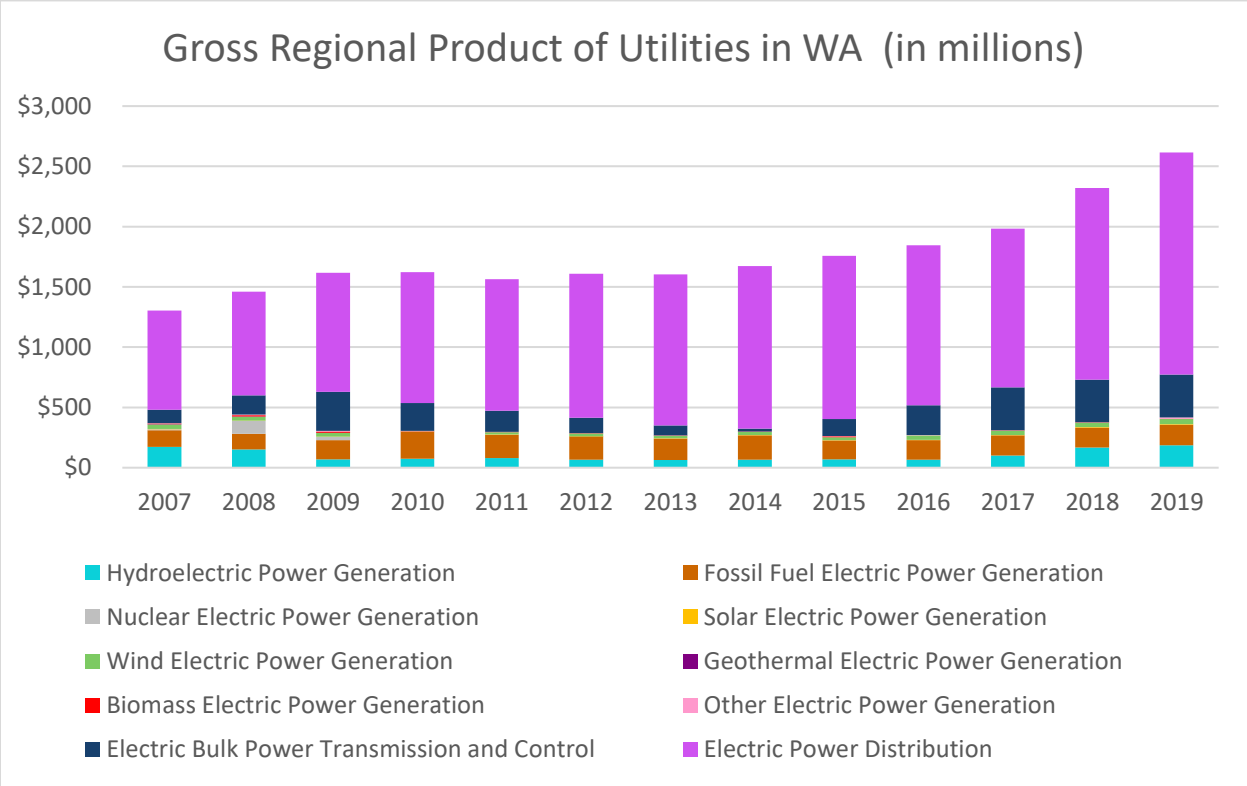


Figure 6. Gross Regional Product of Utilities in WA. Source: EMSI, 2021

Isolating industries related to electric power generation allows for a clearer view of how the state's fossil fuel industry changed over the years. This energy source has accounted for most of utilities' employment and gross regional product since 2010. But the recent federal and state commitments to fight against climate change by decreasing greenhouse gas emissions helped rein in this production source. As a result, fossil fuel's employment and output value decreased significantly starting in 2018, as cleaner sources of electricity replaced it. Hydroelectricity and wind energy production now account for most of the employment and output value among electricity producers, besides fossil fuel.

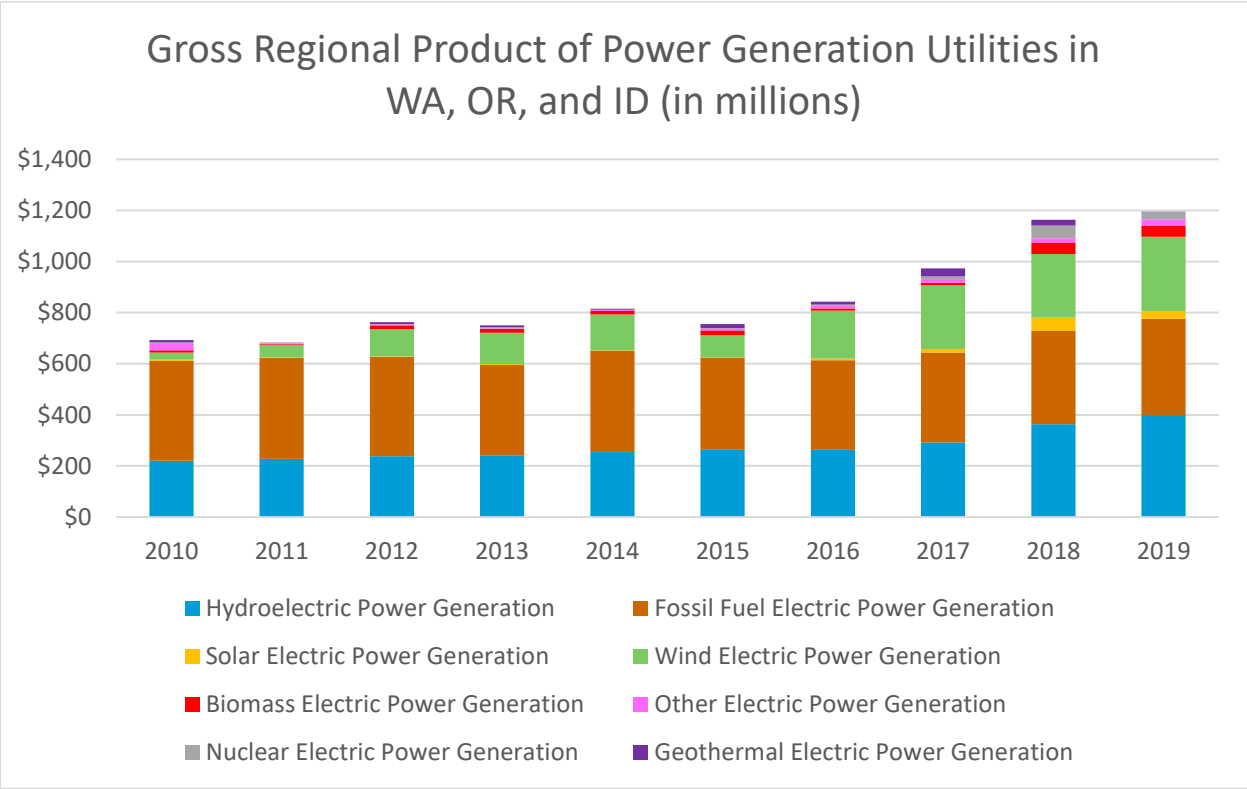


Figure 7. Gross Regional Product of Power Utilities in WA, OR, and ID. Source: EMSI, 2021.[38]

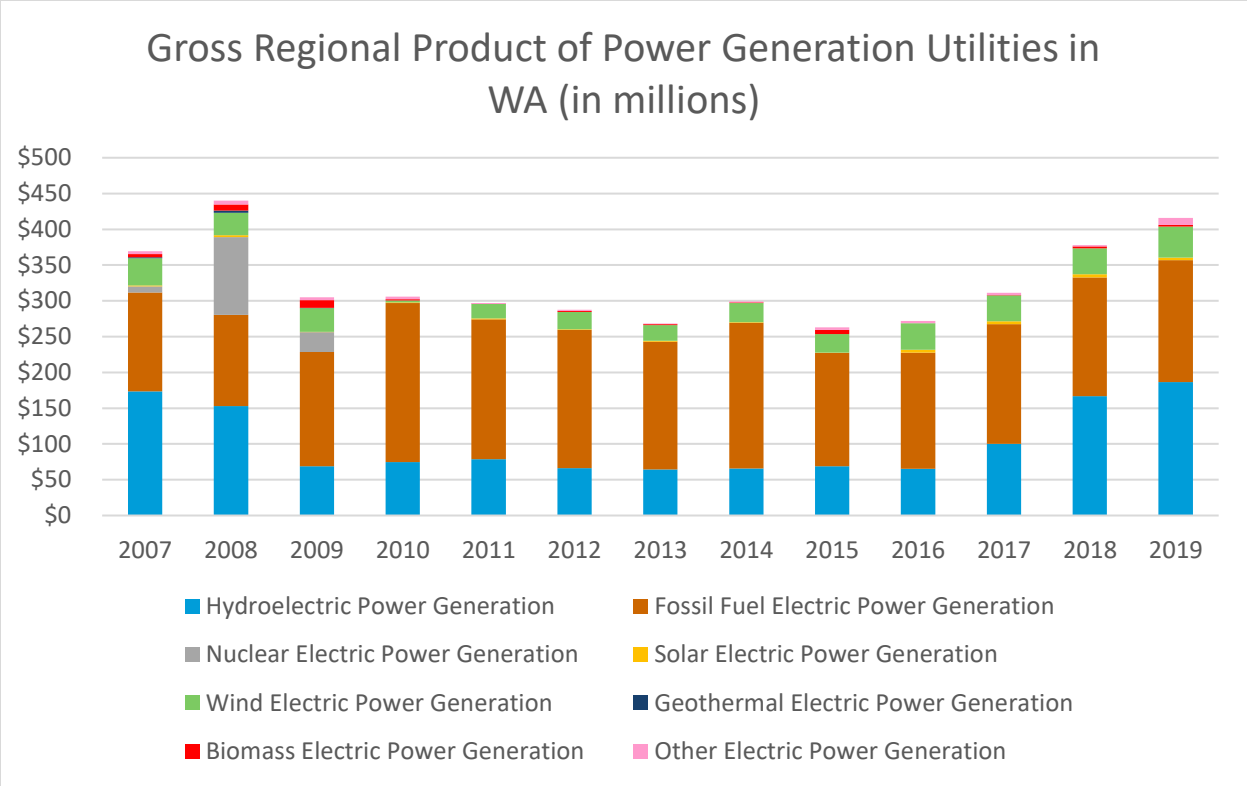


Figure 8. Gross Regional Product of Power Utilities in WA. Source: EMSI, 2021

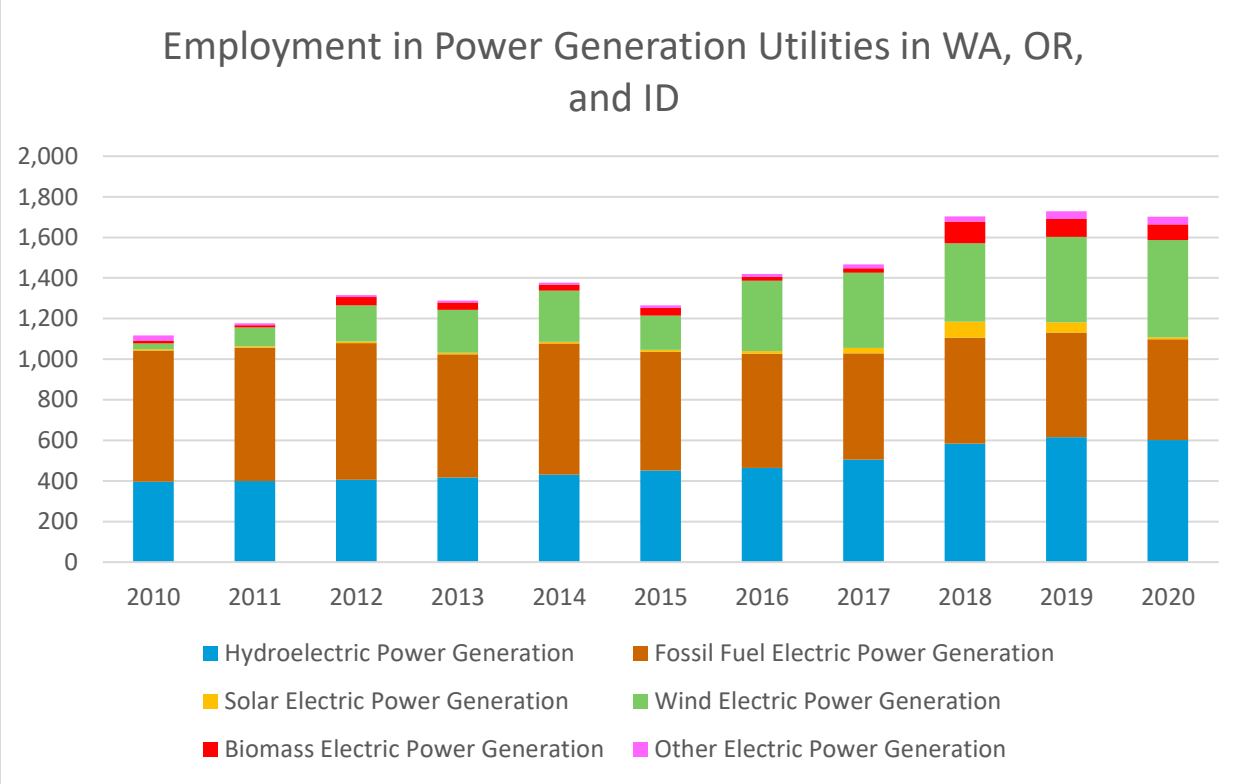


Figure 9. Employment in Power Generation Utilities in WA, OR, and ID. Source: EMSI, 2021.[38]

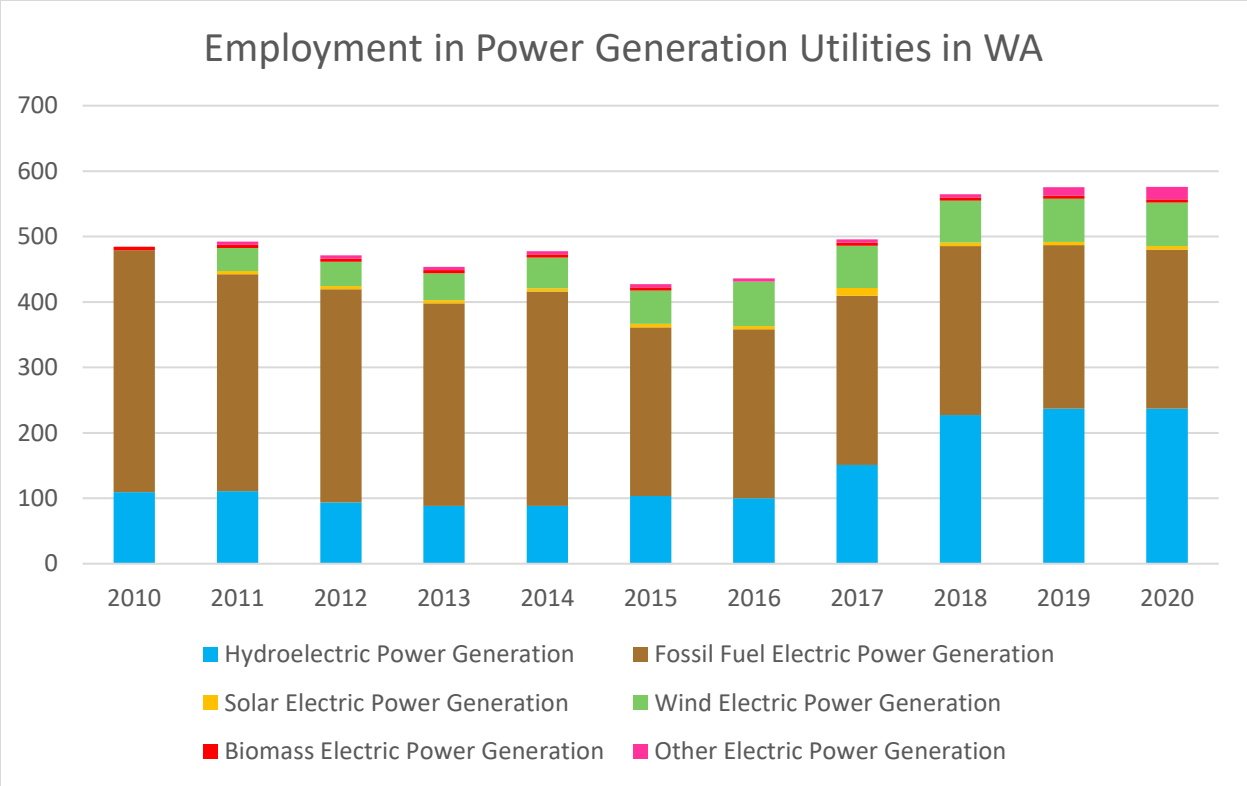


Figure 10. Employment in Power Generation Utilities in WA. Source: EMSI, 2021

Though employment in fossil fuels is still significant, it has been on a downward trend since 2010. Employment in this sector declined by 23% in Washington, Oregon, and Idaho between 2010 and 2020, and it is expected to keep declining at this pace between 2020 and 2030 (-25%).

The inverse is true for employment in hydroelectric power generation, which experienced a sizeable growth (+51%) between 2010 and 2020. The increase in employment is expected to slow down significantly in the next decade (+7%) as most of the labor adjustment to clean energy-related policies would have already happened.

Similarly, employment in wind electric power generation skyrocketed between 2010 and 2020 (+418%). This increase is expected to slow down dramatically to +49% in the next decade. Finally, employment in other electric power generation utilities (which include biogas, waste, and other biogenic substances) rose steeply in the last decade due to reduction in greenhouse gas emissions efforts. However, these impressive numbers for wind and other electricity sources should be put in perspective, as initial employment in these sectors was extremely low (29 and 25 workers in 2010 respectively).

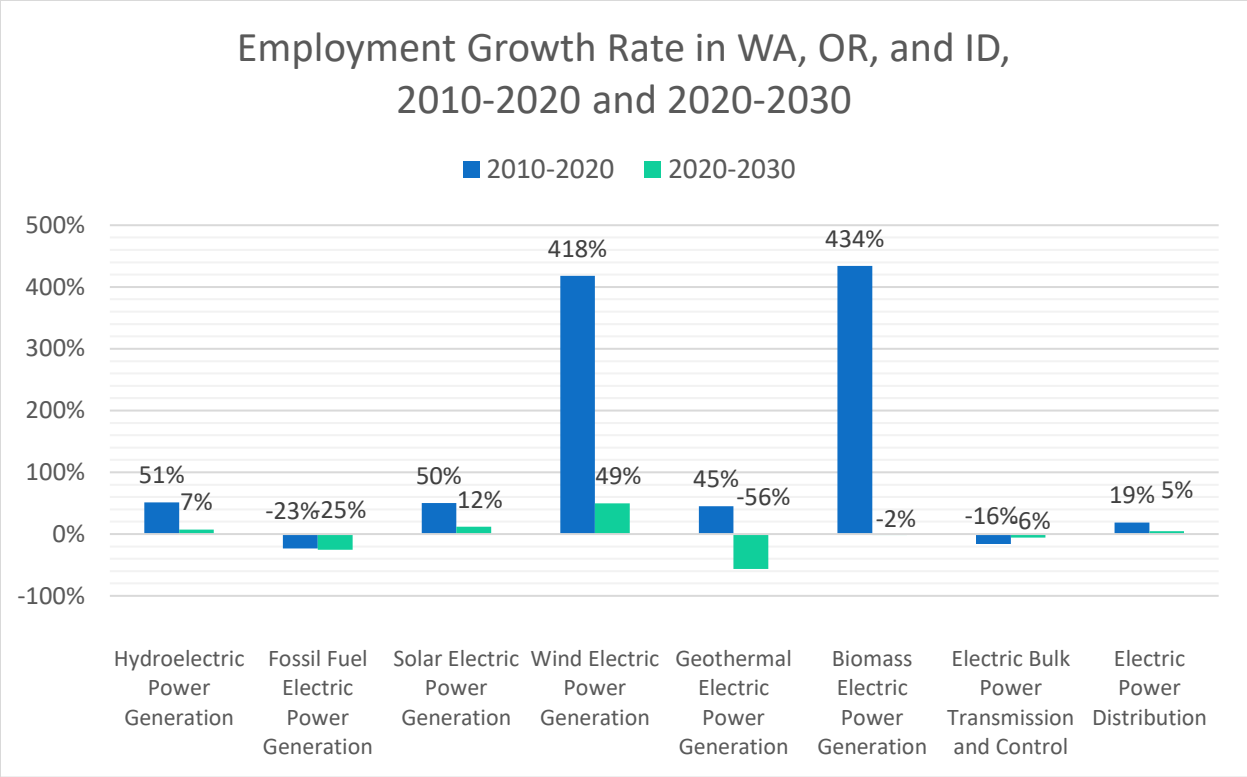


Figure 11. Expected Employment Growth Rate in WA, OR, and ID Utilities, 2010-2020 and 2020-2030. Source: EMSI, 2021.[38]

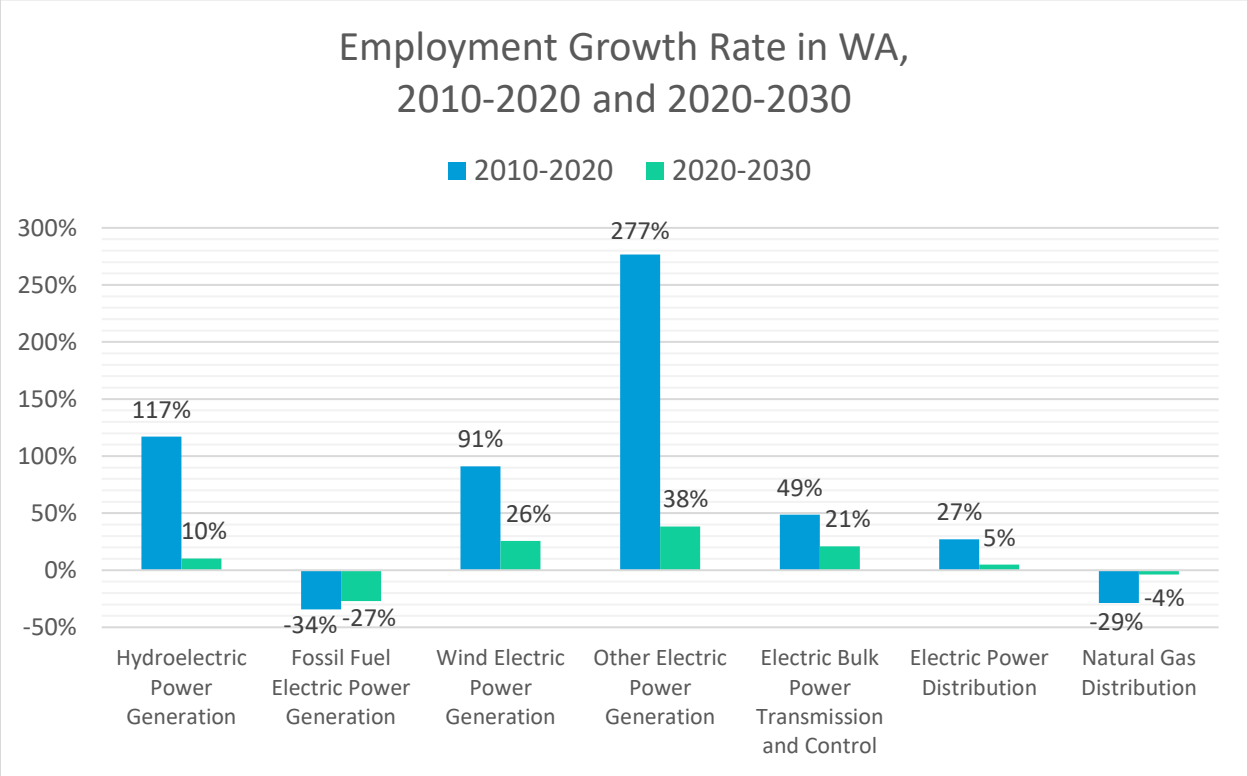
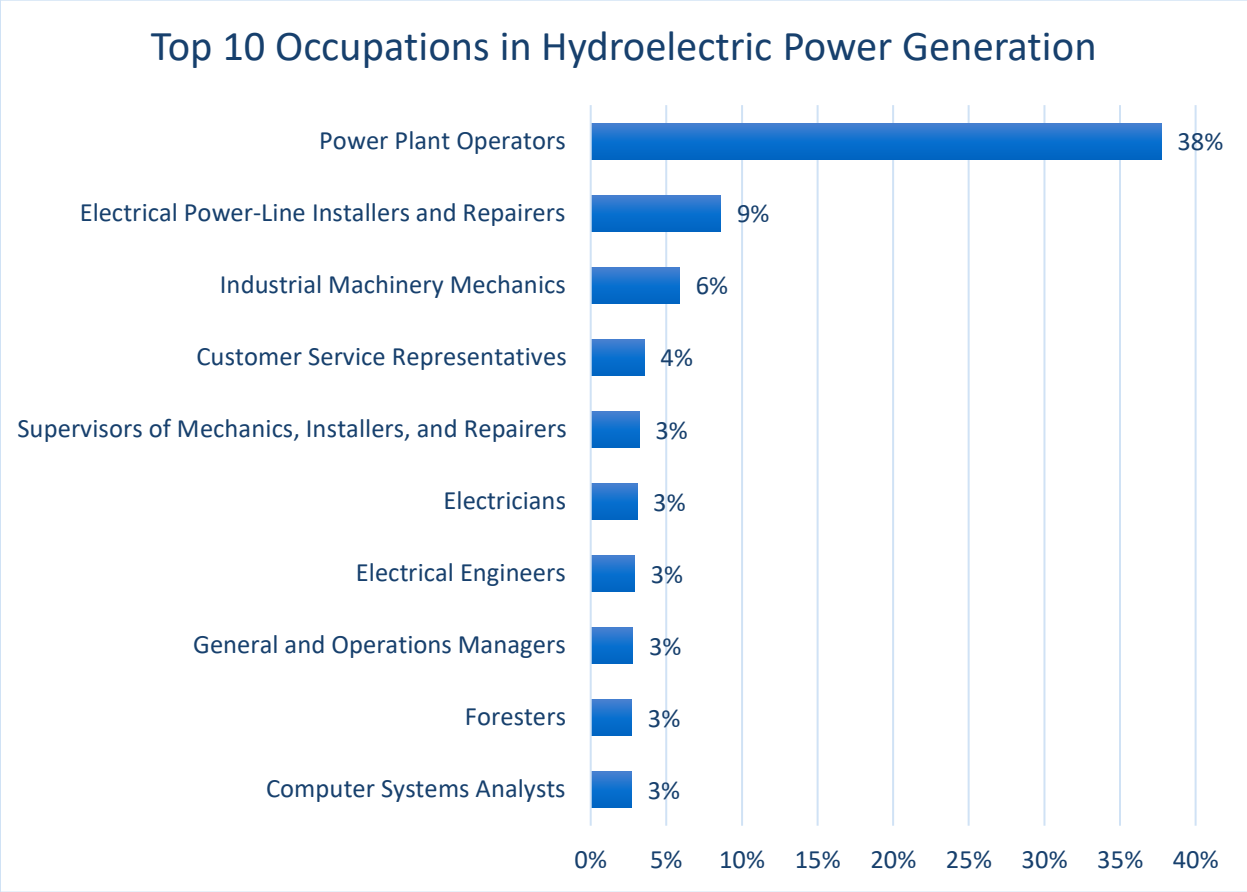
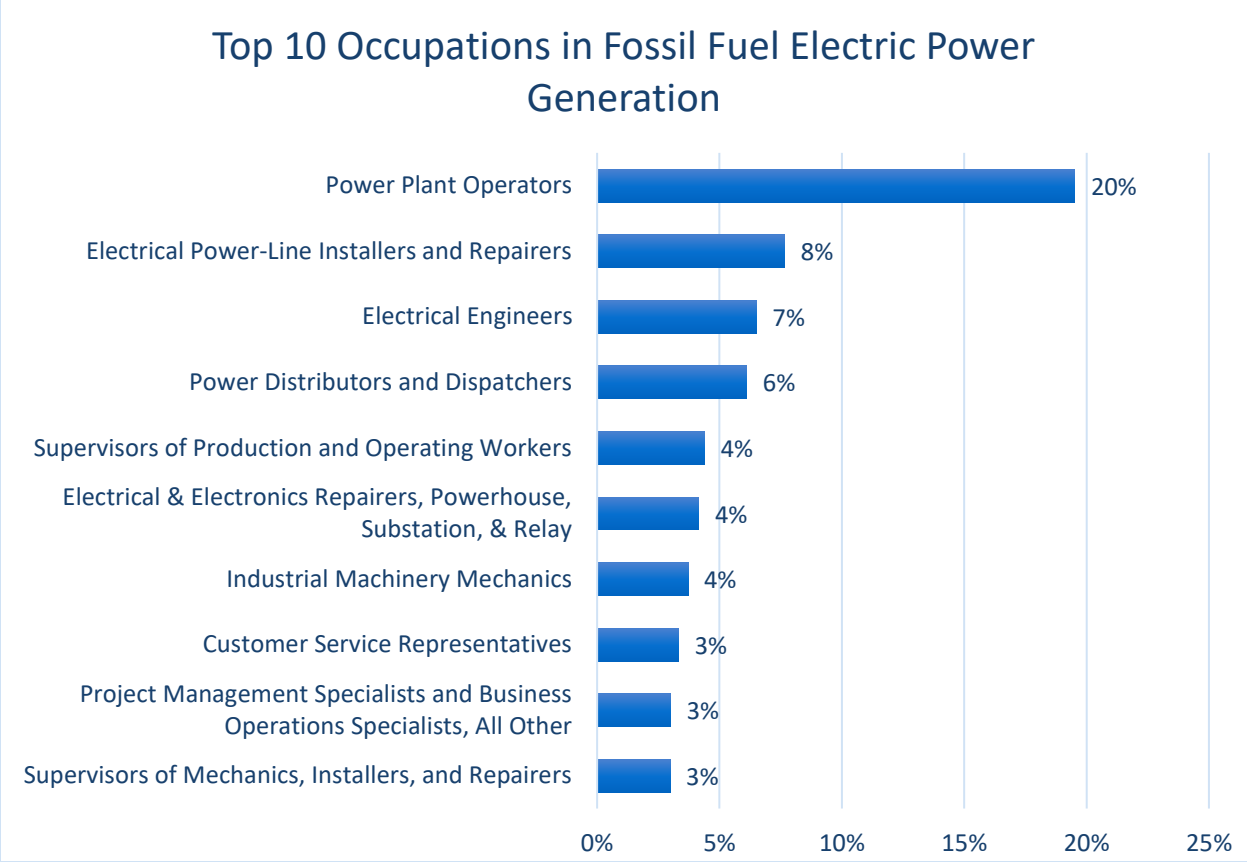


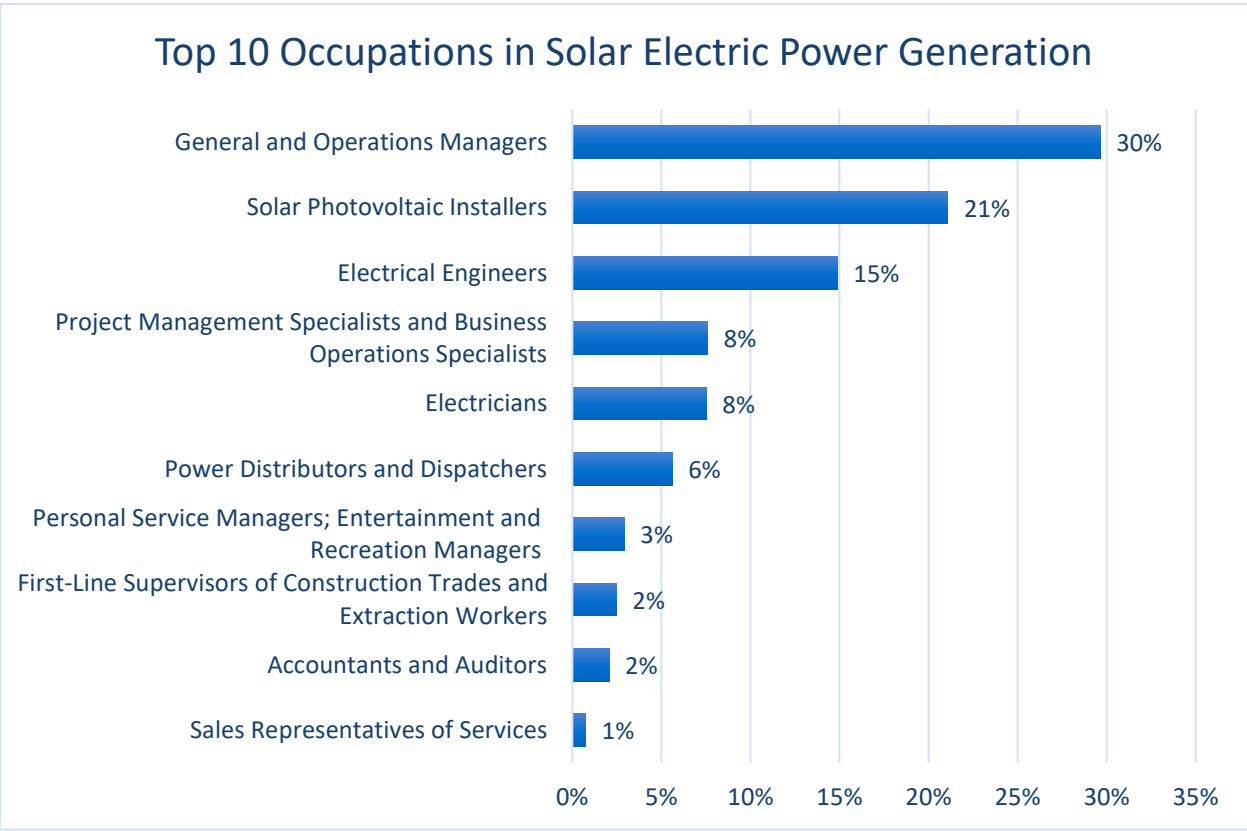
Figure 12. Expected Employment Growth Rate in WA Utilities, 2010-2020 and 2020-2030. Source: EMSI, 2021

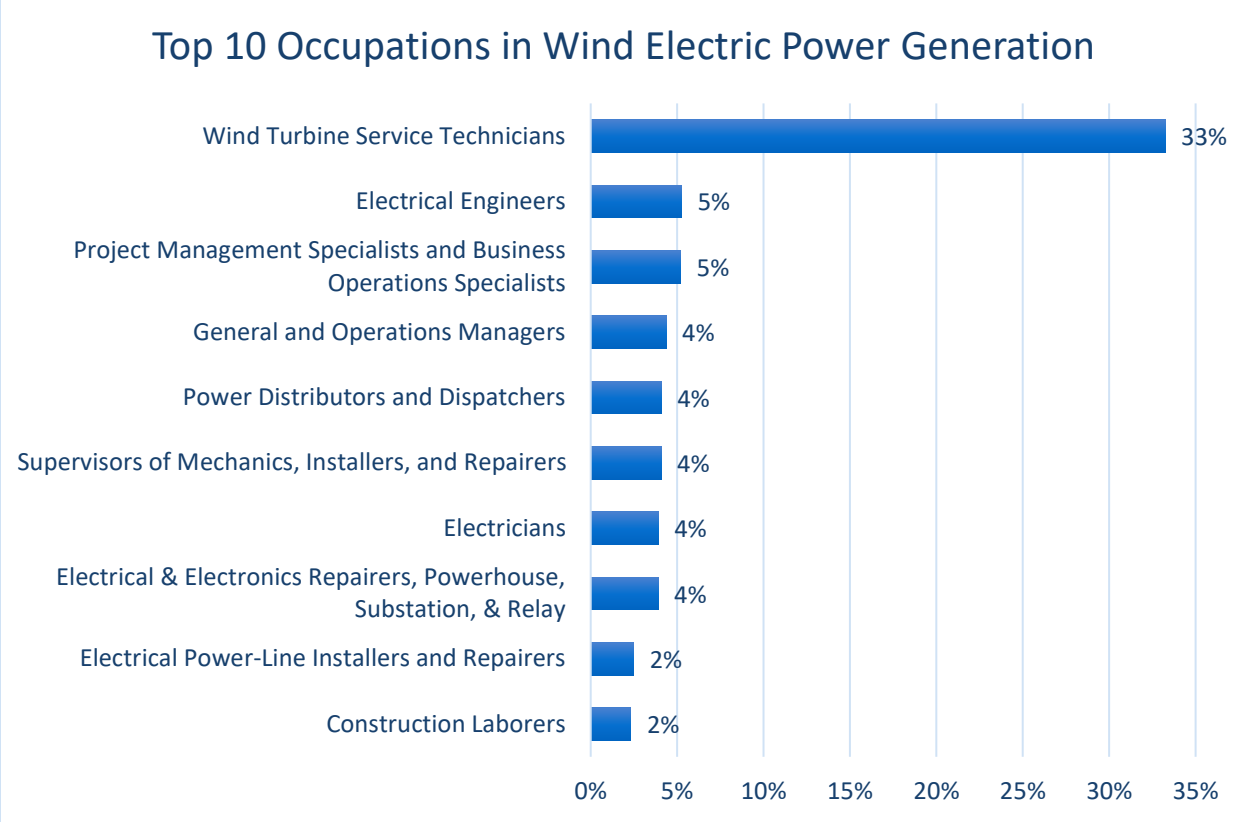
Key occupations

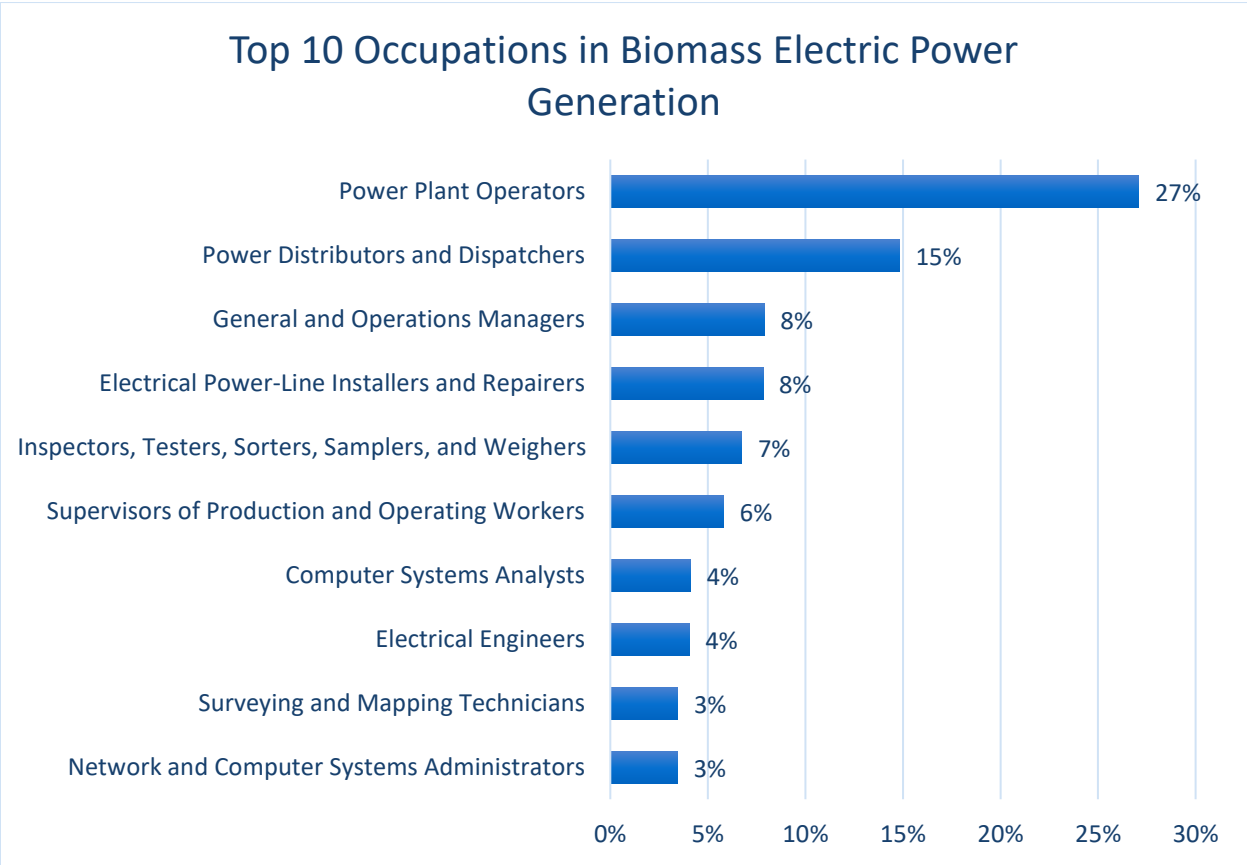
Utilities may rely on different occupations depending on their electricity production source and role (distribution vs. production). The following set of graphs presents the top ten occupations in each utility sector. Overall, Electrical Power-Line Installers and Repairers make up most of the workers in the utilities in Washington, Oregon, and Idaho (1,635 or 17.4% of utilities' workforce). Electric Engineers, Power Plant Operators and Customer Service Representatives come next and respectively make up 6.9%, 6.7%, and 5.1% of the utilities' total workforce.

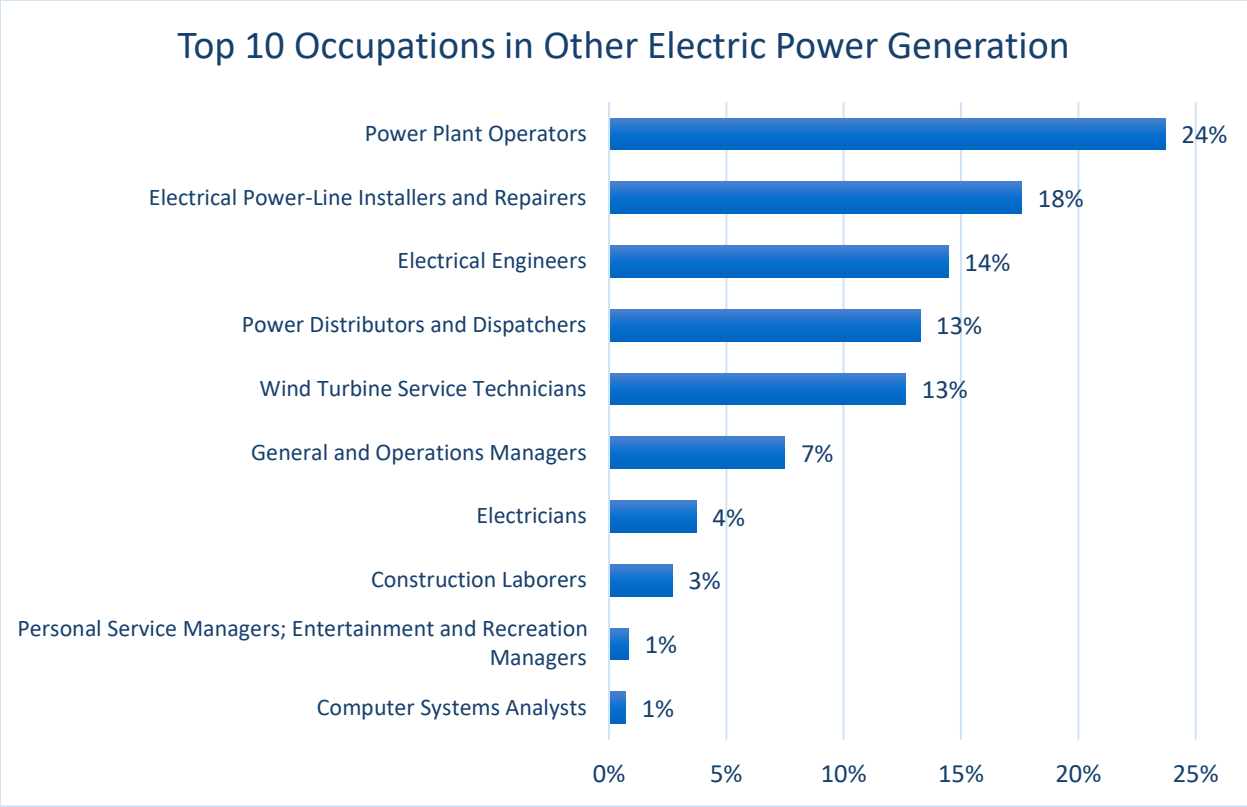


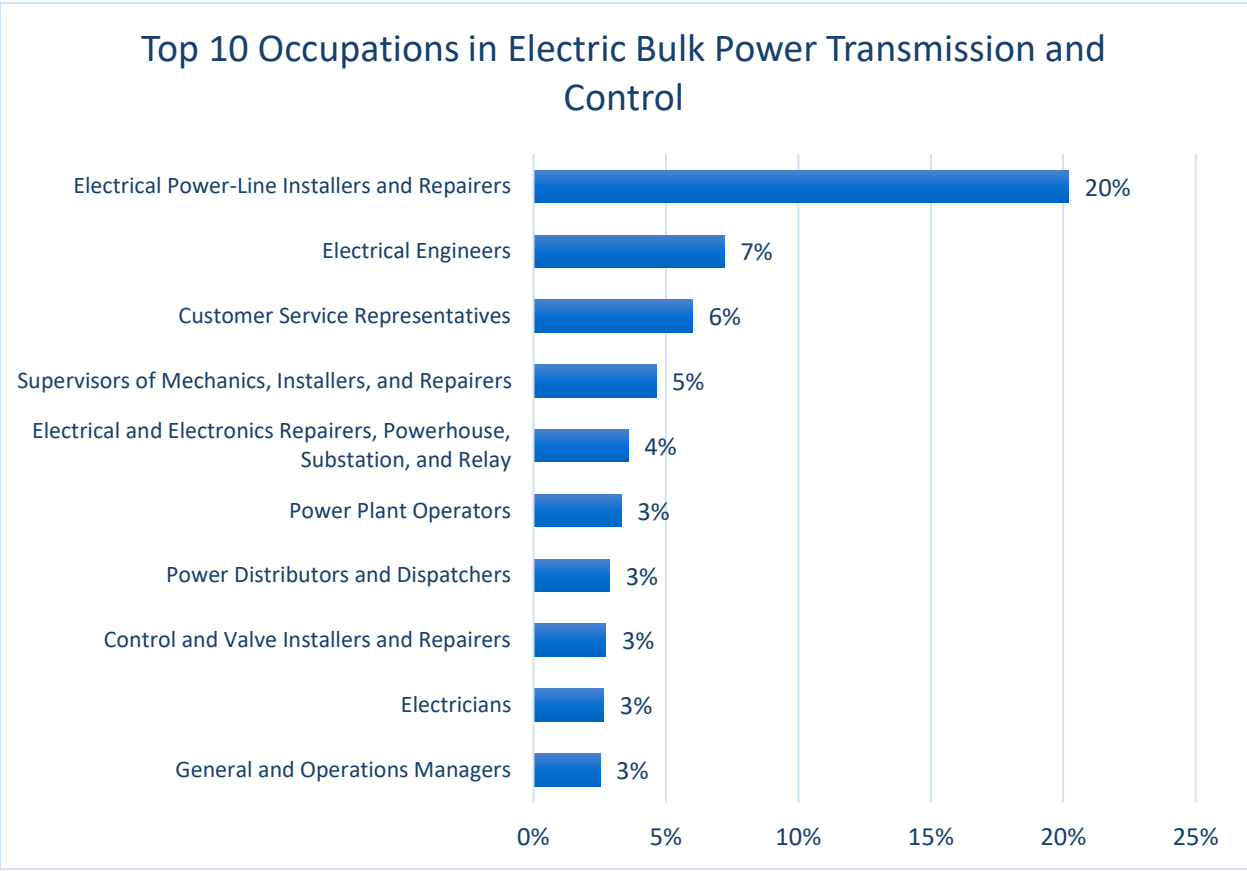

Top 10 Occupations in Fossil Fuel Electric Power Generation
Power Plant Operators
20%
Electrical Power-Line Installers and Repairers
8%
Electrical Engineers
7%
Power Distributors and Dispatchers
6%
Supervisors of Production and Operating Workers
4%
Electrical & Electronics Repairers, Powerhouse, Substation, & Relay
4%
Industrial Machinery Mechanics
4%
Customer Service Representatives
3%
Project Management Specialists and Business Operations Specialists, All Other
3%
Supervisors of Mechanics, Installers, and Repairers
3%
0%
5%
10%
15%
20%
25%


Top 10 Occupations in Solar Electric Power Generation
General and Operations Managers
30%
Solar Photovoltaic Installers
21%
Electrical Engineers
15%
Project Management Specialists and Business Operations Specialists
8%
Electricians
8%
Power Distributors and Dispatchers
6%
Personal Service Managers; Entertainment and Recreation Managers
3%
First-Line Supervisors of Construction Trades and Extraction Workers
2%
Accountants and Auditors
2%
Sales Representatives of Services
1%
0%
5%
10%
15%
20%
25%
30%
35%


Top 10 Occupations in Wind Electric Power Generation
Wind Turbine Service Technicians
33%
Electrical Engineers
5%
Project Management Specialists and Business Operations Specialists
5%
General and Operations Managers
4%
Power Distributors and Dispatchers
4%
Supervisors of Mechanics, Installers, and Repairers
4%
Electricians
4%
Electrical & Electronics Repairers, Powerhouse, Substation, & Relay
4%
Electrical Power-Line Installers and Repairers
2%
Construction Laborers
2%
0%
5%
10%
15%
20%
25%
30%
35%


Top 10 Occupations in Biomass Electric Power Generation
Power Plant Operators
27%
Power Distributors and Dispatchers
15%
General and Operations Managers
8%
Electrical Power-Line Installers and Repairers
8%
Inspectors, Testers, Sorters, Samplers, and Weighers
7%
Supervisors of Production and Operating Workers
6%
Computer Systems Analysts
4%
Electrical Engineers
4%
Surveying and Mapping Technicians
3%
Network and Computer Systems Administrators
3%
0%
5%
10%
15%
20%
25%
30%


Top 10 Occupations in Other Electric Power Generation
Power Plant Operators
24%
Electrical Power-Line Installers and Repairers
18%
Electrical Engineers
14%
Power Distributors and Dispatchers
13%
Wind Turbine Service Technicians
13%
General and Operations Managers
7%
Electricians
4%
Construction Laborers
3%
Personal Service Managers; Entertainment and Recreation Managers
1%
Computer Systems Analysts
1%
0%
5%
10%
15%
20%
25%


Top 10 Occupations in Electric Bulk Power Transmission and Control
Electrical Power-Line Installers and Repairers
20%
Electrical Engineers
7%
Customer Service Representatives
6%
Supervisors of Mechanics, Installers, and Repairers
5%
Electrical and Electronics Repairers, Powerhouse, Substation, and Relay
4%
Power Plant Operators
3%
Power Distributors and Dispatchers
3%
Control and Valve Installers and Repairers
3%
Electricians
3%
General and Operations Managers
3%
0%
5%
10%
15%
20%
25%

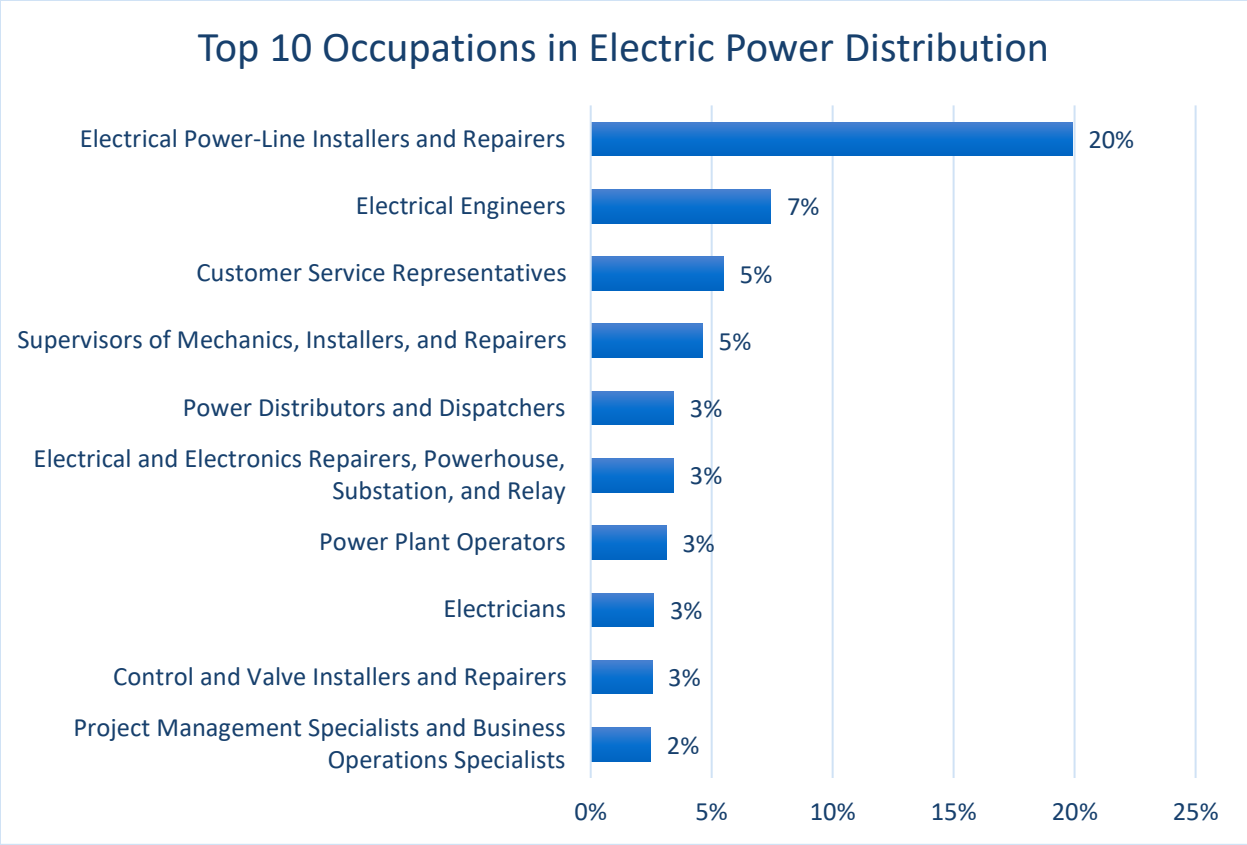


Figure 13. Top Ten Occupations by Utility in 2020. Source: EMSI, 2021.[38]

Demographics

Utilities in Washington, Oregon, and Idaho have long workforce tenure as utility employees tend to remain with their employer for many years or even their entire career. As a result, utility workers skew older than other industries. The graph below presents the utility workforce by age. Unfortunately, some industries are not shown due to a lack of data (solar, nuclear, geothermal, biomass, and other electric power sources). Still, compared to the entire workforce in the three states, utilities exhibit a smaller percentage of younger workers below 44-years-old (57% in Washington, Oregon, and Idaho compared to 47% in the utilities). Recent industries like wind electric power generation, and industries that just ramped up their employment, like hydroelectric power generation, have a more significant proportion of 19-44-year-olds (53% for wind and 45% for hydro).

On the other hand, middle-aged workers are more common in "legacy" utilities such as fossil fuel. Workers aged 45-54 make up 27% of this industry, compared to 26% for all utilities and 20% for Washington, Oregon, and Idaho.

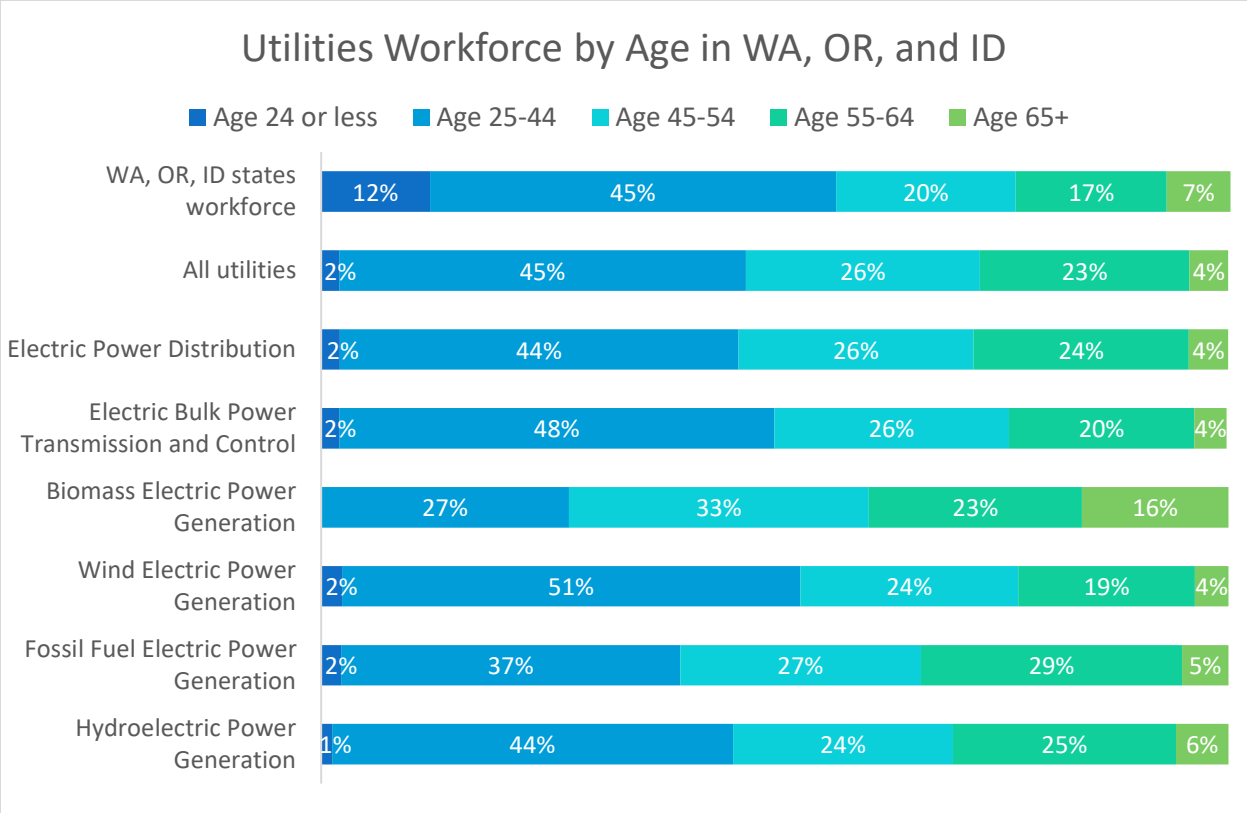


Figure 14. WA, OR, and ID Utility Workforce by Age in 2019. Source: EMSI, 2021.

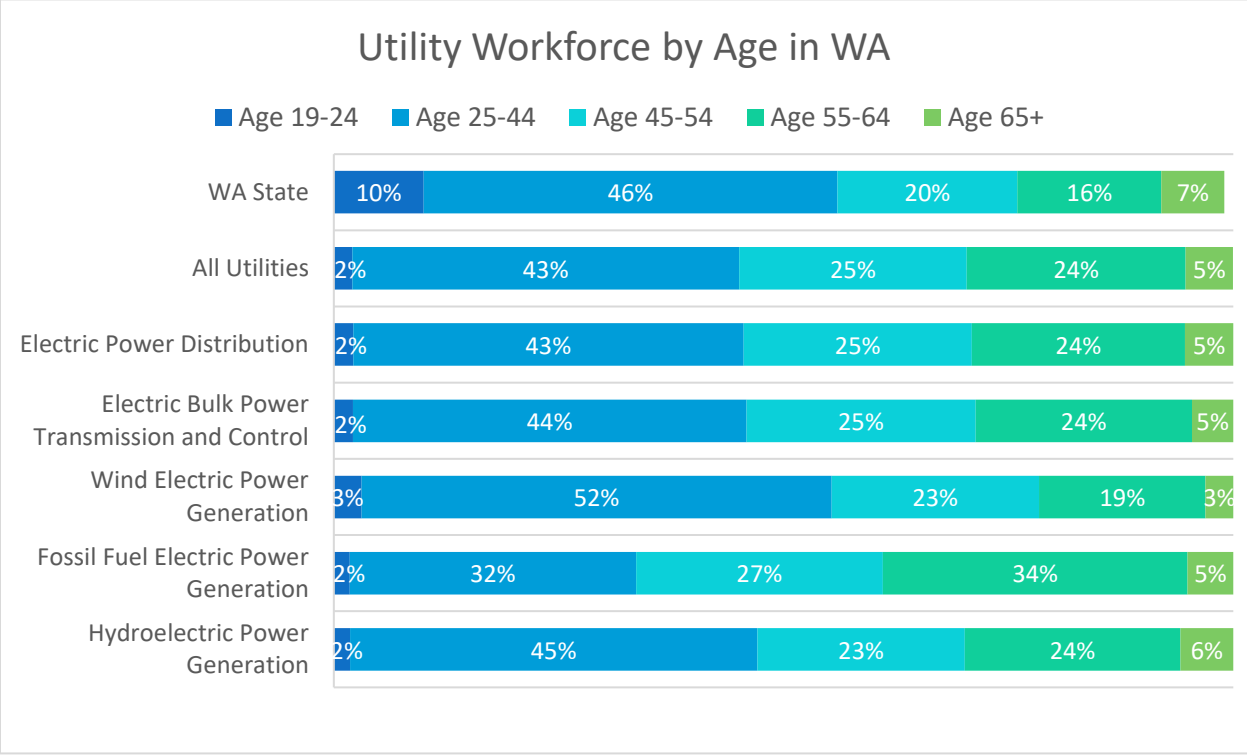


Figure 15. WA Utility Workforce by Age in 2019. Source: EMSI, 2021.

The discrepancy between the utilities and the rest of the states' workforce is even greater when it comes to gender. While women make up 48% of the states' workforce, they only make up 28% of the utilities' workforce. Moreover, they are severely underrepresented in biomass and geothermal power generation firms (14% of the labor force). Still, even in industries that hire the most women, female workers make up approximately 30% of the distribution and transmission workforce, and even less in generation utilities (27% in wind and 25% in hydroelectric power generation), far below other industries in the states.

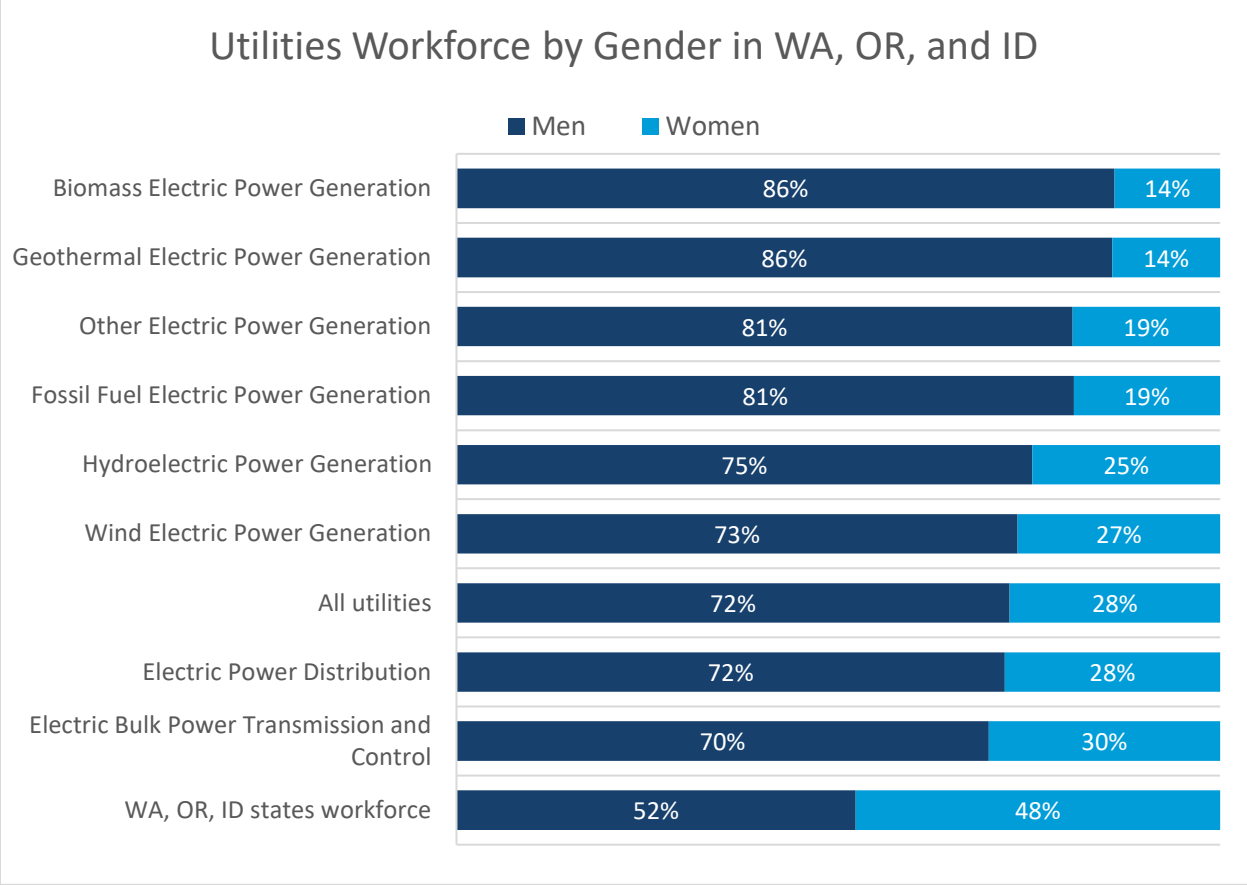


Figure 16. WA, OR, and ID Utility Workforce by Gender in 2019. Source: EMSI, 2021.[38]

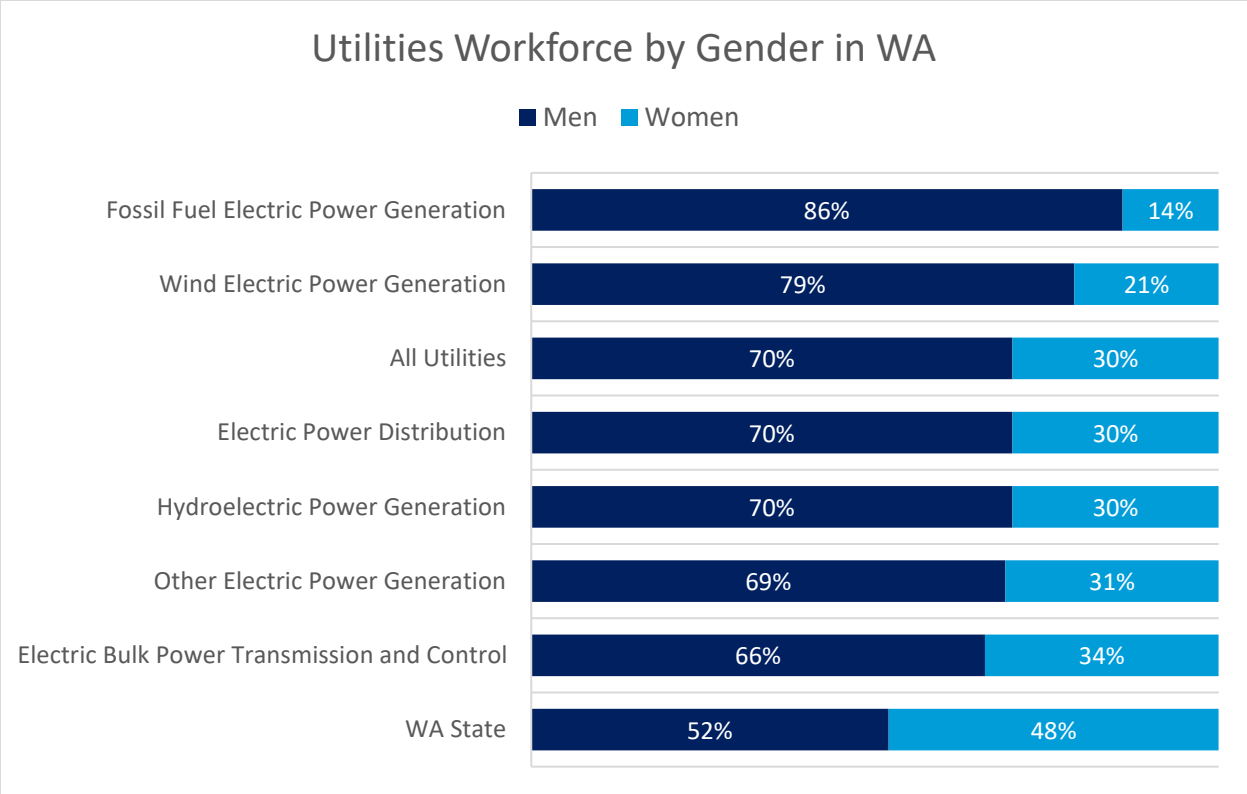


Figure 17. WA Utility Workforce by Gender in 2019. Source: EMSI, 2021.

The difference between the state's overall workforce racial distribution and the utilities' workforce racial representation is similarly stark. Black, Indigenous, and other People of Color (BIPOC) workers account for 27% of the states' workforce but only 12% in utilities. None of the utilities have a percentage of BIPOC workers larger than the states' overall workforce. The most representative are the Electric Bulk Power Transmission and Control workers, 15% of whom identify as a race other than white. Among utilities in power generation, the percentage of BIPOC workers is largest for wind electricity generation.

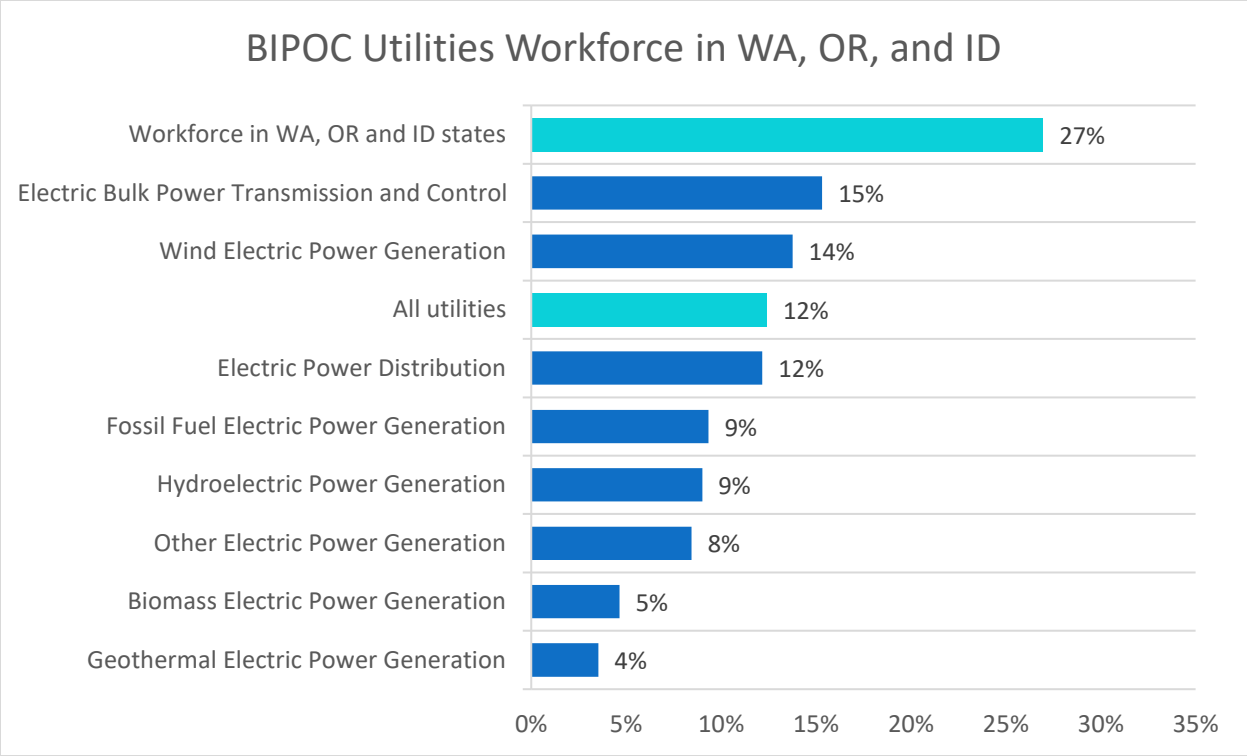


Figure 18. WA, OR, and ID BIPOC Utility Workforce. Source: EMSI, 2021.[38]

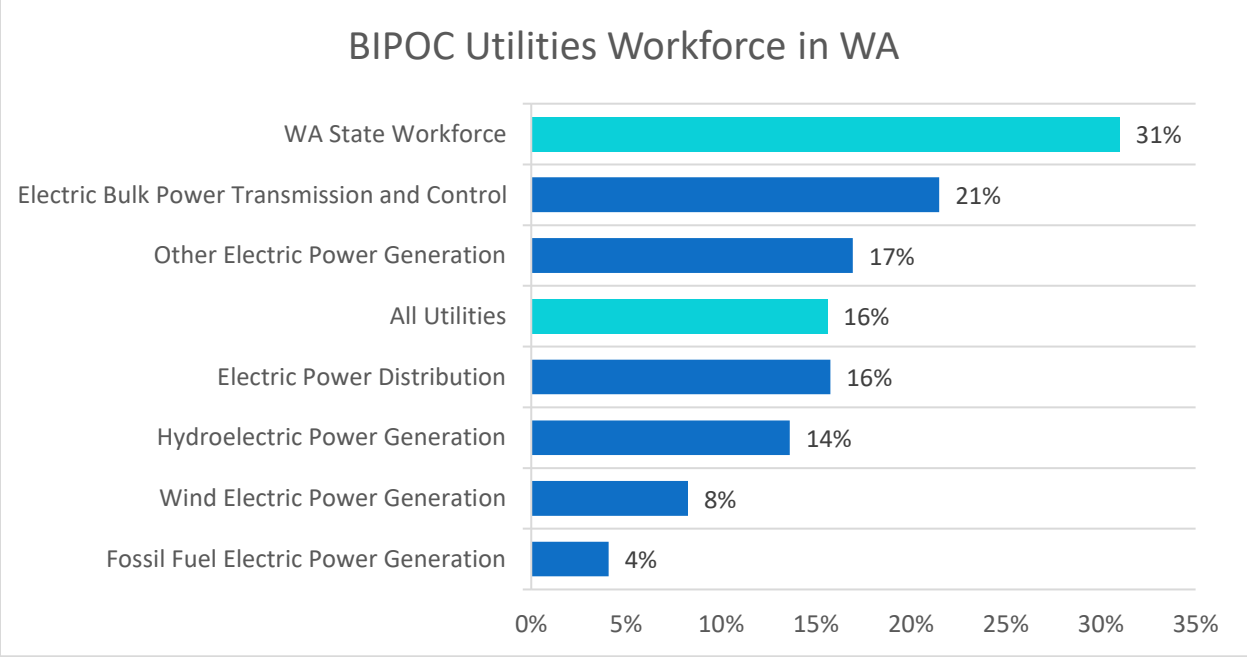


Figure 19. WA BIPOC Utility Workforce. Source: EMSI, 2021

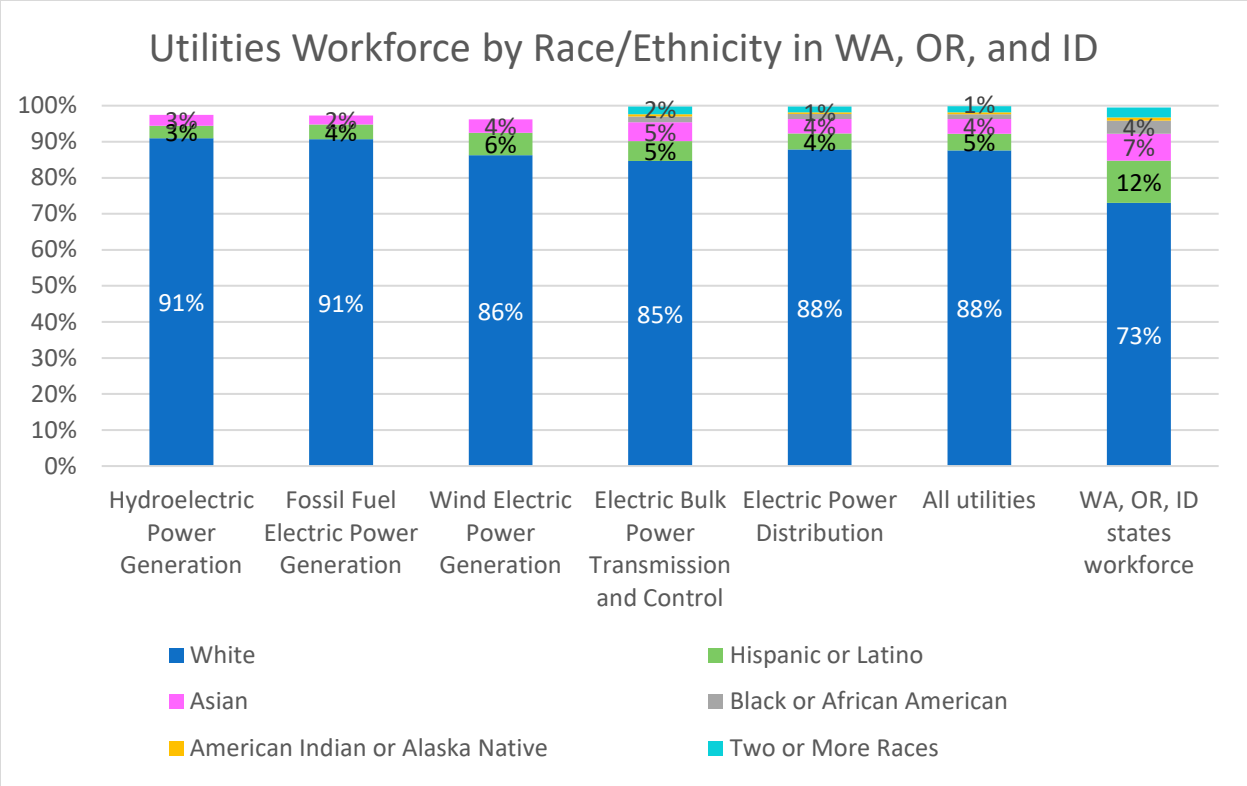


Figure 20. WA, OR, and ID Utilities Workforce by Race/Ethnicity. Source: EMSI, 2021.[38]

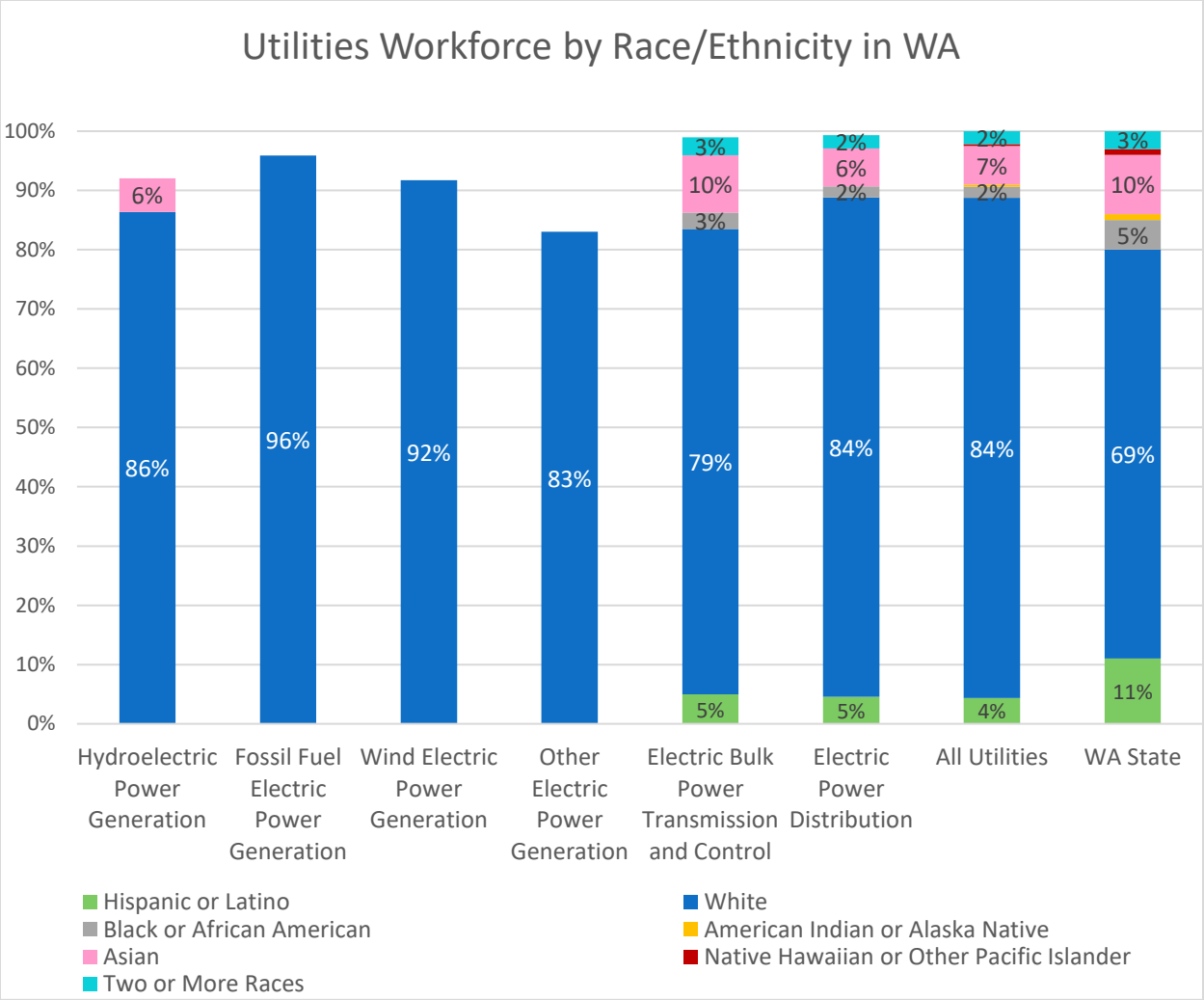


Figure 21. WA Utilities Workforce by Race/Ethnicity. Source: EMSI, 2021

CURRENT STATE OF WASHINGTON STATE'S ENERGY SECTOR

Recent and Emerging Clean Energy Efforts

Clean energy efforts intensity varies widely by the utility. Some utilities have been working simultaneously on multiple projects in the past couple of years, while others have not launched any new programs or services in that direction. For instance, one utility interviewed invested in multiple solar farms, distributed energy resources, and green energy procurement on behalf of customers. Of course, effort and project types will depend on several factors like whether the utility is production-only or production and distribution, what their current energy sources are, and local policy priorities.

Among utilities interviewed, they reported making investments in clean energy projects in the following areas in the past several years:

- Energy storage
- Electrification of transportation
- Energy efficiency
- Grid modernization
- Solar
- Wind
- Modular nuclear electrical generation

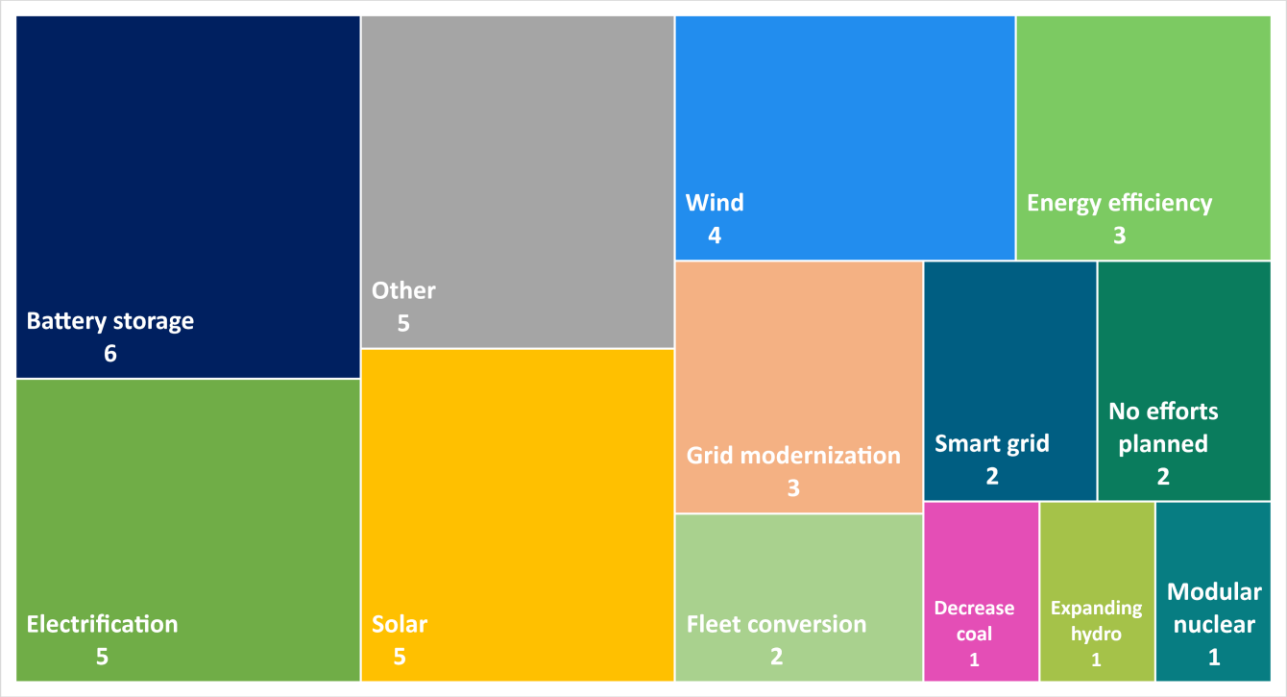


Figure 22. Clean Energy Efforts Planned or Implemented Since 2019: Interviewees Mentioning at least One Related Project.

Though the reported investment in wind and solar appear limited, the Bonneville Power Administration interconnection queue shows 68 solar projects and 60 wind turbines in the power region (respectively 22 and 25 in Washington state specifically). [39]

SMART GRID AND GRID MODERNIZATION

The utility management representatives most frequently reported projects focused on efficient energy distribution, developing infrastructure to support transportation electrification, grid modernization, and smart grid management.

For example, one utility representative reported about an automation project that has been underway:

> *FLISR, fault limiting isolation, and service restoration, it's basically a way to automatically detect and restore when a fault occurs on the grid. We've had a number of events this year on the distribution automation project, where the FLISR switches operated during storm events. So a tree limb falls and knocks out a power line, creating a fault. And you can automatically and quickly isolate that and restore power. So, we get customers back online on those circuits in 40 seconds rather than 12 hours.*

The need to manage a more dynamic and unpredictable energy flow when people are more dependent on the grid than ever clearly demands a more sophisticated grid.

ELECTRIFICATION OF TRANSPORTATION

Transportation electrification was among the most consistent themes in the interview, particularly the interviews with utilities managers and training program representatives. The most common type of project is E.V. charging stations for commercial and residential customers; utilities are contracting installation. In addition, energy research representatives are focusing on transportation electrification, more specifically on fleet conversions.

Transportation electrification is recognized as both an opportunity and a significant responsibility. It will increase the overall demand for electricity, while the utility industry must move to eliminate key on-demand sources, such as coal and natural gas. And because people will also be relying on the grid for transportation, it is more important than ever that the grid be reliable. At the same time, having thousands of extra batteries to dump and store excess power generated by variable sources like wind and solar has excellent potential to help with smoothing of supply and demand.[28]

The other notable transportation electrification project is the electrification of ferries. This project is still in the planning phase and is complex given the load that having two ferries docked and charging will place on the grid. However, battery storage technology will provide capacity to store excess energy generated by variable sources and help smooth electricity demand.

ENERGY STORAGE

As noted above, the role of energy storage is critical to a transition to clean energy. Bringing more non-emitting power generation online quickly necessarily means bringing more variable power generation online, primarily wind and solar. As is often remarked during the interviews and

elsewhere, the wind doesn't always blow and the sun doesn't always shine, but people still need power. Interviewees focused on how, in a grid that increasingly relies on variable energy sources, storage ensures continuity in energy distribution.[28] It will allow utilities to store excess energy production when the sun is shining and the wind is blowing to meet customers' demand when the wind or solar production is low but demand is high.[*] There was widespread concern among most utility representatives about having adequate storage and the many unknowns surrounding the technical implementation

There were two types of storage that interviewees were considering:

- Battery
- Pump storage

Battery Storage

Battery storage was by far the more common and closely related to smoothing demand for transportation electrification. The projects in implementation or under consideration range from battery back-ups for a community microgrid project to large-scale flow batteries.

Regarding transport electrification, charging all-electric trucks, buses, or even larger modes of transportation (e.g., ferries) creates a significant surge in electricity demand. Instead of relying solely on the grid and potentially reducing supply to other customers, stored energy would allow utilities to efficiently tackle these surges and balance supply and demand to serve all consumers.

Battery storage provides a cheaper and cleaner alternative to natural gas, though substantial work is still needed to integrate large-scale battery storage into the grid.[41] Battery storage research is ongoing and, while some utilities have dedicated teams working on this topic, there are not many concrete implementation plans. For example, large-scale battery storage capacity is crucial to understand how utilities can rely on this new technology to satisfy demand. Recent advances have allowed ramping up capacity to several hundreds of megawatts,[42] providing enough electricity to power several thousands of homes. Similarly, recent breakthroughs in

[*]Sometimes the wind blows too much, and dams cannot stop the water flowing through them. In 2010, wind farms in the Columbia River Gorge produced two nuclear power plants' worth of extra power during a windstorm. Because the grid could not absorb all of that power, operators had to take the windmills offline at significant cost to the investors.[40]

vehicle batteries significantly improved battery stability and reduced charging time, paving the way for a longer vehicle lifetime and more robust consumer demand.[35]

The question of battery storage raises a fundamental question: where is the line between advanced manufacturing and clean energy? The Department of Commerce places these under the same umbrella. There is significant interest in the synergies between the two. Interviewees were interested in exploring how the state can leverage a high demand for clean energy in Washington state to develop clean energy manufacturing capacity in the state, primarily battery and solar panel manufacturing. Though there was significant interest in this potential, interviewees consistently spoke of the need to distinguish between the two, so the Center of Excellence for Clean Energy (CECE) maintains a clear identity and purpose.

Pump Storage

Surprisingly, given the state's dependence on hydroelectricity, only three interviewees mentioned pump storage. One interviewee mentioned pump storage as a concept, while two others highlighted the large project in Klickitat County under review. It is the state's largest power storage project with 1,200 megawatts of capacity.[43]

SOLAR

The other common type of project either launched or in planning is solar projects. The projects range from community solar projects to utility-scale. One of the most critical elements of this was the role of electricians. In Washington state, electricians, rather than solar installers, install solar panels. Labor representatives see this as critical to maintaining the labor standards and wages for clean energy jobs.

As part of their training, the International Brotherhood of Electrical Workers (IBEW) Local 77 has installed an array in Richland on Energy N.W. property. Unfortunately, the Department of Energy has slowed the installation of more solar and wind capacity on the Hanover site. It is well suited for both and already has high voltage lines leaving the property.

ENERGY EFFICIENCY

The other somewhat less frequent but still consistent theme was energy efficiency. This theme came from both utilities managers and researchers. Both noted that it is integral to meeting emissions goals. One utility manager noted how it has grown with the pandemic. In Seattle, with the local ordinances eliminating heating oil and natural gas, heating, ventilation, and air

conditioning (HVAC) efficiency is important to ensure that demand can be met and lower the cost of transitioning to other energy sources.

As was noted, the entry-level jobs associated with energy efficiency are often "climbing around in your attic and crawl spaces, dealing with all kinds of undesirable things," and not well-paying. However, jobs on the next step up are good jobs. The Clean Energy Tech program at Shoreline Community College is an important training pathway for these jobs.

Even utilities not engaged in recent clean energy efforts highlighted that they primarily rely on hydropower, a renewable electricity source that does not directly emit greenhouse gases.[44] A number of them also reminded us that new hydroelectric projects were built around considerations for the welfare of local communities and limiting environmental damages.

COVID-19's Impact

EFFECT ON CLEAN ENERGY EFFORTS

Most utilities interviewed minimized the impact of the pandemic on their recent or future clean energy projects. The bulk of impacts from the COVID-19 outbreak happened at the beginning of the pandemic, while utilities' workforce adapted to their new virtual work environment. Since then, most of the projects' leadership team has worked online, and projects have advanced regularly. Officials interviewed during this project did not seem worried about the pandemic's impact on their respective clean energy projects.

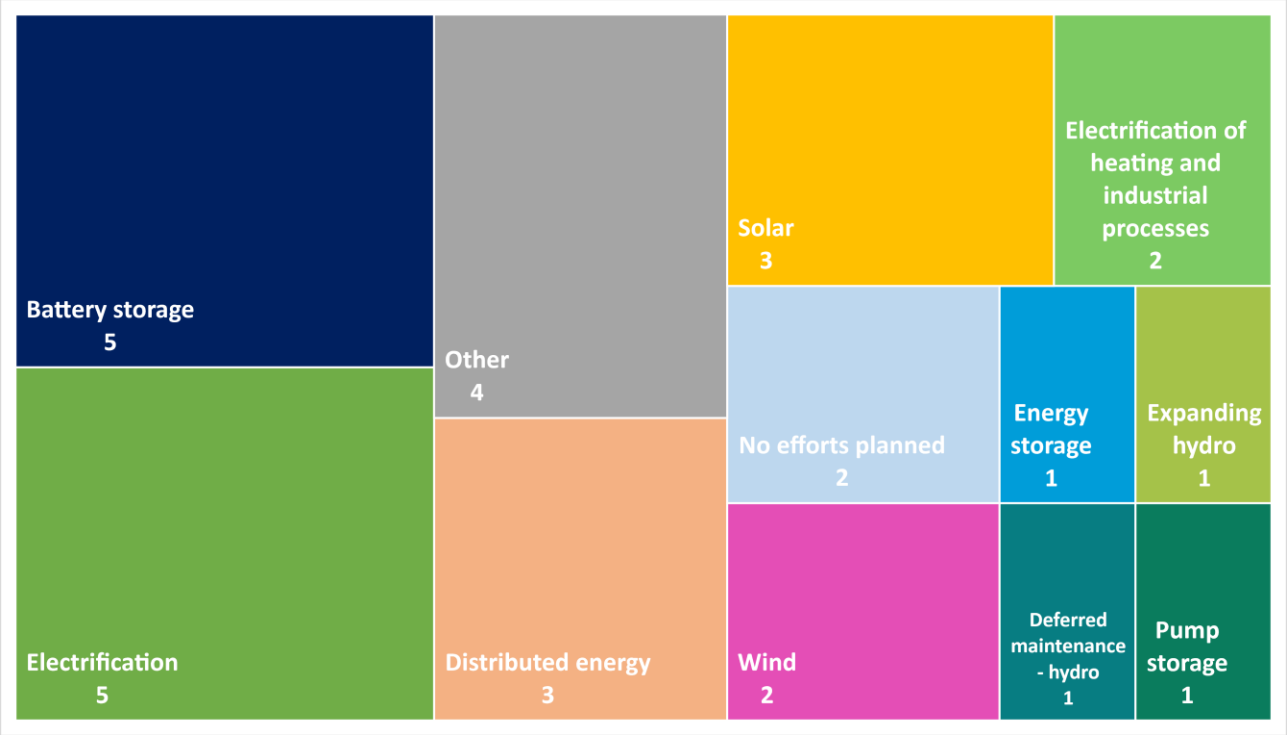


Figure 23. Future Clean Efforts: Interviewees Mentioning at least One Related Project.

One utility representative noted how they put their clean energy work on hold early in the pandemic. But their team used this pause to undertake more strategic planning. When the active implementation resumed, they were better prepared, and their work has accelerated as a result. However, the pandemic seemed to have broader implications for the workforce.

EFFECT ON THE WORKFORCE

Recruitment and Hiring

First, some organizations had a formal hiring freeze while others simply slowed due to the rapid shift to virtual onboarding. The lack of trust surrounding all-virtual recruitment has sometimes impacted the hiring pace and onboarding process. Teams and recruiters' lack of knowledge of this new technology, coupled with the belief that new hires would be less engaged or that it would be more challenging to judge applicants' knowledge and character, have made them cautious about virtual recruitment. Some utilities even relied more than usual on technology to avoid hiring in this unfamiliar context.

In contrast, with utilities that were recruiting, the virtual environment decreased recruitment friction and costs. Candidates are no longer required to fly back and forth for an interview,

expanding the pool of potential applicants. Some representatives commented on how it was "weird" bringing people on with minimal in-person contact, but they have adapted.

A small number of utilities expressed concerns about not being able to compete for applicants who are interested in a permanent remote position. For example, one utility representative noted that they lost a key cybersecurity professional to a job that was 100% remote. Due to the nature of utilities, workers must live close to these infrastructures, and most cannot operate 100% remotely. These factors might make it harder to compete with other companies offering flexible work arrangements.

Finally, one interviewee expressed concern about the lag in contractors being able to staff projects because they had had to lay off or furlough so many employees during the pandemic. In addition, their training pipelines were slowed or interrupted.

Training

The situation is similar for utilities' in-house apprenticeship programs due to the impracticality of transposing hands-on training to a virtual environment. Social distancing restrictions significantly limited training and electrician and linemen crew teamwork.

Changing Responsibilities

Expanded responsibilities are another consequence for the workforce of the pandemic. For example, information technology and cybersecurity teams implanted new safety protocols to protect networks and data transmissions in internal communication. Similarly, in an effort to minimize in-person contacts and protect both field workers and consumers, collection employees expanded their skill set to move on to other roles like maintenance.

The Impact of State and Federal Policies

CLEAN ENERGY TRANSFORMATION ACT (CETA)

Though utilities are the focus of CETA's regulatory heft, several of the utility representatives interviewed expressed that it did not affect their operations. They were already in the process of taking steps to either be GHG-neutral or were only producing hydroelectric power.

Despite this, there was a consistent theme that the drive to diversify energy sources coupled with investing in grid moderation was critical to building a resilient system. No one reported that the February 2021 grid failure in Texas had changed the conversations they were having because

they were already concerned with grid resiliency.* However, they did indicate that this event reinforced the importance of the work they were already doing or planning.

Uncertainty about Meeting Targets

However, two utility representatives did express that CETA was front-of-mind for them. One representative is the electrification and strategic technology director, and their day-to-day focus is on implementing the technology necessary to meet state and local emission targets. The other was a representative of hydroelectric utility. They characterized their utility as middle-of-the-pack when it came to preparedness to meet CETA's requirements: on track to meet early targets but uncertain how they would meet the 2025 target. That being the case, this representative appreciated that CETA was forcing utilities to collaborate and plan on a regional level because, like them, many of Washington's utilities do not have a road map for how they will reach 100% carbon-free generation.

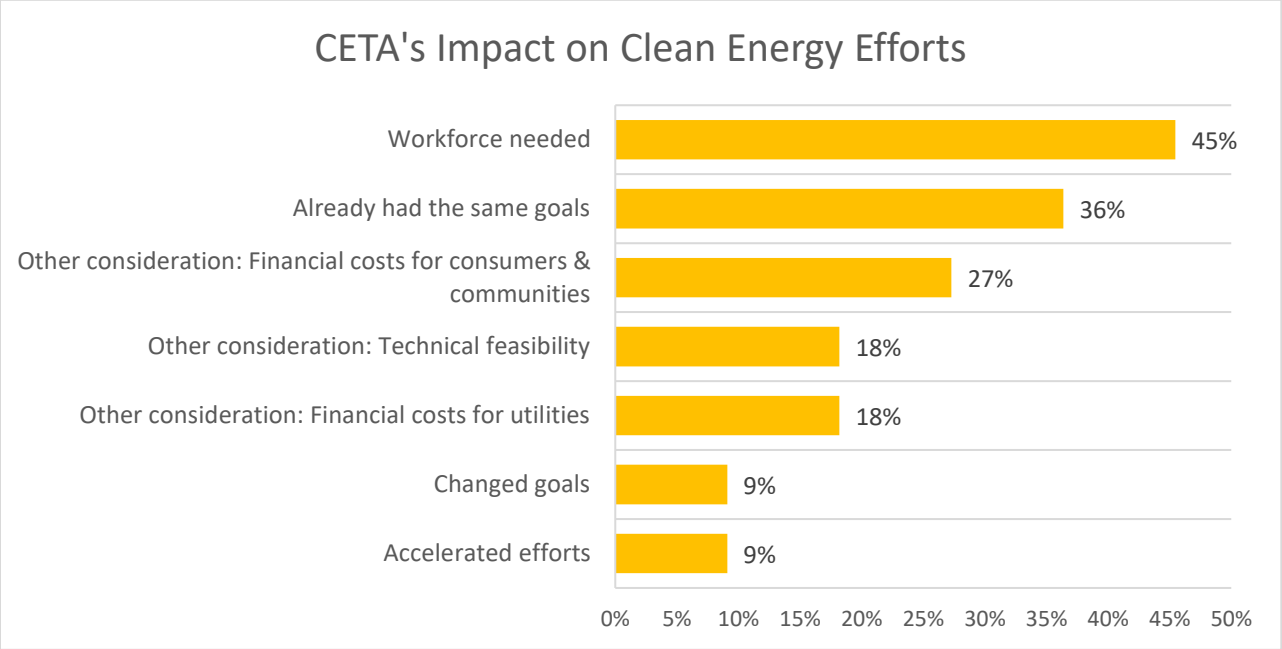


Figure 24. CETA's Impact on Utilities' Clean Energy Efforts: Percentage of Utility Representatives Interviewed Mentioning the Related Impact, out of Interviewees Who Answered This Question

Even among utility representatives who are more confident about meeting CETA's requirements, there are significant concerns regarding the technical feasibility of satisfying demand with renewable and zero-carbon sources. For example, one interviewee noted the gap between the

* Many also noted that the grid in Texas is not connected to the rest of the United States, increasing its vulnerability, and that the regulatory environment in Washington state is very different than Texas.

power generation that will be taken off-line by prohibiting coal-fired power and what new wind and solar projects are slated to produce.

Some utilities have been thinking of adding hydrogen fuel derived from natural gas to their fuel mix. Hydrogen generation poses some unique risks, as it requires safe thermal output and moving explosive materials through pipelines. In addition, uncertainty regarding future infrastructure and its maintenance protocols are barriers to hydrogen projects.

EQUITY CONCERNS

While equity is very central to the recent Washington state clean energy legislative language, there continue to be two* primary concerns about equity with the implementation of CETA and other legislation:

- Cost to consumers
- Good jobs

Cost to Consumers

While utilities will bear the upfront costs of upgrading current facilities to limit GHG emissions, investing in renewable sources of energy production, and ramping up battery storage capacity, it is unclear to some of those interviewed how this will be reflected in consumers' bills.[28]

The recent decrease in solar and wind energy production costs could mitigate these concerns and help generate cheap GHG-free electricity. The SunShot 2030 from the Solar Energy Technologies Office established a cost target of $0.03 per kWh for utility-scale production.[45]

Good Jobs

Similar to the consistent use of equity language, the clean energy legislation has also included strong labor language. Labor representatives were optimistic about this language, noting that they had failed to capitalize on the opportunities that the American Recovery and Reinvestment Act (ARRA) of 2009 offered during the Great Recession. They are also concerned about a just transition for workers in fossil fuel-dependent jobs and industries and highlight the importance of ensuring that they are made whole if their jobs are made obsolete.

* There is a third element of equity embedded in the legislative language: prioritizing heavily-burdened communities for pollution reduction efforts and energy transformation projects.[28] This element did was not a major theme in the interviews.

In addition, from the labor perspective, they already have the capacity to do the work. As one interviewee noted, "electricians were the first green-collar jobs. They have already been green jobs." For example, IBEW has successfully asserted that in Washington state, electricians install solar panels, which increases the pay of those who install solar panels. Labor representatives would like to see that pattern repeated wherein new clean energy is done by people in legacy occupations with strong training and a history of collective bargaining. It is consistent with recent research that shows that high road labor policies have minimal impact on the total cost and speed of transition and may be offset by higher labor productivity. In other words, good jobs pay for themselves.[46]

CHANGE IN WORKFORCE NEEDS

Finally, while a handful of utilities do not anticipate an important change in their workforce from CETA-related projects, there is a recurrent theme of existing occupations needing new skills.

CETA and the related grid modernization will require the following:

- Digital skills
- Data analytics skills
- Education and community engagement skills
- Innovation and flexibility

The first two skills are technical and primarily focused on implementing smart grid technology and meeting equity targets for service provision and employment.

The latter two are soft skills and, as one interviewee noted, reflect the change in the fundamental nature of the utility industry. First, several individuals noted they needed their workers to be more innovative and ready to adopt new technology and new ways of doing things to function in a fast-changing field. This need is in contrast to the utility industry's primary directive for the past century: stability.

The second is the importance of community engagement planning and implementing projects that truly advance equity and education for bringing consumers along with all of the changes in the field. Again, in contrast to traditional utility operation, which has been very top-down and technocratic.

Despite the changes in skills needed that people identified, few noted newly emerging job titles. Instead, for the most part, interviewees described it as "the same jobs with a new focus." The

few new job titles identified were at the director and project management level, focused on new technologies and community engagement.

There were mixed responses to the lack of new job titles. For example, a training program representative and researcher expressed frustration and the need for new titles to accurately portray the transformation in the field and better prepare people for the workforce. In contrast, as noted above, labor representatives are satisfied with maintaining existing job titles and feel that it is accurate to maintain existing job titles and simply update those worker's skills.

Current staff, like plant operators, will still need to update their skillset to new technologies to stay relevant in the industry.

FEDERAL POLICIES

While interviewees were not specific about which proposed federal legislation they were most anticipating, they were preparing for an infusion of funds directed at expanding clean energy across the board. Several mentioned preparing for or anticipating that funds would be available for new wind and solar projects, both community and utility-scale. Labor representatives want to be more proactive about capitalizing on this opportunity than they were in 2009 with ARRA projects. They are confident in their capacity to scale up their training capacity to meet demand, though recent research has demonstrated persistent undersupply of electricians.[47]

Recent and Current Workforce Trends

HIRING

Overall, utilities' core occupations revolve around electricians, mechanics, and hydro-operators. While electricians and mechanics can be recruited upon completing their training, utilities often require operators to have multiple years of experience. This requirement, coupled with the small number of training programs, has made it difficult to find many applicants. As a result, some

utilities interviewed ask the CECE to provide guidance and resources to help them solve this particular shortage.

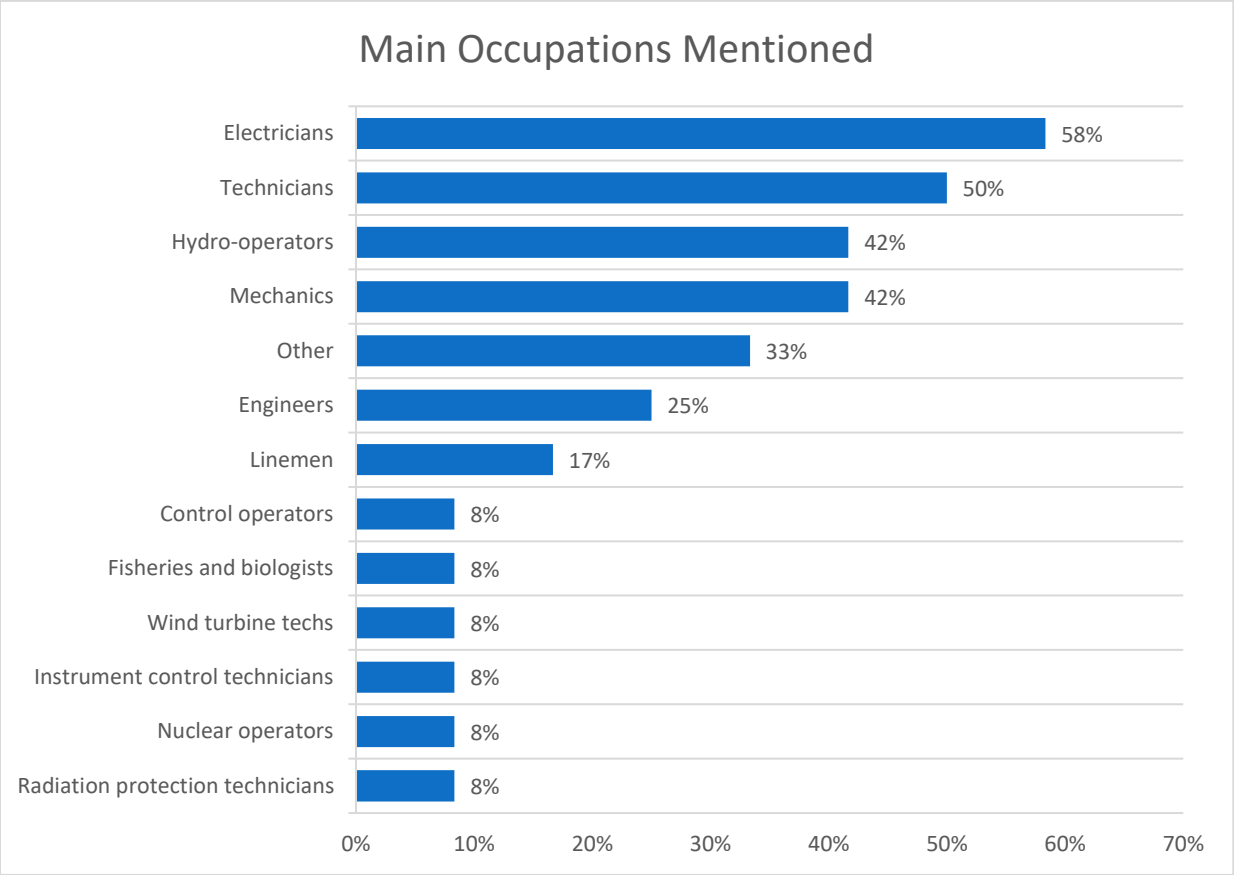


Figure 25. Main Occupations: Percentage of Utility Representatives Interviewed Mentioning the Related Occupation, out of Interviewees Who Answered This Question.

In addition, another workforce theme that emerged was a general lack of long-term workforce planning, which makes the utilities very reactive in their approach to hiring and internal workforce development. One interviewee expressed interest in support from the CECE in approaching workforce planning, starting with better workforce data on updated job skills profile, worker availability, and occupations needed for specific clean energy projects.

DIVERSITY

Many of the interviewed utilities identified diversity as one of their most pressing workforce challenges. The leading cause appears to be the lack of diversity in the applicant pool, particularly in the Pacific Northwest, which is not as diverse as other parts of the country. Though many utilities report improvements in both race and gender diversity, it is clear that it is a relative improvement and, with few exceptions, utilities remain far from representative.

There has been an improvement in gender diversity, particularly among engineers and leadership. Though utilities draw heavily from the veteran community, which is highly diverse, there has been little movement on racial diversity which is still lacking among all occupations, particularly in crafts and apprenticeships.

Figure 26. Recent Workforce Challenges: Percentage of Utility Representatives Interviewed Mentioning the Related Challenge, out of Interviewees Who Answered This Question

Attracting applicants from Black, Indigenous, and other People of Color (BIPOC) communities is now a shared goal among many utilities. To that end, they have implemented several strategies to support these efforts:

- Creating community-specific employee resource groups and leveraging these groups' networks to distribute job openings descriptions.
- Changing interview practices so that panels include at least one person from the applicants' communities to help review applications and conduct interviews. If this is not feasible, managers must set up an alternate panel and notify management.
- Educating immigrant communities about working in the utility industry to relieve reported anxiety about working with electricity among candidates from countries where utilities have not been operated as safely as in the United States.

Many expressed that they would appreciate the support from CECE in improving their ability to recruit, hire, and retain a racially and gender-diverse workforce.

RETENTION

Utilities are facing two retention issues, both stemming from the utility industry necessarily prioritizing stability. First, as noted above, the utility industry skews older. As a result, senior personnel retiring, and succession planning are a concern.

The second concern is specific to clean energy research: the troubling pace at which the sector has been losing candidates and staff to big technology companies. The recent interest of large companies to decrease their GHG emissions, stemming from intensive server use and other energy-intensive operations, to improve their public profile has led them to invest in power purchase agreements. In 2020, Amazon was the largest corporate clean energy dealmaker in the country.[48] This has led to the creation of a sustainability team and multiple clean energy power production projects. The company now owns 71 solar or wind farms and 135 on-site solar systems.[49] It is challenging for utilities to compete against these tech companies known for attractive salaries and newly remote work environments. They offer lower salaries and a much more traditional work culture. Some utilities also operate in smaller cities or remote areas, making it more difficult to attract candidates to these areas without an extraordinarily attractive job offer.

Finally, other concerns include finding candidates, particularly young candidates, who would not fail the mandatory drug test, and enough young people interested in going through an apprenticeship instead of enrolling in a post-secondary institution, a common concern for all trades.

Future Workforce Trends

Industry representatives anticipate that many of the workforce challenges outlined in the previous section will continue to impact the industry in the medium and long term.

DIVERSITY

Current workforce diversity will take time to reflect the state demographics due to the lengthy careers in the utility sector: a low churn rate prevents the rapid intake of new diverse (and younger) workers because of the small number of new vacancies. Additionally, the lack of diversity in the talent pool is perceived to be a direct consequence of the lack of diversity in training programs' student population. At the same time, the demographic trends of a workplace are often self-reinforcing. As a result, diverse workplaces become more diverse, and homogenous workplaces do not.

When labor organizations and high schools promote the benefits of trades occupations (electricians, mechanics, operators, etc.), they stimulate high school graduates' interest in related training programs. In addition, pre-apprentice programs explicitly targeted at underrepresented demographics like ANEW successfully attract a more diverse pool of trainees.

More could be done by leveraging various application channels and hands-on short training programs and highlighting programs like Shoreline Community College's Clean Energy Technology Program. In addition, CECE could engage with and help expose current and potential students to the industry. Examples of efforts to do this include cybersecurity competitions targeted at female high school students or short-term summer programs allowing K-12 students to discover the trades in a safe environment.

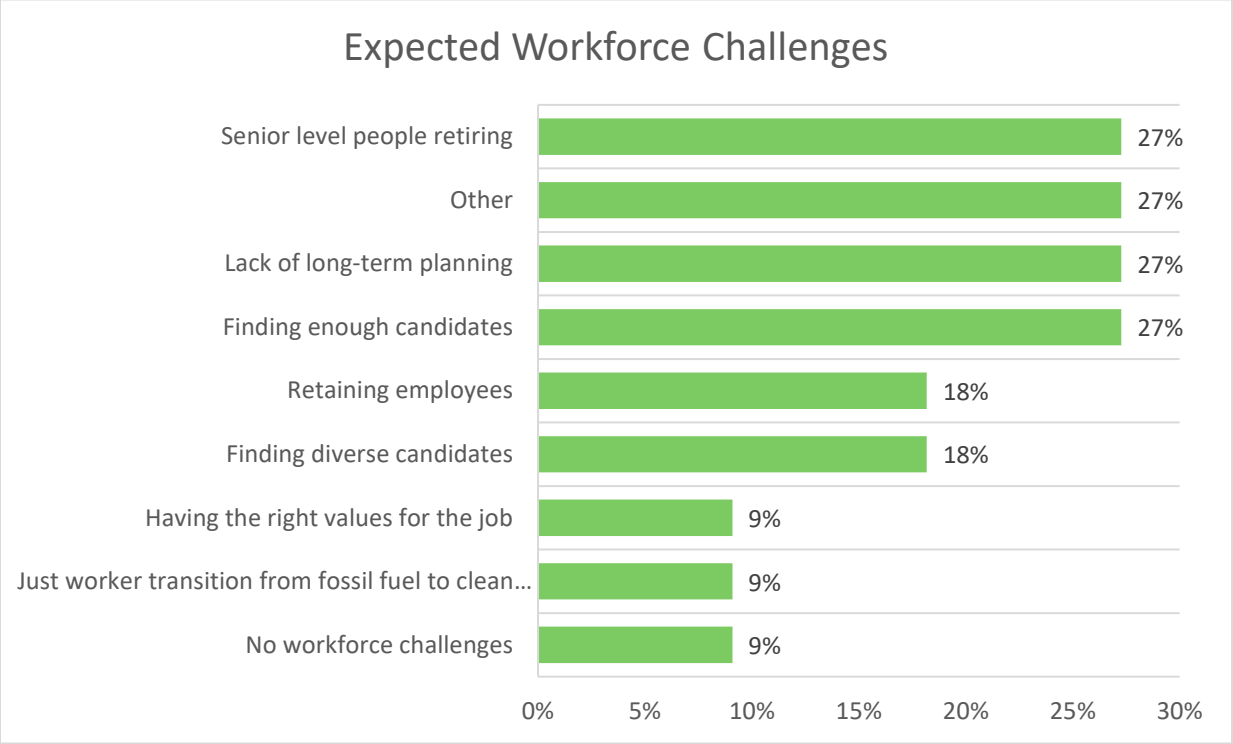


Figure 27. Expected Workforce Challenges: Percentage of Utility Representatives Interviewed Mentioning the Related Challenge, out of Interviewees Who Answered This Question.

Equally importantly, the handoff from the pre-apprenticeships and short-term training to apprenticeships needs to be improved. Currently, candidates from underrepresented groups often fall through the gaps between these programs and do not move along the career ladder.

RECRUITMENT AND RETENTION

Competition with large technology companies, particularly for clean energy experts in research and engineering, will intensify in the future. The increasing discrepancy in salary and the ability to work remotely full-time in some companies will make it harder for utilities to compete. In addition, less attractive packages, geographical inflexibility, and workplaces in smaller communities might hamper utilities' ability to hire new talent. These benefits that correspond to their downsides should also be advertised to encourage applications: stable careers, balanced work-life culture, and the exciting perspective to significantly impact the regional environment. Interviewees noted how many young applicants are values-oriented and attracted to the opportunity to contribute to climate change mitigation.

Additionally, current roles will need to shift and adapt to new clean energy sources technology and device integration. First, current staff will need to improve their technology and computer skills to stay current with recent clean energy production trends. For example, solar, wind, or hydrogen rely on production methods very different from hydroelectric power. Understanding electricity production and distribution from these sources will help current staff better grasp their organization as a whole. Besides these new sources, there seems to be a common call for better computer and communication skills across utilities.

INCREASED COMPLEXITY

CETA and other regulations have pushed for a stronger commitment towards reducing carbon emissions across many sectors, from energy efficiency and green construction to transportation electrification and clean energy production. These individual efforts are expected to generate greater integration across smart buildings, transportation systems, and electricity distribution. For example, buildings will increasingly have their own energy storage, potentially leading to interconnected storage systems across multiple buildings to create a virtual power plant. Electric public transit and individual vehicles will also connect to the grid to communicate loading and surge times. This increased integration will modify communication and security protocols and the nature of many roles. As a result, utilities' workforce needs to be ready to integrate multiple information and communication technologies into their skillset, regardless of their role in the organization.

CYBERSECURITY

Cyberattacks are also on the rise, and the digitization of a distributed grid opens up the possibility of new threats. Until recently, the utility industry has reportedly been slow to acknowledge the

risk. Among those interviewed, there was a consensus that cybersecurity experts need to be trained in the utility industry and all utility workers to be trained on cybersecurity. Everyone knows it is an issue, but no one is fully prepared to address it.

There are cybersecurity apprenticeships for control systems (e.g., those used in utilities and manufacturing) in development. But, because the manufacturing sector was attuned to the risk earlier, the work so far has focused on manufacturing.

Besides expanding cybersecurity teams' skill sets to include industrial control systems, utilities should provide short-term training to other field workers, engineers, and technicians to recognize threats and establish safe practice protocols. These skills should also be taught in training programs to make students more appealing to employers and equip them with an understanding of real-world threats and security protocols. Employee training severely decreases systems vulnerability.

EMPLOYABILITY/SOFT SKILLS

Some utilities reported challenges with younger recruits lacking soft skills and basic computer skills (e.g., Microsoft Office suite). In particular, communication, teamwork, decision-making, and critical thinking are crucial skills in emergencies. High-impact, low-probability events put enormous pressure on teams. Therefore, adaptability and flexibility are essential to successful crisis management, and recruits should have strong verbal and written communication skills.

Training program coordinators and researchers note this is a perennial complaint of employers. They observe that some of this should be attributed to friction between generations. Another significant component of this complaint they identify is unrealistic expectations about what the education system can accomplish, particularly given years of resource constraints and working with similarly resource-constrained students. The Shoreline program incorporates teamwork, communications, and job-readiness skills into its training. At the same time, employers need to increase their engagement and support in training, as employer investment in training has been flat, and public investment has fallen precipitously in the last two decades.[50]

CLEAN ENERGY JOBS

Finally, occupations needed to support clean energy efforts encompass the trades, engineering, and other analytical positions. They include electricians, electrical engineers, power plant operators, biologists, power analysts, power traders, data analysts, and solar technicians.

Ramping up the supply of electricians will require expanding current apprenticeship capacity and creating new pre- and regular apprenticeship programs. Unfortunately, the talent pool of experienced hydro-operators is also limited, with only two registered programs in Washington state for Energy Management and Systems Technology/Technician in Central Washington University and Centralia College.[38] As a result, some utilities are reporting having increasing difficulties in hiring for such roles. Interestingly, opposite trends seem to be impacting the labor market. While some utilities indicated that they intend to ramp up hiring in the occupations outlined earlier, others expect automation, digitization, and increased productivity from remote working to decrease the need for future hiring. Furthermore, smaller utilities have been contracting out field workers needed to carry out clean energy projects managed by in-house project managers. These contradicting trends coupled with a lack of long-term planning by some utilities make it difficult to precisely estimate which occupations will be most in-demand in the future.

CONCLUSION

The Washington state utility sector is rapidly moving to decarbonization. Sector representatives are largely optimistic about meeting early targets, though there is less certainty about the technical feasibility and cost of reaching fully carbon-free energy generation.

Events in Texas did not cause representatives to reassess their goals but reinforced them. They were already aware of the grid's vulnerabilities and motivated to improve the grid's resiliency in the face of increasing disruption due to climate change. Similarly, representatives are aware that the grid and their operations are vulnerable to cyber-attacks and acknowledge the need to expand their cybersecurity workforce and training.

The transition to clean energy largely depends on the same occupations that the sector currently employs. However, there was general agreement that those occupations will have to evolve and acquire new skills to implement clean energy projects. Utilities also want to increase the diversity of their workforce. They have implemented several strategies to pursue greater diversity, though the industry's low turnover means progress is slow.

The Center of Excellence for Clean Energy can support the clean energy industry by:

- Continuing to provide a valuable connection between industry and training programs
- Engage current and potential students and expose them to the industry
- Promote clean technology training programs

- Provide high-quality labor forecasts and workforce data on job skills and clean energy specific occupations
- Support and inform the industry on recruitment, hiring, and retention best practices

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APPENDIX A: INTERVIEWS

Name	Title	Organization
Jay Pickett	Chief Hydro Officer	Army Corps of Engineers
Jeremy Gall	Training Development & Safety Manager	Avista Utilities
P.J. LeCompte Jr.	Supervisor of Apprentice Training Progs	BPA
Steve Lorence	General Manager for Corporate Support Services	Energy NW
Dennis Skarr	IT Instructor	Everett Community College
Dan Kay	System Engineering Supervisor	Grays Harbor PUD
Tom VanNorman	Co-Founder	ICS Village
Barbara Hins-Turner	Former CECE Executive Director	Independent Contractor
Katie Garrow	Deputy Executive Director	MLK Labor Council
Troy Nutter	Manager, Training & Operations	PSE
Allan Robert (Bob Guenther)	Board of Directors Treasurer	Regional Education & Training Center
David Logsdon	Director of Electrification and Strategic Technology	Seattle City Light
Louise Petruzzella	Director, Clean Energy Tech Program, Faculty	Shoreline Community College
Alice Massara	Workforce Development/pipeline development	Tacoma Power
Daniel Schwartz	Director	UW Clean Energy
Brian Young	Clean Tech Sector Lead	Washington Department of Commerce
Todd Currier	Director, Safety & Labor Relations	WSU Energy Program
Alan Hardcastle	Sr. Researcher	WSU Energy Program
Keith Weir	Business Representative	IBEW 46

APPENDIX B: ELECTRICAL UTILITIES IN WASHINGTON

Type	Utility
Investor-Owned Utility	Avista Corporation
	Bonneville Power Administration
	PacifiCorp
	Puget Sound Energy
Federal Utility	DOE Richland (Hanford)
Municipal Utilities	Blaine
	Centralia
	Cheney
	Chewelah
	Coulee Dam
	Eatonville
	Ellensburg
	Fircrest
	McCleary
	Port Angeles
	Seattle City Light
	Sumas
	Tacoma Power
	Vera Water & Power
Public Utility District	Asotin
	Benton
	Chelan
	Clark
	Clallam
	Cowlitz
	Douglas
	Ferry
	Franklin
	Grant
	Grays Harbor
	Jefferson
	Kittitas
	Klickitat
	Lewis
	Mason No. 1
	Mason No. 3
	Okanogan
	Pacific
	Pend Oreille
	Skamania

Type	Utility
	Wahkiakum
	Whatcom
Rural Electric Cooperatives	Benton REA
	Big Bend Electric Cooperative
	Columbia REA
	Elmhurst Mutual Power & Light
	Inland Power & Light
	Lakeview Light & Power
	Modern Electric Water Co.
	Nespelem Valley Electric Co-op
	Ohop Mutual Light Co.
	Okanogan County Electric Co-op
	Orcas Power & Light Cooperative
	Parkland Light & Water Co.
	Peninsula Light Co.
	Tanner Electric Cooperative
	Clearwater Power Co.
	Alder Mutual Light Co.
	Northern Lights, Inc.
Tribal Utility	Yakima Power

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