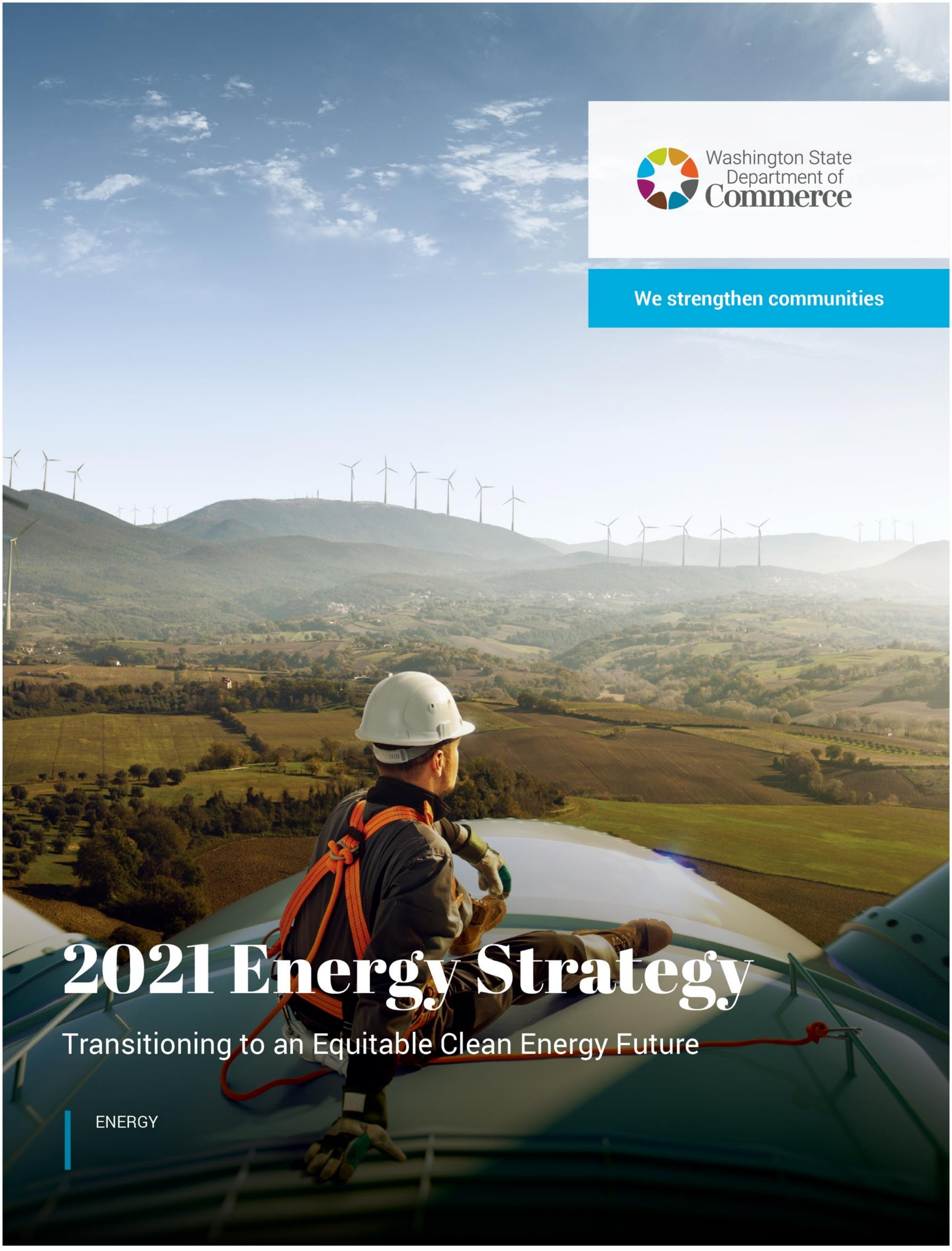

Washington State Department of Commerce

We strengthen communities

2021 Energy Strategy

Transitioning to an Equitable Clean Energy Future

ENERGY

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Introduction

Washington's Clean Energy Promise and Challenge

As we work together to recover from the economic impacts of the COVID-19 pandemic, climate change continues to threaten the health and economic security of Washingtonians. Rural and low-income communities are disproportionately exposed to this threat. Avoiding the worst impacts of climate change requires an aggressive, comprehensive commitment to decreasing greenhouse gas emissions rapidly and equitably across all Washington State's energy sectors: transportation, buildings, electricity and industry. The longer we delay in taking definitive action, the greater the threat to current and future generations, and the more costly it will be.

In 2019, the Washington State Legislature directed the Department of Commerce revise the State Energy Strategy, last updated in 2012, to align the strategy with the requirements of the Energy Independence Act,[1] the Clean Energy Transformation Act[2] and the state's greenhouse gas emission reduction limits.[3] State law declares that a successful state energy strategy balance three goals[4] to:

a) Maintain competitive energy prices that are fair and reasonable for consumers and businesses and support our state's continued economic success;
b) Increase competitiveness by fostering a clean energy economy and jobs through business and workforce development; and
c) Meet the state's obligations to reduce greenhouse gas emissions.

To meet those goals the Legislature further lays out nine principles to guide strategy development and implementation.[5]

The Department of Commerce developed the 2021 State Energy Strategy collaboratively with stakeholders and members of the public. The Legislature established a 27-member advisory committee made up of legislators, government officials, and representatives of civic organizations, energy and utility businesses, as well as public interest advocates.[6] The committee met multiple times between January and December 2020, weighing in on emerging analysis, findings and potential policies.

The public also had opportunities to be involved throughout the development of the 2021 State Energy Strategy. General outreach efforts included communication through an email sign-up list, creating awareness at existing venues and events and implementing opportunities for public listening and comment in meetings and online.

Toward the end of the process, there was a public hearing to provide a forum for the Department of Commerce to gather formal input on the draft strategy. Whenever possible, advisory committee

[1] Chapter 19.285 RCW.
[2] Chapter 19.405 RCW.
[3] Chapter 43.21F.090 RCW.
[4] Chapter 43.21F.010 RCW.
[5] Chapter 43.21F.088 RCW.
[6] Chapter 43.21F.090 RCW.

meetings and discussions were open to the public, accessible remotely and included an opportunity for public comment.

While the strategy was developed transparently and collaboratively, there is more outreach to be done to guide implementation of the identified recommendations. Moving forward, Washington's communities and families must have the opportunity to inform strategy implementation. There must be additional technical, financial and human resources for community participation in the clean energy transition. This includes planning, evaluating and implementing energy and resilience projects that meet the needs of communities in all parts of the state.

At the same time, we must identify and amend laws and rules, remove barriers and change systems that prevent equitable and just participation in our policy choices and the costs and benefits of implementing them, while also evaluating progress, building information (e.g., technical, social and political), and learning from engagement efforts. Explicitly including an adaptive management approach into implementation will strengthen and make the state energy strategy more relevant into the future.

Steps must be taken to coordinate and collaborate among policy makers in local governments, in Tribal governments, across state government and in regional organizations. All of those actors are engaged in decarbonization at some level, creating a patchwork of goals, standards, programs and outcomes around the state. To achieve a dramatic turnaround in outcomes, and a more equitable transition, Washington will need to adopt a more coordinated "whole-system" approach emphasizing the contributions and technical support of the many players involved.

Washingtonians feel the impacts of climate change and the lack of a cohesive and forward-looking approach every day. Examples include the burden of heating costs for those who live in drafty and inefficient homes; the cost of moving communities and infrastructure out of harm's way due to rising sea level; the costs to families dealing with asthma, heart conditions and other health impacts due to poor air quality; the loss of food availability, jobs and livelihoods due to ocean acidification; and much more. These examples illustrate the cost of inaction.

The 2021 State Energy Strategy offers a path forward for Washington to transform its economy to be vital and productive without relying on fossil fuels and their pollution. This transformation – deep decarbonization – requires significant public and private commitment. It requires investment in equipment and infrastructure, innovation and workforce development.

At the same time, there will be savings with less spending on fossil fuels imported from outside the state. Implementing the strategy will result in job creation, economic development, environmental protection and improved public health. Solutions are all around us in the choices we make – from the cars we buy, to how we heat our homes to the way we train our workforce.

We can achieve this transformation in a way that supports our other public policy goals for economic development, reliable and affordable energy supply, good-paying jobs social equity and environmental justice. We can make this transition in a way that both cleans up our air and jumpstarts our economy. We know it's possible because it's happening right now all over our state. Washington's culture of innovation, our skilled workforce and competitive advantage are our greatest assets, and they are the reasons we are a global leader in the clean energy transition.

Governor Jay Inslee
Creating a Model for Global Decarbonization
through Washington State Science, Engineering and Technology
Washington Academy of Sciences
Sept. 17, 2020

Executive Summary

Avoiding the worst impacts of climate change requires a comprehensive commitment to decreasing greenhouse gas emissions. Washington launched initial efforts with legislation to require clean electricity and efficient buildings. Much more is required in the near term to realize the transition to a clean economy. The path forward requires investment and action and promises a stronger and more just economy.

The 2021 State Energy Strategy is designed to provide a roadmap for meeting the state's greenhouse gas emission limits. Enacted in 2020, the law commits Washington to limits of 45% below 1990 levels by 2030, 70% below 1990 levels by 2040 and 95% below 1990 levels with net zero emissions by 2050.[7]

The path to a clean energy economy outlined in this strategy requires rethinking virtually every aspect of energy use in Washington. The state needs more efficient buildings, smarter appliances, vehicles using new sources of energy, investments in industrial processes, a stronger electricity grid and significant innovation.

As a state known for innovation and environmental stewardship – and one that is already committed to a 100% clean electricity grid – Washington is poised to lead the nation in policies and actions to spur the innovation and investment required to put our state on the road to reducing emissions to net zero by 2050, while improving quality of life and driving economic growth, particularly in light of COVID-19's devastating economic impacts. A just and equitable state energy strategy is a necessary condition for success. The strategy must benefit people, businesses, and rural, urban, highly impacted and indigenous communities throughout the state.

Developing a Deep Decarbonization Framework

The analytical framework for the 2021 State Energy Strategy is a comprehensive assessment of the options for achieving the state's emissions limits. This "deep decarbonization pathway" analysis searches for the lowest cost path to reduce emissions based on what we know today about

[7] Chapter 43.21F.090 RCW.

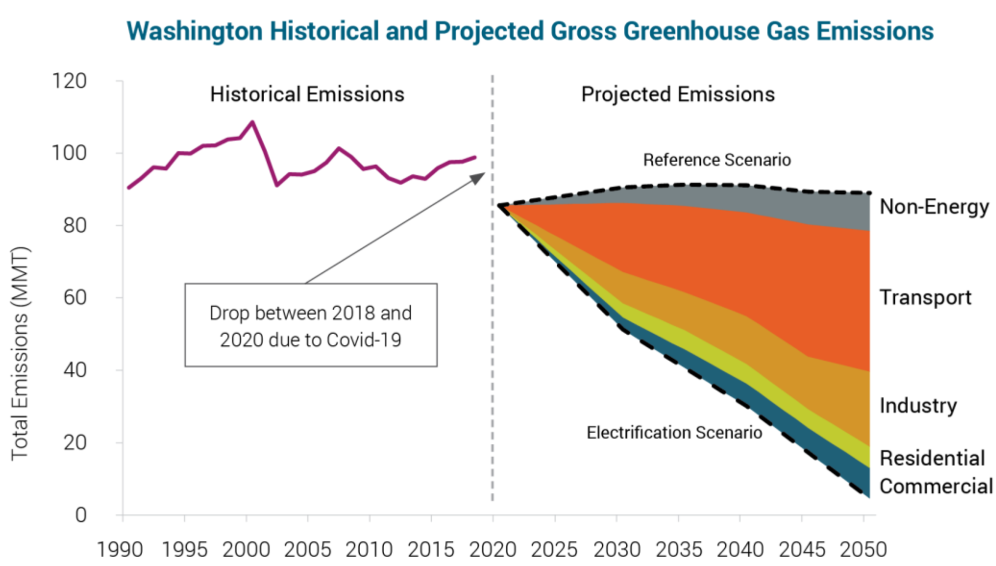
technologies, costs and markets. By exploring multiple pathways, the analysis illuminates tradeoffs for decision makers.

Washington's legislatively mandated emissions limits decrease steeply over the next nine years and eventually require the replacement of virtually all fossil fuels. The range of feasible pathways is smaller than studies have found when analyzing less ambitious limits. To meet the current limits, Washington needs to move aggressively on multiple fronts, especially to meet the 2030 limit.

- **Transportation**, at 45% of the state's 2018 emissions, in this sector Washington must embrace a multi-pronged strategy of electrifying as many passenger, truck and freight vehicles as possible; investing immediately in the infrastructure required to support massive vehicle electrification; and developing incentives and land use plans to reduce miles traveled and increase other modes of transport, such as transit, cycling and walking.
- **Buildings**, with 23% of the state's emissions, require a 10-year market transformation approach that combines transitioning from fossil gas to electrification, with deep levels of efficiency for new and existing buildings, and smart building demand management.
- **Electricity**, at 16% of the state's emissions, must be 100% clean by 2030 and by 2050 roughly double its output, while continuing to provide reliable power.
- **Industry** must be a focus of policy makers to reduce emissions where possible; develop clean fuels and carbon capture; work with energy-intensive, trade-exposed (EITE) businesses to mitigate the impacts of the clean energy transition; and develop a clean energy industrial policy to guide the state's low-carbon future.

Figure 1 below shows the state's total historical gross greenhouse gas emissions from 1990 to 2018 and projected gross emissions from 2020 to 2050 by source.

Figure 1. Historical and Projected Gross Greenhouse Gas Emissions in Washington State



Source: Washington State Department of Ecology for historical emissions (2018 value is preliminary). Washington State Energy Strategy Deep Decarbonization Pathways model for projected emissions (p. 26).

The deep decarbonization approach of looking at multiple sectors of the economy simultaneously yields insights that could easily be missed in a sector-by-sector approach. For example, an important cross-sector finding is that clean fuels, such as renewable hydrogen and clean synthetic or biogenic fuels, will be key to decarbonization. Washington can produce these products using clean, renewable electricity, carbon captured from industrial processes and fuels derived from biomass. Doing so can improve the flexibility of the electric system to manage high levels of intermittent renewable power generation. These fuels will replace fossil fuels in uses that cannot be quickly or completely converted to direct use of electricity.

Priority Recommendations

The 2021 Washington State Energy Strategy identifies policies and actions to achieve the state's greenhouse gas limits and transition to 100% clean energy. This represents a significant and intentional transition for the state's economy. Highly impacted communities and vulnerable populations have the most to gain from this transition, since they are most at risk to climate effects. At the same time, decarbonization also presents many opportunities for addressing inequities among the residents and communities in our state including:

- Enhancing resilience in rural Washington; improving the quality of life for people of color and low-income communities and ensuring highly impacted communities and communities of color equitably benefit from the transition to clean energy;
- Growing and diversifying Washington's economy, increasing the prevalence of good, family-sustaining jobs by expanding access to education and training for workers;
- Improving health outcomes with more deliberative siting processes, upgrades to aging housing stock and cleaner transit options; and
- Improving the comfort of homes, growing neighborhood businesses and ensuring basic necessities are accessible and affordable to more Washingtonians, including those without an automobile or living in our most remote communities.

The strategy is organized by broad sectors of the state's economy, where similar technological and policy issues are present. It includes dozens of individual recommendations for action by policy makers, government agencies, utilities, the private sector and individual households. At a high level, the priority near-term recommendations are:

- **Communities.** Climate change will inflict its greatest harm on highly impacted communities, Tribes, rural areas and low-income households, just as the economic and health impacts of COVID-19 are now disproportionately affecting those same populations. Absent deliberate and committed efforts, the envisioned clean energy transformation could easily leave these communities worse off.
  - Adopt state policies to achieve universal broadband access.
  - Examine clean energy policies for equity impacts in development and during implementation.
  - Provide needed funding for communities to invest in the clean energy transformation.
  - Support workers to ensure they have the skills for clean energy jobs and adopt policies to protect workers in transition.

- **Transportation.** No sector is as important as transportation to achieving decarbonization, nor as complex in its operation and governance. Two cross-cutting legislative actions are key to progress in this sector:
    - Establish specific targets for vehicle sales, transportation demand and emissions with accountability measures for meeting those targets.
    - Adopt a low carbon fuel standard – a comprehensive mechanism to replace fossil fuels with electricity, hydrogen and clean synthetic or biogenic fuels.
- **Buildings.** There is great potential to reduce and eventually eliminate the use of fossil fuels to heat and power Washington's residences, offices, warehouses, shops and other buildings.
    - Replace the direct consumption of fossil fuels, primarily natural gas, with high-efficiency electric heat pumps for space and water heating.
    - Strengthen and deepen energy efficiency programs and standards to focus on avoiding and reducing emissions.
    - Adopt specific targets and accountability for greenhouse gas emissions in the built environment.
- **Industry.** Policy makers and the private sector would benefit from more information, technology and coordination.
    - Conduct a thorough assessment of opportunities to transition to low-emission industrial production and collect information about the use of fossil fuels in industrial processes and the opportunities to increase efficiency and switch to electricity.
    - Coordinate with other jurisdictions to adopt consistent policies that recognize and reward lower emission in-state production.
    - Enhance research and development programs and state agencies' data and analytical resources.
    - Promote development of clean fuels refining and carbon capture.
- **Electricity.** Washington is on its way to eliminating greenhouse gas emissions from electricity with the implementation of the Clean Energy Transformation Act (CETA). Structural changes are needed to ensure the capacity to provide electricity to replace fossil fuels in transportation, buildings and industry.
    - Invest in new transmission capacity and renewable generation, coordinating with other states.
    - Develop distributed energy resources along with smart capabilities on the grid and in consumer equipment to ensure reliability and flexibility.
    - Strengthen mechanisms to ensure resource adequacy and efficient electricity markets.

Crosscutting Issues

While the strategy is primarily organized along the ways energy is used in the economy – by end-use sectors –several cross-cutting issues arise in more than one sector. In many cases, these issues will not be addressed effectively within any one sector or would best be resolved at a higher level. These include:

1. Increased Resources for Planning, Data Analysis and Outreach

A common theme across the strategy is the lack of adequate capabilities in government to evaluate, communicate and plan for the clean energy transition. In the industrial sector, policy makers lack basic information about manufacturing processes, opportunities for efficiency and conversion to renewable energy and the effects of potential carbon reduction.

Planning and accountability in the transportation sector is shared across multiple jurisdictions with inadequate coordination and unclear policy direction. Progress in the building sector will require more staff resources to develop a net-zero energy code and benchmark the energy performance of existing buildings. The transition also requires more effort by the state to provide technical assistance and outreach to industry, local government, highly impacted communities and consumers.

Role of Investment in an Equitable and Inclusive Transition.

Throughout the strategy there is a common pattern over time where aggressive climate action requires substantial initial investment in equipment and infrastructure. This upfront cost yields a payoff in later years in reduced purchases of fossil fuels while providing an immediate opportunity for skilled workers and businesses. It also requires access to capital on reasonable terms.

For example, the electricity sector must invest in transmission capacity and grid enhancements to capture the benefits of fossil-free renewable electricity. Transportation needs charging and fueling stations. Housing needs retrofits. High-efficiency consumer equipment and vehicles are often more expensive to purchase but much less expensive to operate.

Because the strategy relies so heavily on investments and infrastructure, there is substantial risk that actions will exacerbate the inequitable distribution of wealth and prosperity. Those with access to capital, such as home equity or savings, could make the upfront investments to shift to less expensive clean energy. This could leave those without resources paying for expensive fossil fuels and the infrastructure used to produce and deliver them. Public sector mechanisms to finance the transition are necessary to avoid this result.

2. Universal Broadband Access as a Foundation for Energy Transition

While outside the customary ambit of energy policy, the need for universal broadband access emerges across sectors. There are multiple examples where universal, reliable Internet access is required to capture energy efficiency improvements and increase access to fossil-free energy resources. Perhaps the most obvious is to reduce travel by enabling work from remote locations. This is another area with great risk of injustice. Without universal broadband access, many of the clean energy benefits identified in the strategy will be realized only by wealthier households and those outside rural areas.

3. Transition of the Fossil Natural Gas Industry

Natural gas is an important part of the state's economy, with billions of dollars invested in distribution infrastructure, millions of customers using its product, and thousands of people employed in the industry. Fossil natural gas has a lower emissions rate per unit of energy than either coal or petroleum. As a result, in some contexts natural gas has been identified as a clean source of energy.

However, the state's long-term greenhouse gas emissions limits cannot be achieved while continuing current uses of this fuel. Some uses will be replaced by clean electricity. Another option is to substitute renewable natural gas or a synthetic gas made using clean electricity. A well-planned transition is required to protect the interests of all concerned.

4. Valuable Role of Comprehensive Pricing Mechanisms

This strategy includes numerous recommendations targeted at specific energy uses or economic sectors, but it also identifies a need for broad-based mechanisms to help ensure that energy prices are not distorted by ignoring the costs of pollution. In the transportation and industrial sectors, the recommended approach is a low carbon fuel standard, which creates a price premium for fossil fuels and rewards electricity, biomass and other clean fuels for their emissions benefits.

The market recommendations for the electricity sector can help power generators and utilities identify clean power and realize appropriate value for it. More accurate pricing of energy, as a standalone policy, is unlikely to achieve emissions reduction limits. Specific policies will be more successful when energy prices properly align with environmental and other costs.

5. Benefits of Research, Development and Early Deployment

The strategy avoids reliance on yet-to-be-invented technologies, but it embraces many solutions that are not yet widely deployed. Electric and hydrogen vehicles, advanced building techniques, green hydrogen production and intelligent grid devices are examples. The emphasis on advanced technology is unavoidable with the ambition of the state's emissions reduction limits. It presents an opportunity to make even more and faster progress through research and innovation, and to boost the state's economy.

These efforts might yield efficiency gains or cost reductions for energy storage, nuclear power generation, geothermal energy, offshore wind, power grid control or many other technologies. This calls for collaboration with research universities, national laboratories, federal agencies and private sector innovators.

6. Development of Green Hydrogen and Clean Fuels

The deep decarbonization modeling and the state energy strategy identify an important role for clean fuels in every sector of the energy economy. Green hydrogen is of particular significance, because it could serve both as a flexible load for the electric system and as a feedstock for production of synthetic fuels. This could create new jobs and businesses in the state and help the transportation sector to transition to electricity.

Production of biofuels and renewable natural gas will support the agriculture and forest sectors and provide valuable substitutes for fossil natural gas and petroleum. As these examples illustrate, the development of clean fuels involves complex production and distribution processes crossing multiple sectors of the economy. There is worldwide interest in these low-carbon fuels and therefore ample opportunity to work with other states and countries in deploying them.

A. Build an Equitable, Inclusive, Resilient Clean Energy Economy

Climate change threatens human health and access to clean air, safe drinking water, nutritious food and shelter. The Governor's Interagency Council on Health Disparities' Environmental Justice Taskforce[8] found that vulnerable populations and overburdened communities experience disproportionate, cumulative risk from environmental burdens, including climate change. Low-income communities are

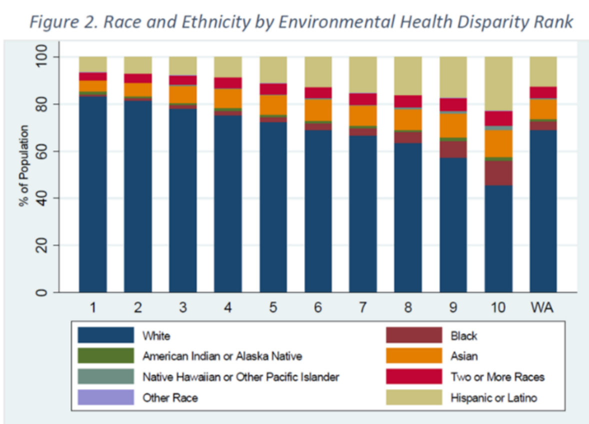
[8] "Environmental Justice Task Force," Governor's Interagency Council on Health Disparities, accessed November 1, 2020, https://healthequity.wa.gov/TheCouncilsWork/EnvironmentalJusticeTaskForceInformation.

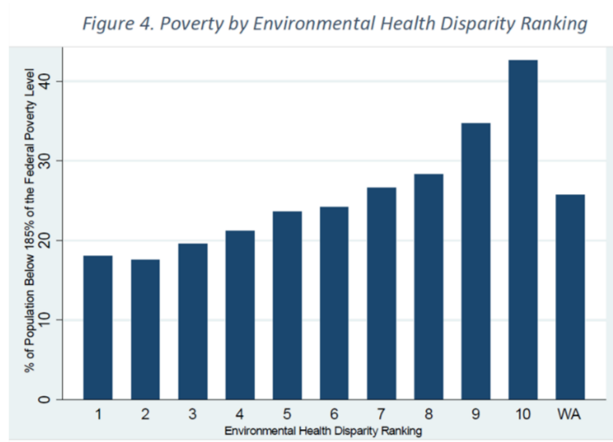
disproportionately more likely to experience the environmental and health disparities associated with climate change (Figure 2 and 3).[9,10]

Environmental disparities include increased air pollution, water contamination, flooding and wildfires. Health disparities include increased rates of asthma, cancer, heart attacks, infectious disease, infant mortality and heat stress. Communities at the greatest risk of these hazards are also more likely to be under 185% of the federal poverty level.[11]

Communities and families experiencing environmental health disparities and other burdens created by the disproportionate impacts of pollution are less able to adapt to or recover from climate change impacts. Environmental equity will be achieved when no single group or community faces disadvantages in dealing with the effects of the climate crisis, pollution, environmental hazards or environmental disasters.

Figure 2-Race and Ethnicity; Figure 3-Poverty by Environmental Health Disparity Rank





Source: Environmental Justice Task Force: Recommendations for Prioritizing EJ in Washington State Government. Figure 2, page 14; Figure 4, p. 16.

Addressing these disparities requires acknowledging the inequities that have led to them. This transition is underway. As the EJTF's *Recommendations for Prioritizing EJ in Washington State Government* report details, Washington has become an international leader in environmental justice over the last two decades, culminating in the Clean Energy Transformation Act of 2019 (CETA).

CETA requires that the state's transition to a 100% renewable and non-emitting electric grid includes the equitable distribution of clean energy benefits and reduction of burdens to communities highly impacted by climate change. The law provides tax preferences for clean energy projects meeting protective labor and contracting standards and requires Commerce and the state's utilities to assess

[9] "Environmental Justice Task Force: Recommendations for Prioritizing EJ in Washington State Government," Fall 2020, https://healthequity.wa.gov/Portals/9/Doc/Publications/Reports/EJTF%20Report_FINAL.pdf.

[10] Joe Casola et al., "An Unfair Share Washington State: Exploring the Disproportionate Risks from Climate Change Facing Washington State Communities" (UW Climate Impacts Group, UW Department of Environmental and Occupational Health Sciences, Front and Centered and Urban@UW, 2018).

[11] Charles Lee, "Identifying and Prioritizing Environmentally Impacted and Vulnerable Communities," https://www.epa.gov/sites/production/files/2019-08/documents/state_ej_webinar_1-identifying_and_prioritizing_communities_ppt_resources_04.16.19.pdf. p.45.

energy assistance available to low-income households across the state.[12] Among other factors, under CETA utilities must consider energy and non-energy benefits for and costs to vulnerable populations and highly impacted communities in their resource and clean energy planning. They must mitigate energy burdens and consider the adequacy of energy assistance programs.

CETA is a foundation for Washington's equitable, inclusive and resilient clean energy economy. Implementation of the 2021 Energy Strategy should build on this. Experience tells us and data confirms that, the costs and benefits of our energy future will not be shared equitably without intentional action. Policy makers must embed equity, resiliency and inclusivity into policy design and implementation.

Equitable energy policy design addresses inequities, while creating environmental and economic opportunities for all. It can strengthen the economy by supporting good, family-sustaining jobs for both urban and rural workers of all levels of educational attainment. It can mitigate the hazards of rising sea levels and ocean acidification on Washington's coasts and heat stress and wildfires in the eastern parts of the state. It can also offer the opportunity to improve democratic participation across state and local government and creates public confidence in government.

The state must empower and provide opportunity for active participation by all of Washington's communities and residents. Equitable policy design will allow communities across the state to take advantage of economic and technological advancements of the clean energy transition.

1. Define Populations While Recognizing that No Single Definition May be Satisfactory

Many definitions of equity exist, and no single definition can perfectly capture the expectations and goals of all communities and populations. The EJTF developed a recommended statewide definition for environmental justice, building on the U.S. Environmental Protection Agency's definition by adding outcomes for Washington.[13] This definition provides a starting point to identify and address current injustices and to inform future decisions and actions:

> The fair treatment and meaningful involvement of all people regardless of race, color, national origin or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies. This includes using an intersectional lens to address disproportionate environmental and health impacts by prioritizing highly impacted populations, equitably distributing resources and benefits and eliminating harm.

The equity discussion woven throughout this strategy leans on this definition, in particular its use of "highly impacted populations" to name the priority communities whose inequities need to be identified and addressed. Highly impacted populations have connections across race and ethnicity, income, housing status, immigration status and heath disparities.

This definition has its limitations. Highly impacted populations are not a monolith and it is important to hold space for community members and advocates to come forward and weigh in on process and policy development. Each community, family and individual will have different histories and needs. There is no one-size-fits-all mentality when it comes to equitable policy design. For instance, the inequities that

[12] "Supporting Washington's Clean Energy Economy and Transitioning to a Clean, Affordable, and Reliable Energy Future," Pub. L. No. SB 5116 (2019), https://app.leg.wa.gov/billsummary?BillNumber=5116&Initiative=false&Year=2019.

[13] "Environmental Justice Task Force: Recommendations for Prioritizing EJ in Washington State Government."

exist in urban areas may well differ from those of rural areas. Policy needs to recognize and include elements that address the full spectrum of interests impacted.

Action:

- Policy makers, stakeholders and the public must recognize the different perspectives of highly impacted populations and the limitations of any single definition when writing, enacting, implementing and analyzing energy policy.

2. Break from Historical Patterns and Narratives

CETA and the recent law revising Washington's greenhouse gas reduction limits[14] acknowledge that it is in the public interest to embed equity in our state's energy policy. Yet historical conversations and solutions in energy policy tended to focus on energy price, assuming low costs for all are equitable and that local participation will occur without direct and specific outreach and inclusion. Much of the conversation on equity by policy makers ignores the role of history in shaping the lived experiences of highly impacted populations. This results in the perpetuation of exclusion and inequities.

- **Equity must consider the price of energy but also energy sufficiency and the health and economic impacts from energy production.** It is not an equitable result if everyone receives low electricity rates and gas prices, while highly impacted populations disproportionately bear the health and economic costs of our energy system or lack sufficient energy to live healthy, productive lives.
- **Equity is not in and of itself assured through fair and open public meetings.** Fair and open public comment sessions do not invite comments from those historically excluded. These voices must be intentionally sought out, respected, empowered and privileged.
- ***The clean energy transition will not be equitable if it benefits only a few or if the costs are equally distributed across communities.*** The institutions largely responsible for our current inequities share a common responsibility to assist highly impacted communities and ensure their participation in the clean energy transition.

Action:

- Recognize that historical energy policy has been based on incomplete understanding of equity and offer more holistic, historically informed context for ensuring an equitable outcome.

3. Encourage Public Participation and Empower Historically Underrepresented Voices

Public and community participation is important to ensure energy policy is informed by local knowledge, meets local needs and is viewed as legitimate by the local community. Whenever possible, enhanced technical assistance should be provided to facilitate the involvement of smaller communities, organizations, utilities and companies. The system must have capacity to consult with and include communities and community members must have a seat at the table in designing programs and selecting projects.

[14] Chapter 70A 454.020 RCW.

Examples of successful, robust community outreach in our state, include Puget Sound Sage's climate equity community-based participatory research,[15] and the Climate Equity Task Force and public participation for the King County Strategic Climate Action Plan 2020 Update.[16] There are emerging frameworks from statewide environmental justice efforts, such as the newly release report from Front and Centered, "Accelerating a Just Transition in Washington State,"[17] exploring the intersection of governance, regenerative economics and community power.

The EJTF developed a detailed set of public participation guidelines and recommendations. (See the Equity Appendix A for further discussion of these public participation strategies.) There must be a commitment to fully fund and develop the enabling tools and strategies and take a ground-up approach to the design, adoption and implementation of our state's energy policies.

In addition, state and local governments must continue intentional and thoughtful engagement with Tribal governments to understand the different ways Tribes approach their relationship with energy. Steps must be taken to ensure meaningful outreach and opportunity for participation by all of Washington's Tribes. In addition to direct engagement with Tribal staff and leaders, organizations such as the Affiliated Tribes of Northwest Indians, the Association of Washington Tribes and the National Congress of American Indians are valuable forums in which to collaborate on climate and energy issues.

Among other factors, for Tribes the design and implementation of Washington's energy policy must strengthen sovereignty. Planning efforts conducted by Tribes can help inform the actions of other governments. Examples include the Spokane Tribe's climate action plan,[18] the Makah Tribe's renewable energy plan[19] and climate resilience plan,[20] and the Quinault Indian Nation's climate resilience plan.[21]

A crucial component of ensuring meaningful engagement in the clean energy transition is providing the technical, financial and human resources for community participation. This includes planning, evaluating and implementing energy and resilience projects that meet the unique needs of the state's diverse communities. Policy makers must identify and amend laws and rules, remove barriers and change systems that prevent equitable and just participation in policy choices, and be comprehensive in determining the costs and benefits of implementing those policies.

The process to develop the recommendations in the 2021 State Energy Strategy was conducted with stakeholder and public engagement and input. Most notably, the process was informed by consultation with many technical experts and a 27-person Advisory Committee designated by the Legislature and including, among others, legislators, government officials and representatives of civic organizations,

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[15] "Powering the Transition: Community Priorities for a Renewable and Equitable Future" (Puget Sound Sage, 2020), https://www.pugetsoundsage.org/wp-content/uploads/2020/06/PugetSoundSage_PoweringTransition_June2020-1.pdf.
[16] Matt Kuharic, Jamie Stroble, and Lara Whitley Binder, "King County 2020 Strategy Climate Plan" (King County, 2020).
[17] "Front and Centered Approach to Equitable Greenhouse Gas Reduction in Washington State" (Front and Centered, 2020), https://frontandcentered.org/accelerating-just-transition-in-wa-state/.
[18] "Sustainable Community Master Plan" (Spokane Tribe of Indians, 2013), https://spokanetribe.com/wp-content/uploads/2020/03/FINAL_2015_SCMP.pdf.
[19] RobertLynette, John Wade, and Larry Coupe, "Comprehensive Renewable Energy Feasibility Study for the Makah Indian Tribe," March 31, 2005, https://doi.org/10.2172/850362.
[20] "Makah Tribe – 2017 Project," accessed November 1, 2020, https://www.energy.gov/indianenergy/makah-tribe-2017-project.
[21] "DOE Assists Quinault Indian Nation with Plans for a Climate-Resilient Community," Energy.gov, 2016, https://www.energy.gov/indianenergy/articles/doe-assists-quinault-indian-nation-plans-climate-resilient-community.

energy and utility businesses, as well as public interest advocates. Meaningful community outreach and participation was limited due to a compressed schedule and limited in-person opportunities due to the global pandemic. More robust participation needs to occur in the implementation of the strategy.

Action:

- Incorporate community participation as a part of the design, adoption and implementation of policies flowing from the state energy strategy across all levels of government, ensuring the availability of the financial, technical and human resources necessary to meaningful involvement by those historically underrepresented.

4. Prioritize Energy Resiliency as Part of Energy Policy and Planning

Climate change exacerbates and worsens the impacts of natural disasters: sea-level rise, floods, heat waves, extreme weather, increased wildfires and infectious diseases. Planning for these events goes hand-in-hand with clean energy planning. Both involve the siting and construction of new transportation and energy infrastructure and investments in the social infrastructure and social safety net.

These investments make public and community institutions resilient. However, there is always the temptation to wait until a crisis happens before doing anything about it. Preparation should be by design, not in response to disaster. Resiliency must be prioritized as part of upfront energy planning. Communities must be sufficiently resourced to design, plan, prepare and implement resiliency measures.

Action:

- Incorporate energy resilience in policy design and energy planning.

5. Embed Equity in the Design of Clean Energy Policies and Programs

Figure 4 and Table 1 outline a seven-step process for building equity into clean energy policies and programs. The applicability of each step to any one particular energy policy or program may vary. However, it is useful to evaluate every clean energy policy and program using these metrics to ensure equitable policy and programmatic design.

Figure 4. Build an Equitable and Inclusive Clean Economy

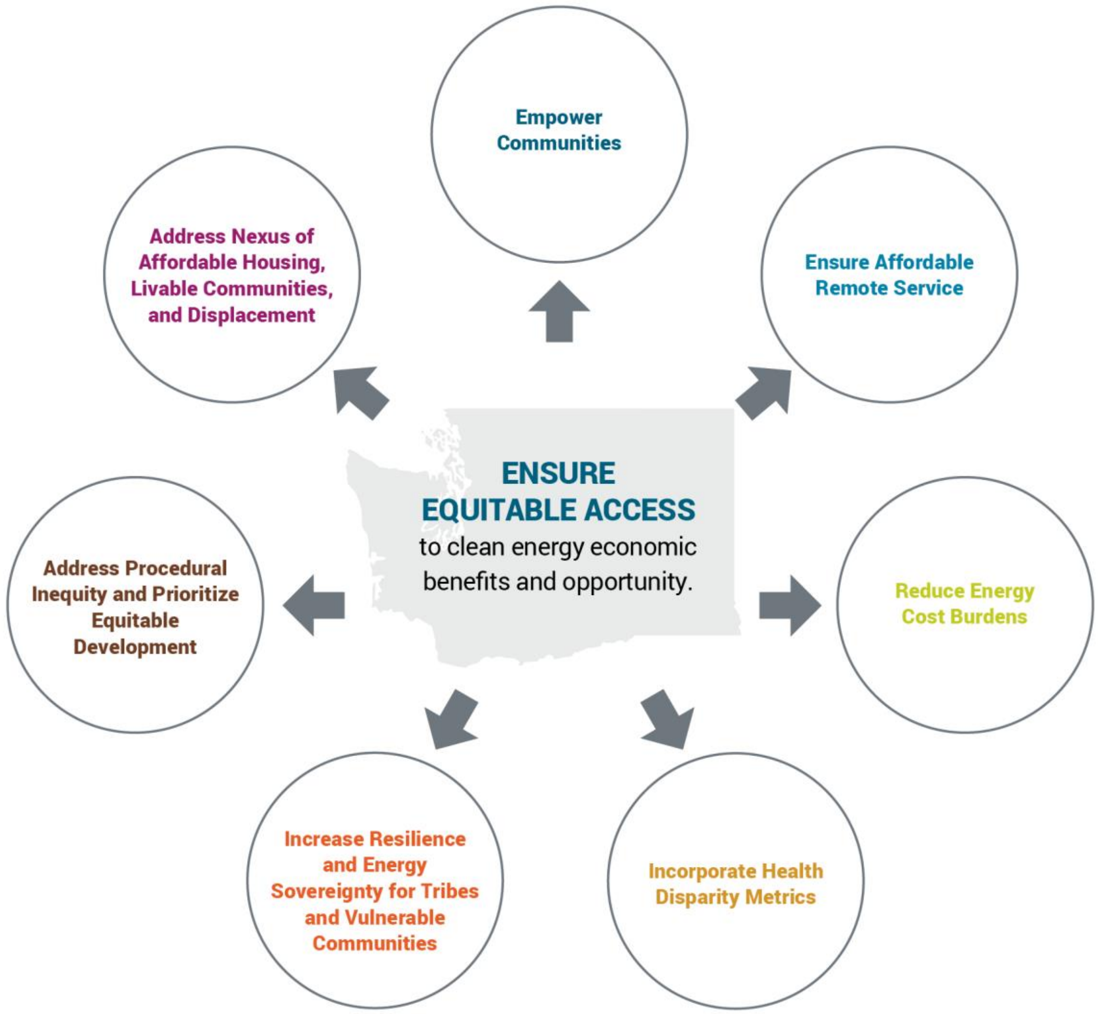

Table 1. Seven-Step Process for Building Equity into Clean Energy Policies[22]

Equitable Policy Design	Highlights and Priorities
1. Ensure equitable access to economic benefits and opportunity by empowering communities.	▪ Support participatory processes, direct funding, removal of barriers to autonomy and independence and greater access to processes and decisions.
2. Ensure universal and equitable access to affordable remote service options.	▪ Efforts must be expanded to develop affordable, quality broadband, including in rural and unserved or under-served areas.
3. Center program design on reduction of energy cost burdens.	▪ Reduce home energy and transportation costs for highly impacted populations by focusing on cost burden as a metric in planning.
4. Incorporate health disparity metrics into energy planning.	▪ Improve health and safety, safeguard against health and safety risks and improve access to the physical, service and social conditions linked to health and well-being by operationalizing a health disparity metric in energy planning.[23]
5. Increase resilience and energy sovereignty for Tribes and energy independence for vulnerable communities.	▪ Support the efforts of communities especially prone to instability from climate change and other natural disasters, such as communities located in the Cascadia Subduction Zone, wildfire prone areas and communities impacted by fossil fuels.[24]
6. Address procedural inequities in program design and prioritize equitable development.	▪ Perhaps the most significant combined equity-and-energy gains can be made through planning. The state has an opportunity to help guide clean and equitable development of programs and funding that support development.
7. Address nexus issues of affordable housing, livable communities and displacement in energy policy.	▪ Work with housing policy experts to address unhoused and displaced communities through energy policy design, especially focusing on cost burdens.

Another way to ensure that a policy or program is equitably designed is to evaluate it by the three different types of equity: 1) structural equity; 2) procedural equity; and 3) distributional equity as

[22] Kuharic, Stroble, and Binder, "King County 2020 Strategy Climate Plan." p. 173.
[23] "How Do Neighborhood Conditions Shape Health? An Excerpt from Making the Case for Linking Community Development and Health" (Center on Social Disparities in Health, Build Healthy Places Network, Robert Wood Johnson Foundation, 2015), https://www.buildhealthyplaces.org/content/uploads/2015/09/How-Do-Neighborhood-Conditions-Shape-Health.pdf.
[24] "Resilient Washington Subcabinet Report" (Washington Military Department's Emergency Management Division, 2017), https://mil.wa.gov/asset/5ba420648fb16.

described in Figure 5.[25] These three dimensions are foundational to environmental justice work and help focus policy design on equitable outcomes for communities. Each dimension requires distinct strategies to be achieved:

Figure 5. Three Dimensions of Environmental Justice Work

Action:

- Governments need to evaluate proposed and existing policies using a framework for equitable policy design and ensuring meaningful engagement in policy design and implementation by those affected. Local communities and advocacy organizations in turn need to hold policy makers and government officials accountable when policies fail to meet these criteria.

B. Achieve the State's Greenhouse Gas Emission's Limits

1. Washington State Emissions

Washington's residents and businesses were responsible for 98.9 million metric tons of greenhouse gas emissions in 2018, the year of the most recent state emissions inventory. Nearly half (45%) of the emissions were from transportation. The state's transportation emissions approximate the U.S. average per capita – compared to other states, Washingtonians drive slightly less per capita[26] but consume more fuel for freight, air and ship travel.

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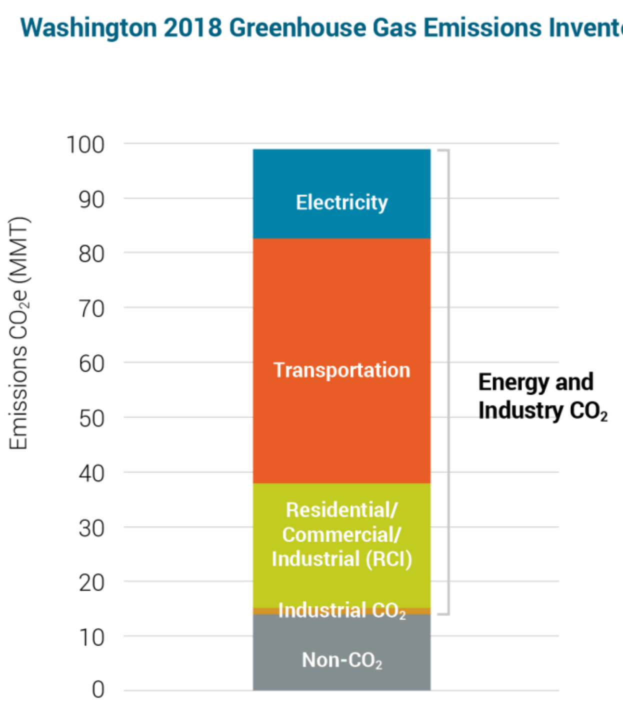
[25] Tina Yuen et al., "Guide to Equitable, Community-Driven Climate Preparedness Planning" (Urban Sustainability Directors Network, RAIM + Associates, May 2017), https://www.usdn.org/uploads/cms/documents/usdn_guide_to_equitable_community-driven_climate_preparedness-_high_res.pdf.

[26] "U.S. VMT Per Capita By State, 1981-2017," 2019, https://www.enotrans.org/eno-resources/u-s-vmt-per-capita-by-state-1981-2017/.

The reason transportation is dominant in Washington's greenhouse gas emissions profile is due to the state's relatively clean electricity supply. Only 16% of Washington's greenhouse gas emissions in 2018 were from the electric sector. Buildings and industry comprised nearly a quarter of emissions, and non-energy/non-CO_2 emissions were approximately 15%. (See Figure 6.)

Washington's greenhouse gas emissions have grown by roughly 10% since 1990, the baseline year from which to calculate the state's emissions limits. Consequently, our 2030 emissions target of a 45% reduction relative to 1990 translates to a 53% reduction relative to emissions in 2018. (See Figure 7.)

Figure 6. Washington State 2018 Greenhouse Gas Emissions Inventory by Sector

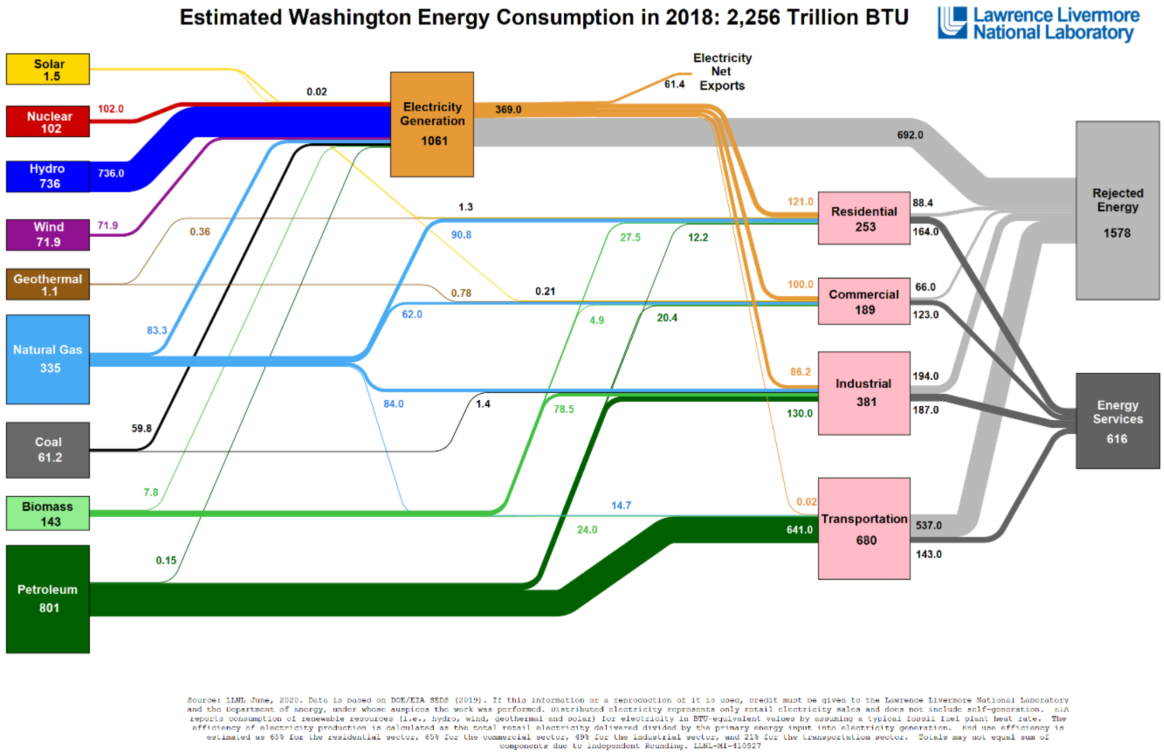


Source: Washington State Department of Ecology Greenhouse Gas Inventory.

The state's 2018 emissions result from energy consumption as depicted in Figure 7 below, which shows an estimate of Washington's energy consumption in 2018 using Energy Information Agency data.[27]

[27] "Estimated Washington Energy Consumption in 2018," Lawrence Livermore National Laboratory, accessed December 1, 2020, https://flowcharts.llnl.gov/content/assets/images/charts/Energy/Energy_2018_United-States_WA.png.

Figure 7. Estimate Washington Energy Consumption in 2018



1.1. Pathway to Zero Net Emissions in 2050

The objectives of the 2021 State Energy Strategy are directly linked to the revised greenhouse gas emissions reductions limits established by the Legislature in 2020. Updating limits set in 2008, the Legislature established ambitious economy-wide goals: a 95% reduction below 1990 levels by 2050, with interim economy-wide emissions limits of 45% below 1990 levels by 2030 and 70% below 1990 levels by 2040.

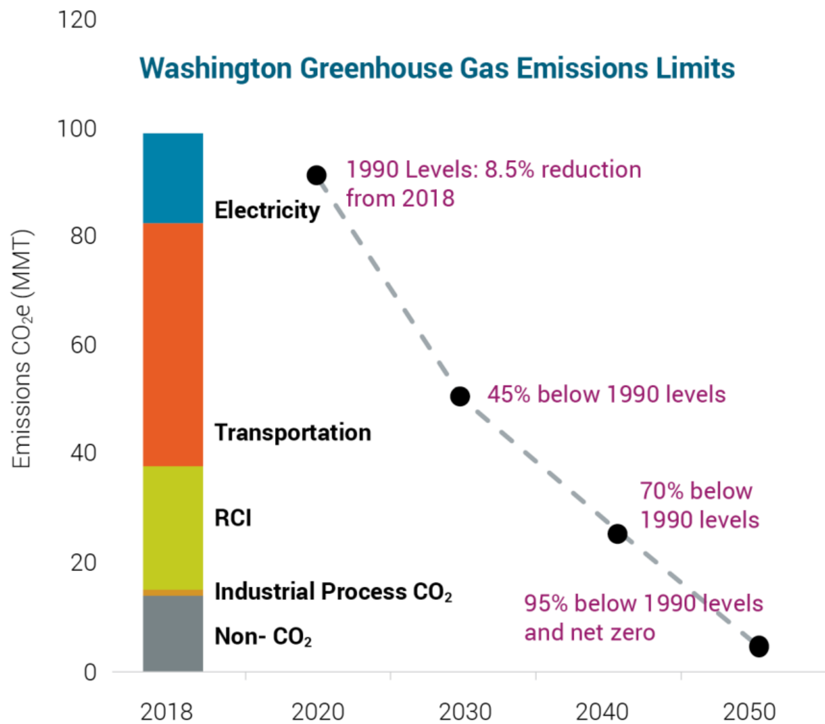
In addition, the state committed to net zero emissions by 2050, which means that the residual 5% (or 5 $MMTCO_2e$) of emissions in 2050 will need to be balanced by an equivalent amount of biological or geological emissions removal from the atmosphere. These limits are established in statute[28] and are based on scientific assessment of the pace of emissions decline needed globally to keep warming to within 1.5 degrees Celsius above pre-industrial levels.

This strategy focuses on the CO_2 emissions that result from energy use, but the statewide emissions limits cover all types of greenhouse gas emissions, including non-CO_2 emissions, such as methane from agriculture, waste, and natural gas leakage, and perfluorochemicals in aluminum production. While reductions in non-CO_2 emissions are possible, the solutions are highly uncertain.

[28] Chapter 70A.45.020 RCW.

For the purpose of modelling for this strategy, we assume that all of the non-CO_2 greenhouse gas emissions in 2050 will be offset by biological or geological sequestration, thereby achieving the net zero limit of state law. This means that, in 2050, energy and industrial CO_2 emissions (referred to as energy emissions in the rest of this section) must be zero. This allows for the use of carbon-neutral fuels, including zero net emissions biofuels and synthetic fuels that capture carbon from the atmosphere and release it again. Figure 8 shows the trajectory of limits to be achieved by 2050 based on Washington State's 2018 greenhouse gas emissions.

Figure 8. Washington State 2030-2050 Greenhouse Gas Emission Limits *(assumes residual 5% of 1990 emissions remaining in 2050 will be offset by biological or geological sequestration)*



Source: Washington State Department of Ecology and Washington State.[29]*Washington State Energy Decarbonization Modeling 2020, Evolved Energy Research (p.15).*

1.2. Washington's 2030 Emissions Challenge: Cutting Energy Emissions in Half

Meeting the state's emission reduction limit for 2030 is at least as challenging as reaching the deeper 2050 limit and will require all sectors of the economy to reduce emissions at a rapid pace.

Translated proportionately to the energy emissions, the 2030 limit is equivalent to removing 45 million tons of the 85 million tons of CO_2 emitted from energy in 2018. The state starts from a 69% clean electricity grid that contributed 16 million tons of CO_2 in 2018. If all electricity emissions were removed, Washington's 2018 emissions would have to drop a further 29 million tons to meet the 2030 state limit.

[29] Chapter 70A.45.020 RCW.

Additional emission reductions will need to come from measures other than decarbonizing electricity. These measures include electrification and efficiency improvements to energy using technologies in buildings, transportation and industry and displacing fossil fuel use, primarily in transportation, with clean fuels.

The challenge for Washington will be implementing a decarbonization strategy integrated across all sectors of the economy that reduces energy-related greenhouse gas emissions in half in 10 years.

2. Pathways to Decarbonization

To examine potential paths to meet the 2030 and 2050 emissions limits, the Department of Commerce commissioned deep decarbonization pathways modeling. This effort analyzed alternative decarbonization scenarios within a modeling framework to inform the selection of policies and actions to decarbonize the state's energy sector over the coming decades.

Evolved Energy Research conducted this analysis using the EnergyPATHWAYS and RIO modeling suite. Earlier versions of these models have supported decarbonization modeling for the region and the state.[30] The modeling for the state energy strategy incorporates current technology and economic data; the state's clean electricity and emissions limits; state and regional assumptions developed in consultation with stakeholders; and a set of scenarios that capture the effect of potential strategies. The full technical report for the 2021 State Energy Strategy deep decarbonization modeling can be found in Appendix B. In this section, we address the modeling's key conclusions.

2.1. Decarbonization Scenarios

The deep decarbonization modeling explores one Reference Scenario and five decarbonization scenarios described in Table 2. The results tease out the key opportunities and challenges in decarbonizing all sectors of the energy economy at the pace indicated by the state's emissions limits. All five decarbonization scenarios modeled meet those limits.

[30] "Deep Decarbonization," accessed November 2, 2020, https://www.governor.wa.gov/issues/issues/energy-environment/deep-decarbonization.
"Northwest Deep Decarbonization Pathways Study", 2019, accessed December 1, 2020, https://tinyurl.com/y42w3a6v.

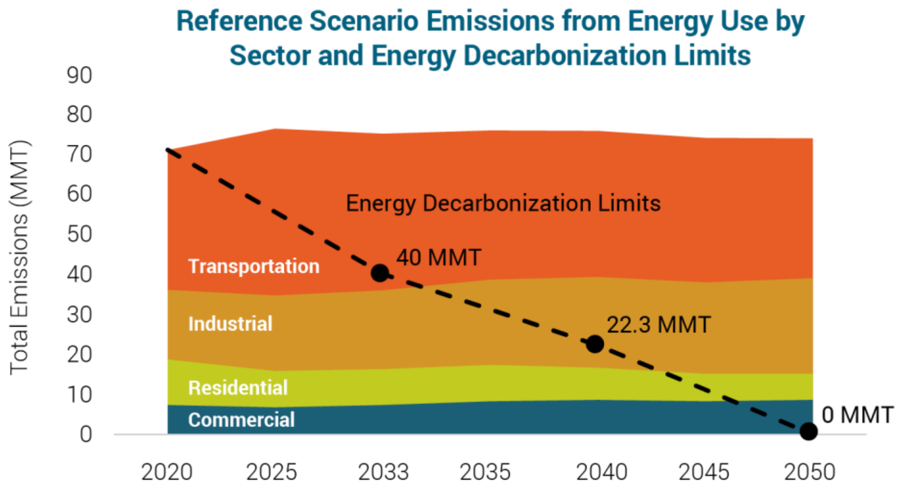
Table 2. Scenarios Analyzed, Reference Scenario and Five Decarbonization Scenarios

Scenario	Summary	Key Questions	Policy Mandates
Reference	Business as usual	Assumes current policy is implemented and no emissions target	No constraints on emissions.
Electrification	Investigates a rapid shift to electrified end uses	What if energy systems achieved aggressive electrification and aggressive efficiency, and relatively unconstrained in-state and out-of-state technology were available?	Meets 2050 net zero emissions target
Transport Fuels	Investigates reaching decarbonization targets with reduced transportation electrification	What if energy systems achieved aggressive electrification and aggressive efficiency, and relatively unconstrained in-state and out-of-state technology were available?	
Gas in Buildings	Investigates reaching decarbonization targets by retaining gas use in buildings	What is the difference in cost of retaining gas appliances in buildings?	
Constrained Resources	Investigates a future that limits potential for transmission expansion into Washington	What alternative investments in in-state resources would Washington make if transmission expansion is limited due to siting/permitting challenges?	
Behavior Changes	Investigates how lower service demands could impact decarbonization	What if policy-driven or natural behavior changes (i.e., more telecommuting post COVID-19) lower service demands?	

Source: Washington State Energy Decarbonization Modeling 2020, Evolved Energy Research (p.21).

In each decarbonization scenario, the model finds the lowest cost way of supplying energy to meet the 2030 and 2050 emissions limits. Technology costs are based on the best publicly available projections. Actions to reduce emissions cross the sectors of the economy. Comparing the scenarios provides useful information about the best strategies for decarbonization, targeting the lowest cost actions first. Projected Reference Scenario emissions from energy use and the energy emissions limits for the decarbonization scenarios are shown in Figure 9.

Figure 9. Washington State Trajectory to 2050, by Energy Consumption in Each Sector



Source: Washington State Energy Decarbonization Modeling 2020, Evolved Energy Research (p.26).

The Reference Scenario reflects future developments consistent with the U.S. Department of Energy's Annual Energy Outlook's Reference Scenario, as well as current policy in the region. For example, the state's 100% clean electricity law (CETA) is reflected in the Reference Scenario. Even with the elimination of emissions from electricity under CETA, Washington's overall emissions do not decrease in the Reference Case because without new policies fossil fuel consumption will increase as fast as the electricity sector phases out fossil fuels.

The decarbonization scenarios investigate different pathways toward reaching the state's greenhouse gas emission limits, with each scenario reflecting different policy priorities and/or uncertainties in future outcomes. Comparisons between and among the different investments and overall costs of decarbonizing the economy in each scenario inform the policy choices in the 2021 State Energy Strategy.

The Electrification Scenario explores the impacts of a rapid shift to electrified end uses. The Transport Fuels Scenario models a slower transition to electrification in transportation, either due to policy driving a more gradual shift, or because of slower than expected electric vehicle adoption.

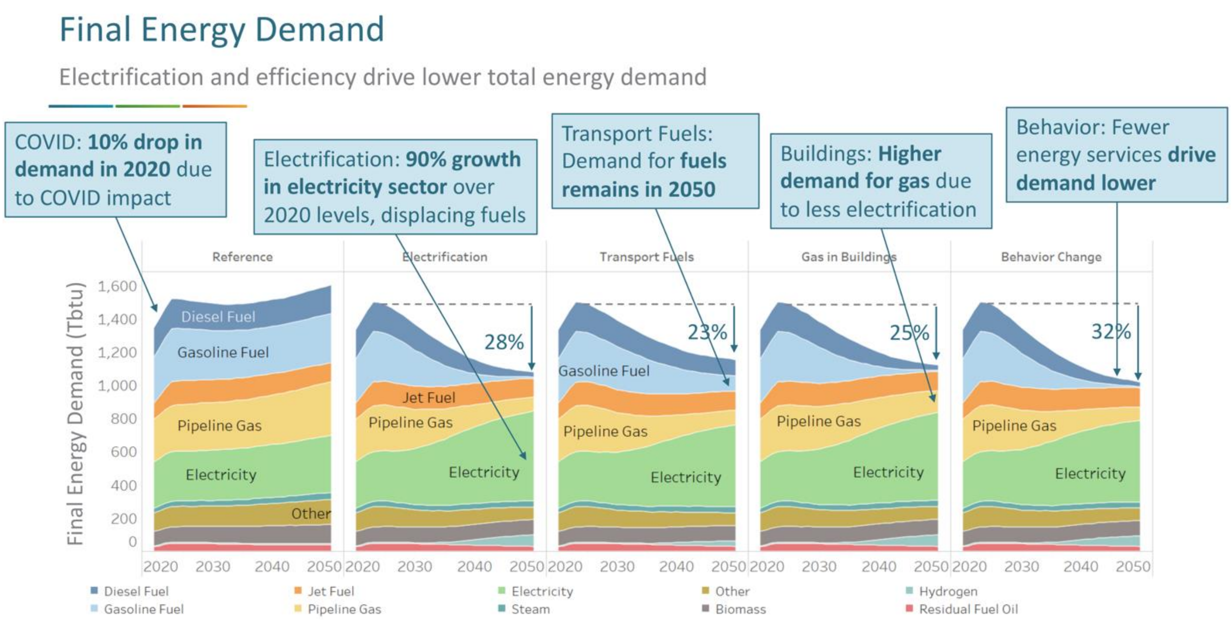
The Gas in Buildings Scenario models a future where demand for gas in the built environment, such as for heating and cooking, remains through 2050. Gas supplied through the pipeline can include a blend of different types of gas. This blend is referred to as "pipeline gas" in the remainder of the strategy. Pipeline gas can be partially or even fully decarbonized by replacing fossil gas with cleaner alternatives such as biogas, synthetic gas or hydrogen.

The Constrained Resources Scenario models the impact if Washington were unable to expand transmission interties to other states. Finally, the Behavior Change Scenario evaluates the impact of consumer choices to decrease their energy consumption by driving less and reducing their demand for energy services in buildings. For the assumptions behind all six scenarios, please see the Appendix B.[31]

2.2. Changes in Energy Demand

In all five decarbonization scenarios, electrification and efficiency drive lower total final energy demand than in the Reference Scenario, where energy demand in 2050 increases by 6% relative to 2023, the year we assume the economy has recovered from the COVID-19 pandemic (see Figure 10). In all scenarios other than Behavior Change, customers have the same demand for energy services. For example, they heat their homes to the same temperature and drive the same number of miles. Final energy demand varies because of differences in the energy efficiency of the different types of equipment customers can use to provide these services. For example, a battery electric vehicle requires less energy per mile than an internal combustion engine fueled by gasoline.

Figure 10. Total Energy Demand 2020-2050



Source: Washington State Energy Decarbonization Modeling 2020, Evolved Energy Research, page 28.

However, improvements in efficiency cannot happen overnight. Retiring existing equipment – a late model gasoline vehicle for example – is expensive. Replacing equipment on that scale would be infeasible all at once. Therefore, we assume, conservatively, that customers invest in more efficient equipment only at the end of the useful life of their existing equipment, a time when they would have bought new equipment anyway. The total stocks of equipment in homes, businesses and on the road is of varying age at any given time. It takes time to roll over total stocks of equipment to more efficient and cleaner versions.

[31] Washington State Energy Strategy Decarbonization Modeling Final Report Draft. Evolved Energy Research. November 30, 2020. https://www.commerce.wa.gov/wp-content/uploads/2020/11/WA-SES-EER-DDP-Modeling-Final-Report.pdf.

Using energy more efficiently through electrification and other measures reduces overall demand and the investment needed in energy supply infrastructure and fuels. The costs of the new equipment necessary to lower final energy demand is likely greater than the cost of less efficient equipment. However, reducing supply infrastructure and fuel investments saves money. How a scenario compares in total cost to any other depends on its relative demand- and supply-side costs.

In the Electrification Scenario, total energy demand drops 28%. Electricity demand grows 90% over 2020 levels by 2050, displacing fossil fuels in buildings and transportation through assumptions that drive replacement of existing equipment with electrified appliances and vehicles at the end of their useful lives. The Constrained Resources Scenario shares the same final energy demand as the Electrification Scenario and is therefore not shown.

Total energy demand drops the least in the Transport Fuels Scenario (23%). Demand for fuels is still significant in 2050 because greater numbers of internal combustion engines will remain on the roads. These vehicles have lower energy efficiency than electric alternatives.

The Gas in Buildings Scenario sees a 25% drop in total energy demand by 2050. In contrast to the Electrification Scenario, customers replace gas consuming appliances with more efficient modern gas appliances. Differences in the pace of electrifying transportation accounts for the largest differences in demand between the scenarios.[32]

The Behavior Change Scenario achieves the greatest drop in demand for energy (32%) with less use of the services that energy provides in transport and buildings. This scenario illustrates the benefits if policy makers act to encourage driving cars less and using fewer energy services in buildings. As we will see, achieving the levels of electrification required to hit the 2030 emission reduction limit presents several technical and economic challenges. This puts an even finer point on the need to encourage less energy use wherever possible.

2.3. Modeling the Supply Side

The previous section presents the demands for energy in Washington with different assumptions about the types of equipment customers would adopt on the demand side. The next step of the modeling determined the least-cost way of providing that energy through investments in and operations of Washington's energy supply. This includes the infrastructure to produce, store and transport fuels and electricity.

Section 1.2 introduced the challenge of reducing emissions by 2030. The relatively small amount of emissions from electricity in Washington means that if we were to decarbonize all electricity production, additional emissions reductions in other forms of energy use would still be needed. By 2030, the system will look different, depending on the scenario, as described in the previous section.

Adopting electrified energy uses and more efficient equipment means electricity demand will increase as a share of the total demand, but overall total energy demand will be less. Due to the limits on how fast equipment can be replaced with these more efficient options, reaching the target also requires

[32] Ibid, page 29.

reducing emissions by using clean fuels. Clean fuels in this section refers to fuels produced from biomass (biofuels) and fuels derived from hydrogen production through electrolysis (synthetic fuels) including hydrogen itself.

This section explores these two top-line strategies in energy supply:

1. Building a clean electricity sector to supply expanding electric loads
2. Decarbonizing fuels to meet the short-term emission limits

2.3.1. Building a Clean Electricity Sector to Supply Expanding Electric Loads

Total demand for electricity nearly doubles by 2050 in the Electrification Scenario and expands significantly in the other scenarios. Supplying this electricity from clean electricity sources is cheaper than other alternatives such as decarbonizing fuels. Washington's electricity supply is already 69% clean because of the state's significant hydro resource, however we assume there is no opportunity to expand hydroelectricity supply in the future, so wind and solar resources provide the additional energy needed.

In 2020, Washington is a net exporter of energy. As renewable generation fills the state's additional energy needs, Washington becomes a net importer, bringing in 43% of its electricity by 2050 in the Electrification Scenario, 36% of which comes from Montana and Wyoming wind. To understand where imports into Washington derive from throughout the West, please see page 39 of the technical report in Appendix B. The lower relative cost of these out-of-state resources versus in-state opportunities limits the growth of new renewable capacity in state until 2040 when Washington starts to build solar and offshore wind.[33]

Quantities of resources built in Washington are relatively similar across the decarbonization scenarios with the exception of the Constrained Resources Scenario. By constraining transmission expansion into Washington, more clean electricity must come from in-state resources. Prior to 2040, electricity needs are largely met with increased imports of renewable energy from other states as in the other decarbonization scenarios. However, in 2040 to 2050, significantly more in-state solar and offshore wind are built as the capacity to import more from elsewhere is exhausted. In-state solar capacity in 2050 is 18 GW versus 12 GW in the Electrification Scenario, and offshore wind capacity is 10 GW versus 4 GW in the Electrification Scenario.[34]

In all decarbonization scenarios, wind is the dominant form of energy in the Western U.S. by 2050, followed by solar. This drives expansion of transmission across the West to take advantage of both renewable and geographic resource diversity. Northwest wind and Southwest solar are relatively complementary resources, and energy flows across the West increase to take advantage of this diversity to lower total system costs. Greater interconnection among the 11 Western states is a key part of all scenarios and points to the importance of expanded regional coordination and transmission to lower overall decarbonization costs. Six GW of new transmission (the maximum permitted in the model) are added between Montana and Washington and 5 GW between Idaho and Washington by 2050.[35]

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[33] Ibid, p. 37.
[34] Ibid, p. 36.
[35] Ibid, p. 40.

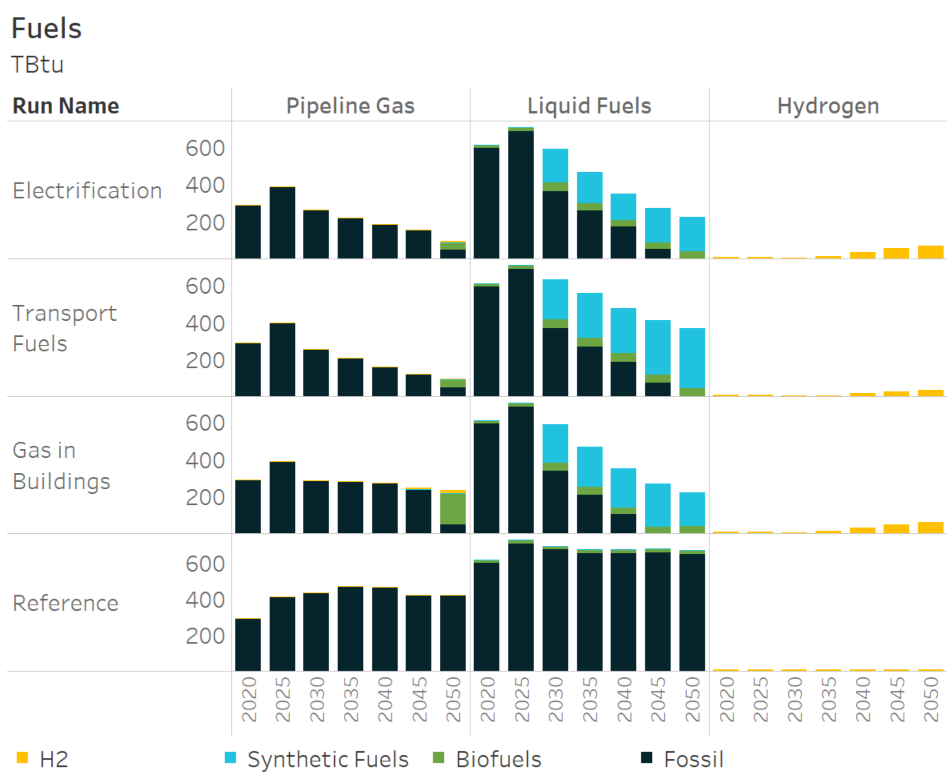
Part of the increase in electric loads in all scenarios comes from new flexible loads, including from electrolysis and electric boilers. Synthetic fuels derived from hydrogen, such as clean diesel, gasoline and jet fuel, can be cheaply stored. This allows electrolysis loads to ramp up during periods of plentiful renewable energy production and reduce or go offline during times of lower renewable output. This novel, large flexible load helps balance the grid and shore up reliability.

2.3.2. Decarbonizing Fuels to Meeting the Emissions Limits

Another critical finding is the importance of clean fuels to achieving the 2030 and 2050 greenhouse gas reduction limits. In all decarbonization scenarios, liquid fuels are not eliminated, but they are fully decarbonized by 2050 with a combination of synthetic fuels, biofuels and hydrogen. These fuels are produced using renewable electricity, biomass and, in some cases, carbon captured from industrial processes. Clean fuels substitute for fossil-based gasoline, diesel, and jet fuel.

The need for clean liquid fuels to meet the 2030 emissions limits is driven in part by restrictions on the rate at which the transportation fleet can be converted to battery electric or hydrogen vehicles and the rate that end uses in buildings can be electrified. The 2030 limit requires significant expansion of the clean fuels industry to reduce emissions from transportation. Figure 11 shows how fossil fuels are decarbonized in three of the decarbonization scenarios compared to the Reference Scenario.

Figure 11. Clean Fuels are Important to Reach Decarbonization Limits



Source: Washington State Energy Decarbonization Modeling 2020, Evolved Energy Research, page 42.

2.4. Costs and Benefits of Decarbonization

Energy costs include investments in supply-side equipment, such as wind and gas turbines, transmission and clean fuels production infrastructure; and operating costs of the equipment, such as operations and maintenance and fuel. In the decarbonization scenarios, energy costs also include investments in more efficient or electrified demand side equipment, such as electric vehicles and heat pumps. The costs of decarbonization include investments in these categories that are greater than in the Reference Scenario. For example, the expanding electricity sector with rapid electrification of end uses requires more investment than in the Reference Scenario, where loads stay relatively consistent.

Additional equipment costs for decarbonization are largely offset by savings from the avoided purchase of fossil fuels. The decarbonization costs are the net difference in costs between the decarbonization scenarios and the Reference Scenario. There are additional costs and benefits not included in this calculation – the analysis considers only direct infrastructure and operating costs and does not include other categories, such as growth in jobs. Health benefits to Washington residents from improved air quality are also not included in these totals, however the health benefits and their impact on net costs is covered at the end of this section.

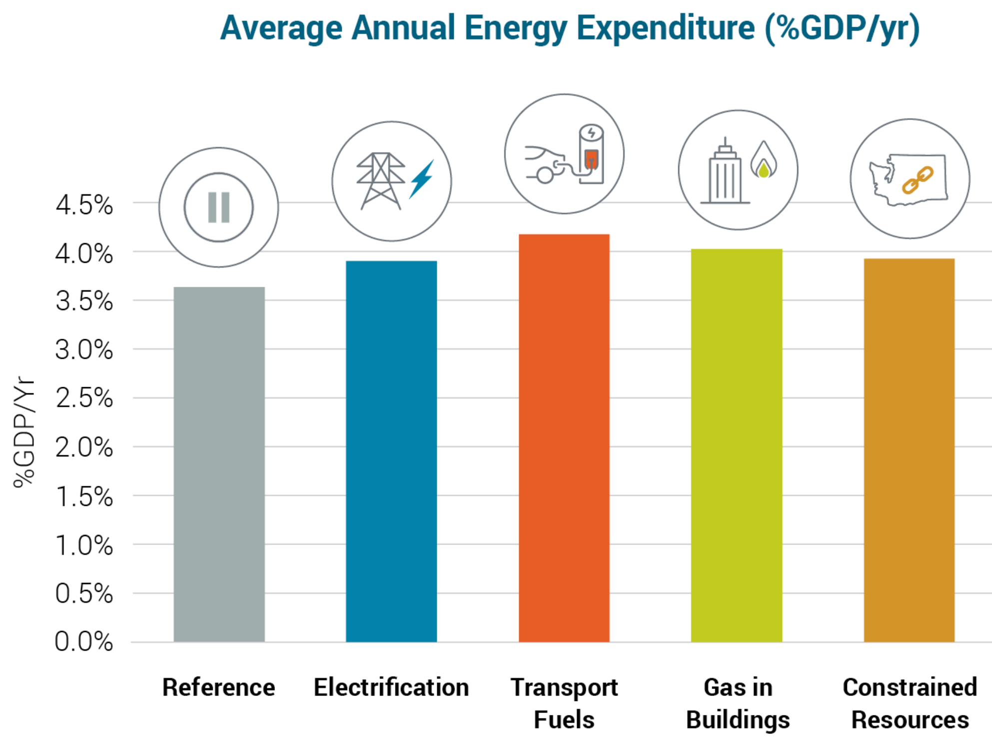
Annual energy spending[36] as a percentage of GDP averaged over the 30-year period from 2020 to 2050 is only slightly higher than the Reference Scenario for the decarbonization scenarios as Figure 12 shows. Rapid electrification and efficiency measures, transmission expansion and access to out-of-state resources achieve the lowest costs in the Electrification Scenario.

The Transport Fuels Scenario, where fewer vehicles are electrified or transition to hydrogen, requires more clean fuels, which drives higher costs. But the slower transition to EVs means fewer demand-side equipment costs. Not pursuing building electrification in the Gas in Buildings Scenario avoids investments in electricity distribution but relies on higher consumption of more costly clean fuels. Leaving gas in buildings in the short term will require even more clean fuel investment in the future.

The Constrained Resources Scenario yields cost results that are approximately the same as the Electrification Scenario, albeit with different investments in different locations. The Electrification Scenario invests in new transmission capacity to access high-quality wind and solar resources in other states. The Constrained Resources Scenario invests less in transmission but spends more to build renewable resources in and offshore from Washington. Even in the Constrained Resources Scenario, Washington relies on large quantities of imported energy. Additional investments in offshore wind in 2045 and 2050 are reasonably competitive against out-of-state onshore wind and the investment in transmission to access it based on forecasted prices.

[36] Annual energy spending is reported in this section as the levelized investment in infrastructure plus operating costs, such as for fuels and operations and maintenance.

Figure 12. On Average, Spending for Decarbonization is Slightly Higher than the Reference Scenario

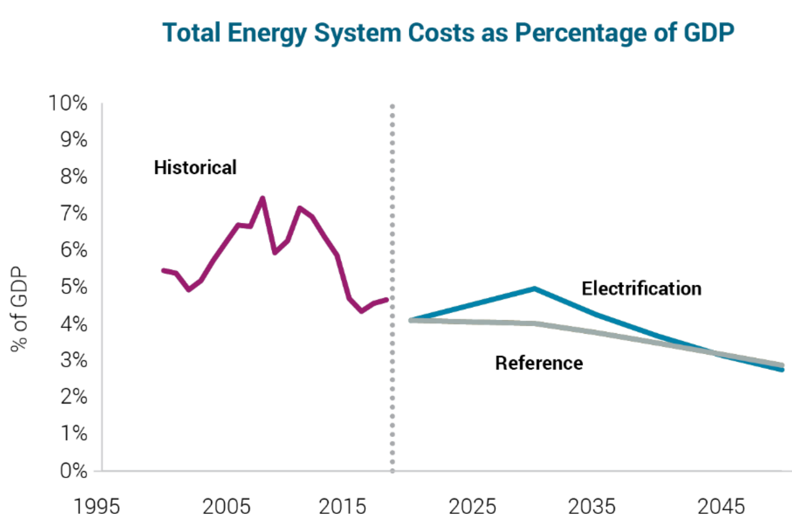


Source: Washington State Energy Decarbonization Modeling 2020, Evolved Energy Research, page 52.

2.4.1. Decarbonization Spending across the Scenarios

Net direct economic benefits exceed costs by the 2040s relative to the Reference Scenario, based on the assumed resource prices used in the model. Decarbonization requires a significant investment between 2020 and 2030 to reach the stringent 2030 emissions reductions target, but energy spending in the lowest cost Electrification Scenario drops below the Reference Scenario in the 2040s (Figure 13).

Figure 13. Total Levelized Energy System Cost as a Percentage of Washington GDP relative to Historical

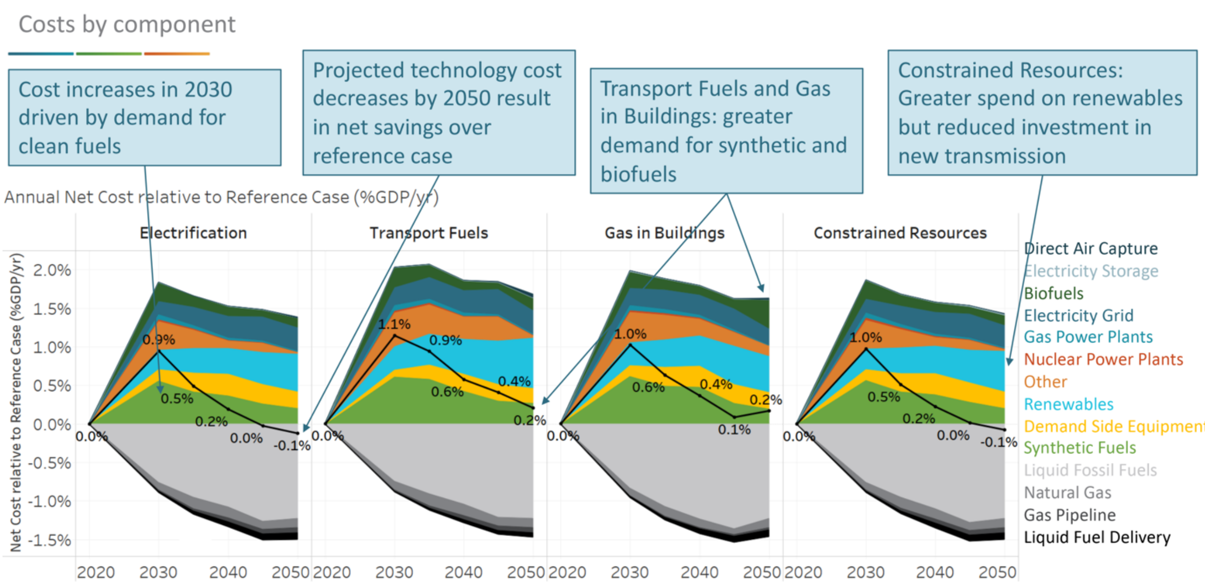


Source: Washington State Energy Decarbonization Modeling 2020, Evolved Energy Research, page 55.

Demand for clean fuels drives cost increases in the short term, but the projected decrease in decarbonization technology costs results in savings over the Reference Scenario in 2050 as seen in Figure 14. Decarbonization costs are projected to remain below the historical average of energy spending.

The economy is forecasted to grow at a faster rate than energy consumption between 2020 and 2050 lowering energy costs as a share of total GDP. Price spikes in energy spending in the last two decades were caused by fuel price volatility and the 2008-2009 recession. Decarbonizing the economy acts as a hedge against fuel price volatility in the future by reducing the fraction of energy spending on fossil fuel imports and therefore reducing exposure.

Figure 14. Cost Components of Decarbonizing Relative to Reference Case



Source: Washington State Energy Decarbonization Modeling 2020, Evolved Energy Research, page 54.

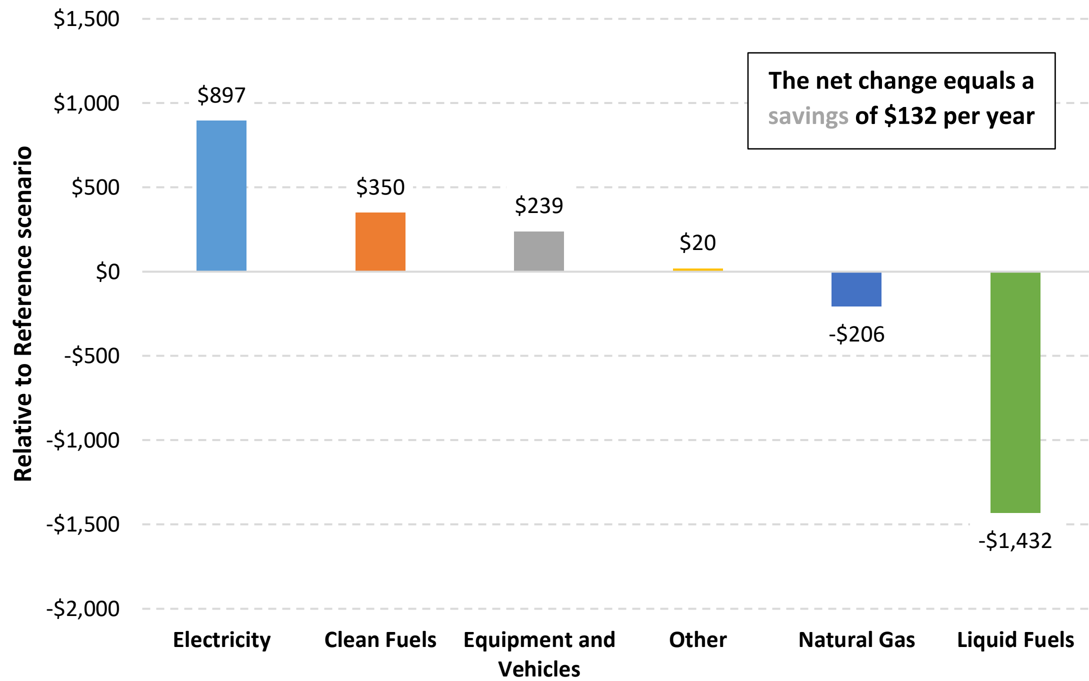
Relative to the Electrification Scenario, spending in the other decarbonization scenarios is higher, as shown in. Retaining fuel use in transportation or in buildings requires greater investment in clean fuel production which is more costly than the electrification of end uses in the Electrification Scenario. Restricting the expansion of Washington's interties in the Constrained Resources Scenario is also more expensive.

The Behavior Change Scenario points to significant savings with actions that incentivize people to use less energy. Behavior changes might include choosing housing with a shorter commute distance or operating a building at a lower thermostat setting. However, a lack of information about the cost to achieve the changes in behavior hampers full understanding of the savings. It is recommended that the state further study options for cost-effective behavioral measures that would decrease demand for energy.[37]

[37] Ibid, p. 57.

On a per capita basis, by 2050 the Electrification Scenario would save the average energy customer in Washington approximately $132 per year, and the Constrained Resources would save about $83 per year, as seen in Figure 15, based on forecasted technology costs and fuel prices.

Figure 15. Per Capita Spending by Average Washington Energy Customer in the Electrification Scenario in 2050



Source: The Economic and Health Impacts of Deep Decarbonization in Washington, FTI Consulting, November 25, 2020.

The costs reported above include investments in energy demand and supply side equipment, fuels, and other operating costs. Beyond these direct costs, Washington will experience benefits from decarbonization including reduced impacts from the changing climate if the rest of the world also decarbonizes, and improved air quality.[38] Displacing fossil power generation with renewables and electrifying the vehicle fleet both contribute to cleaner air for Washingtonians.

Figure 16 summarizes the air quality improvements associated with decarbonization from 2020 compared to 2050, which include elimination of mercury emissions and over 90% reductions in nitrogen (NOx) and sulphur dioxide (SO_2)emissions from power generation, as well as significant reductions in particulate matter and NOx emissions from transportation. Figure 17 shows how decarbonization would greatly improve Washington's air quality.

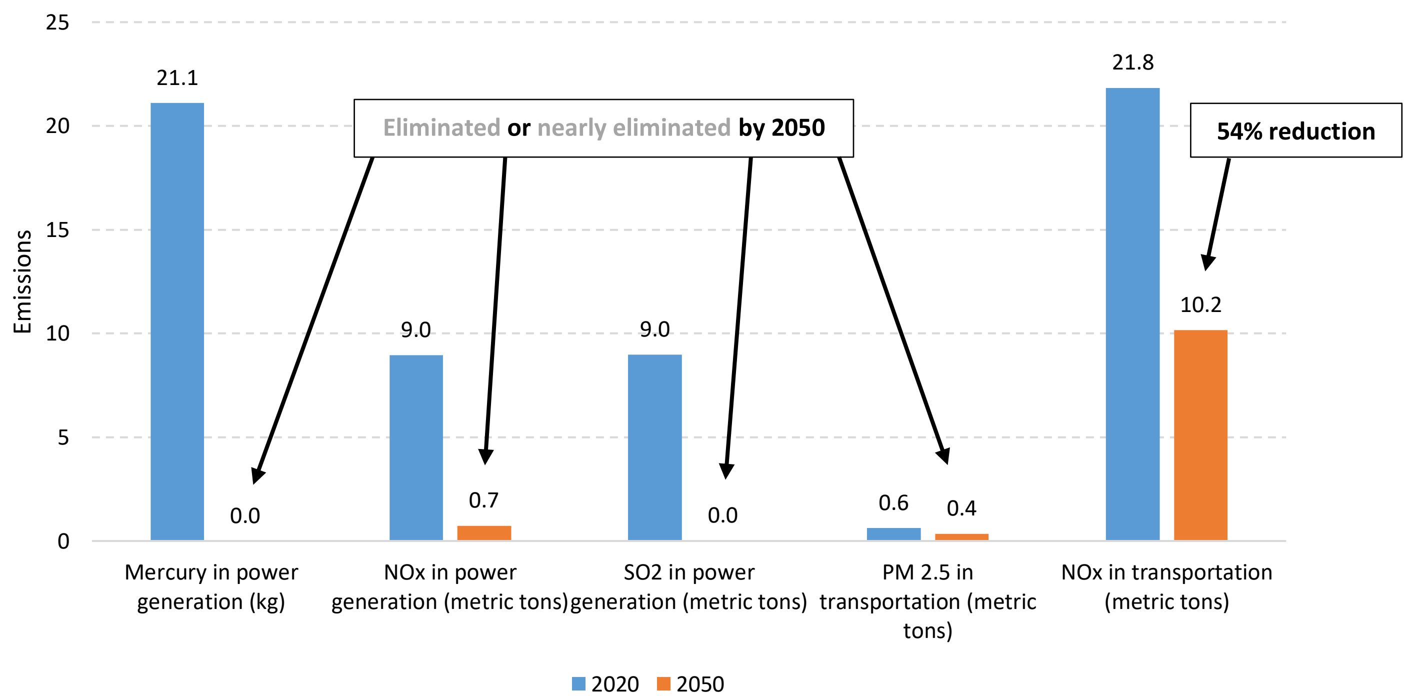
[38] "Global Co-Benefits of Decarbonisation" (University of Cambridge, Centre for Climate Change Mitigation Research), accessed November 30, 2020, https://www.4cmr.group.cam.ac.uk/filecab/global-co-benefits.pdf.

Figure 16. Summary of Air Quality Impacts from Decarbonization

Sectoral Source	Compound	Emissions in 2020	Emissions in 2050	Percent Change
Power Generation	Mercury (kilograms)	21.1	0.0	**-100.0%**
Power Generation	NOx[39] (metric tons)	8.959	0.739	**-91.8%**
Power Generation	SO_2[40] (metric tons)	8.985	0.024	**-99.7%**
Transportation	PM 2.5[41] (metric tons)	0.635	0.354	**-44.2%**
Transportation	NOx (metric tons)	21.839	10.165	**-53.5%**

Source: The Economic and Health Impacts of Deep Decarbonization in Washington, FTI Consulting, November 25, 2020.

Figure 17. Decarbonization Greatly Improves Washington's Air Quality



Source: The Economic Health Impacts of Deep Decarbonization in Washington, FTI Consulting, November 25, 2020.

[39] Various nitrogen oxides, which have negative respiratory and cardiovascular effects.
[40] Sulfur dioxide, which has negative respiratory effects and is a component of acid rain.
[41] Particulate matter generally smaller than 2.5 micrometers, which can cause lung and cardiovascular disease.

2.4.2. Addressing Uncertainties

The costs and benefits presented here are subject to the uncertainties inherent in future technology price forecasts, fuel price forecasts, technology availability and many other factors. Uncertainty increases further into the future and the cost of decarbonization is more sensitive to some costs than others.

For example, electric vehicle forecasts have one of the largest impacts on decarbonization costs. Vehicles are the largest energy-consuming infrastructure purchase that many customers and businesses make. Small changes in vehicle cost projections have large impacts on forecasted decarbonization costs. A 10% change in electric vehicle prices impacts decarbonization costs by 0.25% of GDP in 2030 and 0.2% of GDP in 2050. In recent years, forecasts for electric vehicle costs have dropped year to year. If this trend continues and electric vehicles are cheaper in the future than current forecasts suggest, total decarbonization costs will be reduced.

3. Modeling Implications for Washington's Energy Policy

The modeling offers insights for pathways to achieve the state's emissions reductions limits. Meeting these limits will require a clean electricity grid by 2030, doubling down on energy efficiency to reduce energy use and electrifying as many energy end-uses as practical. These actions alone do not achieve the 2030 emissions target in any of the modeled scenarios. To further reduce emissions and meet the limits, clean fuels must displace a portion of fossil fuel use in the economy.

Energy efficiency and electrification require significant investments in new technology and infrastructure. They are dependent on customers replacing inefficient appliances, processes and vehicles with efficient or electrified options.

The process of replacing technologies, such as appliances and vehicles, takes time and meanwhile cleaner fuels will reduce emissions from gasoline and diesel vehicles that remain on the road. Accelerating development of a clean fuels industry in the next 10 years is critical to meeting Washington's 2030 limits. In the Electrification Scenario, by 2030 a third of all liquid fuels in Washington are from clean sources, either bio or synthetic replacements for conventional fossil fuels.

In the longer run, as more of the vehicle fleet electrifies, clean fuels may play a diminished role in decarbonization in Washington but will remain key to decarbonizing air travel and other applications where electrification is more challenging.

Additional sector-specific insights from the modeling include:

3.1. Transportation Sector-Specific Results

Key conclusions from the modeling regarding the transportation sector are:

- The Transport Fuels Scenario with lower levels of transport electrification is more costly than the Electrification Scenario with higher levels of transport electrification. Pursuing faster rates of transportation electrification should lower the cost of meeting the state's greenhouse gas limits.
- While electrifying passenger vehicles is a cost-effective strategy to achieve economy-wide net zero emissions by 2050 and helps reduce the need to invest in clean energy technologies for

economy-wide decarbonization, demand for fuels remains high in 2030 even in the Electrification Scenario. In 2030, 73% of vehicles on the road are still internal combustion engines using gasoline in the Electrification Scenario. This is because it takes time for long-lived assets, such as cars and trucks, to come to the end of their useful life and be replaced by new electric vehicles.[42]

- For heavy-duty trucks, we assume demand for hydrogen for long-distance hauling by 2050, including electric trucks. This drives the need for hydrogen refueling and delivery infrastructure. Whether hydrogen fuel cells are favored for some transportation applications in the future will depend on the relative development of propulsion technologies. For short-haul trucks we assume a transition to 100% electric.[43]

3.1.1. Implications for State Energy Policy

- Transportation electrification is key to cost effectively decarbonize Washington's economy. The sooner the state can electrify vehicles, the greater the avoided investment in more expensive clean fuels, including their associated infrastructure and feedstocks. The more the state can reduce VMT and encourage sustainable mobility, the less scale will be required in expanding the clean fuels industry, which is still in early stages of development. Taking early action now to reduce the 2030 need for clean fuels has significant cost benefits. Costs are on average 0.2% lower as a percentage of GDP in the Electrification Scenario than in the Transport Fuels Scenario, where less electrification is achieved.
- Because there are fewer current low-carbon alternatives for aviation – electrification technology is still nascent – clean fuel production for air travel could provide both a near-term and long-term strategy, given that significant demand for jet fuel is likely to remain through 2050.

3.2. Building Sector-Specific Results

Key conclusions from the modeling regarding the building sector are:

- The Gas in Buildings Scenario is more costly than the Electrification Scenario in 2030 and beyond, particularly when approaching net zero emissions in 2050. This is because greater quantities of clean fuels are required to offset the emissions from gas in the Gas in Buildings Scenario. The cost of those additional clean fuels is higher than the cost of the electrification measures in the Electrification Scenario.
- Decarbonizing liquid fuels rather than pipeline gas is more cost effective because fossil liquid fuels are more costly. This means higher savings from clean liquid fuels alternatives.
- Electrification and efficiency measures in buildings drives a 26% reduction in final energy demand in the Electrification Scenario and a 13% reduction in the Gas in Buildings Scenario versus the Reference Scenario in 2050. However, the pace of stock rollover to new efficient technologies limits action by 2030, with reductions of 6.5% in final energy demand in the Electrification Scenario and 3.5% in the Gas in Buildings Scenario versus the Reference Scenario.

[42] "Washington State Energy Strategy Decarbonization Modeling Final Report Draft." p. 30.
[43] Ibid, p. 31.

3.2.1. Implications for State Energy Policy

- Converting building end uses to electricity is less expensive and more energy-efficient than a strategy focused on creating synthetic pipeline gas, even if buildings convert to high-efficiency gas equipment. To decarbonize the economy while retaining fossil gas use in buildings, clean gas would need to displace fossil gas in the pipeline. Producing clean gas requires investment in infrastructure and feedstocks. At present forecasted prices for these processes versus electrification of appliances, the electrification option results in a 0.3% of GDP savings annually by 2050 when comparing the Electrification Scenario to the Gas in Buildings Scenario.
- The benefits of measures in buildings that reduce energy use are high in both the near term and long term. This points to the value of early and aggressive action to improve energy efficiency, including electrification and other efficiency measures in buildings.
- Many more energy efficiency measures will be cost effective in a decarbonizing world. By reducing energy use through energy efficiency, the state will reduce the need for investment in infrastructure resulting in cost savings.

3.3. Industry Sector-Specific Results

Key conclusions from the modeling regarding the industrial sector are:

- All the decarbonization scenarios included the same assumptions for the industrial sector, therefore we cannot draw any direct conclusions about one industrial strategy versus another. When comparing the Electrification Scenario to the Transport Fuels and Gas in Buildings Scenarios we know that lowering energy consumption through electric vehicle purchases or electrified building end uses, lowers total costs by avoiding expensive clean fuels. Lowering energy consumption in industry will also avoid expensive clean fuels with significant cost savings. Electrification and other efficiency measures in industry will be cost effective so long as their implementation is cheaper than the production of the clean fuels they avoid.

3.3.1. Implications for State Energy Policy

- As with the other sectors, cost-effective electrification and/or efficiency measures will lower total decarbonization costs by avoiding expensive infrastructure investments.
- Industrial carbon capture can provide a significant fraction of the carbon stream used to produce synthetic fuels, which points to the need for determining how much carbon capture potential exists in Washington state.
- Industrial flexible loads could be a major new industry in the future, producing hydrogen through electrolysis that is used in production of clean fuels.

3.4. Electricity Sector-Specific Results

Key conclusions from the modeling regarding the electricity sector are:

- Increasing electricity demand through electrification and expanding the electricity system to serve those demands with clean electricity is a cost effective decarbonization strategy. Comparing the Electrification Scenario to the Transport Fuels and Gas in Buildings Scenarios shows that the greater levels of electrification in the Electrification Scenario results in cost savings.

- Washington imports 43% of its clean energy from inland wind-rich states (Montana and Wyoming) in the Electrification Scenario in 2050. The increased energy flows across multiple states and balancing areas will require investment in new transmission and the efficient use of imports as a balancing resource. Efficient dispatch, akin to a single balancing authority for western grid operations, is assumed in the model.
- Transmission expansion across the West is a key part of lowering costs in the model results. Expanding transmission, however, is a long, difficult process with many hurdles to overcome. Early planning and determination of feasible projects and project costs should begin now to prepare for transmission in the future. Updated feasible path expansions and associated costs can be used in future State Energy Strategies to reevaluate the economics. While the additional costs resulting from no transmission expansion into Washington in the Constrained Resource Scenario are relatively small ($0.5B/yr by 2050), expansion in the rest of the western states still occurs in that scenario.
- Washington has limited build of in-state renewable resources in all decarbonization scenarios until 2040. Prior to that, it is more cost effective to import clean energy from cheaper out-of-state sources. Between 2040 and 2050, Washington adds solar and offshore wind (12 GW and 4 GW, respectively, in the Electrification Scenario).
- Synthetic fuels produced through electrolysis will play a major role in decarbonizing the Washington economy, increasing electricity demand, and providing long-term balancing capabilities for the electricity grid.
- Absent technology breakthroughs in zero-carbon alternatives, the Northwest builds 11 GW of gas plants, 3 GW of which are in Washington, for reliability by 2050. Gas generators in Washington burn de minimis quantities of gas after 2030 because of the need to reduce emissions and the large balancing capabilities of both the hydro system and electrolysis built for fuels production by 2030. However, these gas generators provide capacity during infrequent reliability events. CETA requires 100% clean electricity delivered to loads by 2045 in Washington. By 2045, all gas burned during these events is clean gas.

3.4.1. Implications for State Energy Policy

The twin challenges of decarbonization in Washington are pace (to reach 2030) and scale (to reach 2050). Rapid change across all sectors of the economy is required to meet the 2030 challenge. Pace applies to the electricity sector in two ways. The first is to meet the need for new infrastructure to support electrification of end uses with clean electricity. The second is production of synthetic fuels that may be a component of providing clean fuels to reach 2030 targets.

Scale, over a longer time period, requires infrastructure investments supporting a doubling of electric load in Washington. Resource availability across the West will drive Washington from being a net exporter of electricity to importing a significant fraction of resources (43% in the Electrification Scenario).

- Rapidly electrifying end uses, wherever possible, will drive down the need for clean fuels production and reduce the investment in the infrastructure needed to produce them. This will drive expansion of the electricity sector.

- Planning for transmission expansion at the distribution and transmission levels is key to enabling this shift in the power sector. Distribution planning will support the shift to electric vehicles and electrified end uses in buildings. Pursuing transmission expansion of interties now allows Washington to maintain the option of importing additional low-cost renewables in future. While the savings from expanding Washington's interties are relatively low ($0.5B/yr by 2050), planning to expand interties ensures Washington retains multiple decarbonization pathway options. By doing so the state reduces the risk that future challenges to implementation in any one pathway jeopardize achieving Washington's emission limits.
- The model determines resource adequacy as if the West were a single balancing area. While not a replacement for detailed resource adequacy studies, the model shows greater coordination and energy flows will require resource adequacy determination on a regional rather than local basis. Resource adequacy modeling will also have to evolve to incorporate energy-constrained, as well as capacity-constrained, conditions to ensure reliability during periods of low energy availability. This includes treatment of large industrial flexible loads as resources for reliability.
- Furthermore, transmission expansion and greater interregional energy flows taking advantage of geographic and renewable resource diversity, and interregional balancing using large new flexible loads found in the modeling results, will only be possible with better regional coordination. The benefits of regional integration will increase in the future as the emissions limits become tighter and electricity loads grow through electrification and electrolysis.

The modeling results determine in-state investments in new resources. However, the model does not have a representation of the distribution system and the potential benefits from deferral of investment in distribution infrastructure from locating resources close to load. Renewable potential assessments will determine how in-state resources should be sited to maximize net benefits including indirect benefits such as equity, job growth and environmental protection.

C. Use Energy More Efficiently and Decarbonize Transportation Energy

Transportation is the state's number one source of greenhouse gas emissions. It also is a major source of local air pollution that disproportionately impacts public health in communities living near roadways, port facilities, industrial activity and railways – communities where highly impacted populations often reside. These populations are particularly sensitive to transportation pollution due to health, economic and other environmental factors. Meeting the state's emission limits will require a transformational shift in how people and goods move from place to place.

Structural issues regarding existing transportation systems must be addressed alongside the required reduction in greenhouse gas emissions. To create accessible, affordable, safe and sustainable mobility opportunities that work for all Washingtonians – particularly highly impacted populations who often lack historical mobility investments – the transportation system must prioritize efficiency and equity improvements.

The approach outlined here uses multiple policies to achieve comprehensive benefits, including improved public health due to reduced co-pollutants, increased physical activity, reductions in traffic-related injuries,[44] greater economic opportunities due to lower costs and more mobility choices and increases in quality of life in both urban and rural areas. A balanced approach holds the most promise to achieve the necessary outcomes – aggressive reductions in emissions and meaningful improvement in environmental and economic benefits to communities.[45]

This balanced approach includes two complementary elements: using energy more **efficiently** and **decarbonizing** the energy that is used. The first element, transportation system efficiency, can be addressed by reducing the number of vehicle-miles required to meet people's needs and support economic activity. There are two basic ways to do this. The first is to *reduce the need for travel*, which means either shortening the distance that people and goods have to travel (e.g., through improved urban design) or avoiding the need for trips altogether (e.g., via telecommuting).

The second is to *shift travel onto more efficient modes*, such as public transit, which can move more passengers per vehicle, or rail and maritime freight transport, which can carry more goods at once. Although certain approaches may be more relevant in an urban, suburban or rural environment, comprehensive implementation will result in both equity and efficiency benefits. Nearly all of these approaches require coordination across multiple jurisdictions.

Any single approach, if pursued in isolation, is likely have limited effectiveness. King County, for example, has found that to achieve its VMT reduction goals, the most effective and lowest-cost strategy is to combine land use policy (focusing on compact, transit-oriented development), enhancement of transit service and travel-demand management policies including vehicle usage charges.[46] An important goal of state policy, therefore, should be to promote complementary approaches in local and regional transportation planning, development and operation. A key first step for transportation sector strategies is to provide a roadmap – with clearly defined targets – describing how the state will achieve an equitable transition to a zero-carbon transportation sector.

1. Move People and Goods More Efficiently and Equitably

People and goods are often transported across the same roads. Land use policies and road system designs influence both passenger and freight travel. Cost, efficiency and accessibility determine whether people and goods travel by road, rail, sea or air.

Moving people and goods more efficiently, therefore, requires a holistic, integrated approach across modes, taking into account different transportation needs and purposes, including commuting, regional and long distance passenger travel, commercial services, shopping and leisure trips, short-haul freight transfer and delivery and long-haul freight.

Strategies for improving transportation efficiency and equity fall into two categories:

- **Improving the design and operation of Washington's transportation networks.** State government has considerable leverage over how Washington's transportation systems are

[44] Particulate emissions from tire wear, for example, can present a health hazard on par with car exhaust: "Non-Exhaust Emissions from Road Traffic" (Department for Environment, Food and Rural Affairs; Scottish Government; Welsh Government; and Department of the Environment in Northern Ireland, 2019), https://uk-air.defra.gov.uk/assets/documents/reports/cat09/1907101151_20190709_Non_Exhaust_Emissions_typeset_Final.pdf.

[45] Harvard Chan C-CHANGE, "New TRECH Project Research Update on Health Benefits of TCI Policy Scenarios," October 6, 2020, https://www.hsph.harvard.edu/c-change/news/trechstudy/.

[46] Kuharic, Stroble, and Binder, "King County 2020 Strategy Climate Plan."

developed, operated and connected. Although responsibilities for different aspects of the systems are spread across multiple jurisdictions, the state can take important steps to improve coordination, set priorities and enable local and regional actions.

- **Improving vehicle fuel economies.** Here, state government has less direct influence, but can drive improvements by continuing to require vehicles to meet California emission standards, and by establishing programs to accelerate the retirement of inefficient vehicles.

1.1. Set Clear and Ambitious Targets

An important first step in meeting the state's greenhouse gas emission limits is for the state to establish targets and milestones that provide clear direction and authority for action. In the case of transportation, the actors are state agencies, regional and metropolitan planning organizations, and county and local governments.

Additionally, direction is needed regarding land-use planning and needed infrastructure investments to reduce the need for, and shift modes of, travel. Two elements are essential here: updating the state's existing VMT reduction targets and establishing new, explicit targets for transportation and broadband infrastructure.

The decentralized structure of Washington's transportation system makes the development and oversight of common targets both challenging and important. As the Joint Transportation Committee (JTC) has noted: "What is sometimes referred to as the 'state transportation system' is actually a decentralized network managed by a variety of jurisdictions, including the state, Tribal nations, counties, cities, port districts and public transit authorities."[47] Transportation system needs are largely defined from the "bottom up," with each jurisdiction identifying specific requirements for maintenance and new capital expenditures based on local circumstances.

The state already engages in discrete planning exercises to consolidate information about local transportation needs. This information informs certain decisions about state-level policies and investments. WSDOT's Active Transportation Plan,[48] for example, is soliciting input from local communities about walking and cycling infrastructure needs with a goal to coordinate efforts to meet these needs. Going forward it will be increasingly important to align local transportation planning efforts with statewide VMT reduction goals.

Enhancing statewide VMT reduction goals will not – in and of itself – achieve Washington's transportation accessibility and sustainability goals. Metrics that capture the greenhouse gas and co-pollutants of miles traveled as well as the efficiency of those trips are necessary. Efficiency metrics may include, but are not limited to, energy intensity per passenger-mile, travel time for trips, availability of mobility choices or completion of mobility projects.

Actions:

- The Legislature, in consultation with WSDOT and local transportation organizations, should adjust and update state VMT reduction targets to reflect existing VMT levels and the state's

[47] BERK Consulting, "Statewide Transportation Needs Assessment: July 2020 Phase I Report" (Joint Transportation Committee, 2020), http://leg.wa.gov/JTC/Documents/Studies/Statewide%20Needs%202019/FinalReport_StatewideNeeds.pdf.
[48] Washington State Department of Transportation, "WSDOT Active Transportation Plan 2019," October 23, 2020, https://wsdot.wa.gov/travel/commute-choices/bike/plan.

greenhouse gas emission limits. See Appendix C for detailed VMT background and recommendations.

- The Legislature should consider transportation efficiency and emission targets to accompany updates to VMT reduction targets. (See Appendix C.)
- The Legislature should direct WSDOT and Commerce to set new, discrete, near- and long-term targets for transit and active transport infrastructure development, transit service expansion and broadband access in consultation with local and regional jurisdictions as well as highly impacted communities.

1.2. Improve Transportation System Planning and Coordination, Prioritizing VMT Reduction

In assessing statewide transportation needs, the JTC found that there is no consistent, statewide approach to identifying needs and planning for improvements, nor are there consistent standards for levels of service. To improve the efficiency and equity of Washington's transportation system, the state must take steps to set statewide priorities for land-use planning, infrastructure development and service improvements. Resources must be provided to enhance the capacity of local jurisdictions and local community groups to pursue those priorities. Strategy, design and deployment should reflect the needs of each community.

To achieve statewide greenhouse gas emissions limits, the state must set clear priorities for local jurisdictions to follow. One approach is for the Legislature to adopt evaluation metrics for funding proposals based upon key policy goals. Metrics should be developed and prioritized through collaboration with multiple stakeholders, including relevant state agencies, local governments, planning authorities, Tribal nations, port districts, transit authorities, chambers of commerce and frontline and underrepresented community groups. (See Appendix C.)

Effective inter-jurisdictional coordination is essential for the success of VMT-reducing measures, including the development of transit systems, walking and cycling infrastructure and intermodal connections. Existing planning tools for public transportation, such as the Statewide Human Services Transportation Plan and the State Public Transportation Plan, leave pronounced planning and reporting gaps for pedestrian and bicycle infrastructure.

Coordination among organizations is key: funding and resourcing is needed where it lacks, and evaluation of existing coordination must occur where results are slow or absent. Although effective cross-jurisdictional coordination is a key goal of the state's regional transportation planning organizations (and federally funded metropolitan planning organizations), the state could amplify these efforts by expanding funding criteria to include elements such as transit and alternative mobility projects.

In addition, while building out transit and active transport infrastructure is an important goal, there must be active local engagement to ensure build out happens and meets community needs. Funding should be made available to support participation in equity advisory groups involved in transportation planning and implementation.

The siting of housing developments near services, amenities and transportation services can result in a 20-40% reduction in VMT, and a corresponding decline in greenhouse gas emissions and congestion.[49] A study conducted in King County found that residents of the most walkable neighborhoods drive 26% fewer miles than those living in the most sprawling areas. Similar studies elsewhere find a 33% reduction in VMT for households living in more dense developments with a diversity of uses, accessible destinations and interconnected streets when compared to households in low-density areas.[50]

Smaller communities may lack resources to engage in the land-use planning exercises and infrastructure development that would maximize transportation system efficiency and equity, especially where inter-jurisdictional coordination is required. For all jurisdictions, one way to address such gaps is to provide model code and rules for local jurisdictions to incorporate into their transportation system planning. Materials should facilitate coordination around transit-oriented corridor planning, development of transit and active transport infrastructure, and zoning for transit-oriented, mixed use, compact development, including elements related to implementation, administrative procedures and community engagement.

For example, a standard checklist for lane-widening proposals could facilitate evaluation of alternatives and ensure consistency and coordination with other transportation system elements. Similarly, investment in and preservation of low-income housing, community-serving businesses and cultural centers near transit creates more opportunities for those with the fewest choices. Sound Transit, is developing a model rule for corridor planning that will help to align local efforts with regional objectives.[51] The Puget Sound Regional Council has developed similar model codes and policies.

Actions:

- The Legislature, in collaboration with WSDOT and other agencies, should adopt and apply metrics for state transportation funding linked to key efficiency and equity outcomes.
- The Legislature, state agencies and local governments should take steps to incentivize and remove barriers that restrict transit-oriented development. (See Appendix C.)
- The Legislature, in consultation with state agencies and local governments, should link cross-jurisdictional coordination and community engagement with funding related to the planning and implementation of land-use policies, TOD, transportation demand management (TDM) measures (including vehicle usage charges or similar policies), transit and active transport infrastructure development, and other measures designed to reduce VMT and enhance accessibility and mobility.
- The Legislature should direct and fund WSDOT or Commerce to establish and manage a clearinghouse of model code, model rules, policy packages and standardized checklists as a resource for local jurisdictions engaged in transportation system planning and development, including to help inform comprehensive plans and development codes.

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[49] "Housing and Climate Change" (California Department of Housing & Community Development, 2013), https://www.hcd.ca.gov/policy-research/plans-reports/docs/pb04housing_climate_change0214.pdf.

[50] Reid Ewing et al., "Growing Cooler: The Evidence on Urban Development and Climate Change" (Urban Land Institute, 2007), https://www.nrdc.org/sites/default/files/cit_07092401a.pdf.

[51] "Federal Transit Administration Awards Sound Transit $2 Million for Everett Link Transit-Oriented Development Pilot," Sound Transit, June 15, 2020, https://www.soundtransit.org/get-to-know-us/news-events/news-releases/federal-transit-administration-awards-sound-transit-2.

- The Legislature should fund WSDOT and Commerce to provide centralized assistance for jurisdictions to engage and support the development and implementation of model code related to corridor planning, "smart growth" zoning and land use policies, transit-oriented development and related infrastructure development

1.3. Expand and Align Transportation Funding with Emissions and Equity Goals

Building a more efficient and equitable transportation system in Washington will require investment to develop and maintain new infrastructure and to ensure that existing infrastructure continues to be safe and functional. It will also require a reprioritization of funding to align investments with VMT reduction and equity targets and to support the coordination needed for building efficient, interconnected transportation networks.

In its 2020 Statewide Transportation Needs Assessment, the Washington Legislature's JTC found that jurisdictions at all levels lack sufficient funding to meet current transportation needs.[52] Current state transportation funding derives from unreliable revenue sources that fluctuate significantly with macroeconomic conditions. Gas taxes and vehicle fees collected by the state account for a large portion of the transportation budget.

Gas taxes are also subject to the 18th Amendment of the Washington State Constitution, which requires that revenue collected through gas taxes and some vehicle fees only be used for "highway purposes." Vehicle fees, some of which are not subject to constitutional limitations, mostly fund the multimodal account. The JTC report explores a range of alternative revenue sources that could be adopted to fund the state's transportation systems and provide stable and diverse funding sources including and in addition to the more limited gas tax and vehicle fees.

With decarbonization, one important funding consideration is the replacement of lost gas tax revenues as more drivers adopt electric vehicles. The Washington State Transportation Commission (WSTC) recently identified a road usage charge (RUC) as one possible substitute for the gas tax and provided a series of recommendations to support implementing a RUC. [53] The WSTC continues to study this concept, including conducting an analysis of potential equity impacts of a RUC and developing frameworks for modeling a variety of types of vehicles.

Current transportation system policy goals for Washington include economic vitality, preservation, safety, mobility, environmental protection and stewardship.[54] Although several of these goals intersect with reducing emissions, improving transportation efficiency, reducing VMT and enhancing equity, none explicitly target the outcomes or approaches needed to achieve them. Expanding state policy goals and defining public transportation and active transport infrastructure as expressly targeted public goods would help steer investment where it is most needed for achieving the state's climate and equity goals.

As noted in section 1.2, inter-jurisdictional coordination and community engagement are essential for the success of VMT-reducing measures and infrastructure projects. In conjunction with making funding *contingent* on effective coordination and local engagement, funding should be sufficient to cover these

[52] BERK Consulting, "Statewide Transportation Needs Assessment: July 2020 Phase I Report."
[53] Washington State Transportation Commission, "Washington State Road Usage Charge Assessment Final Report," 2020, https://waroadusagecharge.org/wp-content/uploads/2020/01/WSTC-Final-Report-Vol-1-WEB-2020_01.pdf.
[54] Chapter 47.04.280 RCW.

requirements. Existing state and federal funding mechanisms often emphasize upfront planning, project, or policy design, and may provide insufficient funding for full implementation.

Processes behind state and federal funding also select individual elements of a project, resulting in some project "legs" being separated and unfunded from the entire project and other modes. In some cases, important "last mile" connections between transportation network elements go unfinished (e.g., street designs accommodating pedestrian or bicycling access to transit systems).

Washington's current transportation planning and funding models make it too easy for responsible jurisdictions to overlook or ignore synergies or overlaps with other types of infrastructure, or connections with other elements of the transportation system. For example, common use rights-of-way for transit projects may also accommodate electrical or communications infrastructure. The state should adjust and expand transportation funding, where needed, to ensure successful "back end" implementation and evaluation. Where relevant, for example, funding could be allocated separately for the implementation of approved plans rather than in a single tranche covering planning and implementation. Funding should also expressly target evaluation efforts that inform and improve subsequent project stages or policy revisions.

In the development stage, transit corridors can more easily be expanded to include pedestrian and cycling amenities, improving connections between different modes. Freight transport efficiency could be improved if the development is coordinated between distribution networks and port, rail and other infrastructure. Allocating more funding to implementation efforts could help to address these gaps, but funding restrictions can limit jurisdictions from considering indirect "external benefits" in both the planning and implementation phases.

Actions:

- The Legislature must identify and establish stable funding mechanisms for transportation maintenance, preservation and system improvements across all modes. The funding must be stable, equitable, accessible to all jurisdictions and sufficient to cover programmatic and capital needs.
- The Legislature should expand transportation system policy goals to expressly address VMT reduction, efficiency, greenhouse gas emissions reductions and equity as a means to achieve accessibility and environmental stewardship objectives.
- The Legislature should fully fund inter-jurisdictional coordination and community engagement as part of transportation system improvements.
- The Legislature should establish a fund to support opportunistic consideration – and incorporation – of connections between transportation system elements, and between these systems and other beneficial infrastructure.

1.4. Remove Barriers to Transit, Walking and Cycling

Boosting transit ridership and use of active transport options requires a comprehensive approach involving land-use change, transit service expansion and appropriate travel-demand management measures implemented at local and regional levels. The state can play a key role in assisting these efforts.

Public transit service is a universal need, not limited to urban and suburban areas. Rural and Tribal communities benefit from public transit, as well as van pools,[55] paratransit and ridesharing programs that typically operate on minimal budgets. These services should be enhanced and expanded, including through adoption of EVs for providing service.[56] Washington's public transit providers face budget challenges under their current funding models. Stabilizing and expanding transit funding with more direct and consistent state funding would help to expand access and maximize the public benefit value of transit services.

In Washington State, 28% of people live in or near poverty. These households are 6.8 times less likely to own a car than higher income households.[57] On average, light rail systems produce 62% less and bus transit 33% less greenhouse gas emissions per passenger mile than private vehicles.[58] Making public transit safer, more convenient and more accessible will increase ridership and reduce emissions.

Electric bicycles (e-bikes) and scooters can reduce transportation-related congestion, local air pollution and greenhouse gas emissions. However, e-bikes typically cost more than traditional bikes and can be unaffordable for many people. Many countries, states and cities have adopted incentives for e-bikes to reduce their upfront costs and accelerate adoption, including state-funded rebates or discounts offered through electric utilities.[59]

WSDOT oversees a longstanding, statewide commute trip reduction (CTR) program that encourages employers to promote alternatives to commuting via single-occupancy vehicles, including by making teleworking options available to employees.[60] After the law was amended by the 2006 Commute Trip Reduction Efficiency Act,[61] implementation shifted and the state's primary role became assisting local jurisdictions in establishing CTR plans. This has led to uneven application correlated, in part, to the availability of transit and active transportation options.[62] The CTR program could be updated and expanded, for example by requiring participation by public and private employers of a certain size where new or expanded offices or facilities are constructed in areas of high congestion and/or available transit and active transport options.

Actions:

- The Legislature and local governments should adopt incentive programs that reduce the relative cost of transit and other alternative travel modes.
- Along with increasing and stabilizing transportation funding, the Legislature, local governments and transit agencies should explore options to make transit universally affordable, including

[55] "Farmworkers," accessed October 23, 2020, https://calvans.org/farmworkers.
[56] Shared-use Mobility Center, "SUMC Celebrates Launch of New EV Rideshare 'Green Raiteros,'" accessed October 23, 2020, https://sharedusemobilitycenter.org/sumc-celebrates-launch-of-new-ev-rideshare-green-raiteros/.
[57] "2016 Washington State Public Transportation Plan" (Washington State Department of Transportation, 2016), https://wsdot.wa.gov/sites/default/files/2019/10/15/PT-Report-WashingtonStatePublicTransportationPlan-2016.pdf. p. 33
[58] "2016 Washington State Public Transportation Plan." p. 35
[59] Portland State University et al., "How E-Bike Incentive Programs Are Used to Expand the Market" (Transportation Research and Education Center (TREC), May 2019), https://doi.org/10.15760/trec.223.
[60] Washington State Department of Transportation, "Commute Trip Reduction," October 23, 2020, https://wsdot.wa.gov/transit/ctr/home.
[61] Zachary James Wieben, "What Contributes to Successful Commute Trip Reduction in the State of Washington? A Focus on Transit Accessibility" (University of Washington, 2017), https://digital.lib.washington.edu/researchworks/handle/1773/40307
[62] Ibid.

creating a statewide transit pass option, with providing means-tested transit subsidies for low- and no-income riders, or establishing fare-free transit statewide.

- Urban and rural transit improvements, funded by the Legislature and local governments, should center racial equity and ensure that BIPOC, people with low income and people with disabilities are the most direct beneficiaries of these investments.[63]
- Invest in transit infrastructure including security, lighted streets, covered stops and pedestrian crossings.
- The Legislature, local governments and businesses should explore options for providing incentives for e-bike and other e-ride devices.
- WSDOT, in partnership with the Legislature, transit agencies and the private sector, should explore ways to expand the reach of Washington's CTR program.

1.5. Support Measures to Reduce Freight VMT

Policies to induce mode-switching for long-haul freight – for example, using rail instead of trucks – are best implemented at the national level. However, growth in freight demand is expected to increase, and the state should ensure that all available options are pursued to mitigate the number of vehicle-miles needed for transport and delivery.

A priority for state policy should be improving "last mile" freight logistics, including the movement of goods from ports and rail depots to warehouses and distribution centers, as well as the delivery of goods to businesses and households. The specific kinds of interventions needed depend on the locale but may include trip optimization measures such as timing intermodal connections, improved curb-space management, dedicated freight lanes, planning and centralization of logistics centers, optimizing the location of fueling (and for electric vehicles, charging) infrastructure and local rules requiring off-peak urban delivery schedules to avoid congestion. These measures, along with electrification of short-haul delivery and drayage vehicles, could also significantly reduce health and pollution impacts in low income communities.[64]

The state's options to affect long-haul freight mode choice and efficiency are more limited, but it should support national or regional efforts through in-state land-use planning and infrastructure development. This includes optimizing local connections to improve the economics of rail and shipping transport.

Actions:

- To help improve the efficiency of local freight logistics and reduce pollution in Washington's frontline communities, the Legislature should provide funding to help local jurisdictions study freight travel reduction opportunities, plan for infrastructure improvements and implement optimization measures.
- Local governments should have access to sufficient resources to conduct planning and implementation in coordination with broader VMT reduction and efficiency efforts and in

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[63] Puget Sound Sage and Transportation Choices, "More Places, Better Connections: Transit Priorities for Residents of South Seattle and South King County," 2020, https://www.pugetsoundsage.org/research/research-equitable-development/more-places-better-connections/.

[64] University of Washington, "Supply Chain Transportation & Logistics Center," October 23, 2020, https://depts.washington.edu/sctlctr/.

collaboration with the freight sector, other agencies and jurisdictions, as well as impacted communities.

- WSDOT and local governments should explore ways to support cost-effective in-state rail and port operations, including through land-use planning, the development of complementary infrastructure and improved routing of local freight deliveries connected through rail depots and ports.

1.6 Continue to Support Vehicle Fuel Economy Improvements

Fuel economies for passenger and freight vehicles are largely determined by federal standards. Washington has limited authority to improve average fuel economies unilaterally. However, by continuing to join with other states in following California's "clean car rule"[65] regulating greenhouse gas tailpipe emissions for passenger vehicles and "clean truck rule"[66] setting targets for sales of medium- and heavy-duty zero-emission vehicles, the state can significantly reduce energy consumption, save on fuel costs and lower greenhouse gas emissions.[67] The state may also be able to accelerate fuel economy improvements through vehicle purchase and retirement programs or similar measures.

Following California vehicle emission standards, as allowed under federal law, will be critical to reducing statewide transportation greenhouse gas emissions over the next 10 years.

Vehicle buyback programs can also help improve cumulative fuel economies by taking older, less efficient vehicles off the road, including trucks and drayage vehicles. A buyback program could be a cost-effective way to reduce the need for costly synthetic fuels if adoption of ZEVs fails to keep pace with what is needed to meet state greenhouse gas reduction limits (see Section B - Achieving Our Carbon Emissions Goals).

A vehicle buyback program could provide low income residents cash toward a new vehicle. A buyback program in British Columbia called "BC-Scrap It" also allows participants to opt for payments toward transit passes, car share and ride share services, or e-bikes.[68]

Actions:

- The Department of Ecology must continue to implement California "advanced clean car" emissions standards and follow through with implementation of measures needed to match California's ZEV sales targets for medium- and heavy-duty trucks.
- The Legislature, in consultation with Commerce and Ecology, should explore whether a state-run vehicle buyback program could cost-effectively and equitably contribute to near-term greenhouse gas reductions, and, if feasible and appropriate, adopt such a program.

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[65] California Air Resources Board, "Advanced Clean Cars Program," accessed October 23, 2020, https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/about.

[66] California Air Resources Board, "15 States and the District of Columbia Join Forces to Accelerate Bus and Truck Electrification," October 23, 2020, https://ww2.arb.ca.gov/news/15-states-and-district-columbia-join-forces-accelerate-bus-and-truck-electrification.

[67] Federal law grants California a waiver allowing the adoption of more stringent emissions standards, which other states are free to follow. See https://ww2.arb.ca.gov/resources/fact-sheets/pollution-standards-authorized-california-waiver-crucial-tool-fighting-air.

[68] "Scrap Vehicle Rebates and Incentives for BC Residents," accessed October 14, 2020, https://scrapit.ca.

2. Electrifying Vehicles and Switching to Low-Carbon Fuels

Rapid advancements are being made in technology for electric vehicles (EV) that rely on batteries (BEVs) or hydrogen fuel cells (FCVs), and development of low-carbon liquid and gaseous fuels. BEVs in particular are already making strong inroads in the passenger vehicle market and to a lesser extent the freight vehicle market. Upfront costs are rapidly declining, driving range is increasing, and more options across vehicle classes are becoming available. BEVs are expected to reach cost parity across passenger vehicle classes by the mid-2020s.[69]

BEVs provide consumers with numerous advantages over gasoline-powered vehicles, including per-mile cost savings when substituting electricity for gasoline, and cheaper, less frequent maintenance. Electric vehicle adoption will improve local air quality in Washington communities through the reduction of co-pollutants like $PM_{2.5}$ and NO_x. Vehicle exhaust is currently the largest source of air pollution in the state, contributing to asthma and other respiratory and cardiovascular diseases.[70]

Despite these advantages, market forces alone will not achieve the pace of BEV and FCV adoption that is needed to meet Washington's greenhouse gas reduction limits. Moreover, the deep decarbonization modeling shows that accelerating vehicle electrification will yield substantial cost savings by reducing the need to produce synthetic fuels for use in conventional vehicles.

Universal access to charging and fueling infrastructure is crucial to accelerating the pace of transportation decarbonization, but other policies are required as well (See Figure 11). These policies must synchronize with broader clean and accessible mobility policies, such as increasing public transit and active transportation. As in other states, a key step for Washington will be to set clear near- and long-term targets for BEV and FCV sales and adoption.

BEVs, and increasingly FCVs, also provide opportunities to reduce emissions and costs for rail and off-road transportation (e.g., construction equipment, farm equipment, and warehouse and port vehicles). Efforts are already underway to electrify marine vessels, including conversion of Washington's ferries to hybrid EV operation and the development of shore power facilities at Washington's ports. Shore power in particular could dramatically reduce in-port emissions from international shipping.

In 2019, Washington state ferries submitted their 2040 Long Range Plan to the Governor and the Legislature.[71] The plan recommends that WSF leverage the need for new vessels to meet and exceed carbon dioxide emissions reduction requirements under state law. To accomplish this and to cut fuel consumption, the plan recommends building new vessels to use hybrid propulsion technology instead of full diesel engines, a large investment in the electrification of the fleet by 2040, and the electrification of 17 terminals.

Electrification is also a promising option for decarbonizing short-haul air travel. Policies to accelerate BEV and FCV adoption generally should include measures such as charging and fueling infrastructure development to address these transportation segments as well.

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[69] Nick Albanese, "BNEF Electric Vehicle Outlook 2020," https://efiling.energy.ca.gov/getdocument.aspx?tn=233410.

[70] Washington State Department of Health, "Sources of Outdoor Air Pollution and Health Impacts," October 23, 2020, https://www.doh.wa.gov/CommunityandEnvironment/AirQuality/OutdoorAir.

[71] "Washington State Ferries Long Range Plan," Washington State Department of Transportation, accessed December 1, 2020, https://wsdot.wa.gov/ferries/about-us/planning/long-range-plan/the-plan.

Not all segments of the transportation sector can be readily electrified through onboard battery storage. As the deep decarbonization modeling results suggest, long-haul freight trucks, some off-road vehicles, and long-distance rail, shipping and aviation will likely need to rely on liquid or gaseous fuels for the foreseeable future. This is mainly due to range and energy density requirements, as well as the fact that many vehicles in these segments have long lifetimes.[72] Part of Washington's strategy should be to expand clean fuels production and, where needed, encourage the development of associated transport and fueling infrastructure (e.g., hydrogen for FCVs). Chapter E-Promote Clean and Competitive Industries discusses policy approaches for fostering the development of an in-state clean fuels industry.

One way for Washington to advance its energy and climate goals in a market-friendly and technology-neutral way would be to adopt a low carbon fuel standard (LCFS). In California and Oregon, LCFS policies have incentivized clean fuel production and development of charging and fueling infrastructure, and accelerated adoption of EVs and low carbon fuels across all transportation segments (on-road, off-road, rail, marine and aviation). A similar standard in Washington could accelerate decarbonization of the transportation sector throughout the Northwest and result in an in-state clean fuel industry that is both domestically and internationally competitive (see both Chapter C-Use Energy More Efficiently and Decarbonize Transportation Energy and Chapter E-Promote Clean and Competitive Industries for discussions of an LCFS).

2.1. Set Clear and Ambitious Statewide Targets

Arriving at targets that are consistent with the state's emissions limits will be challenging but are realistic in light of market and legal constraints. As difficult as the transition will be, the need for specific targets is clear, as is the need to establish accountability and responsibility. Phasing out the use of gasoline- and diesel-powered vehicles by mid-century is key to achieving Washington's emissions limits at minimum cost. Targets for EVs, low-carbon fuel adoption and associated infrastructure development will send an important signal to regulatory agencies, the public and the private sector, allowing for better planning and coordination. Ongoing tracking of progress will increase accountability and allow policy efforts to adapt over time.

For passenger cars to be fully zero-emissions by mid-century, nearly all new car sales will need to be EVs by 2035.[73] The faster this transition occurs, the less costly it will be to meet the state's greenhouse gas emissions limits. Explicit near- and long-term targets for BEV and FCV adoption will help keep the state on track. Vehicle replacement targets should be especially aggressive for diesel-fueled, short-haul vehicle classes that contribute disproportionately to local air pollution, especially in frontline communities (e.g., school and transit buses, utility and service vehicles, local freight delivery, drayage and off-road vehicles).

Targets are also required for charging and hydrogen fueling infrastructure, since adequate charging is required for market acceptance of BEVs and FCVs. Infrastructure must be widely available, affordable and accessible to communities and vehicle classes. Rural areas outside the reach of mass transit systems will require BEV and FCV options to achieve low-carbon transportation.[74] The potential economic

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[72] International Energy Agency, *Energy Technology Perspectives 2020*, Energy Technology Perspectives (OECD, 2020), https://doi.org/10.1787/d07136f0-en.

[73] The typical lifetime for light-duty vehicles is around 15 years.

[74] Sarah White, Laura Dresser, and Joel Rogers, "Greener Reality: Jobs, Skills, and Equity in a Cleaner U.S. Economy" (University of Wisconsin-Madison, 2012), http://repository.law.wisc.edu/s/uwlaw/item/27119.

benefits to rural drivers are substantial because rural drivers spend up to twice as much as urban drivers on fuel.[75,76]

In addition, the state should explore options for increased community-scale air quality monitoring,[77] especially in areas close to major roadways, freight depots, ports and other facilities that produce substantial transportation-related air pollutants. Improved access to air quality data will empower communities and measure whether the areas with the highest pollution burden are realizing the health benefits of vehicle electrification and clean fuels.

Actions:

- The Legislature, in consultation with state agencies, should set targets for EV and FCV adoption, differentiated by vehicle class. These targets must be aligned with ambitious targets in memoranda of understanding that Washington has agree to with other states. [78] See Appendix C for detailed target recommendations and additional information on California's various rules.
- The Legislature should direct and fund a comprehensive BEV charging and FCV fueling infrastructure needs assessment. See Appendix C for additional details on the infrastructure needs assessment.
- The Legislature, in consultation with state agencies and upon completion of the infrastructure needs assessment, should set explicit targets for charging and refueling infrastructure deployment as well as accompanying state funding.
- The Department of Licensing must continue to publicly track annual metrics on BEV and FCV adoption; Commerce should develop and track metrics for infrastructure deployment.
- The Legislature, in partnership with Ecology, should expand deployment of community-scale air quality monitoring in highly burdened communities.

2.2. Improve Planning and Oversight of BEV Charging and FCV Fueling Infrastructure

In addition to the targets and assessment described in section 2.1, the envisioned deployment of adequate charging and fueling infrastructure buildout would be well-served by creating a state-level planning and development entity. By providing needed accountability and communication, this entity would help ensure the equitable, efficient, coordinated and timely implementation of capital projects needed to deploy BEV charging and FCV fueling infrastructure at a rapid pace. The entity should be in charge of conducting statewide needs assessments (section 2.1) and work with state agencies and the Legislature to cover infrastructure gaps that other public entities and the private sector may not address.

[75] "The Clean Energy Future Protecting the Climate, Creating Jobs and Saving Money" (Labor Network for Sustainability & Synapse Energy Economics, 2015), https://www.synapse-energy.com/project/clean-energy-future-protecting-climate-creating-jobs-and-saving-money.

[76] "Electric Vehicle Benefits for Washington" (Union of Concerned Scientists, 2019), https://www.ucsusa.org/sites/default/files/attach/2019/04/State-Benefits-of-EVs-WA.pdf.

[77] Elena Craft et al., "Making the Invisible Visible: A Guide for Mapping Hyperlocal Air Pollution to Drive Clean Air Action" (Environmental Defense Fund, 2019), https://www.edf.org/sites/default/files/content/making-the-invisible-visible.pdf.

[78] For example, Washington is a signatory to a 15-state memorandum of understanding to work collaboratively to advance and accelerate the market for electric trucks and buses: California Air Resources Board, "15 States and the District of Columbia Join Forces to Accelerate Bus and Truck Electrification," accessed October 23, 2020, https://ww2.arb.ca.gov/news/15-states-and-district-columbia-join-forces-accelerate-bus-and-truck-electrification.

The planning body should clearly identify roles and responsibilities for entities involved in infrastructure planning and development, including public and private utilities, RTPOs and MPOs, local and tribal governments, public and private vehicle fleet owners, equity advisors, frontline community groups and others. Planning and development criteria should prioritize projects that will reduce air pollution in disproportionately impacted communities, especially around ports and distribution centers identified through a cumulative impacts analysis tool.

The private sector can drive some of the investment that will be needed to serve growing BEV and FCV infrastructure demand.[79] Typically, however, private providers target EVSE investments only in more lucrative areas. For major capital projects, especially those involving large capacity installations serving ports, fleets, rail, on-road freight and aviation, direct public funding may be needed. Public support may also be needed to support EVSE investment in areas underserved by private actors – including urban and suburban neighborhoods and rural areas. The state's electric utilities should also be encouraged to make investments in EVSE that in the near term would not be supported by private investment.

Rapid adoption of electric vehicles will require widespread access to charging equipment. Ensuring adequate capacity and infrastructure to incorporate EVSE in new buildings and in building retrofits is essential for expanding access and making EVs a desirable option for businesses and households.

Actions:

- The Legislature should establish a permanent BEV charging and FCV fueling infrastructure planning and development body responsible for setting near- and long-term priorities, coordinating among different stakeholders and jurisdictions, and helping to secure funding.
- To enable widespread access to EV-charging equipment, the Legislature should establish – and promote enforcement of – building codes that require installation of conduit, wiring and panel capacity needed to support EVSE in new and retrofitted buildings, including commercial buildings, office buildings and multi-family dwelling units. (See Chapter D-Decarbonizing the Built Environment.)
- The Legislature, in consultation with state agencies, local governments and transit agencies, should identify major BEV charging and FCV fueling infrastructure projects with significant public benefit and provide these with direct public investment.
- The Legislature and state agencies should directly support, or further enable electric utilities to support, EVSE in underserved urban and rural communities.

2.3. Accelerate the Market for BEVs and FCVs

The market for BEVs and FCVs is developing quickly, particularly for passenger vehicles. Still, the pace of adoption will need to accelerate to meet greenhouse gas reduction limits. A range of parallel and complementary actions will push the market further and ensure equitable and affordable access.

An opportunity for immediate progress is converting public and private vehicle fleets to BEVs and FCVs. Fleet owners can achieve economies of scale when purchasing new BEVs and FCVs, helping to drive

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[79] Conner Smith, "Investment in Public EV Charging in the United States" (Atlas Public Policy, Alliance for Transportation Electrification, n.d.), https://www.atlasevhub.com/wp-content/uploads/2020/02/Investment-in-Public-EV-Charging-in-the-United-States.pdf.

greater market demand and potentially lowering costs across the market. The same dynamic can work for infrastructure for BEV charging and FCV fueling.

Over time EVs can offer significant operational savings over internal combustion engine vehicles, but the initial purchase price can be prohibitive for many buyers. To accelerate market penetration of EVs, Washington should continue to provide and expand financial incentives. In doing this, policy makers should ensure equitable outcomes, ensuring measures prioritize residents who cannot afford to purchase and finance a new car.

Rapidly accelerating EV adoption in the near-term will require acquainting as many consumers as possible with the features and advantages of EVs. At the same time policies must confront potential concerns such as “range anxiety” issues related to maximum travel distance and availability of charging and fueling options. State-supported education and outreach efforts could help achieve these aims. As with rebate programs, the state’s electric utilities should be enlisted in these efforts.

Actions:

- The Department of Enterprise Services, with support from the Legislature and other state agencies, should continue and expand efforts to convert state-owned vehicle fleets beyond the current goal of at least 50% of new state passenger vehicle purchases being EVs.
- The Legislature should pursue accelerative policies, including financial incentives, loan programs, fleet targets and outreach campaigns for public and private fleets. Assistance priority should be targeted to drivers bearing the direct costs of vehicle operation and ownership. See Appendix C for detailed fleet conversion recommendations.
- The Legislature should enhance existing and restore expired electric vehicle and low carbon fuel incentives and reduce disincentives. See Appendix C for expanded discussion of these incentives and disincentives.
- The Legislature should support robust, comprehensive and accessible EV outreach and education. See Appendix C for expanded discussion of outreach and education opportunities.

D. Reduce Energy Consumption and Emissions in the Built Environment

Buildings represent approximately one-fifth of Washington’s greenhouse gas emissions. This includes emissions related to electric generation. The greatest portion of the sector’s emissions come from the direct combustion of natural gas and other fossil fuels in buildings for space heating, water heating and cooking.

The deep decarbonization modeling analysis described in Chapter B-Achieve the State’s Greenhouse Gas Emission Limits identified a combination of energy efficiency and electrification as the least-cost strategy to meet the state’s greenhouse gas emissions limits for buildings. Consistent with this finding, this chapter recommends policies and actions required to implement an electrification strategy in Washington buildings.

A buildings electrification strategy presents a suite of opportunities and challenges. Increasing the adoption of energy efficiency and converting space and water heating to high efficiency heat pumps[80]

[80] A description of the wide range of heat pump and chiller applications for buildings and district heating systems is included in Appendix D.

requires refocusing energy efficiency policies to carbon reduction policies. Market transformation efforts will be required to prepare contractor infrastructure, pilot innovations and drive consumer acceptance. It requires capital investments with full consideration of equity and distributional cost impacts. Building upgrades will need to be scheduled in such a way as to avoid housing or business disruptions.

The buildings sector relies on and creates opportunities to support policies from other sections of the state energy strategy. Decarbonizing buildings depends on the electricity sector to provide clean electricity, requires the industrial sector to provide low-carbon building materials and refrigerants and supports deploying distributed energy resources, including renewables and load control services, such as solar and battery storage systems. Buildings will also serve as a distribution hub for electric vehicle charging.

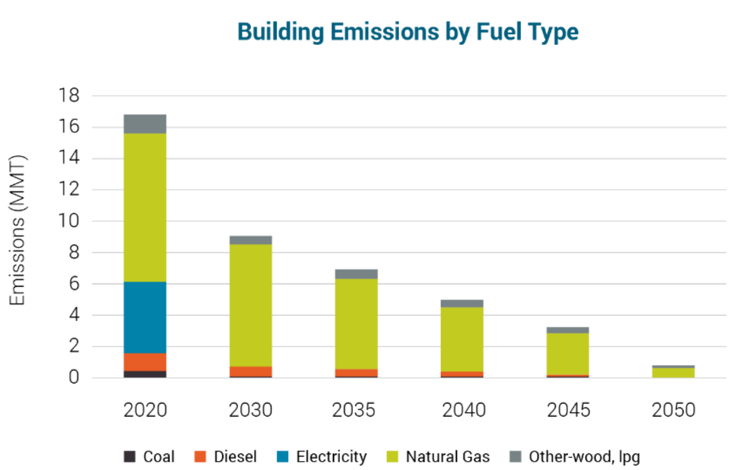
Decarbonizing the building sector requires the state to:

- Maximize energy efficiency
- Maximize electrification
- Optimize buildings as grid resources
- Minimize embodied carbon and refrigerant emissions

The following three figures illustrate the challenge and pace of implementing the Electrification Scenario in buildings. Currently, electricity contributes 27% of building energy greenhouse gas emissions, natural gas contributes 56% and a combination of diesel oil, propane and other fuels contributing the remaining 17%. Implementing CETA will reduce electricity emissions to carbon neutral by 2030. To meet the state's greenhouse gas reduction limits, emissions from gas in buildings must decline by 14% in 2030 and continue to decline at an increasing rate through 2050 (Figure 18).

To meet the 2030 limits, high-efficiency electric strategies will need be implemented at every available opportunity. Ideally, this would mean every time fossil fuel or electric resistance equipment is scheduled for renewal, it would be replaced with high-efficiency electric equipment. All new construction would need to be designed and constructed to meet low energy, zero carbon standards.

Figure 18. Electrification Scenario: Distribution of Building Sector Emissions by Fuel Type



Source: Deep Decarbonization Model

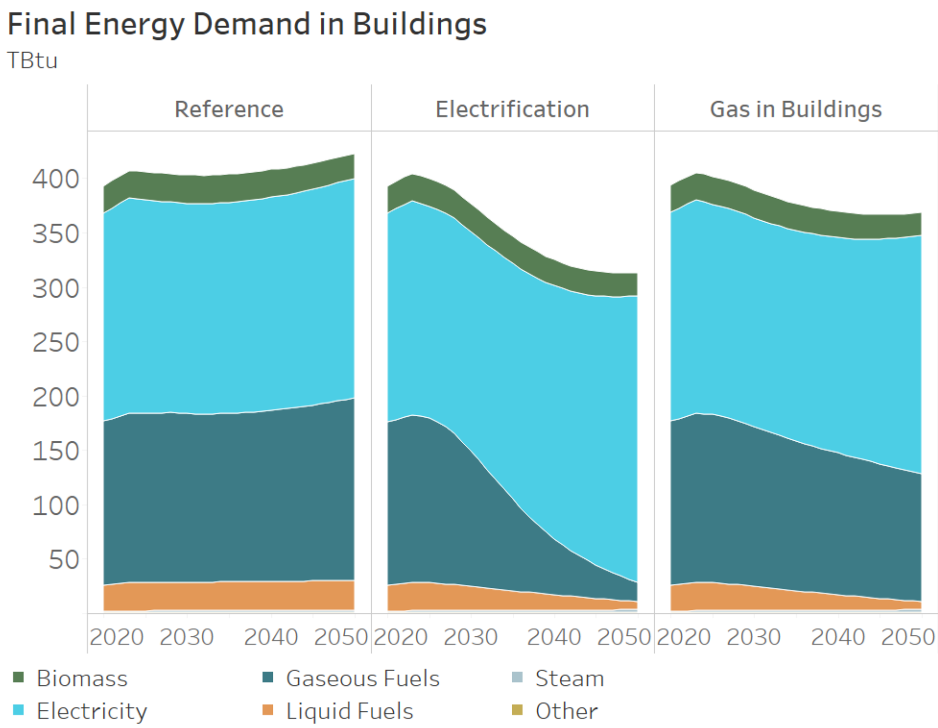
Figure 19 demonstrates the shift in equipment type and fuel included in the deep decarbonization modeling.

Figure 19. Equipment Sales and Stock Shares Driving Energy and Emissions Reductions in the Electrification Scenario

Source: Deep Decarbonization Model

In Figure 20, the electrification scenario results in the building sector reducing all energy loads by 26% in 2050 with energy efficiency actions. This will be a combination of building improvements and conversion of existing electric resistance space and water heating to heat pump technologies. The loads currently served by fossil fuels must be converted to high efficiency electric. This results in an increase in electricity requirements of 30% compared to the reference case.

Figure 20. Scale and Pace of Energy Use Reductions Required to Meet Economy-Wide Emissions Limits



Source: Deep Decarbonization Model

In addition to energy use, buildings contribute to greenhouse gas emissions through the manufacturing of construction materials and carbon embedded in refrigerants used in heat pumps and cooling systems. Embodied carbon – carbon emissions attributed to construction materials – accounts for 11% of annual global emissions.[81] Furthermore, HFC refrigerants are a very potent greenhouse gas. Building policies and programs must drive demand for lower carbon building materials and encourage the transition to less harmful refrigerants.

1. Establish a Building Decarbonization Policy Framework

Washington's building policies need to directly address the state's greenhouse gas emissions limits. Over the last 40 years, Northwest states and utilities have developed a robust regional power and energy efficiency planning and delivery system. This system does not address greenhouse gas emissions directly. The central elements of this framework must be fast-tracked to meet the 2030 greenhouse gas emissions limits. At the same time, institutional and market capacity development is needed to meet the 2050 limits.

Building up manufacturing and retrofitting capacity to transform the building stock is a significant task requiring market predictability and longer lead times. It is critical that the state adopts the basic structure of the building sector transition now, so policies, codes and standards can be put in place on a

[81] "Why the Building Sector?" (Architecture 2030, n.d.), https://architecture2030.org/buildings_problem_why/.

timeline that provides predictability in the form of clear signals that building owners and market forces can respond to.

The state needs a new policy framework harmonizing and delivering deep energy and greenhouse gas savings. Optimizing energy use, rather than just reducing it, will decarbonize the building sector. This means switching away from programs based solely on reducing energy use to programs that value outcomes based on energy utilization and greenhouse gas emissions limits. There needs to be a shift to standardized performance-based metrics and labeling across all policies and programs.

The transition to a more efficient, decarbonized building stock will succeed only if all Washingtonians have a stake in its success and the transition benefits all Washington communities. Energy efficiency programs have focused primarily on reducing energy use or costs, while in many cases ignoring the co-benefits of improved resiliency, public health and climate adaptability. Building electrification and energy efficiency policies and programs should enable equitable outcomes for low-income communities, including improvements in public health outcomes, increases in energy affordability and making homes more comfortable.

1.1. Expand Building Decarbonization Leadership Capacity

State government will need to increase its role in energy planning, energy code development and program implementation for the state to meet its greenhouse gas reduction limits. Much of the leadership, research, analysis and planning for the current Northwest energy efficiency industry is conducted at the regional level as part of the power planning process required by the 1980 Northwest Power Act.[82] Energy efficiency in buildings is evaluated as a least cost resource rather than a decarbonization imperative that must be accelerated. Washington state government will need to build off of the infrastructure currently supporting efficiency and provide the resources and policies necessary to support decarbonization efforts in the building sector.

Actions:

- Expand and clarify the roles and responsibilities for a state energy office and other state agencies to provide analytical and planning capabilities directly supporting building decarbonization.
- Work with regional organizations to align energy efficiency research, planning and market transformation efforts. Create situational awareness with data resources supporting policy development and implementation plans.
- Align with the efforts of existing organizations and alliances, including workforce development, community organizations in the development of planning specific to their needs.
- To further augment institutional decarbonization capacity, the state should strategically amplify, fund and align with efforts of existing organizations and alliances, including workforce development and community organizations. These organizations must be provided intervener compensation for substantive engagement in regulatory or planning proceedings.

[82] “Northwest Power Act” (Northwest Power and Conservation Council, n.d.), https://www.nwcouncil.org/reports/columbia-river-history/northwestpoweract.

1.2. Develop a Detailed Washington Building Decarbonization Plan

This state energy strategy lays out a high-level roadmap and set of policy recommendations for the building sector. The state needs to further develop a more detailed building decarbonization plan. California's Assembly Bill 3232[83] requires the California Energy Commission to develop a detailed plan to reduce building sector emissions by 50% by 2030. The California plan must include detailed building characterization, segmentation, technical and fiscal analysis and set emissions reduction targets.

Washington needs to develop a comparable plan with the expectation that it will be reviewed periodically to assure continued effectiveness. A large scope of stakeholders will need to be brought into the effort to assure success. Planning should uniquely address the challenges this transition poses for single-family, multifamily, various sizes of commercial buildings, campus or district configurations, private and public ownership, rural and urban locations, BIPOC and low-income communities.

Action:

- Develop a state decarbonization plan for buildings covering each part of the buildings sector in every region of the state.
- Within the plan, establish clear energy utilization targets and greenhouse gas emissions limits for buildings by type, including interim and final targets. Include methods for incorporating campus or district thermal distribution systems. Use these targets to guide adoption of mandatory energy codes, building performance standards and utility program designs.
- Develop an electrification and heat pump program to electrify the building sector using the least cost and most strategic approach, while addressing equity and market capacity considerations. Consideration for consumer access and equitable distribution of benefits should be included.
- Develop market transformation roadmaps to identify the interventions required in technology, supply chain delivery, contractor education and consumer marketing.
- Seek to increase consumer and business financing options. For example, develop residential PACE financing programs similar to the recently adopted CPACER option.[84] Consider on-bill financing administered by utilities or other mechanisms.
- The plan shall be developed with an inclusive public process addressing specific needs of communities, with focus on equity and inclusion.
- Washington's building decarbonization strategy must couple non-energy policy with energy policy, such as energy efficiency mandates that protect against increases in rent leading to displacement, and support for workforce development efforts to ensure equitable access to career-track jobs in and beyond building decarbonization.

1.3. Align Utility Ratepayer Programs Funded around Decarbonization Performance Outcomes

Utilities will play a significant role in taking building decarbonization to scale. Utilities work within an existing energy and conservation planning framework and have programmatic mechanisms for reducing energy use. By virtue of their customer base they have direct relationships with every residential and commercial building in the state.

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[83] Zero-emissions buildings and sources of heat energy (Chapter 373). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB3232.

[84] HB 2405 - 2019-20, Concerning commercial property assessed clean energy and resilience.

Energy conservation potential is developed in the context of each utility resource plan. Conservation is chosen when it provides the least-cost resource. The social cost of carbon has recently been added as a consideration during this planning increasing the value of conservation compared with alternate approaches resulting in continued greenhouse gas emissions. This may lead to increased utility participation in conservation acquisition, although these impacts will not be uniform across all utility service territories or across all buildings in the state. Utility planning and efficiency efforts also need to be structured to achieve building performance energy utilization targets and greenhouse gas emissions limits.

Action:

- Structure performance-based mandates as the critical path for each building segment to meet the state's low-energy and zero-carbon building targets. Utility programs and market transformation efforts should then be required to directly align with and support the success of the mandates in drawing down energy use and emissions.
- Adopt policies and programs for determining baselines, attribution, energy and greenhouse gas emission reductions and the determination of least-cost approaches.
- Develop structures that assure funding allocations respond to the needs of low-income and other vulnerable customers.
- Identify utility regulation or utility performance incentives required to assure outcomes.

1.4. Accelerate Adoption of Low Greenhouse Gas Emissions Refrigerants and Equipment

In addition to energy use, buildings contribute to greenhouse gas emissions through the manufacturing of construction materials. Emissions are also embedded in refrigerants used in heat pumps and cooling systems. Embodied carbon — carbon emissions attributed to construction materials — accounts for 11% of annual global emissions.[85] Hydrofluorocarbon (HFC) refrigerants are also very potent emitters.

Manufacturing techniques have been developed to control or reduce these emissions. Businesses can now manufacture concrete with reduced environmental impacts. Cross-laminated timber provides a zero-carbon wood product that can be used in building construction. Regulations to control and eventually eliminate HFCs are being developed and implemented.[86] Meanwhile, a global initiative to reduce the impacts of refrigerants has been adopted under the Montreal Protocol,[87] which continues to spur chemical and equipment manufacturers to develop products that use less harmful constituents.

Washington adopted regulations to reduce the impacts of refrigeration chemicals through HB 1112 (2019).[88] The statute requires less damaging HFCs, or suitable substitutes used in various equipment applications, and implements refrigerant management processes. Relatedly, the Washington State Building Code Council has voted to adopt a reference standard that will allow the use of A2L refrigerants in refrigeration and air-conditioning including the use in occupied dwellings.[89] The scope of these efforts

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[85] "Why the Building Sector?"
[86] Chapter 173-443 WAC.
[87] "About Montreal Protocol," UN Environment Programme, n.d., https://www.unenvironment.org/ozonaction/who-we-are/about-montreal-protocol.
[88] "Hydrofluorocarbon Greenhouse Gas Emissions," Pub. L. No. House Bill 1112 (2019), http://lawfilesext.leg.wa.gov/biennium/2019-20/Pdf/Bills/Session%20Laws/House/1112-S2.SL.pdf?q=20201129212221.
[89] Alex Ayers, "WA Code Council Paves the Way for Use of A2L Refrigerants," November 13, 2019, https://blog.hardinet.org/wa-code-council-refrigerants.

is limited but encouraging. As new equipment is developed and made available, Washington's laws and rules will need to take advantage of new opportunities while continuing to manage refrigeration systems.

Actions:

- The State Building Code Council should adopt the most recent editions of national equipment standards allowing installation of low emissions refrigerants in buildings
- The State Energy Office should incorporate low emissions refrigeration opportunities as they become available as part of market transformation efforts.
- The State Board of Community and Technical Colleges should incorporate application of state regulations for refrigerant management in industry-related coursework. The board should support training programs related to new equipment as they become available. Capacity building and training for minority- and women-owned construction businesses and contractors should be prioritized for development.

2. Maximize Energy Efficiency and Electrification in Buildings

Washington's core strategy for meeting its greenhouse gas limits must focus on retiring and replacing equipment in buildings with high-efficiency electric systems and achieving deep energy efficiency savings to reduce electric loads. The existing utility programs, energy code and building energy performance standards provide a good foundation for this transition. However, these policies and programs cannot deliver the increased sales share of high-efficiency technologies and electrification needed to meet the 2030 and 2050 greenhouse gas emissions reduction limits.

To meet these limits, Washington will need a comprehensive suite of revamped and new policies that put the building sector on a path to meet the 2030 and 2050 limits. Plans should uniquely address the challenges that this transition poses for single-family, multifamily, various sizes of commercial buildings, campus or district, private and public ownership, rural and urban locations and low-income communities. To increase the resiliency of the building stock for occupants, energy policy must be coupled with affordable housing, public health and anti-displacement policies.

This strategy flows from the proposed building decarbonization policy framework described above. It is designed to reduce the risk of locking in carbon-emitting technologies and practices that will hold back Washington's ability to meet greenhouse gas limits. The strategy includes the following components to support the development of a robust policy and market for each building type and size: performance disclosure, mandates, complementary utility programs, accelerated market transformation and financing.

Energy efficiency and electrification programs need to be focused on metrics, such as public health outcomes to track progress toward increasing equitable outcomes, as there is a known gap in the data available regarding the efficacy of building electrification efforts for low-income communities.

2.1. Strengthen and Expand Energy Codes and Standards

Washington's energy code and performance standards should be revised or adopted to incorporate the state's greenhouse gas emissions limits. The Washington State Energy Code[90] regulates the construction

[90] Chapter 19.27a.020 RCW.

of new residential and nonresidential buildings, additions, major renovations and establishes equipment replacement efficiency criteria. The state building energy performance standard[91] (BPS) implements a strategic energy management program to improve the energy performance of existing nonresidential buildings greater than 50,000 square feet in floor area. Both are structured primarily as energy efficiency standards rather than as explicit carbon emissions standards. Washington has not adopted a residential building performance standard.

Codes are an important element of providing broad benefits to all housing types and are the least-cost approach to implementing energy efficiency and carbon reduction in buildings. Codes and standards will also be important elements of deploying EV charging infrastructure and distributed energy resources (DER) technologies. The state building code already includes requirements to develop EV charging infrastructure, including in apartments[92] and incentives for renewable energy generation. But other DER features, such as load control are not similarly incentivized.

This section and action items are expanded in Appendix D to provide more background and recommendations for action.

Actions:

- The energy code statute should be revised to require the State Building Code Council to adopt zero-carbon and all-electric construction and efficiency mandates no later than the 2027 code, fully achieving incremental improvements each code cycle from 2021 to 2027. Funding for technical development, code implementation and evaluation of progress should be provided.
- Consider additional energy code provisions to expand deployment of DER technologies, such as on-site generation and utility-integrated load control.
- Continue to evaluate the role of net zero energy buildings[93] as a resource in the context of building and DER policies.
- Expand the scope of the BPS to include buildings with less than 50,000 square feet with a stepped path to low energy and zero carbon by 2050. Modify the BPS with provisions specific to smaller buildings.
- Adopt a mandatory residential performance standard to scale up the residential retrofit market. Include comprehensive equity and workforce provisions for both rental and owner-occupied homes and identify the unique opportunities and challenges faced by all residential segments including single family, multifamily and manufactured housing.
- Dissemination of information should be operationalized at the state level through training programs.
- To ensure affordable housing units in Washington are able to comply with the building performance disclosure policies, there should be flexibility in compliance timelines and targeted education and training programs in multiple languages.

[91] Chapter 19.27a.210 RCW.

[92] Chapter 51-50-0427 WAC, Section 429.

[93] Net zero energy buildings use very little energy and include renewable onsite generation resulting in annual net zero energy consumption on site.

- Capacity building and training for minority- and women-owned construction businesses and contractors should be prioritized during policy development. Design training programs for energy audits with incentives or requirements to hire from low-income communities.
- Customize performance standards for affordable housing and rent-stabilized units to reduce displacement and enable streamlined compliance. Integrate benchmarking requirements into qualified allocation plans (QAPs) that determine low-income housing tax credit (LIHTC) allocations.[94]
- Ensure inclusion of local and Tribal government representatives during the process of developing the energy code and building performance standards framework and strategy.

2.2. Lead by Example with Public Capital Projects and Energy Management

The state capital budget provides funding for new construction, major renovations and minor works projects in the public sector. This includes projects for state, local and Tribal government, higher education and K-12 schools, low-income housing and nonprofit institutions. Given their long service life, the allocation of capital funds for these public projects should include requirements for planning, construction and operation consistent with achieving the state's greenhouse gas emissions limits and build on existing efforts to lead by example.

Participation of multiple state agencies and coordination with local governments would support the transition. The State Efficiency and Environmental Performance (SEEP) Office[95] coordinates with partners across the state government to reduce greenhouse gas emissions, reduce energy costs and eliminate solid waste and toxic materials from state agency operations. The Energy Savings Performance Contracting program at the Department of Enterprise Services and financing provided by the State Treasurer's Office support state and local government efficiency programs. The Housing Trust Fund and OSPI manage allocations to low-income housing and K-12 education.

Actions:

- Update Office of Financial Management requirements for capital budget requests to implement electrification in all applicable projects.
- Require all new public buildings funded by the capital budget to be all-electric and zero-carbon.
- Require existing public buildings to minimize building energy loads and convert carbon-based fuel systems to all electric high-efficiency systems.
- Transition campus district heating and cooling systems to zero carbon by reducing total heating demand, reducing or eliminating peak demands, converting district steam to hot water or electrifying central heating systems.
- Implement robust energy management and operations and maintenance programs for each public building or site consistent with the state BPS and to work towards low or zero greenhouse gas emissions.
- Prioritize decarbonization of public buildings in low-income communities, specifically public schools and hospitals.

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[94] Andrea Krukowski and Andrew Burr, "Energy Transparency in the Multifamily Housing Sector: Assessing Benchmarking and Disclosure Policy" (Institute for Market Transformation, 2012).

[95] SEEP was initiated by EO 20-01. For program details see: https://www.commerce.wa.gov/growing-the-economy/energy/state-efficiency-and-environmental-performance-seep/.

- Ensure funding is available for building efficiency projects in all communities.
- Continue to coordinate state efforts through SEEP and consider additional support to align all projects funded through the state capital budget with the state's greenhouse gas emissions limits established by RCW 70A.45.
- Ensure decarbonization for rural public buildings through funding allocations.

2.4. Align Utility Programs with State Mandates

Under this strategy the share of Washington's building stock covered by state mandates would increase before 2030. State mandates consist of the energy code and the BPS, including performance disclosure requirements. The mandates will be structured to progressively reduce energy use and carbon in buildings with the ultimate goal of low-energy, zero-carbon buildings by 2050. Utility programs and regulation must be similarly structured to reduce energy and emissions consistent with meeting the 2030 and subsequent greenhouse gas emissions limits. The energy code should be strengthened to hit low-energy zero-carbon and must be done in the three remaining three-year code cycles (2021, 2024 and 2027).

Utilities and the Northwest Energy Efficiency Alliance have been key partners in encouraging technology development and adoption to improve energy efficiency. Strategic energy management has also been deployed. These strategies are structured to achieve incremental savings compared to the code or existing building baseline. Utilities can continue to drive and accelerate achieving building-specific energy and greenhouse gas emission limits to be developed further during the detailed energy planning described above in section 1.2.

Action:

- Utility building efficiency programs should be designed to achieve energy utilization and greenhouse gas emission limits as is already recognized in utility conservation potential assessments and conservation program implementation plans.
- The Utilities and Transportation Commission (UTC), State Energy Office and interested participants should develop targets and processes to support utility efforts, including revisions of utility conservation planning and cost recovery mechanisms.

2.4. Create and Fund a High Efficiency Electrification Program

To reach building electrification targets, an electrification program should be developed and implemented. The program should provide funding generated from all building energy end uses, including electric, gas and liquid petroleum through a public benefits charge, carbon fee or economy-wide cap and trade program. Funds would be allocated to end-use customers who install high-efficiency heat pumps for space and water heating, convert gas cooking to electric cooking and or choose other identified electrification opportunities.

Current utility efficiency programs are often siloed by fuel source and may be constrained by regulations that limit funding cross-sector fuel conversions. Liquid petroleum and transportation-only electric and gas customers fall outside of the scope of utility efficiency programs. A crosscutting electrification program would overcome these constraints and could be operated as an independent customer distribution plan, or through existing utility programs. The program should include mechanisms to ensure participation by low-income households, based on input from organizations that represent their interests and communities. Implementation should involve utilities, market transformation experts and heating, ventilation and air conditioning (HVAC) professionals.

A program that implements high-efficiency electric space and water heating will impact most building energy customers in the state, given that the majority of electric heating still uses electric resistance heating equipment. Gas and oil heating and hot water systems will need to be replaced by heat pumps.

Action:

- The State Energy Office should develop and implement a high-efficiency electrification program to incentivize adoption of heat pump technology in existing residential and nonresidential buildings, including marketing, workforce development and certification and equitable distribution of incentives.
- In anticipation of increased workforce demand, the State Board of Community and Technical Colleges should develop a heat pump training and certification program for contemporary heat pump installation and maintenance. Training will need to be broadly distributed throughout the state and be designed to assure opportunities are provided to low-income communities.

2.5. Broaden the Scope and Scale of the Low-Income Household Energy Programs

Low-income households bear a disproportionate housing and energy cost burden relative to other households. Existing sources of energy assistance, including both federally-funded and utility-funded assistance, do not adequately address the home energy affordability gap in Washington.

The number of Washington households participating in the state's Weatherization Assistance Program (WAP) each year represents just a fraction of eligible households. According to the 2019 Home Energy Affordability Gap data, there are 749,112 households living at or below the income qualification threshold to receive WAP services.[96] Public funding at existing levels is insufficient to provide the scale and scope of services needed.

Commerce administers the state's WAP services with funding from U.S. Department of Energy's WAP, the U.S. Department of Health and Human Services' Low Income Home Energy Assistance Program (LIHEAP), the Bonneville Power Administration (BPA) and the state-funded Weatherization Plus Health Matchmaker Program. These four funding sources are highly leveraged with utility conservation funds from many, but not all, utilities in the state.

Services provided by WAP, while important to reduce energy burden, are insufficient to address the statewide needs from deferred maintenance in affordable housing stock and the negative health impacts of substandard housing. The program is not currently structured to allow for broad electrification, or to increase access to renewable energy resources that would lower household energy burden and energy inefficiency.[97]

[96] "Home Energy Affordability Gap" (Fisher, Sheehan & Colton: Public Finance & General Economics, n.d.), http://www.homeenergyaffordabilitygap.com/03a_affordabilityData.html.
[97] "2019 Biennial Energy Report: Issues, Analysis and Updates" (Washington State Department of Commerce, December 2018), https://www.commerce.wa.gov/wp-content/uploads/2013/01/COMMERCE-Biennial-Energy.pdf.

The state has made two important changes to broaden the scope of the weatherization program in recent years. In 2015, House Bill 1720[98] allowed funding to include healthy housing improvements and in 2017, Senate Bill 5647[99] created a home rehabilitation revolving loan program for low-income owner-occupied households in rural communities. There is more work remaining to expand the scope and funding scale for these critical services.

In addition to improving access to energy assistance and weatherization programs, low-income and rural communities often lack access to high-quality broadband services, which acts as a barrier to participation in energy efficiency benefits.

Actions:

- Increase funding for low-income weatherization to address a minimum 10% of eligible households annually and continue decoupling the program's eligibility requirements from federal requirements to increase flexibility, allow for re-weatherization and include households that fall just above the income threshold to receive low-income services.
- Facilitate meaningful public participation with highly impacted populations to explore solutions to address historic barriers to accessing the limited resources currently available for weatherization.
- Conduct ongoing engagement with Tribal Governments to explore approaches to systematically expand services to and within Tribal communities. Invest in and leverage workforce capacity within these communities.
- Address the breadth of need for deferred maintenance to make households ready for weatherization by expanding the home rehabilitation revolving loan program statewide and beyond owner-occupied single-family homes. This expansion should include Tribal communities, rental housing and manufactured housing.
- Prioritize services to underserved households within highly impacted populations including rental housing, multifamily housing, non-electrically heated housing and high-energy burden households.
- Provide innovative financing models that can be used to provide low-income households the access to capital needed to decarbonize their homes.
- Expand funding for the state's successful Weatherization Plus Health program as part of a broader strategy to reduce energy burden and improve health outcomes for low-income households impacted by the COVID-19 pandemic.
- Provide universal access to high quality broadband to enable grid integration of appliances and equipment, optimizing buildings and managing load.

2.6. Create Market Transformation in Support of Eliminating Greenhouse Gas Emissions

Market transformation is the strategic process of intervening in a market to create lasting change.[100] As shown in the deep decarbonization modeling, meeting 2030 building energy and emissions reductions goals will require a shift to 100% sales share of high efficiency electric equipment by 2030. High-

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[98] "HB 1720: Concerning Healthy Housing" (2015), https://app.leg.wa.gov/billsummary?year=2015&billnumber=1720&initiative=false.
[99] "SB 5647: Creating a Low-Income Home Rehabilitation Revolving Loan Program" (2017), https://app.leg.wa.gov/billsummary/?BillNumber=5647&Year=2017&Initiative=false.
[100] "NEEA Standard Definitions," NEEA, n.d., https://neea.org/definitions.

efficiency electric space and water heating equipment currently holds a relativity small share of market sales compared to fossil and electric resistance equipment, which needs to change, as does market adoption of other products and practices that improve the energy efficiency of buildings.

Efforts to increase market penetration includes interventions, such as product standards, pilot programs, training for design, sales and installation contractors and incentives for end users. In some cases, it requires earlier interventions that bring new products to the market. Market transformation efforts bring competence, scale and competition to the market, delivering quality services at least cost.

The Northwest Energy Efficiency Alliance, which is funded by the region's gas and electric utilities, has led the energy efficiency market transformation efforts in the region for more than two decades. This organization could be a primary collaborator.

Developing a state market transformation effort is proposed to reflect the electrification outcomes recommended in this strategy. Market transformation must explicitly focus on decarbonization strategies to meet the greenhouse gas emissions limits. The project objective should ensure that each state mandate has a clear and funded market transformation plan for building market capacity and removing technical and financial barriers. In addition, the strategy should identify and create the numerous collaborations required to implement a market transformation effort and a clear funding plan.

Actions:

- The state should develop a market transformation team within the state energy office. The office will be charged with guiding the collaborations required to implement a market transformation intervention.
- Ensure market transformation programs have carve-outs and direct funding for low- and moderate- income households and Tribal nations.

3. Develop Plans for the Long-term Transition of the Natural Gas Distribution System

The future path of emissions reductions in residential and commercial buildings is closely linked to the future of the natural gas distribution system. Fossil natural gas accounts for 80% of the non-electric emissions in the residential and commercial sectors,[101] and these sectors account for 63% of the non-electric consumption of fossil natural gas.[102]

As Figure 18 illustrates, the mix of energy used in buildings is expected to shift dramatically as the state reduces its greenhouse gas emissions with greater use of clean electricity, in place of fossil natural gas. This could result in a substantial change in the role of the natural gas distribution system that currently provides energy to 1.2 million residential and 107,000 commercial customers.[103] Four natural gas distribution utilities deliver fossil natural gas to these customers, who use the fuel for space heating,

[101] Figure 7, "Washington State Greenhouse Gas Emissions Inventory: 1990-2015" (Washington State Department of Ecology, December 2018), https://fortress.wa.gov/ecy/publications/documents/1802043.pdf.
[102] "Natural Gas Consumption by End Use," U.S. Energy Information Administration, n.d., https://www.eia.gov/dnav/ng/ng_cons_sum_dcu_swa_a.htm.
[103] "Number of Natural Gas Customers," U.S. Energy Information Administration, n.d., https://www.eia.gov/dnav/ng/ng_cons_num_a_EPG0_VN5_Count_a.htm.

water heating, cooking and a variety of commercial purposes. Emissions from natural gas used by residential and commercial customers account for 7.2% of the state's total emissions.[104]

The deep decarbonization modeling analysis considered two scenarios to this segment of the state's energy system in meeting the state's overall emissions limits. The Electrification Scenario assumes rapid electrification of gas-consuming appliances in buildings. The Gas in Buildings scenario initially would have used a lower assumption about potential efficiency gains, which was consistent with the current levels of energy efficiency achievement reported by natural gas distribution companies.[105] The final Gas in Buildings scenario maintains use of gas in appliances at the levels they are at today. Both scenarios assume the same levels of appliance efficiency by technology.

Compared to Electrification, the Gas in Buildings scenario uses less electricity and higher quantities of gas. To retain use of fossil natural gas and still meet the emissions targets, the Gas in Buildings Scenario makes greater use of synthetic fuels and biofuels in transportation, and only after 2045 is fossil gas replaced with biogas. The projected overall cost is higher in the scenario that retains gas pipelines as a means of delivering energy to residential and commercial customers. Under either scenario, the amount of fossil natural gas delivered in 2050 is about 90% lower than in the Reference case.

Stakeholders from the natural gas industry have suggested that this analysis reflects a bias against natural gas as an energy source and that it understates the potential to improve efficiency in the use of gas.[106] It does neither. The model evaluates alternative solutions using the best available information about costs and technology and it looks at all sectors of the economy together to arrive at an overall result. The results indicate that conversion from fossil natural gas to electricity results in lower costs. The analysis assumes energy efficiency improvements by technology across all scenarios are the same, where newly installed appliances are highly efficient. With these efficiency assumptions, the Gas in Buildings scenario yields a 45% reduction in gas consumption compared to the Reference scenario.

Industry stakeholders also contend that this analysis ignores the cost of investments already made in distribution system infrastructure. These are substantial: The four distribution companies have invested $6.2 billion in gas utility infrastructure and the undepreciated portion is $4 billion.[107] The latter amount represents an average investment of about $3,000 per customer. The deep decarbonization analysis does not assume that these costs could be avoided under any scenario. They are sunk costs that exist under every scenario.

The 2021 State Energy Strategy does not call for any specific outcome concerning the long-term use of the existing gas distribution system. It does, however, identify benefits in shifting over time from fossil natural gas to electricity. This approach appears to serve the state's consumers and businesses better than one where non-fossil gas is manufactured and delivered by pipeline to end users. Retaining gas as

[104] Figure 7, "Washington State Greenhouse Gas Emissions Inventory: 1990-2015."
[105] Electric utilities in Washington achieved efficiency savings, as a percent of delivered energy, five times the rate achieved by natural gas utilities. American Council for an Energy-Efficiency Economy, "2019 State Energy Efficiency Scorecard," October 2019, tables 7 and 9. https://www.aceee.org/sites/default/files/publications/researchreports/u1908.pdf.
[106] Comments of Cascade Natural Gas, Nov. 12, 2020; Comments of Avista Corp., Nov. 19, 2020; Comments of Puget Sound Energy, Nov. 19, 2020; Comments of Northwest Gas Association, Nov. 19, 2020.
[107] Calculated using reports submitted to the UTC and available at: https://www.utc.wa.gov/regulatedIndustries/utilities/energy/Pages/CompanyAnnualReports.aspx.

an energy form requires more overall energy, both the energy used in the gas production process and the energy lost in combustion at the point of use.

The near-term actions suggested in this strategy would result in a gradual transition, over two to three decades, from fossil natural gas as a fuel source. There is opportunity in the near term for the natural gas industry to pursue a number of actions consistent with its preferred long-term approach:

- Increase energy efficiency to match or exceed the levels assumed in the Gas in Buildings scenario. This would include both the efficiency of end use equipment and the efficiency of the building stock.
- Reduce the greenhouse gas content of its product by incorporating hydrogen and renewable natural gas, using the authority provided by the Legislature two years ago.[108]
- Invest in research and development of green hydrogen and other clean fuels, with the aim of improving the financial viability of gas as a non-emitting energy form.
- Proactively support customers converting to zero-emission heating options, such as solar thermal and geothermal.

These actions would make sense under either an electrification approach or a long-term approach that uses non-fossil gas, and they would help test the feasibility of the general approach advocated by the natural gas industry.

In the meantime, the Legislature should consider whether to restrict growth of the natural gas system and the use of fossil natural gas where zero-emission options are available. Residential and commercial customer growth has slowed in the past decade, but this trend could reverse absent policy action. This would provide the industry, regulators and customers the time needed to develop a long-term transformation approach that is consistent with the state's climate and economic policies. A transition plan could be developed as part of the utility's integrated resource plan and should consider multiple approaches to emissions reduction, including:

- Financing, incentives and other mechanisms to protect members of disadvantaged communities.
- Energy efficiency measures evaluated to reflect the cost of non-fossil gas in the future.
- Conversion on replacement from gas to electric, including geographically targeted conversions.
- Limitations on service area expansion and line extension.
- Rate structures to align customer decisions with expected future costs of pipeline gas.
- Use of hydrogen and renewable natural gas to reduce the greenhouse gas content of the gas product delivered to customers.
- Measures to support gas company workforce transition.
- Accelerated depreciation of gas distribution plant to reduce stranded assets.

Actions:

- Increase energy efficiency and use of hydrogen and renewable natural gas to achieve near-term reductions in greenhouse gas emissions from fossil natural gas.
- Explore legislative and regulatory actions to restrict growth of the natural gas system and the use of fossil natural gas where zero-emission options are available.

[108] Chapter 80.28.390 RCW.

- Develop through the UTC's integrated resource planning process a comprehensive plan for natural gas distribution companies to transition from the use of fossil natural gas.

E. Industrial Transformation and Workforce Development

In pursuing a holistic approach to industrial decarbonization, Washington can focus on areas in which it enjoys a strong competitive advantage. With low-carbon electricity, a highly skilled workforce and established advanced manufacturing industries, Washington can gain early traction in the global race to reduce the carbon intensity of products and materials. Industrial transformation requires better information about how industry uses energy, coordination of climate policy with other jurisdictions, more attention to industrial policy and deliberate efforts to develop the skills of the state's workforce.

1. Build a Dataset and Technologies to Decarbonize the Industrial Sector

Washington's industrial sector accounts for 28% of the state's retail electricity demand[109] and about 28% of the state's greenhouse gas emissions.[110] The highest energy-consuming industries are:

- Agriculture
- Cement & Glass
- Computing Services
- Food Processing
- Forest Products
- Manufacturing/Aerospace
- Petroleum Refining

Every industrial facility and business has some potential to increase energy efficiency and reduce greenhouse gas emissions. A successful clean industrial energy policy is one that supports Washington's entire industrial sector and that takes advantage of the state's existing assets and strengths.

Industry creates greenhouse gas emissions in three ways. *Direct emissions* are the result of fossil fuel combustion for process heat, steam and hot water, on-site electric generation or space heating and are the most dominant. *Indirect emissions* derive from grid electricity consumption. P*rocess emissions* come from the materials in the industrial processes themselves. Examples of process emissions in Washington include fluorinated gases used to etch semiconductors; CO_2 released from calcium carbonate during cement manufacture; and nitrous oxide emissions from degradation of fertilizers used in agriculture. These three sources of greenhouse gas – direct, indirect and process – are interdependent. Managing them presents challenges unique to each industry.

The industrial sector presents a dual opportunity for the clean energy transition: (1) efficiency and greenhouse gas reduction strategies for large-scale industrial energy consumers and (2) development of clean technology and domestic job growth. Balancing these two, sometimes competing, opportunities will require creativity and commitment.

Industrial decarbonization roadmaps that can inform Washington's efforts include:

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[109] "Washington Electricity Profile 2019, Table 8. Retail Sales, Revenue, and Average Retail Price by Sector, 1990 through 2019," U.S. Energy Information Administration, accessed December 1, 2020, https://www.eia.gov/electricity/state/Washington/.

[110] Washington State Department of Ecology Greenhouse Gas Emissions Inventory.

- **Decarbonization of the industrial sectors: the next frontier** (McKinsey & Co.)[111] *An examination that treats industrial decarbonization on a global scale and details technology options in four focus sectors – cement, steel, ammonia and ethylene – with qualitative descriptions of options without quantification of targets or potential.*
- **Transforming Industry: Paths to Industrial Decarbonization in the United States** (American Council for an Energy-Efficient Economy (ACEEE).[112] *Qualitative descriptions of options without quantification of targets or potential that includes some policy discussion.*
- **Manufacturing Agenda: A National Blueprint for Clean Technology Manufacturing Leadership and Industrial Transformation** (Bluegreen Alliance).[113] *A U.S. focused policy analysis that includes substantial consideration of equity concerns but no technical analysis.*
- **Optionality, Flexibility & Innovation: Pathways for Deep Decarbonization in California** (Energy Futures Initiative).[114] *Economy-wide study on California with one chapter focused on the industrial sector that offers quantitative pathways to targets, on an "illustrative" level.*

The deep decarbonization analysis did not include a detailed, process-specific model of industrial sector emissions. Instead, the model assumed that the industrial sector would increase energy efficiency by 1% each year and by 2050 could convert to electricity for 50% of process heating, 100% of machine drives and 75% of building heating and cooling. The result is a substantial reduction in total energy consumption, compared with the Reference Case and a substantial change in the mix of energy forms toward electricity as depicted in Figure 21.

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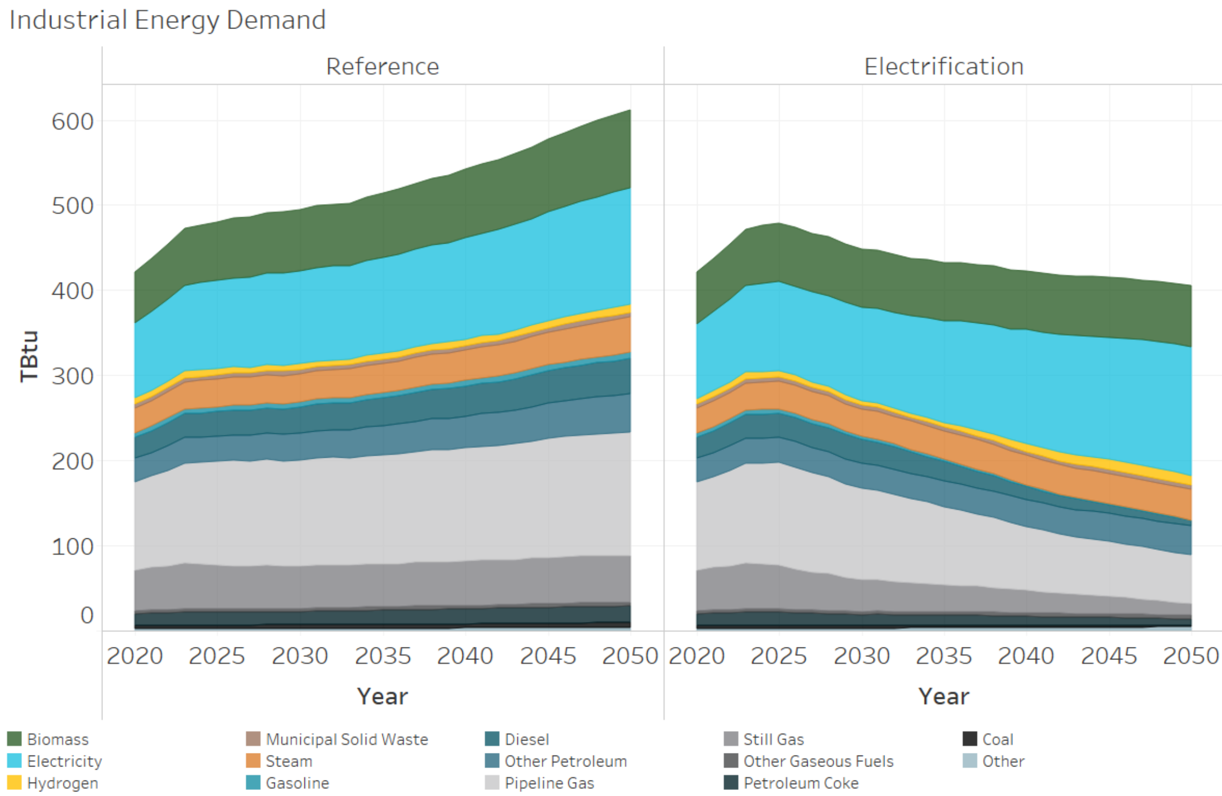
[111] Arnout de Pee et al., "Decarbonization of the Industrial Sectors: The Next Frontier: How Industry Can Move toward a Low-Carbon Future" (McKinsey & Co., 2018), https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Sustainability/Our%20Insights/How%20industry%20can%20move%20toward%20a%20low%20carbon%20future/Decarbonization-of-industrial-sectors-The-next-frontier.pdf.
[112] Andrew Whitlock, Neal Elliott, and Edward Rightor, "Transforming Industry: Paths to Industrial Decarbonization in the United States" (American Council for an Energy-Efficient Economy (ACEEE), 2020).
[113] "Manufacturing Agenda: A National Blueprint for Clean Technology Manufacturing Leadership and Industrial Transformation" (BlueGreen Alliance, 2020).
[114] Ernest J. Moniz, "Optionality, Flexibility & Innovation: Pathways for Deep Decarbonization in California" (Energy Futures Initiative (EFI), 2019).

Figure 21 – Fuels in the Industrial Sector in the Reference and Electrification cases.



Even in the industrial sector, where heat is often the most important form of energy, electrification will be critical. In the deep decarbonization modeling results, electricity replaces liquid and gaseous fossil fuels. Total final energy use in the industrial sector is 33% lower in the Electrification Scenario than in the Reference Scenario by 2050. Electricity starts at a 21% share of industrial energy demand in 2020, increasing to 36% by 2050 in the Electrification Scenario, while gaseous fuels drop from a share of 38% in 2020 to 18% in 2050.

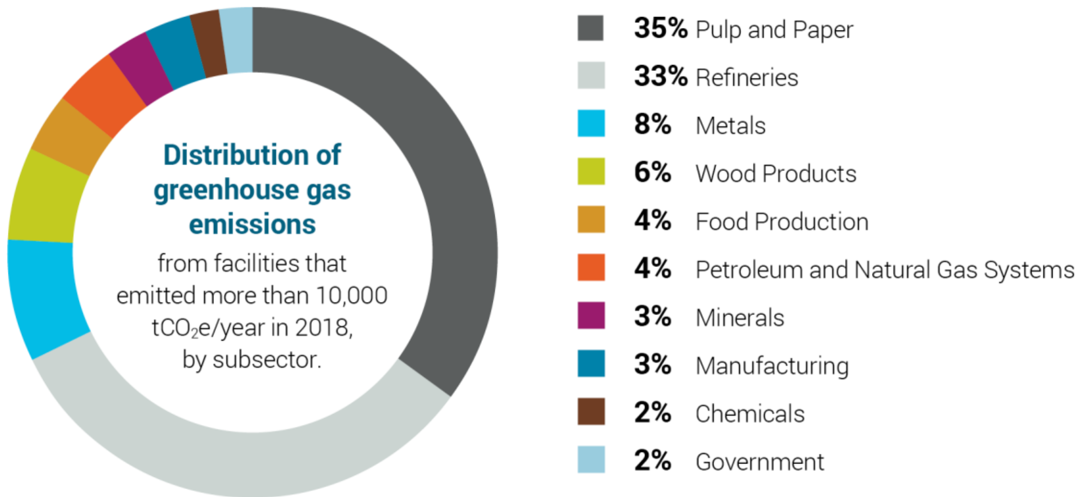
To meet the state's greenhouse gas reduction limits, Washington needs to develop a quantitative, industrial decarbonization roadmap.

1.1. Build the Supporting Datasets

In terms of the value of goods produced, Washington's industrial sector is dominated by aerospace and data processing activities, which account for over 54% of state industrial GDP.[115] These industries rely mostly on electricity and directly emit only a small fraction of the state's emissions. (Figure 22)

[115] As shown in Table 2, in calendar year 2018 the industrial sectors (including agriculture) had a combined gross product of $84.2 billion, of which $45.7 billion were in the aerospace and data processing sectors.

Figure 22-Distribution of greenhouse gas emissions from facilities that emitted more than 10,000 tCO2e/year in 2018, by subsector.



Most emissions from the Pulp and Paper and Wood Products subsectors are biogenic. The Metals subsector is dominated by the Alcoa Ferndale aluminum smelter, which is entering curtailment this year. The Government subsector consists almost entirely of steam plants operated by the federal government and by state institutions of higher education. (subsectors Transportation Fuel Supplier, Power Plants and Waste are excluded)

A handful of smaller industries contribute to most of Washington's greenhouse gas emissions. As shown in Table 3, refineries and pulp and paper facilities together accounted for about two-thirds of Washington's 2018 emissions reported by major facilities to Ecology, while those industries contribute less than 10% of the state's industrial production. Most of the emissions from pulp and paper facilities are due to combustion of biomass, considered less climatically-intensive than fossil fuel combustion because new carbon sequestration may be occurring on the harvested land.

Aluminum and steel production (metals) accounted for another 8% of greenhouse gas emissions, while lumber mills (wood products), food production and petroleum and natural gas systems account for another 4 to 5% each. These facilities produce greenhouse gas emissions from direct combustion of fossil fuels for heat and on-site electric generation as well as greenhouse gas emissions from industrial processes, such as CO_2 from calcination of cement and perfluorocarbons (PFCs) from aluminum production.

Table 3. Washington State's 12 largest industrial sectors, in order of 2018 gross domestic product (GDP).

REMI industrial sector	GSP, mm$
Aerospace product and parts manufacturing	29,591
Data processing, hosting, related services	16,072
Petroleum and coal products manufacturing	5,452
Farm	4,263
Navigational, measuring, electromedical, and control instruments mfg.	2,102
Beverage manufacturing	1,364
Fruit and vegetable preserving and specialty food manufacturing	1,227
Support activities for agriculture and forestry	1,140
Pulp, paper, and paperboard mills	912
Architectural and structural metals manufacturing	858
Plastics product manufacturing	837
Pharmaceutical and medicine manufacturing	826

Source: REMI Outputs from Economic Impacts Modeling

Actions

- The Department of Ecology should increase the subsector breakdown in its industrial sector greenhouse gas inventory. Both combustion and process emissions need to be broken down with the same taxonomy, so that data can be parsed meaningfully for policymaking.[116]
- The Department of Commerce should develop and publish detailed industrial sector energy data (following a coordinated taxonomy with Ecology) using federal Energy Information Administration forms data, or any new state reporting requirements.

[116] In particular, industrial sector emissions from combustion of fossil fuels must be disaggregated from the residential and commercial sectors.

1.2 Assess the Potential for Industrial Sector Greenhouse Gas Reduction Measures

There are four decarbonization approaches for the industrial sector:

Energy efficiency has been and continues to be the highest form of industrial environmental performance. It delivers reduced energy costs, lower direct emissions from on-site energy generation and lower emissions from grid electric generators. Energy efficiency includes lighting, building insulation and heating, ventilation and air conditioning (HVAC) solutions. In the industrial sector specifically, energy efficiency also includes efficient generation of heat and process efficiency, such as high-temperature waste heat recovery, low-temperature waste heat recovery smart manufacturing,[117] variable-speed drives[118] and compressed air efficiency.[119]

Electrification is a particularly powerful tool for industrial decarbonization in Washington. As the state's utilities comply with CETA, the electricity supply will gradually become cleaner. According to the ACEEE, typically only about 15% of the energy consumption in the more energy-intensive industries is electricity.[120] Ample opportunity for expansion of electric consumption exists, including:

- *Fuel-switching boilers* allowing an industrial installation to generate steam either with a fossil fuel or with electricity;
- *Microwave or radiofrequency assist* using the same technology consumers are familiar with in microwave ovens, to more efficiently dry high-water-content feedstocks or products;
- *Heat pumps, microwave or infrared heat* delivering low-temperature process heat more efficiently than steam;
- *Membrane separation technologies* displacing boiling and distillation with the much lower-energy approach of forcing a liquid against a sufficiently fine membrane, especially in petroleum refining;
- *Ultrasound-assisted, electromagnetic or ohmic drying* displacing conventional oven-drying especially in food processing; and
- *Pulsed electric field, ultra-sonification, pulsed light, UV or microwave pasteurization/sterilization* displacing conventional pasteurization and steam autoclave sterilization especially in food processing.

Combined heat and power (CHP). Most industrial facilities need significant amounts of both electricity and heat. CHP is a method for providing both electricity and heat on-site for industrial facilities. It is the use of low-grade heat exhausted by combustion-fired electric generation, for industrial purposes.[121]

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[117] Ellen McKewen, "What Is Smart Manufacturing? (Part 1A)," *CMTC Manufacturing Blog* (blog), accessed November 1, 2020, https://www.cmtc.com/blog/what-is-smart-manufacturing-part-1a-of-6.
[118] "Variable Speed Drives," accessed November 1, 2020, https://www.sciencedirect.com/topics/engineering/variable-speed-drives.
[119] "Compressed Air Systems," Energy.gov, accessed November 1, 2020, https://www.energy.gov/eere/amo/compressed-air-systems.
[120] Whitlock, Elliott, and Rightor, "Transforming Industry: Paths to Industrial Decarbonization in the United States."
[121] Exhaust heat can also be used for additional electric generation, in a combined cycle power plant (usually a combined cycle combustion turbine, "CCCT"). However, we are treating combined cycle power plants as an electric sector technology, not an industrial sector technology.

Heat sharing involves the transportation of heat among multiple facilities. Heat is more difficult to transport than electricity, however it is not impossible. The recent trend toward increased use of hot water or other liquid carriers rather than steam is enabling longer transport distances and reducing energy demand. But even if steam is the carrier, deliberate colocation of facilities makes transport both physically and economically viable. Heat generation benefits greatly from economies of scale, so the economic equation can favor heat sharing more often than is often realized.

The suite of commercially viable technologies for increasing efficiency or reducing carbon intensity in the industrial sector is well understood and well documented. What is not well understood is the potential to lower energy consumption or displace direct fossil fuel combustion with electricity.

Action:

- Inventory the potential associated with different technologies to provide a basis for the calculation of appropriate decarbonization targets for industry.

1.3. Lay the Groundwork for Carbon Capture, Use and Storage

One feature common among industrial facilities is smokestacks. These fixed emission point sources are potential collection points to capture carbon that would otherwise enter the atmosphere as a greenhouse gas. Captured at the emissions point, there are at least three paths to treat CO_2 that mitigate greenhouse gas emissions to a greater or lesser degree:

Geological Storage. This is the conventional vision for carbon capture and storage (CCS), in which CO_2 stack emissions are stored in underground geological formations. Initial investigations by the United State Geological Survey show meaningful potential for geological storage in Washington.[122] In addition, the Pacific Northwest National Laboratory's research is showing previously unrealized potential for carbon storage in the flood basalts common in Washington's landscape.[123]

Carbon Reuse. CO_2 captured from smokestacks can be used as a source for carbon used to produce synthetic fuels. The vehicles or other energy consumers that eventually combust the synthetic fuels still end up emitting CO_2 to the atmosphere, but the carbon is used twice – rather than once – before being released. The climate benefit of the double use comes from the displacement of virgin fossil fuels that the vehicles would otherwise have used.

Built Environment. Carbon in the captured CO_2 can also be used as a component of novel construction materials that sequester the carbon in buildings, roads or other components of the built environment. This approach offers sequestration similar to geological storage, although the average duration of storage in construction materials might be lower than in the case of geological storage. Use in the built environment can encourage displacement of more emissions-intensive materials.

Actions:

- Continue support for research in Washington's geological storage potential for CO_2.

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[122] "National Assessment of Geologic Carbon Dioxide Storage Resources - Results," *U.S. Geological Survey*, Circular, 2013, https://doi.org/10.3133/cir1386.
[123] B. Peter McGrail et al., "Potential for Carbon Dioxide Sequestration in Flood Basalts: SEQUESTRATION IN FLOOD BASALTS," *Journal of Geophysical Research: Solid Earth* 111, no. B12 (December 2006): n/a-n/a, https://doi.org/10.1029/2005JB004169.

- Incorporate carbon capture, use and storage technologies in the portfolio of Centralized Technical Assistance.

2.0. Establish a Technology-Neutral Regulatory Framework

As an alternative to prescriptive, process-specific actions to address industrial emissions, a better approach may be to pursue one or more technology-neutral regulatory frameworks aimed squarely at the primary desired outcome of reducing greenhouse gas emissions. Two such mechanisms are a low carbon fuel standard to reduce the carbon intensity of fuels used in industrial and motor vehicle applications and a regulatory program to reduce emissions from stationary sources, similar to the Department of Ecology's Clean Air Rule.

A third, more comprehensive mechanism would be an economy-wide cap and trade program. Cap and trade is a proven strategy for reducing emissions in the industrial sector. It has been used in many countries around the world and in California, Quebec and to a more limited degree in the Regional Greenhouse Gas Initiative (RGGI), which includes 10 Northeast U.S. states.

2.1. Adopt a Low Carbon Fuels Standard

California, Oregon and British Columbia have all adopted relatively similar low carbon fuel standards (LCFS).[124,125,126,127] An LCFS displaces conventional gasoline and diesel fuels with lower-carbon substitutes. An LCFS could help drive decarbonization across all segments of the transportation sector, as well as foster the development of clean fuels needed for important Washington industries.

Vehicle fleets and light equipment at industrial facilities consume some gasoline, while vehicle fleets, off-road equipment and backup generators use significant quantities of diesel. An LCFS could include off-road diesel, aviation fuel and/or marine fuels to expand its impact on industrial sector emissions.

An LCFS could be structured so that revenue from credit sales fund zero emission vehicle charging and fueling infrastructure and improve the economics of in-state carbon capture and clean fuels production. Biofuels and potentially hydrogen and electrofuels could provide the state valuable flexibility in reducing transportation emissions from difficult to decarbonize activities such as aviation, long-distance or heavy-duty trucking and maritime shipping.

An effective LCFS would encourage clean fuels production in the state and achieve parity with similar standards in Oregon and California. In addition, the LCFS could be designed to account for co-benefits, including feedstock that uses waste products or limits impacts on food crops, co-products of biofuel manufacturing processes,[128] and reduction of wildfire risk by using waste biomass from forest management.

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[124] California Air Resources Board, "Low Carbon Fuel Standard," November 16, 2015, http://www.arb.ca.gov/regact/2015/lcfs2015/lcfsfinalregorder.pdf.California Air Resources Board.

[125] Chapter 754, Oregon Laws 2009, An Act, HB 2186, Relating to greenhouse gas emissions; and declaring an emergency.

[126] Consolidated Statutes of British Columbia, Chapter 16, Greenhouse Gas Reduction (Renewable and Low Carbon Fuel Requirements) Act.

[127] Julie Witcover, "Pacific Coast Collaborative Low Carbon/Clean Fuel Standard Program Comparison" (UC Davis PIEEE, June 2018).

[128] R. Divyabharathi and P. Subramanian, "Hydrothermal Liquefaction of Paddy Straw for Biocrude Production," *Materials Today: Proceedings*, March 2020, https://doi.org/10.1016/j.matpr.2020.02.390.

Action:

- Enact and implement a low carbon fuels standard to establish a market and funding mechanism for clean fuels production.

2.2. Regulatory Tools to Measure, Mitigate and Reduce Emissions from Industrial Sources

In 2016, the Department of Ecology adopted the Clean Air Rule (CAR) to address the major sources of greenhouse gases.[129] The proposed rule adopted emission standards to cap and reduce greenhouse gas emissions from significant in-state stationary sources, petroleum product producers, importers, distributors and natural gas distributors operating within Washington. Covered entities were required to reduce emissions 1.7% each year.

In March 2018, the Thurston County Superior Court ruled that parts of the CAR were invalid, preventing implementation of the rules. Compliance with the rule was suspended. On Jan. 16, 2020, the Washington State Supreme Court ruled that the portions of the rule that applied to stationary sources were valid, but that the portions that applied to indirect sources, such as natural gas distributors and fuel suppliers, were invalid. The Supreme Court sent the case back to the lower court to determine how to separate the rule.

The original CAR was based on greenhouse gas limits in place prior to 2020 (25% below 1990 levels by 2035). A new rule focused on stationary sources and designed to meet the newly adopted 2050 limit could result in a more stringent obligation than the original CAR, potentially requiring annual reductions of 3.5% per year. The Department of Ecology has not yet identified next steps for the CAR.

In a separate action and under explicit direction by the Governor, the Department of Ecology has begun rulemaking to strengthen and standardize the consideration of climate change risks, vulnerability and impacts in environmental assessments for major projects with significant environmental impacts. The rule will establish uniform methods, processes, procedures, protocols or criteria that ensure a comprehensive assessment and quantification of direct and indirect greenhouse gas emissions resulting from the project.

Action:

- Washington should continue to explore regulatory mechanisms to measure, mitigate and reduce greenhouse gas (GHG) emissions from the operation and siting of significant in-state stationary sources, petroleum product producers, importers and distributors and natural gas.

2.3 Address Competitive Issues Raised by Emissions Policies

While there are many advantages to technology-neutral regulatory approaches, they also raise a concern about competitive effects on firms that serve markets outside the state. State-level emissions limits or fees may result in "leakage," where apparent emissions reductions in one state are offset by emissions increases in other states or countries. The industries that are most susceptible to leakage effects are referred to as energy-intensive, trade-exposed industries (EITEs). Examples of EITE industries include pulp and paper, cement, glass and metals manufacturing.

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[129] "Clean Air Rule," Washington State Department of Ecology, n.d., https://ecology.wa.gov/Air-Climate/Climate-change/Greenhouse-gases/Reducing-greenhouse-gases/Clean-Air-Rule.

The appropriate response to concern about leakage is not necessarily to excuse EITEs from emissions reductions, but to structure state policy so leakage risk is anticipated and addressed. First, the state should anchor its industrial emissions policies in a detailed understanding of the manufacturing activity in Washington. Recent work for the Oregon Carbon Policy Office provides a good example.[130]

Without data on energy costs, manufacturing processes and competitive conditions, the state might relax emissions reduction requirements for a firm or industry that would not actually present a leakage risk. It is possible through engineering and economic analysis to measure the actual risk of leakage for individual industries and plants. The results are likely to change over time. The state should undertake this analysis as part of an ongoing regulatory program for direct emitters.

Second, Washington should adopt industrial emissions reduction policies that are consistent with other jurisdictions. Leakage occurs when inconsistent regulations create an incentive to shift manufacturing activity to a less regulated jurisdiction. Strong inter-state partnerships or other multi-jurisdiction approaches can help avoid EITE flight, emissions leakage and job loss to other states. Washington regularly collaborates with Oregon, California and British Columbia through the Pacific Coast Collaborative and other forums. A uniform policy framework among like-minded jurisdictions, such as was developed under the Western Climate Initiative,[131] continues to be the best approach to minimize negative economic and environmental effects among jurisdictions. Just as a geographically large energy economy creates market efficiency, a geographically large policy environment promotes least-cost solutions and accommodates niche markets, experimental policies or staged policy implementation.

Third, Washington should consider incentives for industrial efficiency improvements. Well-designed incentives would enhance the competitiveness of manufacturing firms located in the state and reduce leakage risk.

Actions:

- Develop and maintain data on processes, markets and costs of manufacturing activities in Washington and use this information to identify EITEs and craft responsive emissions reduction policies.
- Maintain and strengthen Washington's engagement with the Pacific Coast Collaborative, with a continued focus on advancing coordinated climate and industrial policies along the West Coast.
- Increase incentives and support for industrial efficiency, emission control and clean technology upgrades, including consideration of an industrial transformation bank, incorporating strong labor and equity standards to fund the retooling and upgrading of Washington's EITEs and low-carbon fuel pilot projects.

4. Develop and Implement a Coordinated Clean Energy Industrial Policy

Emissions from the industrial sector add a complex layer to an already challenging task for policy makers as they seek to promote economic vitality, business development and high-quality jobs. Climate policy must be incorporated into a coherent industrial policy. This approach has proven successful in countries

[130] "Oregon Sectoral Competitiveness under Carbon Pricing" (Vivid Economics, 2018), https://digital.osl.state.or.us/islandora/object/osl%3A676559.

[131] "Program Design and Implementation," Western Climate Initiative, accessed November 1, 2020, https://wci-inc.org/our-work/program-design-and-implementation.

around the world.[132,133,134] With an electric grid considerably cleaner than most states in the U.S., technological expertise, manufacturing history, fuel-refining infrastructure and biomass resources, Washington has an opportunity to become a world leader in the clean energy economy, while at the same time reducing the environmental impacts of existing industries in the state.

Washington possesses significant advantages to attract the manufacturing supply chains of solar, storage and microelectronic technologies that will be key to driving our low carbon economy, particularly as it relates to polysilicon-based technologies.

4.1. Adopt a Comprehensive Clean Energy Plan for Industrial Policy

Industrial policy is a matched set of tools and policies: procurement, workforce development, infrastructure development, tax incentives and research and development. Comprehensive industrial policy for climate and energy goals requires coordinated alignment and aggregation of interventions across different levels of government and between the public and private sectors, leveraging the strengths of agencies, jurisdictions and sectors.

Each country, state, or region's industrial policy generally emerges organically from existing industry clusters that are the natural fit for the jurisdiction's resources, culture and history. New industrial opportunities build on underlying competitive advantages in a region and these competitive advantages may change over time. Thus, an industrial ecosystem is not static and designing a low-carbon future for industry will take patience, focus and coordinated policy.

In some cases, the development of industries has created sacrifice zones, geographic areas that have been permanently impaired by environmental damage or economic disinvestment, often through locally unwanted or unusable land. It is important that Washington's policies ensure that rapid decarbonization does not come at the risk of creating sacrifice zones. In developing a clean energy industrial policy, business leaders, community representatives and labor unions must be engaged from the outset in mapping the priorities of those impacted. The policy must promote labor standards and shared benefits.

The state should lead with an equitable governance policy approach among key constituents to design a process to achieve decarbonization goals expeditiously and maximize benefits while minimizing risks for people who live or work where a project or manufacturing hub may be located and decreasing the likelihood that industries and jobs will leave Washington for other states.

Actions:

- Develop a coordinated clean energy industrial policy framework that supports the ability of industry to help decarbonize the buildings, transportation and electricity sectors and catalyzes regional decarbonization.

4.2 Establish a Clean Industrial Policy for Washington

The success of the Washington State 2021 Energy Strategy and especially its industrial sector provisions, will depend on continued and coordinated participation across state agencies. Strengthened state

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[132] "Investment and New Industrial Policies: World Investment Report 2018" (UNCTAD, Division of Investment, 2018).

[133] Michael Landesmann and Roman Stollinger, "The European Union's Industrial Policy: What Are the Main Challenges?" (The Vienna Institute for International Economic Studies, January 2020).

[134] Todd Tucker, "Industrial Policy and Planning: What It Is and How to Do It Better" (Roosevelt Institute, July 2019), https://rooseveltinstitute.org/wp-content/uploads/2020/07/RI_Industrial-Policy-and-Planning-201707.pdf.

agency leadership could feature more frequent energy planning, increased data gathering authority or increased regulatory authority.

States in the U.S., including Washington, have not typically engaged in frequent energy planning, increased data gathering and increased regulatory authority to steward industrial policy. Getting serious about industrial policy means making a clear home for it, within the state's current organization of agencies. The Office of Economic Development and Competitiveness (OEDC) within Department of Commerce is the obvious location in which to place industrial policy stewardship.

Washington lacks substantive data describing energy consumption by the various industries that comprise the industrial sector. The state possesses only partial data regarding industrial GHG emissions. To better manage industrial energy and emissions, a clear picture of the sector is necessary. Strengthened reporting requirements would improve energy consumption and emissions transparency. To minimize administrative burden, this should be done in collaboration with existing reporting requirements of the U.S. Energy Information Administration, regional air agencies or other entities. Protections for proprietary data could be made to shield public visibility into specific corporations or facilities.

Relatedly, an increased frequency of, or attention to, energy planning would allow for greater control of the pathways Washington takes toward achieving its GHG reduction and industrial policy targets. The current process of a decade or more between energy planning exercises means either that each plan eventually becomes perceived as old and therefore ignored; or, if each decadal strategy is taken seriously, that Washington locks itself into approaches or policies that may no longer be the best choice in the context of changing technologies, politics, or economics as the decade goes by. More frequent planning would enable a nimbler approach to the state's energy policy in the industrial sector.

Increased attention to energy planning also means that the agency expertise built during each energy strategy exercise remains intact, rather than fading away. Improved retention policies for the state could help mitigate the loss of institutional knowledge to the private sector and other government entities.

Regulatory streamlining can and probably should involve a dedicated agency like the Energy Facility Siting and Evaluation Council (EFSEC). A collection of public servants focused on making the deep and often difficult-to-perceive changes necessary to streamline will ensure changes that will not happen by themselves.

Actions:

- The Legislature should establish a headquarters for clean energy industrial policy.
- The Legislature should take additional steps to improve data gathering around energy use in the industrial sector.
- The Legislature should increase the frequency of energy planning for the industrial sector.
- The Legislature should take measures to retain institutional knowledge and ensure that the state is a competitive employer for energy specialists.
- As part of its industrial policy, the Legislature should empower EFSEC with the tools to equitably streamline clean industrial activities.

4.3 Provide Centralized Technical Assistance

The most effective policy framework for decarbonization will be one that includes both a downward pressure on emissions and an upward lift for the technologies that can achieve it. Knowledge about efficiency, electrification, process emissions reduction and carbon capture and storage needs to be broadened so that a wide spectrum of industrial entities have access. Since Washington contains a few entities within each given major industrial subsector, partnering regionally with multiple states to provide centralized technical assistance could be an effective approach.

A few existing programs can serve as examples. Washington's Department of Ecology has a program offering efficiency services to manufacturing and industrial facilities, the primary directives of which are efficiency, waste reduction and reducing regulatory overhead for small- and medium-sized plants. The Washington State University (WSU) Energy Program's industrial services group helps manufacturers adopt efficient technologies, productivity improvements and best practices by integrating and customizing products and services and provides technical assistance, assessments, training and project planning.

The New York State Energy Research & Development Authority manages five industrial programs that combine a focus on efficiency with energy management to increase competitive advantages and resiliency. Three that align particularly well with Washington's industrial energy policy offer strategic energy management, flexible technical assistance and on-site energy manager services.[135] Wisconsin's Focus on Energy program also offers support to industrial buildings through energy and local advisors on energy-saving equipment, technology and renewable energy options to reduce energy consumption and lower energy bills.[136]

Actions:

- Incorporating best practices from other jurisdictions, expand the Department of Ecology's *Efficiency Services for Manufacturing and Industrial Facilities* program and the WSU Energy Program's Industrial Efficiency team.

5.0. Support Clean Energy Research, Innovation and Deployment

As Washington embraces the clean energy transition, leaders can build on the state's foundations in aerospace, maritime, information and communications technology (particularly data center infrastructure, artificial intelligence and machine learning), grid modernization and decarbonizing buildings. Support can be enlisted from Washington's world-class manufacturers, technologists and academic research organizations, including those in regional comprehensive universities across the state.

State policies can catalyze activities that align with sustainability, climate and carbon investment funds being established and policies being adopted by the private sector, including Microsoft, Amazon and other sector leaders. All this will help the state to more readily develop the technology and innovation required to meet the state, national and global climate goals, offer opportunities for economic and job

[135] "NYSERDA Industrial Programs," New York State, n.d., https://www.nyserda.ny.gov/All-Programs/Programs/Industrial-Programs.
[136] "Wisconsin's Focus on Energy," Focus on Energy: Partnering with Wisconsin Utilities, n.d., https://focusonenergy.com/.

growth and strengthen technology supply chains. Collectively, these efforts can help ensure our existing and future industries have access to the tools needed to reduce the carbon intensity of their operations.

As the state advances towards a net-zero emissions future, gas and liquid fuels are expected to continue to be part of the energy mix for some time to come – both as a limited source for electricity generation and for use in specific transportation, building and industrial applications. There is a need to develop and deploy technologies that can economically provide decarbonized fuels.

New technologies being researched, developed and deployed include "green hydrogen"[137] from electrolysis powered by renewable electricity; carbon capture, use and storage which can "decarbonize" conventional fossil fuels used for heat or electricity; and synthetic fuels produced by combining hydrogen and non-fossil sources of carbon. These technologies offer the potential to contribute to a decarbonized future, but require continued investment in research and development, pilot programs and commercialization, as well as a favorable regulatory environment and government financial support to reduce the significant risks associated with bringing new technologies to market.

As discussed in Chapter C-Use Energy More Efficiently and Decarbonize Transportation Energy, even under the aggressive Electrification Scenario, a large number of internal combustion engines will remain on the roads in 2030. This means there will be an immediate need to produce low-carbon liquid fuels to replace fossil fuels. The industrial sector and especially Washington's robust petroleum refining industry, could play an important role in meeting the demand for those fuels during the next decade and beyond.

Petroleum fuels are hydrocarbons, molecules built primarily from carbon and hydrogen and the technologies available to synthesize petroleum substitutes are well known. The petroleum industry in Washington has the equipment and the know-how to become a leading innovator and producer of synthetic fuels. [138,139] Washington's 2030 target is an excellent catalyst for the local refineries to become world leaders in low-carbon fuel manufacture. While the technologies to synthesize hydrocarbons are well known, the *sources* of the carbon and hydrogen atoms used to do so could be defining elements of Washington's clean energy paradigm.

5.1. Continue to Invest in the Clean Energy Fund

Washington's Clean Energy Fund (CEF) was conceived in 2013 to support "projects that provide a benefit to the public through development, demonstration and deployment of clean energy technologies that save energy and reduce energy costs, reduce harmful air emissions or otherwise increase energy independence for the state." SSB 5035 sec 1074(1) (2013). The CEF has received appropriations through a series of biennial budgets up to and including appropriations in the 2019 capital budget.

To date, through awards of $118 million, Washington's CEF investments have successfully leveraged over $400 million to support innovative projects including grid modernization and storage; energy efficiency and renewable energy projects (wind, solar, bioenergy) on farms and in commercial buildings and homes; and deployment of electrification charging infrastructure. The funding has resulted in

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[137] "Hydrogen," BP, n.d., https://www.bp.com/en/global/corporate/energy-economics/energy-outlook/demand-by-fuel/hydrogen.html.

[138] A.A. Lappas, S. Bezergianni, and I.A. Vasalos, "Production of Biofuels via Co-Processing in Conventional Refining Processes," *Catalysis Today* 145, no. 1–2 (July 15, 2009): 55–62, https://doi.org/10.1016/j.cattod.2008.07.001.

[139] Susan van Dyk et al., "Potential Synergies of Drop-in Biofuel Production with Further Co-processing at Oil Refineries," *Biofuels, Bioproducts and Biorefining* 13, no. 3 (May 2019): 760–75, https://doi.org/10.1002/bbb.1974.

energy savings, emission reductions and job creation throughout the energy supply chain, positioning the state as a leader in clean technology development.

In the immediate future, policy makers' investments in the CEF represents a proven opportunity for economic development and position Washington to leverage federal clean energy dollars. In the long term, the CEF has a structure that can help support the innovation and infrastructure adaptation necessary to make our state's clean energy transition. With its strategic goal of "developing, demonstrating and deploying clean energy technologies that save energy and reduce energy costs, reduce harmful air emissions, or otherwise increase energy independence for the state," the CEF can continue to be a tool to build on Washington's clean energy policies and sectoral strengths, ensure costs and benefits are equitably distributed and help the state rebuild our economy.

Action:

- The Legislature and the Department of Commerce should continue to support the Clean Energy Fund (CEF) and deploy the resources consistent with the recommendations of the Energy and Climate Policy Advisory Committee in the Report to the Legislature submitted in Dec. 2020.

5.2. Cluster around Centers of Research, Development and Entrepreneurship

Washington is renowned for its technical innovation, particularly in the aerospace and information industries. The state is home to the Pacific Northwest National Laboratory, one of 17 national energy laboratories. The Clean Tech Alliance represents over 1,100 members facilitating the growth of clean technology companies and jobs through education, research and services. Washington's large and regional research universities also are a ready source of innovation to support an industrial policy based on clean energy.

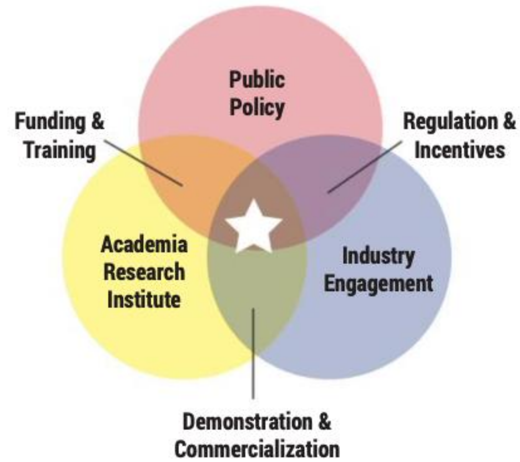
Washington's Maritime Blue Strategy was created in 2019 to accelerate innovation and create the nation's most sustainable maritime industry by 2050. The deep decarbonization modeling for the state energy strategy (see Chapter B) suggests that – without this type of focus - the maritime sector would remain a significant source of fossil fuel consumption in our state.

The Maritime Blue strategy is focused on shifting towards a thriving, low-carbon industry; becoming a global innovation hub; leading the nation in efficient, clean and safe working waterfronts; supporting a 21st century workforce; and establishing a world-class maritime cluster.[140]

[140] "Washington Maritime Blue Launches Ambitious Plan for Economic Growth, Jobs, Ocean Health," January 8, 2019, https://www.commerce.wa.gov/news-releases/growing-the-economy/washington-maritime-blue-launches-ambitious-plan-for-economic-growth-jobs-ocean-health/.

As a "cluster organization,"[141] Maritime Blue gathers businesses, public entities, community organizations, researchers and training institutions together to build a low-carbon marine industry that remains economically competitive. To date, Washington Maritime Blue has assembled 55 industry members along with four research institutions, 14 organizational partners and 22 public sector partners and leveraged $6.5 million in public funding for programming and projects and $250,000 in private sponsorships. It has garnered $32 million in private capital and $6 million in business sales related to the first cohort of 11 start-ups. This innovative project has successfully demonstrated a public-private partnership to develop economic advances for decarbonization of an industry. The example could serve as a framework from which to decarbonize the state's other industries.

The Components of a Cluster



The Role of a Cluster

- Communications & marketing
- Funding & investment
- Knowledge & innovation collaboration
- Incubation and commercialization
- Joint industry projects (JIP)
- Cross-cluster collaboration
- Strategy Review

In addition to nurturing industry clusters, there are opportunities for the state government to partner with individual companies. This can result in carbon reduction to help the state achieve its greenhouse gas emission limits, but also creates a forum for the state to learn from the private sector' initiatives.

Microsoft, for example, has established an investment fund supported by the company's internal carbon tax to provide funding for early stage clean energy technologies.[142] Alaska Airlines plans to reduce carbon emissions with flights powered by sustainable aviation fuel in key routes.[143] Skanska, a construction firm, pledged to eliminate emissions from both direct operations and its supply chain.[144] Amazon has pledged to be zero net carbon by 2040 and announced an initiative to electrify its delivery fleet.[145] PACCAR, a manufacturer of trucks, has invested in improving energy efficiency, reducing emissions, water consumption and waste at its manufacturing facilities, in combination with disclosing its greenhouse gas emissions.[146]

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141 "World Class Cluster," Washington Maritime Blue, n.d., http://maritimeblue.org/cluster-2/.

142 David Roberts, "Microsoft's Astonishing Climate Change Goals, Explained," *Vox*, 2020, http://www.voxx.com/energy-and-environment/2020/7/30/21336777/microsoft-climate-change-goals-negative-emissions-technologies?mbid=&bxid=5ec7510be36b.

143 "Alaska Airlines and Microsoft Sign Partnership to Reduce Carbon Emissions with Flights Powered by Sustainable Aviation Fuel in Key Routes," *Microsoft News Center* (blog), October 22, 2020, https://news.microsoft.com/2020/10/22/alaska-airlines-and-microsoft-sign-partnership-to-reduce-carbon-emissions-with-flights-powered-by-sustainable-aviation-fuel-in-key-routes/.

144 "Skanska UK Pledges Zero Emissions by 2045, Leads Construction Industry in Climate Commitments," *Mighty Earth*, May 19, 2019, https://www.mightyearth.org/skanska-uk-pledges-zero-emissions-by-2045-leads-construction-industry-in-climate-commitments/.

145 Mary Meisenzahl, "Amazon Just Revealed Its First Electric Delivery van of a Planned 100,000-Strong EV Fleet — See How It Was Designed," *Business Insider*, October 8, 2020, https://www.businessinsider.com/amazon-creating-fleet-of-electric-delivery-vehicles-rivian-2020-2.

146 "Paccar: Sustainability," n.d., https://www.paccar.com/about-us/environmental-and-social/environmental/.

Actions:

- Replicate Maritime Blue for other centers of research and development to accelerate and support emerging low-carbon industrial opportunities.
- Create a knowledge center on public-private collaboration to help firms make and meet broader climate commitments through capacity buildings and knowledge sharing.
- Expand programs to incentivize research and market development for commercial low-carbon fuels; heat pumps; embodied carbon materials; direct air capture (DAC); carbon capture, utilization and storage (CCUS); electrification technologies; grid modernization; artificial intelligence and machine learning; and circular economy processes.

5.3. Continue Washington's Leadership in Sustainable Aviation

The ports of Seattle, Spokane and Portland, along with The Boeing Company, Alaska Airlines and Climate Solutions were early out of the gate in creating the Sustainable Aviation Fuels Northwest (SAFN) initiative,[147] the first regional assessment of feedstock pathways for producing sustainable jet fuel in the U.S.

SAFN led to two large USDA-funded advanced biofuels research consortia in Washington, Advanced Biofuels Northwest (University of Washington) and the Northwest Advanced Renewables Alliance (Washington State University), both of which dealt extensively with feedstock and conversion supply chain analysis. Until 2018, the Legislature funded the Sustainable Aviation Biofuels Workgroup,[148] which facilitated conversation among government, the aviation industry, research institutions and biomass feedstock producers to advance sustainable aviation biofuels in Washington.

Today, Washington State University co-leads the Center of Excellence for Alternative Jet Fuels (ASCENT)[149] with the Massachusetts Institute of Technology to create science-based solutions for the aviation industry's most difficult environmental challenges. ASCENT released a study[150] on October 23, 2020 looking at the availability of sustainable biomass in the region.

Actions

- Explore the viability of creating an electric aviation cluster to implement the Green Economy report recommendations to leverage the expertise of the University of Washington's Clean Energy Institute (CEI) to persuade international electric aircraft manufacturers to develop electric aircraft in Washington
- Create a business environment where Washington is seen as a center of excellence for electric aviation.
- Support building a testing facility in Washington for electric aircraft.
- Invest in upgraded infrastructure for testing electric aircraft.

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147 "Sustainable Aviation Fuels Northwest," Climate Solutions: Accelerating the Transition to our Clean Energy Future, n.d., https://www.climatesolutions.org/sustainable-aviation-fuels-northwest.

148 "Sustainable Aviation Biofuels Workgroup" (Washington State Legislature, January 26, 2018), https://apps.leg.wa.gov/ReportsToTheLegislature/Home/GetPDF?fileName=Sustainable%20Aviation%20Biofuels%202017%20Update%20Final_435d458c-b62c-4bdd-868d-8f9e4f0576b5.pdf.

149 "Ascent - The Aviation Sustainability Center," Ascent, n.d., https://ascent.aero/.

150 Port of Seattle and Washington State University, "Potential Northwest Regional Feedstock and Production of Sustainable Aviation Fuel," 2020, https://www.portseattle.org/sites/default/files/2020-07/PofSeattleWSU2019_final.pdf.

- Continue to support the efforts of ASCENT and the Sustainable Aviation Biofuels Work Group to coordinate research, development and deployment of low-carbon liquid aviation fuels.

5.4. Explore a New Hydrogen Economy

Twenty years ago, a vision for the “hydrogen economy” took hold, in which a nontoxic, odorless, gaseous fuel speeds fuel-cell-powered “hypercars.” [151] While development has occurred more slowly than expected, hydrogen can potentially play an important role in reducing greenhouse gas emissions from the industrial sector.

Hydrogen is not an energy source but an energy carrier. Hydrogen requires energy to produce and like electricity, it is only as clean as the feedstock used to produce it. Hydrogen is useful as a directly consumed power source for fuel cells and it can be used hydrocarbon synthesis to produce the liquid fuels to achieve the state’s 2030 greenhouse gas reduction limits. Hydrogen can also be used to promote the manufacture of more novel liquid energy carriers such as ammonia or hydrazine.

Green hydrogen production is an important manufacturing opportunity for Washington industry. Petroleum refineries already include systems to produce and handle hydrogen, so are likely starting points for increasing production. Washington can learn from the European Union’s hydrogen strategy, which calls for building up a hydrogen industry that can enable large-scale use of renewable and low-carbon hydrogen as a replacement for fossil fuels in industry and hard-to-decarbonize sectors, as an energy carrier and form of energy storage and as a feedstock for synthetic liquid fuels.[152]

Actions

- Commerce should work with utilities, industrial firms, federal agencies and other stakeholders to accelerate the development of hydrogen production and should encourage pilot projects and research activities.

5.5. Continue to Assess Biomass as a Foundational Resource

Fossil fuels are the result of geologic sequestration of ancient vegetation. Plants growing today also contain carbon and hydrogen. Whether the state’s liquid and gaseous fuels are derived from fossil sources, dedicated crops, organic waste streams or other biogenic sources, or are synthetic fuels produced from any number of non-fossil sources of carbon and hydrogen, they result in the same two combustion products: carbon dioxide and water. The difference is what happens *after* the feedstocks have been extracted. As biomass derived from the management and harvest of agricultural and forestry crops is utilized for biofuel production, new crops are grown on agricultural and forest lands, extracting carbon dioxide from the atmosphere effectively compensating for what is being emitted through combustion of the biofuel.

Whether in gaseous, liquid or solid form, biogenic fuels can support those industrial processes most in need of heat or most in need of liquid or gaseous fuels, supplementing the role of electricity in meeting thermal needs. The use of biomass resources for heat, electricity and liquid and gaseous biofuels is inherently more complex than other forms of renewable energy production. Biogenic feedstocks offer

[151] *e.g.*, Amory B. Lovins and David R. Cramer, “Hypercars, Hydrogen and the Automotive Transition,” *International Journal of Vehicle Design* 35, no. 1/2 (2004): 50, https://doi.org/10.1504/IJVD.2004.004364.
[152] European Commission, “A Hydrogen Strategy for a Climate-Neutral Europe,” 2020, https://ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf.

opportunities for economic development, waste utilization and value-added co-products absent in other forms of renewable energy generation. Some feedstocks, however, raise concerns about sustainable sourcing, scale and siting.

Action:

- The departments of Natural Resources, Agriculture, Ecology and Commerce, along with WSU's Center for Sustaining Agriculture and Natural Resources, should expand collaborative efforts to assess Washington's biogenic feedstocks to help inform future state policies. With specific focus of on developing markets for low-grade woody biomass from forest management and fire hazard reduction processes, including opportunities for various methods of carbon sequestration as informed by DNR's Carbon Sequestration Advisory Group.[153]

6. Expand Policies to Consider Consumption-based Emissions

Emissions associated with the manufacture and transport of consumer products are referred to as "upstream emissions," "embodied emissions," or "embodied carbon." Washington has some of the most sophisticated low-carbon manufacturing technology capabilities in the world. The state is home to some of the best-in-class facilities on the planet in terms of production of low-carbon building and manufacturing materials such as steel rebar[154] and aerospace aluminum products.[155,156]

Global demand for low-embodied carbon materials will grow as more jurisdictions seek to reduce consumption-based emissions. Washington can continue to lead in low-carbon intensity manufacturing, contributing significantly to in-state and global reductions in greenhouse gas emissions. In addition to decarbonizing existing industry, Washington is emerging as a leader in the global clean tech industry[157] and green building,[158] presenting entirely new opportunities for high-wage jobs and economic growth.

Reducing consumption-based emissions is not an alternative to reducing production-based emissions. They are both essential strategies. Washington's Center for Sustainable Infrastructure[159] and the University of Washington Carbon Leadership Forum[160] are laying important groundwork in this area by developing standardized approaches for measuring embodied carbon.

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[153] "Carbon Sequestration Advisory Group," Washington State Department of Natural Resources, accessed December 1, 2020, https://www.dnr.wa.gov/CarbonAdvisoryCmte.

[154] According to the EC3 calculator, Nucor in Seattle produces the lowest embodied carbon steel concrete reinforcing and merchant bar in the world, and Farwest Steel Corporation with facilities in Oregon and Washington, as well as CT Sales, Inc. in Woodinville and Addison Construction Supply in Tacoma are also some of the lowest carbon producers in the world for fabricated reinforcing bar (https://www.buildingtransparency.org/en/).

[155] Helen Sanders, "Carbon Counting: A Driver for U.S. Sourced Aluminum? (Part 2)," Insights and Inspirations, September 6, 2019, https://www.usglassmag.com/insights/2019/09/carbon-counting-a-driver-for-u-s-sourced-aluminum-part-2/.

[156] Kaiser Aluminum, External Affairs and United Steelworkers Local 338. *Best in Class: Flat Rolled Products.* Based on data from Ecometrica, http://emissionfactors.com, August 2011.

[157] Washington is home to the Clean Tech Alliance, the largest state trade association of clean tech businesses in the U.S.

[158] Paul Roberts, "Growing the Green Economy in Washington State: Exploring an Eco-Nomic Center" (CQC AWC Center for Quality Communities, March 2019), http://cfqc.org/wp-content/uploads/2019/04/ExploreEcoNomincCenterSummary.pdf.

[159] "Center for Sustainable Infrastructure," accessed December 1, 2020, https://www.sustaininfrastructure.org/.

[160] "EC3 Tool Methodology," Carbon Leadership Forum, accessed October 26, 2020, https://carbonleadershipforum.org/projects/ec3-methodology/.

6.1. Conduct a Consumption-based Inventory

To lower consumption-based emissions, it is important to understand Washington's consumption patterns and the extent to which consumption emissions differ from production emissions. Emission inventories that include the embodied carbon of goods and services purchased by consumers are called "consumption-basis" inventories.[161]

King County computed and reported consumption-basis inventories in 2008 and 2015. In 2015, King County's conventional community inventory reported 20 million tCO_2e, while the consumption-basis inventory reported 58 million tCO_2e, well over 2½ times higher.[162]

The state of Oregon has computed consumption-basis emissions for 2005, 2010 and 2015. In 2015, Oregon's conventional inventory reported 63 million tCO_2e, while the consumption basis inventory reported 89 million tCO_2e. The difference in Oregon's case is less dramatic than in King County because the larger geography means that more industrial sources are captured in the conventional inventory. Even so, Oregon's consumption-basis inventory is still some 41% greater than its conventional inventory.[163]

While the Oregon and King County inventories disclosed consumption emissions greater than production emissions, states that export more manufactured products than they import could have lower consumption-based emissions than their production-based emissions. For example, the emissions associated with Washington's aviation manufacturing industry would not be attributed to Washington in a consumption-based approach. Understanding the difference and managing reductions of both is necessary to reduce the global pool of greenhouse gas emissions rather than just shifting where those emissions occur or are measured.

Understanding consumption-based emissions is also important for equity. A household's carbon footprint generally increases with income, ranging from 19.3 to 91.5 tons of CO_2-equivalent annually. The average carbon footprint of the wealthiest households is over five times that of the poorest.[164]

Action:

- Conduct an inventory of the embodied carbon of goods and services purchased by Washingtonians.

6.2. Incentivize Environmental Product Declarations for Products & Materials Consumed in State

Environmental Product Declarations (EPDs) often described as "nutrition labels" for carbon content, make it easy to track embodied carbon and recognize low-carbon producers. By establishing demand for

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[161] Washington State's existing GHG inventory already treats electricity on a consumption basis, counting out-of-state emissions associated with imported electricity and discounting in-state emissions associated with exported electricity. However, doing this for *all* services and products is a much bigger step – electricity is just one of hundreds of product categories that would be estimated in a full, consumption-basis inventory.

[162] King County Greenhouse Gas Emissions Inventory, A 2015 Inventory. December 2017. Cascadia Consulting Group. Hammerschlag LLC., https://your.kingcounty.gov/dnrp/climate/documents/2015-KC-GHG-inventory.pdf.

[163] "Consumption-Based Greenhouse Gas Emissions Inventory for Oregon," accessed October 26, 2020, https://www.oregon.gov/deq/mm/pages/consumption-based-ghg.aspx.

[164] Morteza Taiebat and Ming Xu, "5 Charts Show How Your Household Drives up Global Greenhouse Gas Emissions," *PBS*, September 21, 2019, https://www.pbs.org/newshour/science/5-charts-show-how-your-household-drives-up-global-greenhouse-gas-emissions.

and a willingness to purchase low-carbon products, private sector investments and innovation are encouraged.

EPDs are independently verified and registered documents that communicate transparent and comparable information about the life-cycle environmental impact of products.[165] Without regulatory requirements, the disclosure of life-cycle emissions is left to voluntary private sector action. While some private companies are requiring EPDs for their construction projects, state and local governments are procure and fund many of these products materials. Public agencies could play a significant role in incentivizing better disclosure practices.

Action:

- State agencies, through the State Efficiency and Environmental Performance Office, should explore the potential for EPDs to support environmentally aware procurement policies and establish a baseline for standardized accounting and reporting.

7. Leverage the Economic Transition to Create New Inclusive, Living-Wage Jobs

As Washington transitions to a decarbonized economy, there is an opportunity to support the recovery and competitiveness of the Washington economy and create inclusive, living-wage jobs in a wide range of areas from agriculture and manufacturing, to utilities and construction (Figure 23).[166]

These occupations tend to have higher, more equitable wages and lower educational requirements when compared with other occupations, nationally.[167] Clean energy jobs have the added indirect effect of creating health and climate benefits for Washington communities. The Low Carbon Prosperity Institute estimates that every million dollars invested in clean energy programs leads to $2.4 million in clean air and climate benefits.[168]

Workforce development must be a priority as the state emerges from the current economic recession, which has been especially hard on clean energy jobs. Prior to the economic downturn caused by the COVID-19 pandemic, Washington had a total of 83,728 clean energy jobs. Since the pandemic, the state has lost roughly 20% of its clean

E2 Clean Jobs Washington 2019 Findings	
11x	more clean energy jobs in Washington than fossil fuel jobs
10.1%	of Washington clean energy workers are veterans, nearly double the national average
8.3k	rural Washington residents work in clean energy
7/10	clean energy employees in Washington work at companies with fewer than 20 employees
45%	of Washington's clean energy workforce is located outside the Seattle metro area
5 out of10	counties by clean energy jobs per capita have populations fewer than 100,000—including No.1 Jefferson County which is home to 23 clean energy jobs for every 1,000 employable residents

[165] The International EPD® System, "What Is an EPD? - The International EPD® System," accessed December 28, 2018, https://www.environdec.com/What-is-an-EPD/.

[166] "Clean Jobs Washington 2019" (E2), accessed December 2, 2020, https://www.e2.org/wp-content/uploads/2019/12/E2-Clean-Jobs-Washington-2019.pdf.

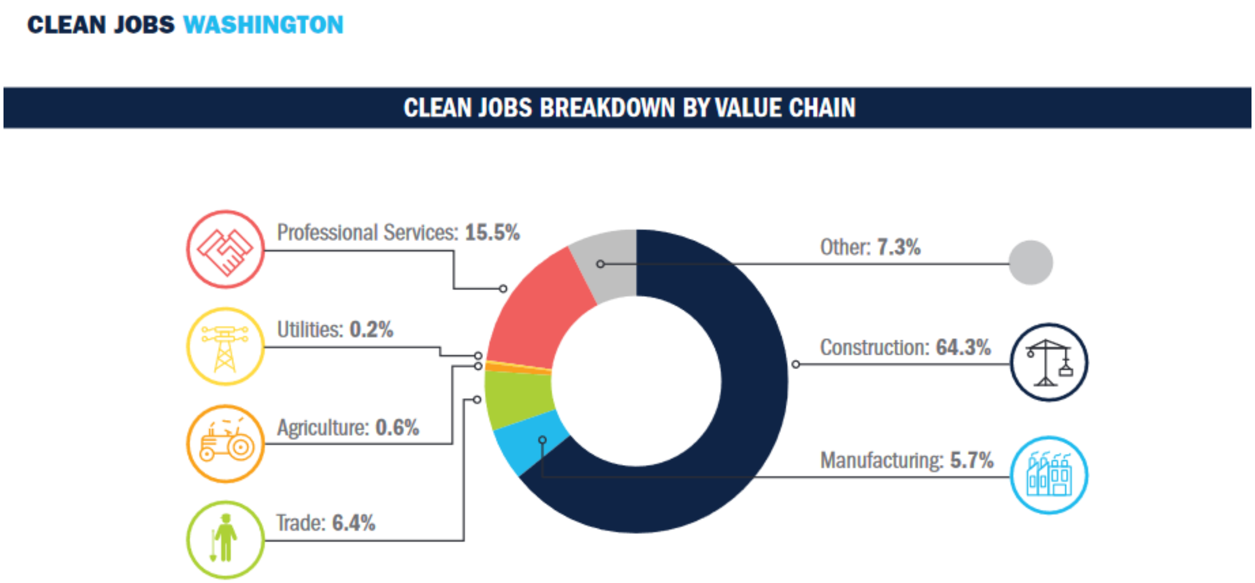
[167] Mark Muro et al., "Advancing Inclusion through Clean Energy Jobs" (Brookings, April 2019), https://www.brookings.edu/wp-content/uploads/2019/04/2019.04_metro_Clean-Energy-Jobs_Report_Muro-Tomer-Shivaran-Kane.pdf#page=18.

[168] Jonah Kurman-Faber, Kevin Tempest, and Ruby Wincele, "Building Back Better: Investing in a Resilient Recovery for Washington State" (Low Carbon Prosperity Institute, Climate Xchange, 2020), https://www.lowcarbonprosperity.org/wp-content/uploads/2020/06/Building-Back-Better-Investing-in-a-Resilient-Recovery-for-Washington-State-Website.pdf.

energy jobs.[169] Not only have these job losses upended the financial security of affected Washington households, they also threaten to deplete the workforce necessary for the clean energy transition.

Washington has experience rebuilding its clean energy workforce in the wake of a recession. In the 2008 financial crisis, the state lost tens of thousands of clean energy jobs. Using American Recovery Reinvestment Act of 2009 (ARRA) funding, the state invested in its workforce, equipping employees with the skills necessary to participate in the clean energy economy. Washington's Weatherization Assistance Program deployed $60 million of ARRA funding to hire hundreds of workers to weatherize 7,000 low-income homes, creating jobs while reducing utility bills and improving thermal comfort.[170]

Figure 23. Washington's 2019 Clean Jobs Breakdown



Source: E2 Clean Jobs Count 2019

ARRA kicked off unprecedented growth in clean energy jobs in the state between 2008 and 2015.[171] Since then, Washington has continued to invest in the clean energy workforce, funding efforts and institutions such as the Washington State Extension Energy Program, the Pacific Northwest Center of Excellence for Clean Energy, the Smart Buildings Center, the Clean Energy Fund, the Weatherization-Plus-Health program, the Community Energy Efficiency Program, the Rural Rehabilitation Program and the Energy Efficiency and Solar Grants Program.[172,173]

Washington's 2021 State Energy Strategy represents an opportunity to further support clean energy jobs and the state's overall workforce. Economic modeling underlying the strategy shows that the

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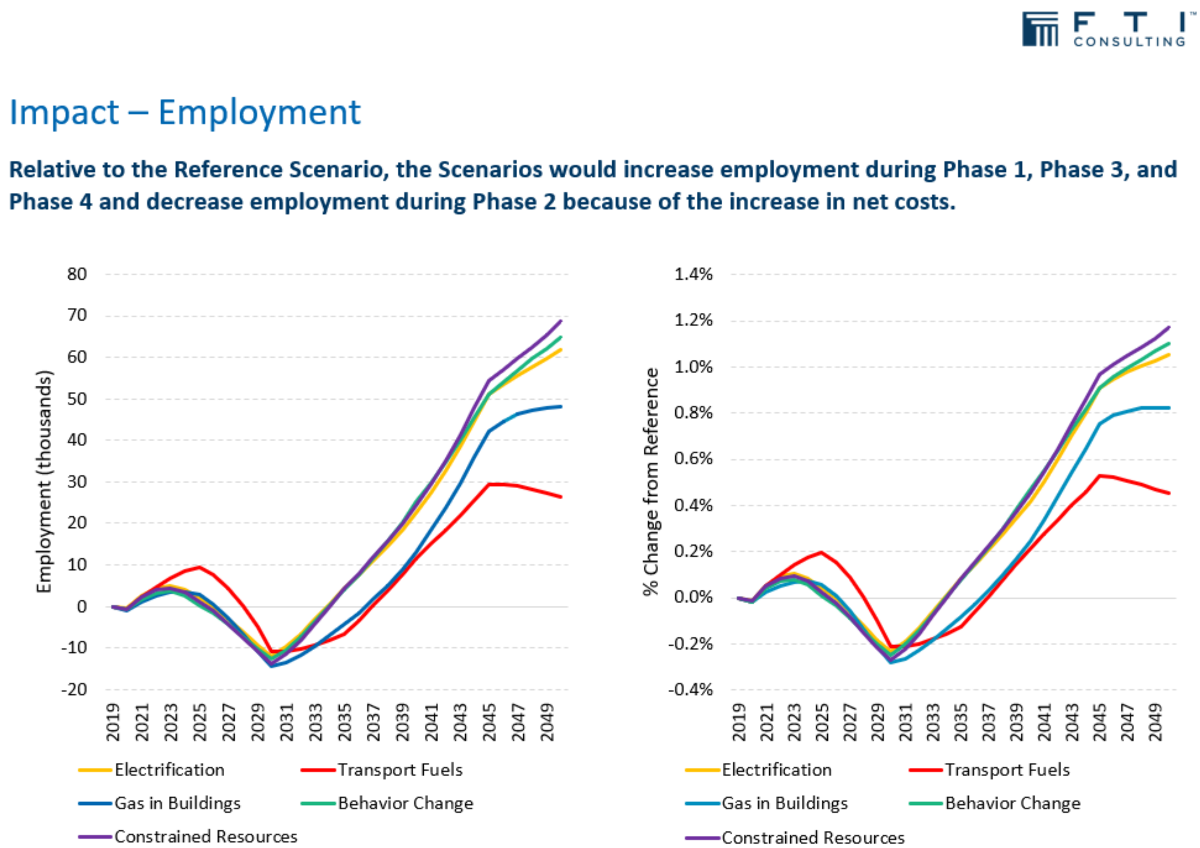
[169] "Clean Energy Unemployment Claims in COVID-19 Aftermath| October 2020 Unemployment Analysis," E2: Business leaders for a better environment, stronger economy, n.d., https://e2.org/reports/clean-jobs-covid-economic-crisis-october-2020/.
[170] Kurman-Faber, Tempest, and Wincele, "Building Back Better: Investing in a Resilient Recovery for Washington State."
[171] Ibid.
[172] "Washington's Clean Energy Roadmap" (U.S. Department of Energy| Energy Efficiency & Renewable Energy, n.d.), https://www.energy.gov/sites/prod/files/2020/02/f71/Washington-Implementation-Model.pdf.
[173] "Workforce Development," Washington State University Energy Program, n.d., http://www.energy.wsu.edu/ResearchEvaluation/WorkforceDevelopment.aspx.

strategy's climate and energy policies can boost employment in the near term and grow the workforce in the long-term. The initial boost comes from investments made to build, transport, install and maintain the clean energy infrastructure needed for decarbonization. Employment takes a slight dip in the late-2020s and early 2030s as the economic benefits of deploying this infrastructure have yet to catch up to costs of the energy transition. Employment then regains speed, outperforming the Reference Scenario by as much as 1.2% (Figure 24).

Figure 24. Impact on Employment of Decarbonization Scenarios



Source: Economic Impact of the Deep Decarbonization Pathways, November 4, 2020 Presentation, FTI Consulting

Policy choices will lead to minor deviations from these predicted trends. Investments in transportation fuels leads to the greatest economic boom in the near term due to investment in manufacturing, delivering and distributing clean fuels statewide. However, long-term economic growth on this pathway is less than other alternatives given lower labor requirements to maintain clean fuel infrastructure. The Electrification and Constrained Resource Scenarios offer the greatest economic benefits over the long-term, but the Constrained Pathway generates roughly 5,000 more jobs in construction in the 2040s (Appendix E). No matter the variation, each pathway increases jobs in the short- and long-term.

Current occupational and demographic trends suggest that not all workers will have an equal opportunity to compete for these jobs. The Legislature will need to pair a coherent, statewide workforce development strategy with inclusive policies that allow all Washingtonians to participate in clean energy economy.

7.1 Invest in Green Public Infrastructure

In Washington state, public works projects require a certain percentage of labor hours for a given construction project be performed by Washington State registered or approved apprentices (Apprenticeship Utilization Requirements).[174] From energy retrofits in public buildings to EV charging stations at state facilities, public works projects offer the opportunity to reduce emissions and generate demand for skilled apprentice labor in clean energy economy.

Most agencies under the authority of the Governor (excluding WSDOT) must require 15% of the total labor hours to be performed by state approved apprentices for projects estimated to cost $1 million or more. WSDOT must require 15% of the total labor hours to be performed by state-approved apprentices for projects estimated to cost $2 million or more. All public works by a school district or four-year higher education institution estimated to cost $1 million or more must contain specifications requiring that no less than 15% of the labor hours to be performed by registered apprentices.

Action:

- Continue to invest in green public infrastructure and consider expanding labor requirements for public projects.

7.2 Invest in Reducing Emissions from State Contracts and Operations

In addition to the statewide greenhouse gas emissions limits, Washington state agencies are subject to a requirement to reduce emissions from state operations.[175] One way to support in-state industry and enlist the private sector in decarbonization is to leverage the buying power of state and local government. In 2020, Governor Inslee issued Executive Order 20-01, concerning State Efficiency and Environmental Performance.[176] When making purchasing, construction, leasing and other decisions that affect state government's emissions of greenhouse gases or other toxic substances, agencies are explicitly directed to consider the benefits and costs, including the social costs of carbon of available options to avoid those emissions. Where cost-effective and workable solutions are available to reduce or eliminate emissions, decision makers are required select the lower-emissions options.

Governments in Washington procure a wide range of products and services. Public contracts present opportunities to support high-quality, accessible jobs. Requiring or incentivizing suppliers and contractors to meet certain labor standards, disclose the emissions performance of their products and follow low carbon practices can support a strong workforce and further the state's progress in decarbonizing. Requiring agencies to factor greenhouse gas emissions into purchasing decisions

[174] Chapter 39.04.320 RCW.

[175] (1) State agencies shall meet the statewide greenhouse gas emission limits established in RCW 70A.45.020 to achieve the following, using the estimates and strategy established in subsections (2) and (3) of this section: (a) By July 1, 2020, reduce emissions of greenhouse gases to eight hundred five thousand metric tons, or fifteen percent below 2005 emission levels; (b) By 2030, reduce emissions of greenhouse gases to five hundred twenty-one thousand metric tons, or forty-five percent below 2005 levels; (c) By 2040, reduce emissions of greenhouse gases to two hundred eighty-four thousand metric tons, or seventy percent below 2005 levels; and (d) By 2050, reduce overall emissions of greenhouse gases to forty-seven thousand metric tons, or ninety-five percent below 2005 levels and achieve net zero greenhouse gas emissions by state government as a whole. (RCW 70A.45.050).

[176] "State Efficiency and Environmental Performance," Pub. L. No. Executive Order 20-01 (n.d.), https://www.governor.wa.gov/sites/default/files/exe_order/20-01%20SEEP%20Executive%20Order%20%28tmp%29.pdf.

supports and drives clean industry—leveling the field for those who have invested in green approaches and motivating others to follow suit.

Action:

- Adopt "Buy Clean / Buy Fair" requirements for public projects.

7.3 Invest in Washington's Smart Buildings Center

Washington's Green Economy Report found that a majority of Washington's clean energy sectors do not have well established workforce pipelines. The report identified 11 recommendations to develop and support workforce pipelines (Appendix E). In addition to those recommendations, a number of other complementary opportunities exist. One of those relates to building energy efficiency and the state's Smart Buildings Center.

Building efficiency continues to be an excellent economic and climate change investment for Washington. It is the single largest clean tech employer and demand is anticipated to grow as a result of market forces and public policy, i.e., the Clean Commercial Buildings Standard (Chapter 285, Laws of 2019). Expanding the state's portfolio of buildings policies to include decarbonization will demand additional expertise.

Washington's Smart Buildings Center is well positioned to meet this growing demand. Located in Seattle, Washington, the Center has been a regional leader in building energy efficiency training and education, offering state of the art trainings in building energy efficiency and nationally recognized building operator certification program—a competency-based credentialing program for building engineers and maintenance personnel.

Employers and trainees highly recommend the Center, but also note the need for trainings to be offered more frequently and for the curriculum to be expanded.[177] Additional funding will also be required to expand outreach and recruitment activities.[178]

Action:

- The Legislature should invest in the state's Smart Buildings Center to expand the Center's curriculum, increase the frequency of its trainings and provide grants and stipends for participants in commercial and residential energy audit certifications, building operator certifications, energy management and energy code training and construction trades. Grants, stipends and trainings should be equitably advertised and offer opportunities to historically under-resourced and underrepresented communities.

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[177] Alan Hardcastle, "Weatherization Workforce Roadmap for Washington State" (Washington State University Energy Program, March 2020), https://www.commerce.wa.gov/wp-content/uploads/2020/11/Wx-Workforce-Roadmap-FINAL-March-2020-Rev-1.pdf.

[178] Ibid.

7.4 Establish Accredited System of Regional Dual-Credit Career & Technical Education Programs

Washington's Centers of Excellence partner with business, industry, labor and the state's education system to create workforce pipelines for industries critical to the state's economic vitality.[179] There are currently 11 Centers of Excellence.[180] Each center specializes in one key sector of the economy.[181]

The Pacific Northwest Center of Excellence for Clean Energy serves as the state's sole Center of Excellence for clean energy.[182] Located in Centralia, Washington, the Center offers 65 community college programs in the areas of power generation, transmission and distribution; solar, wind and hydro technologies; and demand-and-response. Students receive the skills they need to be successful in their chosen industry and externships to demonstrate and further hone their skills.[183] They graduate with ready to meet the state's workforce needs and connections to industry leaders in their fields of study.[184]

As the transition to the clean energy economy accelerates, there will be a need for greater workforce development in areas not currently covered by the Pacific Northwest Center of Excellence for Clean Energy or the Smart Buildings Center. For instance, the state currently lacks a workforce pipeline for the clean transportation sector. The Centers for Excellence provide a model upon which the state can meet its workforce needs as they relate to the clean energy transition.

Action:

- The Legislature should commission the state's Centers of Excellence to identify regional "clusters" of dual credit career and technical education (CTE) courses and funding opportunities in the clean energy sector. Each cluster should advance a degree or certification in two or more careers in clean energy.[185] The Centers of Excellence should engage underserved and underrepresented communities in the development of their programs and recruitment policies. Grant and stipend opportunities for these communities should be part of each program.

7.5 Establish the Washington Climate Corps Program

To complement a dual-credit CTE initiative, the state should establish a comprehensive apprenticeship strategy that provides clean energy and construction training and work experience to young adults and veterans. The Climate Corps would provide hands-on experience and community energy planning to prepare Washington communities for the clean energy transition.

Action:

- The Legislature should establish the Washington Climate Corps through the Washington Service Corps. Intermediary grants should be provided to the Centers of Excellence and Career Connect Washington to link dual-credit CTE graduates to existing registered

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[179] "About Us," Washington State Centers of Excellence, n.d., https://www.coewa.com/about.
[180] "Centers of Excellence," Washington State Centers of Excellence, n.d., https://www.coewa.com/centers-of-excellence.
[181] Ibid.
[182] "Clean Energy," Washington State Centers of Excellence, n.d., https://www.coewa.com/clean-energy.
[183] "Who We Serve," Washington State Centers of Excellence, n.d., https://www.coewa.com/who-we-serve.
[184] "Industry," Washington State Centers of Excellence, n.d., https://www.coewa.com/industry.
[185] Existing COEs representing advanced manufacturing, clean energy, maritime and IT have applied for a federal grant opportunity, but funding is not guaranteed.

apprenticeship programs, connect businesses to established apprenticeship programs and assist industries in establishing new apprenticeship programs when needed.

7.6 Establish a Battery-Electric Bus Fleet Training Program

To meet Washington's greenhouse gas emissions targets will require the conversion of Washington's public buses to battery electric fleets. A new and retrained workforce will be required to operate and maintain these vehicles and their supporting infrastructure.

King County Metro is the first metro area in Washington to begin planning a workforce program for battery-electric buses.[186] In its 2020 Battery-Electric Bus Implementation Report, King County Metro identified that the transition to a battery-electric fleet will require training for battery maintenance, safety and dispatching, operator training, transit control center and service quality.[187] The metro is currently working the industry leaders to develop this program and coordinate and help write the training manuals to meet local transportation requirements.[188] The report notes:

> Longer term, Metro leadership needs to work closely with its operational workforce to assure a successful transition from launch to long-term operations. Metro should also be actively working with local colleges for a pipeline of required trades and competencies as electricians are going to be in high demand as transportation continues to electrify.[189]

Establishing a statewide training workforce pipeline for battery-electric fleets would provide workforce development for the whole state as the state transitions its bus fleets to battery-electric and zero-emission vehicles.

Action:

- The Legislature should establish a workforce pipeline for the operation and maintenance of battery-electric buses and the installation and maintenance of their requisite charging infrastructure. The program should include grants and stipends for underserved and underrepresented communities and the operators and crewpersons of retiring fossil fuel fleets.

7.7 Prepare for a Just Industrial Transition

Even with policy intention and intervention to maintain existing industry and grow new clean industries, some Washington industries may decline over the next decades due to global or national market forces. When possible, that decline should be managed to avoid worker displacement and economic disruption. Planning a just transition is a way to decouple emissions reductions from economic opportunities for communities and workers.

Steps to enable rapid decarbonization (e.g., expedited permitting or siting) should be thoughtfully implemented so as not to create displacement, environmental damage or economic disinvestment in local communities, referred to as "sacrifice zones," often through locally unwanted land use. Tools such

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[186] "Battery-Electric Bus Implementation Report" (King County Metro, January 2020), https://kingcounty.gov/~/media/depts/metro/programs-projects/zero-emissions-fleet/battery-electric-bus-implementation-report.pdf.
[187] Ibid.
[188] Ibid.
[189] Ibid.

as the Washington Environmental Health Disparities Map[190] can help identify communities most impacted by siting a certain industry and to determine the local priorities. The permitting and siting processes must ensure meaningful participation of and representation by those most impacted in decision making.[191]

Long-term planning needs to recognize that fossil fuel use will continue to decline, with or without explicit policy. The state needs a long-term strategy for transitioning the skilled fossil fuel workforce to good-paying, skilled, clean energy jobs.

The landmark 2011 Memorandum of Understanding between the State of Washington and TransAlta to phase out the coal-fired power plant in Centralia is a successful example of a just transition. The agreement includes a commitment by TransAlta to make annual financial assistance payments to support weatherization and energy efficiency; education, worker retraining and economic development in the region (Lewis and South Thurston counties); and grants to support the deployment of clean energy technologies.[192] Under the agreement, $55 million in grant funds are overseen by three Coal Transition Funding Boards: the Weatherization Board, Economic & Community Development Board and Energy Technology Board.[193]

Unit 1 of the Centralia coal plant is slated to shut down on December 31, 2020. Unit 2 will shut down on December 31, 2025. The 15-year timeline adopted for the phaseout plan was designed to minimize job losses by allowing many employees to reach retirement age, or plan ahead to seek new employment.[194]

Over the coming decade, the fossil fuel industry is expected to lose about 140 jobs per year in Washington.[195] Prior to the COVID-19 pandemic, researchers estimated that these job losses could primarily be handled through retirement.[196] Protections for workers, such as pension guarantees,[197,198]

[190] "Washington Tracking Network: A Source for Environmental Public Health Data," n.d., https://fortress.wa.gov/doh/wtn/WTNIBL/.
[191] "Front and Centered Approach to Equitable Greenhouse Gas Reduction in Washington State" (Front and Centered, 2020), https://frontandcentered.org/accelerating-just-transition-in-wa-state/.
[192] "Memorandum of Agreement" (Washington Department of Ecology, December 23, 2011), https://ecology.wa.gov/DOE/files/85/858591f6-dd25-47be-ba1d-0f58264ca147.pdf.
[193] "Centralia Coal Transition Grants," n.d., https://cctgrants.com/.
[194] "TransAlta, Legislators and Environmental Groups Reach Agreement for Centralia's Transition," accessed October 26, 2020, https://www.transalta.com/our-operations/united-states/centralia/community-updates/transalta-legislators-and-environmental-groups-reach-agreement-for-centralias-transition/.
[195] Robert Pollin, Heidi Garrett-Peltier, and Jeannette Wicks-Lim, "A Green New Deal for Washington State" (University of Massachusetts Amherst, 2017), https://www.peri.umass.edu/publication/item/1033-a-green-new-deal-for-washington-state.
[196] Ibid.
[197] Jeremy Brecher, "No Worker Left Behind: Protecting Workers and Communities in the Green New Deal," *New Labor Forum* 29, no. 2 (May 1, 2020): 68–76, https://doi.org/10.1177/1095796020915177.
[198] Elena Foshay, Jill Kubit, and Lara Skinner, "Making the Transition: Helping Workers and Communities Retool for the Clean Energy Economy" (Apollo Alliance and Cornell Global Labor Institute, 2009), http://www.nlg-laboremploy-comm.org/media/Events_Conv2010-GreenEconCornell_ILR_Making_the_T.pdf.

bridges to retirement, wage compensation insurance,[199,200] and retraining are important for a just transition.

Actions:

- Identify the industries that are likely to experience transition and make a transition plan for the workers well in advance of closure. Engage industry leaders, community representatives and labor unions from the outset in mapping the priorities of each group impacted by industrial transition.
- Ensure that transition policies promote labor standards, shared benefits and long-term support for Washington industries and jobs.
- Adopt permitting and siting processes that ensure community participation and representation.

F. 100% Clean Electricity to Meet the Needs of a Decarbonized Economy

Electricity will play a transformative role in meeting Washington's greenhouse gas reduction limits. The state will need to grow and manage clean, reliable electricity generation to meet increasing demand from buildings, industry and transportation. With its relatively clean grid,[201] ambitious clean electricity requirements and deep expertise in electricity, Washington is poised to be a leader in the transition to an electrified, decarbonized economy over the coming decade.

This will require a comprehensive change of the electricity sector – from the interactions of individual customers and communities with the grid to the generation and transmission of electricity across the West. An equitable transformation, as envisioned in CETA, will reflect community priorities for resilience and affordability, encourage customer participation in smart grid services and preserve reliable service.

The electricity sector strategies complement those recommended for other sectors with end uses converted from fossil fuels to electricity where possible. This is particularly true for the transportation and buildings sectors. The strategies will:

- Meet CETA's requirements for a greenhouse gas neutral electricity supply by 2030 and 100% renewable or non-emitting electricity by 2045, while incorporating equity, reliability and resource adequacy principles.
- Fulfill energy and capacity demands created by increased electricity use in transportation, buildings and industry.
- Increase grid resilience and satisfy community demands for electricity services.[202]

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[199] Robert Pollin and Brian Callaci, "The Economics of Just Transition: A Framework for Supporting Fossil Fuel–Dependent Workers and Communities in the United States," *Labor Studies Journal* 44, no. 2 (June 1, 2019): 93–138, https://doi.org/10.1177/0160449X18787051.
[200] Foshay, Kubit, and Skinner, "Making the Transition: Helping Workers and Communities Retool for the Clean Energy Economy."
[201] "Washington State Electric Utility Fuel Mix Disclosure Reports: For Calendar Year 2018" (Washington State Department of Commerce, 2019), https://www.commerce.wa.gov/wp-content/uploads/2020/04/Energy-Fuel-Mix-Disclosure-2018.pdf.
[202] Ralph Kappelhoff et al., "Embracing the Voice of the Customer" (2019 Grid Forward Conference, October 9, 2019). Customer and community demands include enhanced energy security, health and environmental benefits, uninterruptible, high-fidelity power for data operations and the procurement of locally-sourced electricity. 12/2/2020 3:18:00 PM

- Advance an equitable clean energy economy and create living-wage jobs.

Transformational Role of Electricity

The deep decarbonization modeling analysis performed for this strategy, combined with a review of existing decarbonization plans and independent analyses, point to a transformational role for the electricity sector in a decarbonized future. Even in those scenarios with continued use of gas or liquid forms of energy, Washington needs clean electricity to produce those fuels.

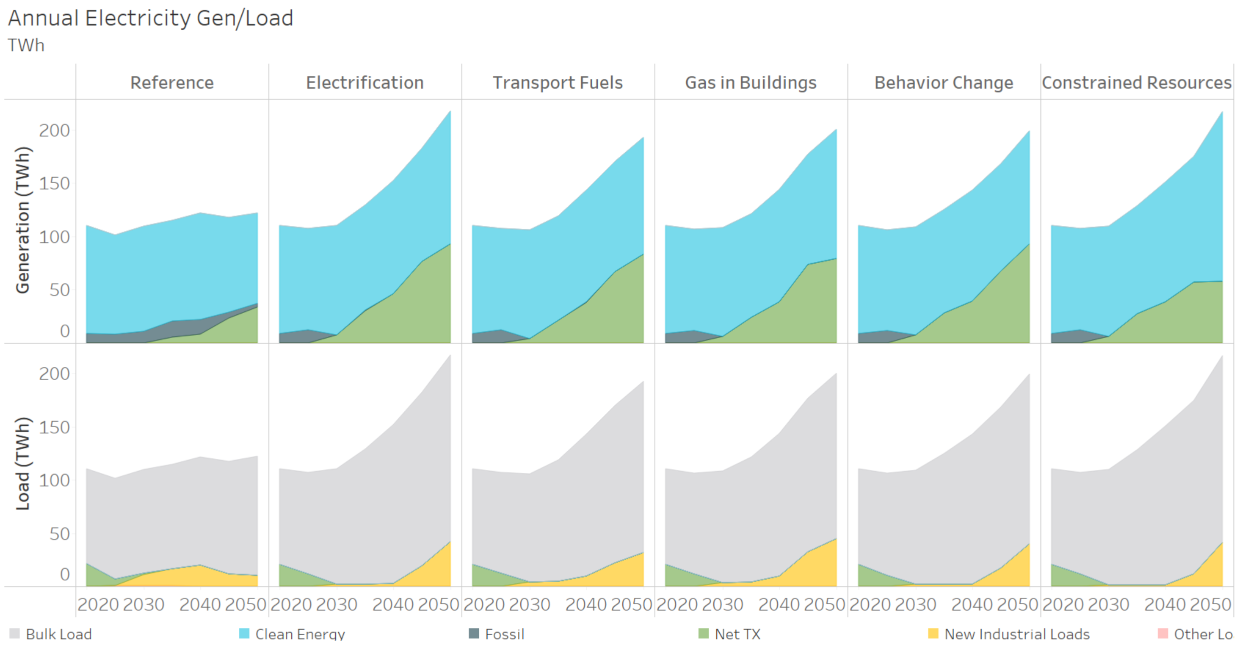
The modeling suggests that electricity demand in Washington could grow by 13-20% over 2020 levels by 2030. Electricity load growth then accelerates, and by 2050 is up to 92% above the 2020 level, as shown in Figure 25. By 2045, 42-50% of the energy used in Washington would be in the form of electricity, up from 21% today. This growth – occurring parallel with CETA requirements for carbon-neutral electricity by 2030 and 100% non-carbon emitting by 2045 – will require diverse, new non-carbon-emitting generation resources.

The transformation to clean electricity will enable and require Washington to use energy more efficiently. In addition to the inherent efficiency advantages of electric vehicles and electric heat pumps over direct combustion alternatives, Washington must continue to prioritize end use efficiency, with particular emphasis on the buildings sector. This has been a successful strategy in the Pacific Northwest for more than 40 years. As the power system evolves, an increasingly smart grid will allow more complex energy management, such as regional demand response programs and other non-wires solutions leading to the efficient use of renewable and non-emitting generation.

Transformation of the Electric Power System

To transform the state's overall energy system, the electric power system requires substantial alteration. New or expanded transmission capacity is required for access to the best renewable resources and to take full advantage of coordination opportunities across the West. A modernized grid will allow more flexibility in operations and more use of distributed resources such as solar, storage and demand response. The institutions and organizations that operate, plan and regulate the electric system also require change.

Figure 25. Potential Future Energy Mix in Deep Decarbonization Modeling



1. Accelerate Investment in Renewable Generating Resources and Transmission

Significant quantities of new clean generation will be required to meet the future energy requirements of Washington's businesses and households. The resource requirements include new power generation facilities, expanded transmission capacity, demand response resources, end use energy efficiency and modernization of the electric distribution grid. Washington's utilities can choose among multiple types of clean generation resources.

The deep decarbonization modeling suggest wind and solar will be the most cost-effective resources, but all resource decisions are subject to more specific analysis, including the 2021 Northwest Power Plan[203] and individual utility integrated resource plans. Under CETA, nuclear generation can compete as well. There also are choices to be made about the location of new generating resources, either within the state or at more distant locations with better energy characteristics but greater transmission requirements. The actual outcome will almost certainly be a combination of resource types sited both in-state and outside Washington.

The electric power system investments required by the transformation can provide an important economic and financial opportunity for workers and businesses. However, after almost 30 years of stable electricity demand,[204] electric resource acquisition of this scale and at this pace will be an unfamiliar challenge for utilities, project developers, planning organizations, the financial community, regulators and siting agencies. The Legislature anticipated this challenge in CETA with additional

[203] "The 2021 Northwest Power Plan," accessed November 1, 2020, https://www.nwcouncil.org/2021-northwest-power-plan.

[204] The state's electricity consumption in 1992 exceeded its consumption in 2018, the most recent year for which data is available. "Table CT3. Total End-Use Energy Consumption Estimates, 1960-2018, Washington," Washington - SEDS - U.S. Energy Information Administration (EIA), n.d., https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_use/tx/use_tx_WA.html&sid=WA.

planning requirements[205] and authority for the Utilities and Transportation Commission (UTC) to use alternative regulatory approaches.[206]

Recommended approaches to meet this challenge focus on a more robust transmission system across the Western Interconnection, an increased focus on resource adequacy, reform of wholesale electric markets, improved data and research about resource options and accelerated modernization of the communications and control abilities in the distribution system.

1.1. Assess the Potential for and Facilitate Deployment of New Clean Energy Resources

To take best advantage of opportunities to develop renewable resources within Washington, utilities will need detailed information about potential locations. Accurate site information could speed resource development, avoid duplication of efforts and reduce conflicts among competing uses, including wildlife and military uses. In 2020, the Legislature funded a pilot study, modeled on work in California,[207] to identify solar sites in the Columbia Basin that minimize conflict among potential uses. However, this funding was among the budget items vetoed due to budget shortfalls related to the COVID-19 pandemic.[208] This pilot study concept should be expanded to a statewide assessment.

An assessment should engage a range of stakeholders and communities, ensure burdens and benefits are shared and incorporate public and environmental health as part of the review. Technical, environmental, legal and economic criteria should reflect the requirements of communities, utilities and project developers. This should inform a statewide effort to identify clean energy corridors or development zones. A successful assessment could support changes to permitting requirements.

Action:

- Funding should be made available to Commerce and electric utilities to conduct a statewide clean energy potential assessment to identify clean energy development zones.

1.2. Strengthen the Transmission System across the West and within the State

A power system that relies primarily on renewable resources will require a more robust and flexible transmission network, compared to a power system that relies on fossil fuels. Enhanced transmission capacity improves access to superior wind resources in the Mountain West and superior solar resources in the Southwest. A robust transmission system increases reliability and reduces the amount of resources each utility must hold in reserve to ensure adequate supplies.

While unsuccessful past efforts could discourage a strategy that relies on out-of-state resources and coordinated operations, the crucial role of transmission, as well as effective market coordination, is demonstrated in recent analysis for the Western Interstate Energy Board.[209] The analysis concluded that

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[205] Chapter 19.280.030 RCW.

[206] Chapter 80.28.401 RCW; Chapter 80.04.250 RCW.

[207] "Mapping Lands to Avoid Conflict for Solar PV in the San Joaquin Valley," May 2016, https://www.law.berkeley.edu/research/clee/research/climate/solar-pv-in-the-sjv/.

[208] Section 604(33), Engrossed Substitute Senate Bill 6168. http://leap.leg.wa.gov/leap/budget/lbns/2020Omni6168-S.SL.pdf

[209] Energy Strategies, "Western Flexibility Assessment" (Western Interstate Energy Board, 2019). https://westernenergyboard.org/wp-content/uploads/2019/12/12-10-19-ES-WIEB-Western-Flexibility-Assessment-Final-Report.pdf

increased regional grid integration and market coordination would lower future electricity costs and significantly reduce the potential for curtailment of renewable generation.

Under baseline business-as-usual assumptions, renewable curtailments could approach 20% of total renewable energy production by 2035. (Curtailment occurs when renewable generation exceeds demand for electricity.) With regional coordination, curtailments would be less than 10% and production costs would be $2.2 billion lower than in the baseline case. In contrast, limited regional coordination—that is, with no day-ahead market—results in the highest increase in costs ($11.3 billion in 2035) and leads to renewable curtailment of 50%.

The needed expansion of transmission capacity will require coordination among utilities, planning agencies and governments. Some stakeholders advocate for creation of a regional transmission organization to administer the transmission grid on a regional basis.[210] The owners of existing transmission resources, such as BPA and various retail electric utilities, are in the best position to advance this work and build on recent progress in establishing NorthernGrid, a collaborative transmission planning entity.[211]

An important element of this work in Washington is the transmission corridors workgroup created by the Legislature as part of CETA.[212] The primary focus of this workgroup is to ensure adequate transmission capacity and appropriate environmental review of transmission projects within the state. In addition to new capacity, additional capacity could be made available within the existing system through the reform of transmission pricing and contract structures.

Actions:

- The Governor's office, the UTC and Commerce should pursue opportunities for enhanced transmission planning and integration across the Western grid and advocate for joint development where feasible.
- Utilities and planning agencies should evaluate the need for joint development of new and upgraded transmission capacity and consider the viability of a regional transmission organization.

1.3. Encourage and Monitor Development of a Resource Adequacy Program

One of the core requirements of CETA is reliable service. Each utility must ensure it maintains enough resources to maintain reliable service under a wide range of operating conditions.[213] The priority of resource adequacy (RA) is demonstrated by CETA's provision allowing a utility to suspend temporary the clean energy transition if necessary to preserve reliability.[214] Commerce is directed to lead an evaluation of the impact of CETA's requirements on system reliability and other values starting in 2023.[215]

In 2019, the Northwest Power Pool (NWPP), composed of major generating utilities serving the Northwestern U.S., British Columbia and Alberta, started a project to address RA. NWPP has proposed a

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[210] "Electric Power Markets," Federal Energy Regulatory Commission, accessed November 30, 2020, https://www.ferc.gov/industries-data/market-assessments/electric-power-markets.
[211] "NorthernGrid," accessed November 30, 2020, https://www.northerngrid.net/.
[212] Chapter 19.405.150 RCW.
[213] Chapter 19.280.030 RCW.
[214] Chapter 19.405.090 RCW.
[215] Chapter 19.405.080 RCW.

program in which individual utilities would adopt consistent standards for the amount and type of resources needed to serve customers reliably. An RA standard and program not only reduce the risk of a shortage of electricity supply, but also lower the amount of resources needed to achieve any particular level of reliability.

While the NWPP initiative is a promising start, ongoing monitoring and evaluation by the UTC and Commerce will be required. The effective implementation of an RA program in compliance with CETA will require complex analysis of resource requirements and the contributions to reliability from diverse resources, such as hydro, wind, solar, storage and demand response.[216] The analytical methods must be consistent and transparent. They must account for the diverse capabilities of these resources to ensure that renewables, storage and hybrid resources compete on an equal footing with thermal resources.

Actions:

- Washington utilities, resource owners and developers and other stakeholders should continue to engage in development of a consistent and non-discriminatory RA program through the NWPP.
- Commerce and the UTC should review the progress and outcomes of the NWPP RA initiative and evaluate the need for additional state action to ensure CETA's RA requirements are fulfilled.

1.4. Reform and Expand Wholesale Electricity Markets

Wholesale markets are important for maintaining a reliable and affordable electricity supply. Invisible but beneficial to individual customers, these markets help utilities balance the supply and demand for electricity. When utilities find a cheaper power source outside their own portfolio, a market transaction avoids the excess costs of building or separately procuring additional resources. Without electricity markets, electricity would be more expensive and less reliable.

Historically, Washington's electric utilities have relied heavily on a bilateral market in which individual utilities, power plant operators and brokers contract for power at the mid-Columbia delivery point on the transmission system.[217] A bilateral market focuses on short-term trades without a central entity to consider other financially feasible trades.

Since 2014, the region's utilities have increasingly relied on the Western Energy Imbalance Market (EIM) to identify and capture cost-minimizing power trades in a centralized system. The EIM was created by the California Independent System Operator and PacifiCorp. By 2022, most utilities serving Washington customers will participate directly or indirectly in the EIM.[218] These markets have saved utility customers in the West more than a billion dollars when compared with the cost for each utility running its own power plants to serve its own customers every hour.[219]

There is value in extending the scope of organized markets to cover more than the short-term market. However, the existing wholesale electricity markets require reform to ensure that market rules do not

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[216] "Redesigning Capacity Markets: Innovation Landscape Brief" (International Renewable Energy Agency, 2019), https://www.irena.org/publications/2019/Jun/Market-Design-Innovation-Landscape-briefs.

[217] "Wholesale Electricity and Natural Gas Market Data," accessed November 1, 2020, https://www.eia.gov/electricity/wholesale/.

[218] "Western EIM Factsheet" (California ISO, 2020), https://www.westerneim.com/Documents/WesternEIMFactSheet.pdf.

[219] "ISO Announces the Western EIM Surpassed $1 Billion in Benefits" (California ISO, Western Energy Imbalance Market, 2020), https://www.westerneim.com/Documents/ISO-Announces-Western-EIM-Surpassed-1Billion-Benefits.pdf.

force utilities to choose between meeting their clean electricity obligations and realizing the efficiency benefits of organized markets. This potential conflict arises because existing markets typically do not differentiate between electricity from renewable sources and electricity from natural gas or coal-fired plants. While market traders have the option to specify that electricity will be renewable, the vast majority of current market transactions are for "unspecified electricity." This market rule is the result of industry practice rather than any legal requirement.

Because of the potential conflict between market practices and clean electricity requirements, in November 2019 Commerce and the UTC convened a carbon and electricity markets workgroup under CETA. The workgroup will provide input into rules to address the use of market purchases to serve retail customers. Commerce and the UTC are required to adopt rules by June 2022.

Electricity market reform is necessarily a multi-state effort. Success will likely require a different organization or governance structure than the EIM, which is controlled by the State of California with participation by a Body of State Regulators.[220] For example, public power utilities in the Northwest have published a set of principles for appropriate governance of an expanded market.[221]

These include establishing a board with a selection process that is durable and independent from market participants or regional governments; giving that board decision making authority over market rules; engaging an independent market expert; including a third party dispute resolution process and ensuring that participation is voluntary. In the longer term, the industry should explore the use of market mechanisms to buy and sell capacity resources, which will become increasingly important as coal and natural gas generating facilities are retired.

Actions:

- Wholesale market participants should develop market rules to allow trade in electricity from sources verified to comply with CETA's clean energy requirements. The UTC and Commerce, with input from the Carbon and Electricity Markets Workgroup, should adopt rules to ensure this outcome.
- Electric utilities should pursue the long-term development of a fully integrated western regional electricity market, beginning with expansion of organized markets to trade day-ahead and longer term resources. Long-term market development should explore opportunities to trade capacity resources including demand response resources.
- Commerce's 2024 CETA evaluation under RCW 19.405.080 should include an assessment of industry progress in developing efficient and resource-specified electricity markets.

2. Building a Smart and Flexible Grid

A smart, flexible and optimized grid is foundational to meeting CETA goals and electrifying the economy while assuring system reliability and resilience at both the distribution and transmission levels. A modern system allows for two-way energy flows, control and management of the entire grid using data

[220] "Western EIM - EIM Body of State Regulators," accessed November 1, 2020, https://www.westerneim.com/Pages/Governance/EIMBodyofStateRegulators.aspx.

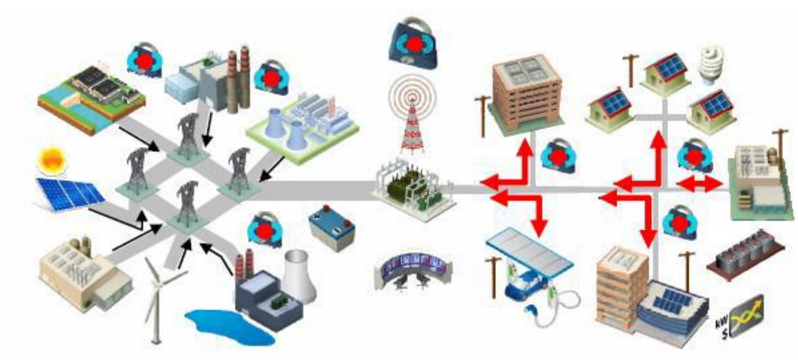
[221] "Northwest Public Power EDAM Governance Interests" (Public Generating Pool, Public Power Council, PNGC Power, Northwest Requirements Utilities, 2019), https://static1.squarespace.com/static/5e9fc98ab8d9586057ba8496/t/5ee532273ef4864f3e274b8e/1592078888146/1-23-2020-EDAM-Governance-Interests-with-logos.pdf.

and digital technologies. The grid must be both resilient and flexible. Resiliency includes the mitigation of and recovery from outages due to a range of possible scenarios including earthquakes, wildfires and human caused cyber and physical attacks. Flexibility gives the system the capacity to manage both centralized and distributed energy resources (DERs) and balance variable loads. For a list of DER technologies and enabling tools please see Electricity Appendix F.

Developing a modern grid will require new planning processes, infrastructure, software solutions and other tools to enable a mix of DER technologies. Grid operators will need new controls to securely and reliability operate that future grid—managing variable demand and supply, ensuring adequate resource capacity and providing resilience.[222] Utilities will need situational awareness of capacity constraints and resilience for critical infrastructure to avoid issues experienced by some states with high penetrations of renewables, such as Hawaii and California.

Supported by new markets for firm capacity and other essential grid services,[223] the deployment of flexible capacity through demand response programs and other "non-wires" strategies, such as microgrids, will reduce grid congestion and improve efficiency, especially at the transmission level. At the distribution level, these adjustments will enable interactive customer engagement and allow for deployment of community-scale resources.

Figure 26. A Modern Grid



A modern electric grid delivers reliable, affordable and clean electricity to consumers where and when they want it. Grid resilience protects customers and businesses from outages. Flexibility ensures that renewable and distributed resources are smoothly integrated into the grid.

Source: U.S. Department of Energy (https://www.energy.gov/articles/launch-grid-modernization-laboratory-consortium)

A better understanding of the value of DERs – especially the value of services ancillary to the grid – will help utilities and regulators understand the full impact and opportunity of these assets. A roadmap for DERs has been laid out through previous work on energy storage. The UTC conducted foundational work[224] to understand regulatory barriers. Five different pilot projects, funded in part by grants from the

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[222] Appendix I: WA State Energy Strategy PNNL Presentation to CETI October 2020

[223] These include frequency response, regulating, contingency and ramping reserves, voltage management and power quality. "Connected Communities, Funding Opportunity Announcement (FOA) Number: DE-FOA-0002206, Appendix J" (Department of Energy, Office of Energy Efficiency and Renewable Energy, 2020), https://eere-exchange.energy.gov/Default.aspx#FoaId9d24afcd-e292-4ea2-a4d3-d36e2b9dd9c7.

[224] "Report and Policy Statement on Treatment Of Energy Storage Technologies in Integrated Resource Planning and Resource Acquisition" (Washington Utilities and Transportation Commission, 2017), https://www.utc.wa.gov/_layouts/15/CasesPublicWebsite/GetDocument.ashx?docID=237&year=2016&docketNumber=161024.

state's Clean Energy Fund (CEF)[225] and supported by analysis by the Pacific Northwest National Laboratory (PNNL), showed how storage can provide a range of services to the grid, such as energy shifting, flexibility and improved distribution system efficiency.[226]

2.1. Expand the State's Energy Infrastructure Security & Emergency Management Capabilities

As transportation and buildings are electrified and "smart" appliances become more ubiquitous, a flexible grid is essential. Flexibility will help to meet variable energy and demand needs (e.g., the timing of vehicle charging) and to deploy distributed stored energy (e.g., storage in vehicle batteries and water heaters). Strengthening and updating the electric grid with new technology can help prevent outages and permit real-time data sharing to increase system-wide efficiency.

At the same time, grid modernization will require a focus on cybersecurity and policies and practices to safeguard privacy. Privacy and security considerations are related but not synonymous. Generally, privacy is about controlling who has access to personal information, and security is about protecting that information from unauthorized access.[227]

Advanced metering infrastructure (AMI) is one of the key components of a smart grid, but its progress has been delayed by – among other factors – concerns about security and privacy.[228] Security protections, incentives for customer participation and opt-out provisions may address these concerns and remove obstacles to full deployment.[229]

Further, with regard to cybersecurity and resiliency, while Commerce is working with the National Association of State Energy Offices (NASEO) to develop and review best practices for the security of solar installations, the overall capacity of Washington's energy emergency management office is stretched thin. Washington should have a full Washington Office of Energy Infrastructure Security and Emergency Management modelled on the U.S. Department of Energy Office of Cybersecurity, Energy, Security and Emergency Response (DOE CESAR).[230]

A fully-funded office would coordinate with local emergency management officials to include assessment data in local hazard mitigation plans, support applications for FEMA resilience (BRIC) funding and coordinate energy resilience data and efforts with other infrastructure planning groups, such as the

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[225] "Federal Research Spurs Washington State to Store Energy," Pacific Northwest National Laboratory, 2014, https://www.pnnl.gov/NEWS/release.aspx?id=1060.

[226] Vilayanur V. Viswanathan et al., "Washington Clean Energy Fund: Energy Storage System Performance Test Plans and Data Requirements" (Pacific Northwest National Laboratory, April 17, 2017), https://doi.org/10.2172/1474881.

[227] National Conference of State Legislators, "Creating Smart Communities, A Guide for State Policymakers, Data Privacy and Security in Smart Communities" page 19 (Nov. 23, 2020), Smart_Communities_v03_11_20_35545.pdf (ncsl.org) https://www.ncsl.org/Portals/1/Documents/energy/Smart_Communities_v03_11_20_35545.pdf

[228] Coley Girouard, "The State of Advanced Metering Infrastructure and Time-Varying Rates, in Three Maps and One Graph. The Leaders – and Laggards – May Surprise You.," *Advanced Energy Perspectives* (blog), accessed October 29, 2020, https://blog.aee.net/the-state-of-advanced-metering-infrastructure-and-time-varying-rates-in-three-maps-and-one-graph.-the-leaders-and-laggards-may-surprise-you. Some stakeholders also express concern about AMI as a tool to perform remote shutoffs and enable workforce reductions.

[229] Dockets U-180525, adoption order 7/29/2020 and Dockets U-180117, policy guidance issued on 4/10/2018.

[230] "Office of Cybersecurity, Energy Security, and Emergency Response," Energy.gov, accessed November 1, 2020, https://www.energy.gov/ceser/office-cybersecurity-energy-security-and-emergency-response.

Washington Infrastructure System Improvement Team (Sync),[231] Public Works Board[232] and the Infrastructure Assistance Coordinating Council.[233]

The Energy Emergency Management Director at the Commerce should have the authority and resources to: coordinate with utilities and local, state and federal emergency management offices about data uses and opportunities; review current industry standards for demand response equipment; coordinate with key state agencies and other stakeholders to identify what standards are already in place and what need to be added; provide educational opportunities for energy providers in cybersecurity best practices and continue to coordinate with NASEO on cybersecurity best practices.

Actions:

- Provide support for increased deployment of advanced metering infrastructure (AMI), with safeguards for privacy and security.
- Expand the energy emergency management program at the Department of Commerce.
- Develop statewide energy security standards.

2.2 Define and Value Required Storage Resources

As the electricity system transforms to 100% clean resources, there is a likely role for energy storage to balance the supply and demand for electricity. Storage options include pumped hydro systems, battery storage systems and other technologies. The need for storage resources should be assessed with care because the deep decarbonization modeling suggests that there may be other, more cost-effective approaches, such as developing hydrogen production as a flexible load. The value proposition for storage in the Pacific Northwest may be different from other regions where hydro resources are not available for short term load balancing.[234]

Long-duration storage, which would enable the region to hold hydroelectric generation from wet years to dry years, is a potentially valuable resource. Storage resources are also likely to be an important tool in increasing the resilience of the electricity grid. For example, community-based resilience hubs equipped with on-site renewable generation and battery storage could provide vital services during natural disasters and extended outages.

A technology-neutral policy toward capacity and demand response resources will allow storage resources to emerge where appropriate. Washington should also ensure that CETA's energy accounting practices accommodate the charging and discharging of storage resources.

Actions:

- Utilities should establish planning and evaluation methods that appropriately identify, define and calculate the value of storage for integration and of variable renewable energy resources and as a source of capacity, ancillary services and additional services such as voltage regulation.

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[231] "Sync - System Improvement Team," Washington State Department of Commerce, accessed November 1, 2020, http://www.commerce.wa.gov/building-infrastructure/sync-systems-improvement-team/.

[232] "Public Works Board - Home Page," Washington State Department of Commerce, accessed November 1, 2020, http://www.commerce.wa.gov/building-infrastructure/pwb-home-page/.

[233] "Infrastructure Assistance Coordinating Council (IACC)," accessed November 1, 2020, https://www.infrafunding.wa.gov/.

[234] A summary of The Growing Role of Energy Storage in Clean Energy Policy can be found here: https://www.ncsl.org/research/energy/the-growing-role-of-energy-storage-in-clean-energy-policy.aspx

- The UTC and Commerce should ensure that CETA's energy accounting methods accommodate the charging and discharging of storage resources within the electricity grid.

2.3. Prepare for Widespread Deployment of Distributed Energy Resources (DERs)

Washington's clean energy transition will require integration of DERs. Clear policy guidance, a common framework and better data can help inform utility and local planning for DER integration, guard against incompatible technology decisions and increase the confidence of investors and regulators. A voluntary, non-adversarial technology process could accelerate the identification and prioritization of the requirements for investments, communications, cybersecurity and technical standards.

There also is a need for a better understanding of the value of DERs and the capacity of distribution systems to host them. DER value analysis will assist utilities in meeting their CETA obligation to identify and acquire demand response resources. Utilities should perform and publish analyses of hosting capacity—that is, the amount of DERs that can be added to the distribution system at a given time and location without compromising power quality or reliability.

Utilities can also identify system constraints, where DERs might be beneficial to the system. Project developers can use data from hosting capacity analyses to make interconnection processes faster and more transparent, identify the optimal locations to deploy DERs and avoid unnecessary distribution grid upgrades.[235] An analysis of critical loads can help local jurisdictions and emergency managers right size and prioritize DERs to promote resilience on the most important parts of the grid. The Oregon Public Utilities Commission's distribution system planning provides a helpful model for UTC and individual utilities.[236]

DER planning involves analyzing the potential contribution of demand-side resources to energy needs and resource adequacy while factoring in the distribution grid upgrades needed to realize that potential. In 2019, the Legislature adopted policy and practices that utilities must address if they pursue distributed energy resource planning.[237] However, DER planning remains voluntary for Washington utilities. The Legislature should continue to assess whether to maintain this approach or provide more specific requirements for DER planning.

Actions

- Request support from the U.S. Department of Energy and Pacific Northwest National Laboratory to convene a distributed energy resource workgroup to identify and resolve grid architecture barriers to DER deployment.
- Utilities should incorporate comprehensive assessments of the value of DERs in the specific context of individual distribution grids by performing and publishing hosting capacity and critical load studies.
- The Legislature should assess whether voluntary distribution system planning is the appropriate policy approach given the requirements of CETA.

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[235] Gwen Brown, "California Adopts First Interconnection Rules to Utilize Hosting Capacity Results," *Interstate Renewable Energy Council* (blog), 2020, https://irecusa.org/2020/09/california-adopts-first-interconnection-rules-to-utilize-hosting-capacity-results/.

[236] "Distribution System Planning," Oregon Public Utility Commission, accessed November 30, 2020, https://www.oregon.gov/puc/utilities/Pages/Distribution-System-Planning.aspx.

[237] Chapter 19.280.100 RCW.

2.4. Pursue Universal, Statewide Deployment of Broadband

The importance of universal broadband access is discussed throughout this strategy. Within the electricity sector, the value of broadband access comes from the role of communication in a flexible, smart electric grid. The electric grid needs universal communication to manage a diverse portfolio of clean energy resources. This approach will require rapid communication of information across the electricity network to individual devices located at customers' premises. Smart, connected end use equipment, such as EV chargers and electric water heaters, interact with grid operators to maintain reliable service.

For example, Washington adopted a requirement that electric water heaters sold in the state have a built-in communications port capable of supporting remote demand response signals.[238] The port can be used with any number of communications devices and networks, which might be a proprietary electric utility network or a broadband Internet connection, but its value as resource to balance the power grid exists only with a reliable data connection.[239]

The electric industry is well-positioned to support widespread deployment of broadband access, combining its own communication requirements with those of education, public safety, business and other parts of society. Several electric utilities already provide telecommunications services in their service areas. For example, 15 public utility districts operate telecommunications systems that are available to retail providers of Internet service.[240] Utilities also can contribute to a societal solution as users of a public network where feasible, rather than investing in proprietary solutions.

Action:

- Adopt a state policy to mandate universal broadband access.

2.5. Advance Grid Modernization with Clean Energy Fund Investments in Resilient & Flexible Projects

Grid resilience is an excellent investment. According to the National Institute for Building Science, every $1 invested in resilience funding through federal agencies saves $6 in averted disaster costs.[241,242] These figures represent the savings to physical infrastructure in the face of natural disasters. As recently recommended by the Energy & Climate Policy Advisory Committee (ECPAC), the Clean Energy Fund (CEF) can invest in new technology and infrastructure required for a successful and equitable transition to clean electricity by adding resilience as a project priority. ECPAC and Commerce also recognize the need to engage communities on how these funds should be deployed to ensure projects that are beneficial to local energy resilience.

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[238] "Appliance Standards," Washington State Department of Commerce, accessed November 1, 2020, http://www.commerce.wa.gov/growing-the-economy/energy/appliances/.

[239] The communications port is described in this BPA report: "Performance Test Results: CTA-2045 Water Heater: Testing Conducted at the National Renewable Energy Laboratory" (Palo Alto, CA: EPRI, 2017).

[240] "PUDs Providing Telecommunications Services," Washington Public Utility Districts Association, accessed November 1, 2020, https://www.wpuda.org/telecommunications.

[241] "National Institute of Building Sciences Issues New Report on the Value of Mitigation," National Institute of Building Sciences, 2018, https://www.nibs.org/news/381874/National-Institute-of-Building-Sciences-Issues-New-Report-on-the-Value-of-Mitigation.html.

[242] "Every $1 Invested in Disaster Mitigation Saves $6," The Pew Charitable Trusts, accessed November 1, 2020, http://pew.org/2D2JuLb.

There is also a long history of supporting infrastructure planning assistance in Washington through the Infrastructure Assistance Coordinating Council,[243] which helps local jurisdictions connect with grants and funding. However, local planning efforts do not often include grid modernization planning. By creating a mechanism for more holistic, institutional support for local clean energy infrastructure planning, flexible and resilient solutions like DERs can be introduced much further upstream in the planning process.

Planning efforts would be enhanced by increased connection between utilities and research institutions and the U.S. Department of Energy, and increased engagement from the clean tech sector. State funding should leverage private, federal or other funding and could include programs that increase resilience through microgrid and transactive projects, deploy demand response or load flexibility, especially with large industrial customers and deploy clean energy solutions for critical load centers.

Actions

- Provide state support for flexible and resilient planning and project development by creating a new cluster within Commerce's Office of Economic Development and Competitiveness to focus on utility grid optimization and DER deployment.
- Target CEF funding to projects that enable flexible load management and increase grid resilience.

3. Facilitate Community Deployment of Renewable Generation Resources and Grid Services

Just as utilities must incorporate equity into their planning, state government must address access and equity in its own programs and funding. The Legislature has begun to signal this change through updated budget instructions for the CEF[244] and by funding efforts like the state Environmental Justice Task Force,[245] which has identified ways that state agencies can incorporate environmental justice priorities into their work.

Historically, state incentives have not been readily accessible to community scale projects. Under the Renewable Energy System Incentive Program (RESIP),[246] over half of the solar installed was for residential scale solar, while community solar accounted for just 1% of projects.[247] Net metering laws often restrict meter aggregation and do not have specific requirements for virtual net metering, limiting access for multifamily projects. Low-income households can have difficulty taking advantage of

[243] "Infrastructure Assistance Coordinating Council (IACC)."
[244] "Substitute Senate Bill 6090" (2018), http://leap.leg.wa.gov/leap/budget/lbns/1719Cap6090-S.SL.pdf.
[245] "Environmental Justice Task Force."
[246] Chapter 82.16.165 RCW.
[247] "The Renewable Energy System Incentive Program: Legislative Report: October 2019" (Energy Program, Washington State University, 2019), http://www.energy.wsu.edu/documents/Renewable%20Energy%20System%20Incentive%20Program%20Report-Oct2019.pdf.

incentives,[248] and a significant gap in adoption of distributed solar technologies exists for communities of color.[249]

To address the inequities created by previous efforts as deployment of DERs is accelerated, community engagement and understanding of opportunities for local capacity-building must be prioritized. Public processes like the King County Climate Equity Task Force and community-based participatory research provide models of equitable and accessible approaches to this work.

Priority communities can be identified using statewide energy equity indicators and environmental health and cumulative impact analysis tools such as the Environmental Health Disparity Map.[250] This and other recommendations are supported by the work of the Environmental Justice Task Force. These tools can also be used in partnership with direct service providers like community action partnerships,[251] who have a rich history of working with state agencies and are well situated for qualifying and engaging with low-income and vulnerable communities.

3.1. Increase the Opportunity for Community DERs and Energy Program Management

Sharing the benefits of DERs allow communities to be in control of their energy supply, provide local clean job opportunities and bring resilience to the grid. However, local projects must compete with the economies of scale that utility-scale projects provide. In addition to helping local jurisdictions obtain the data to help understand the value of resilience on their grid (Section 2), the state can ensure a more equitable clean energy future by supporting local planning resources, including efforts by Tribal governments.

Policies must recognize the individual needs of Tribes across the state and help leverage local energy resources, such a bioenergy, or support projects that promote energy independence, such as microgrids. Both public and private entities can create carve outs in existing programs to account for the unique tax status of Tribes and the structure of land ownership that may prevent Tribes from taking advantage of some financial tools. Programs should help leverage funding from the DOE Tribal Energy Office.

Consideration could be given to forming energy districts as community institutions modeled after Conservation Districts.[252] In addition, a resilience hub program[253] would support deployment of solar generation, storage and microgrids at community centers to provide the surrounding community free access to essential services, such as heating, cooling, device charging and internet access in the event of a grid outage. In addition, providing grants and technical assistance to community centers for the

[248] Bentham Paulos, “Bringing the Benefits of Solar Energy to Low-Income Consumers: A Guide for States & Municipalities” (Clean Energy States Alliance, 2017), https://www.cesa.org/wp-content/uploads/Bringing-the-Benefits-of-Solar-to-Low-Income-Consumers.pdf.

[249] Deborah A. Sunter, Sergio Castellanos, and Daniel M. Kammen, “Disparities in Rooftop Photovoltaics Deployment in the United States by Race and Ethnicity,” *Nature Sustainability* 2, no. 1 (January 2019): 71–76, https://doi.org/10.1038/s41893-018-0204-z.

[250] “Washington Environmental Health Disparities Map” (Washington Department of Health, n.d.), https://www.doh.wa.gov/DataandStatisticalReports/WashingtonTrackingNetworkWTN/InformationbyLocation/WashingtonEnvironmentalHealthDisparitiesMap.

[251] “Washington State Community Action Partnership > Home,” accessed November 1, 2020, http://www.wapartnership.org/.

[252] Conservation districts were established as part of the New Deal and authorized in Washington in 1939 through RCW 89.50. See also, “A Geography of Change” (Winneshiek Energy District, 2019), https://energydistrict.org/wp-content/uploads/2019/01/A-Geography-of-Change-full.pdf.

[253] Kristin Baja, “Resilience Hubs” (Urban Sustainability Directors Network, 2018), https://www.usdn.org/uploads/cms/documents/usdn_resiliencehubs_2018.pdf.

development of resilience hubs in both rural and urban areas of need could encourage local engagement and community independence. Projects may also provide important insights into community focused resilience metrics, which can used to inform a "value of resilience" to be incorporated into regional planning.

In some rural communities, increased support of opportunities for agrivoltaics – the beneficial co-location of solar panels and agricultural activity – could demonstrate that solar projects do not have to compete for land with agricultural production. The state should consider a statewide standard pollinator-friendly solar (see Maryland and Minnesota) and consider funding research and pilot projects.

To help community projects get off the ground, the state can allocate resources to fund community-centered feasibility studies and other outreach and education for flexible and resilient energy projects. Funds can also be used to develop training resources including sample project plans, design standards and sample past projects and templates. Streamlined applications and eligibility can be implemented to eliminate redundancies and the complexity of grant application processes.

Actions

- Develop resources for expanded outreach, technical assistance and education for community efforts.
- Create specific programs for Tribal energy projects that promote Tribal sovereignty and self-determination.
- Support the development of community resilience hubs and energy districts.
- Support clean energy projects that benefit agricultural communities.

3.2 Develop Tools for Equitable Energy Distribution and Deployment

Energy equity indicators, data collection and a publicly accessible energy equity dashboard would assist in ensuring a just transition. The indicators should include both outcome and process measures. Outcome measures, such as increasing renewable energy in communities, must be supported by community engagement process metrics to hold state agencies accountable for increasing meaningful engagement with communities.

To understand current inequities associated with disbursement of energy funds and incentives, Commerce should review past and existing programs that support clean energy (e.g., Clean Energy Fund, Energy Efficiency and Solar grants) and other state incentives, such as the Renewable Energy State Incentive Program and net metering. Commerce should compare the locations of projects supported by public programs with the Environmental Health Disparities Map to identify highly impacted communities. The outcome can be used to identify gaps in service and specific use cases (i.e., multifamily housing) for further investment.

The Legislature and Commerce should use equity design elements for CEF and related energy programs. Those elements could include a lower or no match requirement based on applicant type, a requirement that grant applicants identify how their project will lead to more equitable outcomes, incentives to include underrepresented communities or organizations on project teams and ensuring community-driven outreach and participation in program design and implementation.

Actions

- Perform an equity assessment of existing programs related to renewable energy
- Explore the adoption of energy equity indicators and a publicly accessible energy equity dashboard, including both outcome and process measures.
- Use an equity and environmental justice lens for CEF program structure, design elements and participation.

Appendices

Appendix A-Equity Appendix

Appendix B-Deep Decarbonization Modeling Technical Report

Appendix C-Transportation Appendix

Appendix D-Buildings Appendix

Appendix E-Industry Appendix

Appendix F-Electricity Appendix

Appendix G-Advisory Committee Members

Appendix H-Resources Conducted for Technical Advisory Process

Appendix I-WA State Energy Strategy PNNL Presentation to CETI, October 2020

Appendix J-Washington State Energy Policy Inventory

Appendix K-Data Accompanying Deep Decarbonization Modeling Technical Report

Appendix L-Economic and Health Impacts Modeling

Appendix M-Washington GDP by Sector

Appendix N-Bibliography

List of Acronyms

AI	artificial intelligence
AMI	advanced metering infrastructure
ASCENT	Aviation Sustainability Center
BE	building electrification
BEPS	building energy performance standard
BIPOC	Black, Indigenous, and people of color
BPA	Bonneville Power Administration
BPS	building performance standard
BRIC	Building Resilience in Communities
BUILD	Building Initiative for Low-Emissions Development Program
CAISO	California Independent System Operator
CAR	Clean Air Rule
CCS	carbon capture and storage
CCUS	carbon capture, utilization and storage
CEC	California Energy Commission
CEF	Clean Energy Fund
CEI	Clean Energy Institute
CETA	Clean Energy Transformation Act
CHP	combined heat and power
CO2	carbon dioxide
CTR	commute trip reduction
DDP	deep decarbonization pathway
DER	distributed energy resource
DES	Department of Enterprise Services
DOE	United States Department of Energy
ECPAC	Energy & Climate Policy Advisory Committee
EDAM	energy day-ahead market
EFSEC	Energy Facility Site Evaluation Council
EIM	energy imbalance market
EITE	energy intensive and trade exposed
EJ	environmental justice
EPA	United States Environmental Protection Agency

EPD	environmental product disclosure
ESJ	environmental and social justice
EU	European Union
EUI	energy use intensity
EV	electric vehicle
EVSE	electric vehicle supply equipment
FCV	fuel cell vehicle
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FPL	federal poverty level
GDP	gross domestic product
GHG	greenhouse gas
GHGI	greenhouse gas intensity
GMLC	Grid Modernization Lab Consortium
GW	gigawatt
GWP	global warming potential
HCFCs	hydrochlorofluorocarbons
HDV	heavy-duty vehicle
HFC	hydrofluorocarbon
HFCs	hydrofluorocarbons
HVAC	heating, ventilation, and air conditioning
ICE	internal combustion engine
IRP	integrated resource plan
JTC	Joint Transportation Committee
kW	kilowatt
kWh	kilowatt hour
LCA	life cycle assessment
LCFS	low carbon fuel standard
LDV	light-duty vehicle
LICSD	Low-Income Community Solar Deployment program
LIHEAP	Low-Income Home Energy Assistance Program
LMI	low to moderate income
MDV	medium-duty vehicle

MPO	metropolitan planning organization
MW	megawatt
NASEO	National Association of State Energy Offices
NEEA	Northwest Energy Efficiency Alliance
NWPP	Northwest Power Pool
O&M	operations and maintenance
ODI	Outage Data Initiative
ODS	ozone-depleting substances
PACER	property assessed clean energy and resilience
PIM	performance incentive mechanisms
PNNL	Pacific Northwest National Laboratory
Power Council	Northwest Power and Conservation Council
PUD	public utility district
PV	photovoltaic
R&D	research and development
RA	resource adequacy
RD&D	research, design, and development
RESIP	Renewable Energy System Incentive Program
RIO	Regional Investment and Operations Model
RNG	renewable natural gas
RTF	Regional Technical Forum
RTPO	regional transportation planning organization
RUC	road usage charge
SAFN	Sustainable Aviation Fuels Northwest Initiative
SBCC	State Building Code Council
SEEP	State Efficiency and Environmental Performance Office
SNAP	Significant New Alternatives Policy
TDM	transportation demand management
TNC	transportation network companies
TOD	transit oriented development
USDA	United States Department of Agriculture
UTC	Utilities and Transportation Commission
VMT	vehicle miles traveled

WAP	Weatherization Assistance Program
WECC	Western Electric Coordinating Council
WEIAT	Washington Energy Infrastructure Assessment Tool
WSDOT	Washington State Department of Transportation
WSF	Washington State Ferries
WSTC	Washington State Transportation Commission
ZEV	zero-emissions vehicle