FIRST DRAFT

WASHINGTON STATE 2021 ENERGY STRATEGY

November 2020

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Introduction

Washington's Clean Energy Promise and Challenge

As we work together to respond to and recover from 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 to reduce greenhouse gas emissions, the greater the threat posed by climate change to current and future generations, and the more costly it will be.

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 investments in technology, such as capital spending on low-carbon equipment and infrastructure. At the same time, there will be savings with less spending on fossil fuel. Implementing the strategy will result in job creation, economic development, environmental quality and health benefits, while requiring significant public and private commitment and investment.

> *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 has committed to do its part and has 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 it 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; 95% below 1990 levels with net zero emissions by 2050.[1]

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 that will spur the innovation and investment required to put it 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, frontline, 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" (DDP) analysis searches for the lowest cost path to reduce emissions based on what we know today about 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.

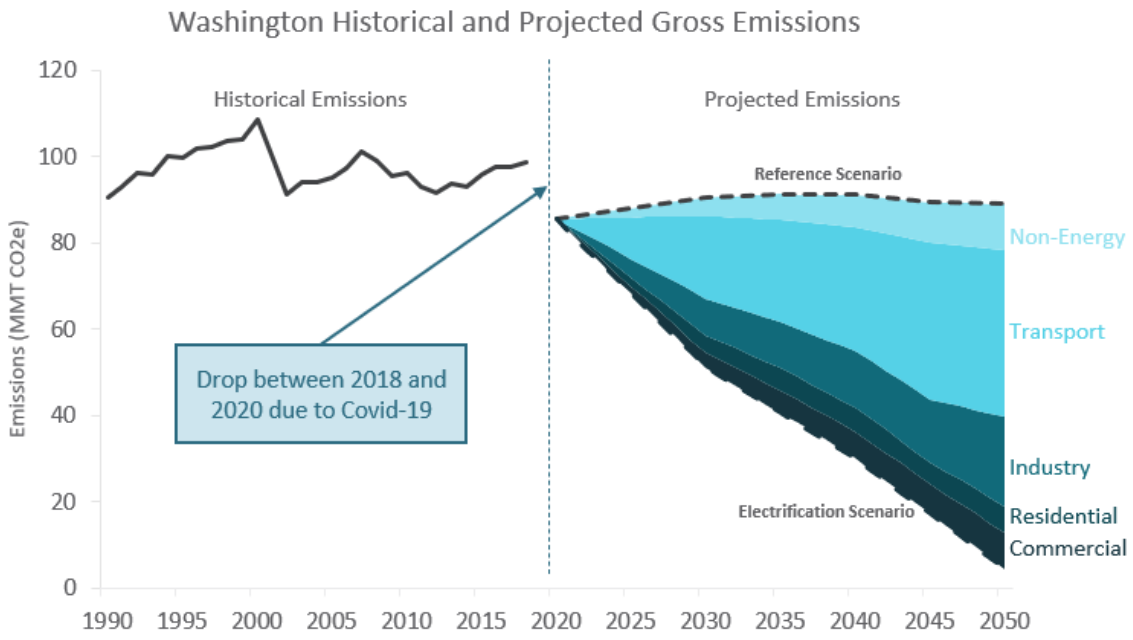
- **Transportation**, at 45% of the state's 2018 emissions, must embrace a multi-pronged strategy of electrifying as many passenger, truck, and freight vehicles as possible; investing immediately in the infrastructure required to support massive vehicle electrification; developing incentives and land 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.

[1] Chapter 43.21F.090 RCW.

- **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 reduce emissions where possible; develop clean fuels and carbon capture; work with energy intensive trade exposed 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 emissions from 1990 to 2018 and projected gross emissions from 2020 to 2050 by source.

Figure 1. Historical and Projected Gross Emissions in Washington State



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

The DDP 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, a key cross-sector finding here is that clean fuels, such as renewable hydrogen and clean synthetic or biogenic fuels, will be a 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 respond to high penetration, intermittent renewable power generation. These fuels will replace fossil fuels in uses that cannot be quickly or completely converted to direct use of electricity.

Key Crosscutting Recommendations

The 2021 State Energy Strategy is organized by broad sectors of the state's economy, where similar technological and policy issues are present. The strategy includes dozens of individual recommendations for action by policy makers, government agencies, utilities, private businesses and individual households.

At a high level, the key and cross-cutting recommendations are:

- **Communities.** Climate change will inflict its greatest harm on frontline 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 the money needed for communities to invest in clean energy transformation.
    - Support workers to acquire the skills for clean energy jobs and enact 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 apartments, 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 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 policy 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 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.

Developing the 2021 State Energy Strategy

The Department of Commerce developed the 2021 State Energy Strategy collaboratively with stakeholders and members of the public. The Legislature established an advisory committee to develop the strategy.[2] The 27-member committee was made up of legislators, government officials, and representatives of civic organizations, energy and utility businesses, as well as public interest advocates. The committee met 10 times between January and December 2020, weighing in on emerging analysis, findings and potential policies.

The development of the strategy used both quantitative and qualitative analysis and included a sector-specific technical advisory process to evaluate and identify policies and actions. As a result of supplemental funds made available by the Legislature, Commerce engaged a team of local and national experts to perform the following tasks:

- **Meta-Analysis**: Review relevant, existing studies, policies and law to provide grounding and context for the rest of the work.
- **Decarbonization Modeling**: Run six scenarios to uncover potential pathways to achieving our climate goals. This modeling was directional but not determinative.
- **Technical Advisory Process**: Perform a deep dive into four energy sectors (transportation, buildings, industry and electricity) to identify key issues and narrow the suite of policies to consider. This process involved interviews with scores of experts, including advisory committee members, to learn about practices that have worked, have not worked, or should be considered. It also included broad scale review of relevant regional, national and international literature.
- **Economic Modeling**: Conduct analysis to fill in gaps in our understanding of the economy-wide impact of the various decarbonization policies and actions being considered. Specifically provide results describing the implications on jobs, economic competitiveness and public health.

The public 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 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 strategies. 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

[2] Chapter 43.21F.090 RCW

their communities. 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.

In addition, steps must be taken to coordinate and collaborate among policymakers 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 that emphasizes the contributions and technical support of the many players involved.

A. Build an Equitable and Inclusive Clean Economy

Washington's executive and legislative branches recognize the value and importance of including equity principles in the crafting and implementation of the state's laws and policy. This practice extends to the energy sector and is specifically recognized in the two statutes that provide the foundation for the 2021 State Energy Strategy.

The law adopting greenhouse gas emissions limits:

> *(1) Global climate change represents an existential threat to the livelihoods, health and well-being of all Washingtonians. Our state is experiencing a climate emergency in the form of devastating wildfires, drought, lack of snowpack and increases in ocean acidification caused in part by climate change.*
> *(2) These threats are not distributed evenly across the state. In particular, rural communities with natural resource-based economies, tribes and communities of lower and moderate incomes will be disproportionately exposed to health and economic impacts driven by climate change.*
> *(3) The longer we delay in taking definitive action to reduce greenhouse gas emissions, the greater the threat posed by climate change to current and future generations, and the more costly it will be to protect and maintain our communities against the impacts of climate change. Unchecked, climate change will bring ever more drastic decline to the health and prosperity of future generations, particularly for the most vulnerable communities.*[3]

And, the Clean Energy Transformation Act:

> *The legislature recognizes and finds that the public interest includes, but is not limited to: The equitable distribution of energy benefits and reduction of burdens to vulnerable populations and highly impacted communities; long-term and short-term public health, economic and environmental benefits and the reduction of costs and risks; and energy security and resiliency. It is the intent of the legislature that in achieving this policy for Washington, there should not be an increase in environmental health impacts to highly impacted communities.*[4]

Similarly, the legislative direction for the development of the 2021 State Energy Strategy requires the Department of Commerce to ensure "that the state's energy system meets the health, welfare, and economic needs of its citizens with particular emphasis on meeting the needs of low-income and vulnerable populations."[5]

The 2021 Washington State Energy Strategy identifies the policies and actions required 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. At the same time, decarbonization presents many opportunities for addressing inequities among the residents and communities in our state including:

[3] Chapter 70A.45.020 RCW
[4] Chapter 19.405.010(6) RCW
[5] Chapter 43.21F.088 RCW

- Enhancing resilience in rural Washington; improving the quality of life for people of color and low-income communities and ensuring frontline 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 improved 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 and/or those living in our most remote communities.

Implementing Washington's energy strategy will deliver long-term benefits, including job and economic growth, financial savings, improved air quality and enhanced resilience. Realizing these long-term benefits will require upfront investments and major shifts. Experience tells us, and the data confirm, that without intentional action, the costs and benefits of the energy transition will not be shared equally. Social, racial, geographic and economic disparities would instead determine which individuals and communities benefit the most, and which would be hit hardest. It is this cycle that equity-oriented policy seeks to disrupt, to ensure that clean energy goals to support a just and sustainable future for all.

Opportunities for community empowerment, local energy independence and capacity and wealth building are central to a plan that will achieve energy equity. The issues must be understood through a community-centered participatory process designed to result in equitable policies.

The 2021 State Energy Strategy was developed with stakeholder and public engagement and input. Most notably, the process was informed by consultation with many technical experts and the robust involvement of a 27-person Advisory Committee including, among others, members recommended by labor unions, tribal governments and civic and environmental organizations.

Yet, the outcome is a product characterized by a compressed time frame and – due to the onset of a global pandemic during the strategy development – limited in-person, on-the-ground public and community engagement. Moving forward, Washington's communities and families throughout the state must have the opportunity to inform the implementation of the strategy.

Additional technical, financial and human resources must be made available for community participation in the clean energy transition. This includes planning, evaluating and implementing energy and resilience projects that meet the needs of the state's diverse communities. At the same time, policymakers must identify and amend laws and rules, remove barriers and change systems that prevent equitable and just participation in policy choices and in determining the costs and benefits of implementing those policies.

The lived experiences of communities and the individual voices and organizations that advocate on their behalf must be valued and relied on. Washington has successful examples of energy equity efforts led and informed by community organizations or community members. These efforts can serve as models and inform the implementation of the energy strategy and future choices. Examples include: Puget

Sound Sage's climate equity community-based participatory research,[6] the Washington Tracking Network's environmental justice mapping project,[7] and King County's Climate Equity Community Task Force to inform and support the 2020 Climate Action Plan.[8]

There also must be ongoing 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 to, 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 things, implementation of the strategy must support self-determination and strengthen tribal sovereignty. Planning efforts conducted by tribes can help inform the actions of other governments. Examples include the Spokane Tribe's climate action plan,[9] the Makah Tribe's renewable energy plan[10] and climate resilience plan[11] and the Quinault Indian Nation's climate resilience plan.[12]

Finally, the COVID-19 epidemic has been a focusing event for equity and access in Washington and across our nation. The impacts of COVID-19 have been disproportionate for certain segments of our population and parts of our urban and rural geography.[13] The pandemic has exposed inequities that have long existed due to historical underinvestment and systematic racism. These realities are not circumstantial. They reflect a status quo that keeps more affluent and white communities comfortable and prosperous at the expense of low-income and communities of color. To address the climate crisis, we must confront the role of systemic racism and oppression in perpetuating climate injustice.

1. Principles for Equitable Policies for Economic Recovery

In the near term, and at a minimum, to support an economic recovery that ensures equity, the following principles guided the choice of policies and actions to include in the state energy strategy. These principles must also be incorporated into the implementation of the strategy moving forward.

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[6] "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.

[7] Esther Min et al., "The Washington State Environmental Health Disparities Map: Development of a Community-Responsive Cumulative Impacts Assessment Tool," *International Journal of Environmental Research and Public Health* 16, no. 22 (November 13, 2019): 4470, https://doi.org/10.3390/ijerph16224470.

[8] Matt Kuharic, Jamie Stroble, and Lara Whitley Binder, "King County 2020 Strategy Climate Plan" (King County, 2020).

[9] "Sustainable Community Master Plan" (Spokane Tribe of Indians, 2013), https://spokanetribe.com/wp-content/uploads/2020/03/FINAL_2015_SCMP.pdf.

[10] 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.

[11] "Makah Tribe – 2017 Project," November 2, 2020, https://www.energy.gov/indianenergy/makah-tribe-2017-project.

[12] "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.

[13] "Washington State COVID-19 Dashboards," Washington State Coronavirus Response, November 2, 2020, https://coronavirus.wa.gov/washington-state-covid-19-dashboards.

1.1. Recognize and clearly state the impacts of the pandemic on Washington

Across Washington, the pandemic has torn the fabric of our communities and families. This includes impacts to income, healthcare, housing, education and food access. Highly impacted communities and vulnerable populations are suffering disproportionally, are provided little protection and are limited in advocacy. These impacts must be clearly acknowledged when designing and implementing policy.

Three Dimensions of Equity

To realize this vision the state must change course because the status quo will continue to perpetuate past inequities. Thus, transformational change is necessary. In setting off down the path of deep decarbonization, there are three dimensions of equity for the state to consider:

Structural Equity

A commitment and action to correct past harms and prevent future negative consequences by institutionalizing accountability and decision-making structures that aim to sustain positive outcomes.[1] To address structural equity, the state should:

- **Align** the state's transportation, energy, economic, and industry goals with climate and equity priorities and with an explicit understanding that failing to do so will continue to disproportionately hurt, and not benefit, people of color and indigenous people.
- **Assess** and analyze the distributional impacts of policy and investment alternatives along racial, economic, and geographic lines.

Procedural Equity

Ensuring that processes are fair and inclusive in developing and implementing any program or policy. To address procedural equity, the state should:

- **Engage** frontline workers and communities—those that will be most directly and acutely impacted by policy decisions—sharing real decision-making power to craft the solutions.
- **Track** outcomes on an ongoing basis to ensure transparency and accountability.

Distributional Equity

Ensuring that resources or benefits and burdens of a policy or program are distributed fairly, prioritizing those with highest need first. To address distributional equity, the State should:

- **Design and implement** policies to prioritize those with highest needs first when it comes to the burdens and benefits of the energy transition, accounting not only for present and future impacts but also past environmental burdens and social and economic disparities.

1.2. Focus on the most vulnerable

Policies must prioritize the systems that ignore or exclude Washington's most vulnerable residents, including undocumented immigrants, Tribal members, communities of color and uninsured individuals and families.

1.3. Maximize participation and co-creation

Determine who needs to be at the table before the work starts. Center community experiences and self-determination by letting everyone participate as an equal partner. Above all, be transparent.

1.4. Policy, programming and benefits must have an equity lens

Ensure that benefits are meaningful and enduring. Seek out opportunities to help communities build wealth and pursue autonomy. Provide resources for capacity building and technical assistance.

1.5. Solutions are intersectional and strategic

Support minority-owned businesses, with an emphasis on small businesses. Support communities disproportionately impacted by climate change, pollution, economic injustice and other oppressive forces. Invest in housing, transportation infrastructure and economic and workforce development.

1.6. Focus on true, tried and known policies

Given limited budgets and the urgency of need, focus on policies and programs that have successfully attained equitable distribution of benefits and reduction of burden. Look to successful community efforts for models to scale up.

1.7. Advance the fight against climate change

Programs and investments must result in reductions in greenhouse gas emissions. Recipients must commit to reducing their climate impacts. New revenue schemes cannot result in increased pollution. Invest in just transitions for workers of climate change-impacting industries.

2. Strategies for Equity in the State Energy Strategy

Implementing the state energy strategy can build on the robust, ongoing statewide efforts to address inequities across Washington. Those efforts include the plans and strategies coming out of Gov. Inslee's Poverty Reduction Workgroup,[14] the Environmental Justice Task Force's strategies[15] for incorporating environmental justice principles into state actions, the New Approaches Pilot[16] testing ways to engage communities, as well as implementation of the equity provisions in CETA discussed above.[17]

Procedural equity must be incorporated in the design and implementation of policies and actions identified in the strategy. Community voices must be centered by engaging frontline communities and organizations in the implementation of this strategy. In addition to this procedural equity, this strategy presents five interconnected, iterative policy design recommendations:

1) **Ensure equitable access to economic benefits and opportunity by empowering communities.** This work can be supported through 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.

[14] "Dismantle Poverty in Washington," November 2, 2020, https://dismantlepovertyinwa.com/.
[15] "Environmental Justice Task Force Information," Governor's Interagency Council on Health Disparities, November 2, 2020, https://healthequity.wa.gov/TheCouncilsWork/EnvironmentalJusticeTaskForceInformation.
[16] "New Approaches: Testing a New Community Engagement Model," Washington State Department of Commerce, n.d., https://www.commerce.wa.gov/serving-communities/newapproaches/.
[17] Chapter 19.405.010(6) RCW.

3) **Center program design on reduction of energy cost burdens.** Reduce home energy and transportation costs for those spending too high a proportion of their income on them 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.[18]
5) **Increase resilience and energy sovereignty for Tribes and 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.[19]
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.

[18] "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.
[19] "Resilient Washington Subcabinet Report" (Washington Military Department's Emergency Management Division, 2017), https://mil.wa.gov/asset/5ba420648fb16.

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

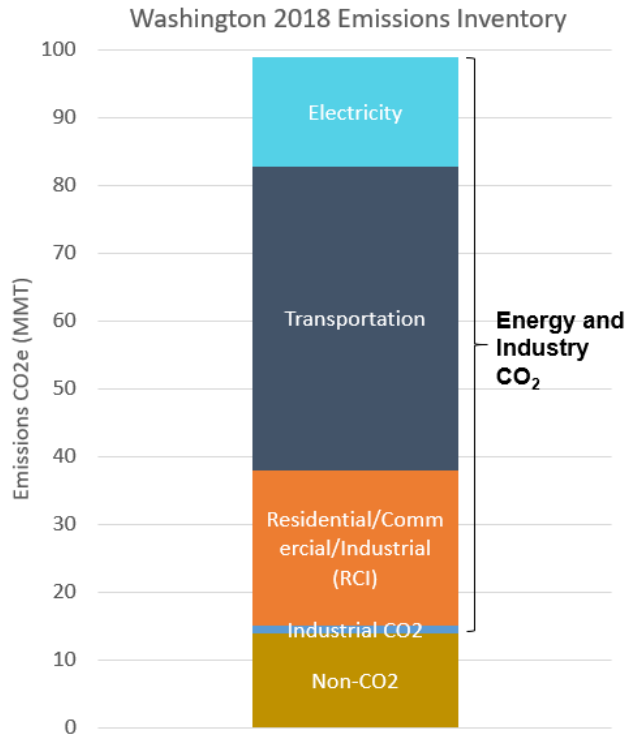
1. Washington State Emissions

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[20] but consume more fuel for freight, air, and ship travel.

The reason transportation is dominant in Washington's greenhouse gas emissions profile is due to the 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 2.)

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.

Figure 2. Washington State 2018 Emissions Inventory by Sector



Source: Washington State Department of Ecology Greenhouse Gas Inventory

[20] "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/.

1.1. Pathway to Zero Net Emissions in 2050

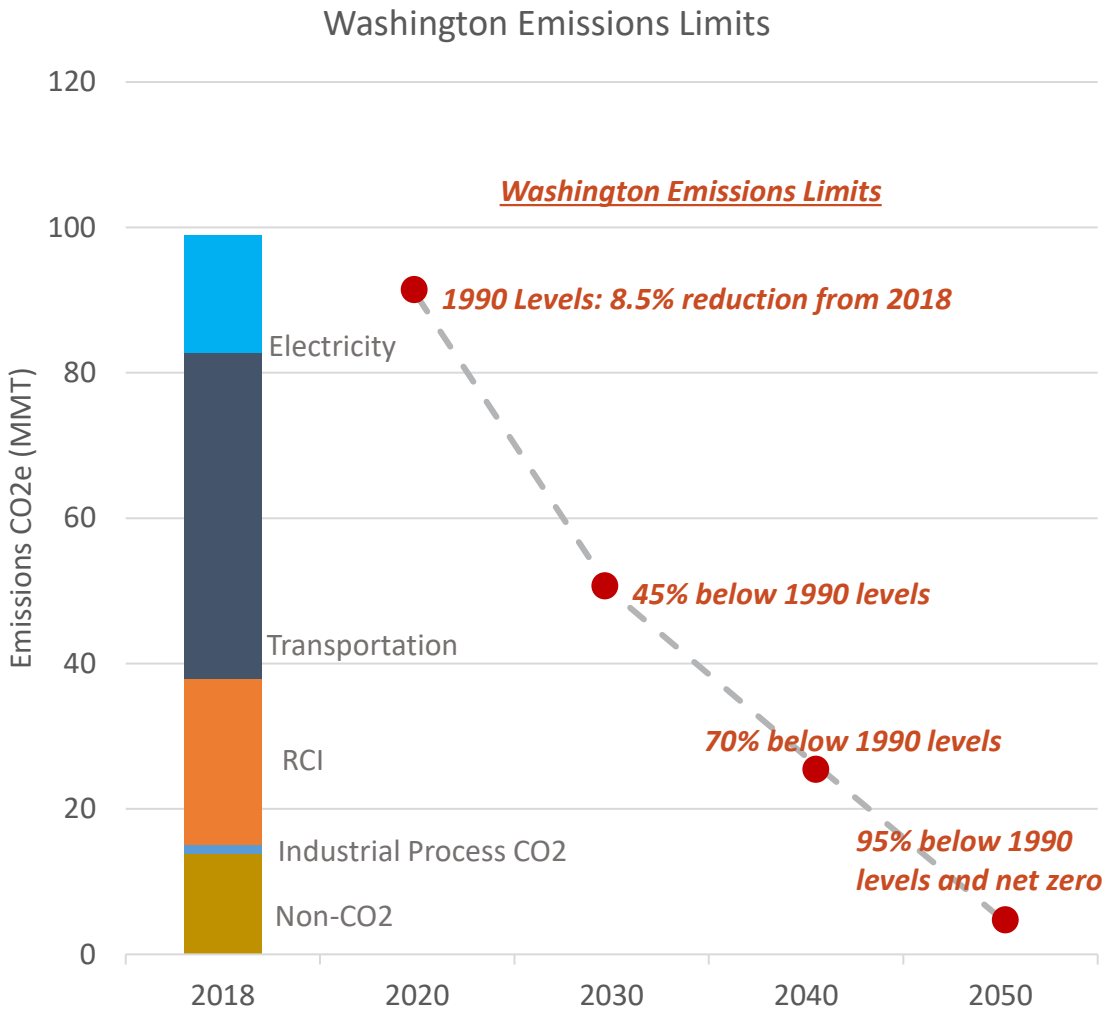
The objectives of the 2021 State Energy Strategy are directly linked to the revised greenhouse gas emissions reductions limits established by the Legislature in 2020. Updating limits set in 2008, the Legislature established ambitious economy-wide goals: a 95% reduction below 1990 levels by 2050, with interim economy-wide emissions limits of 45% below 1990 levels by 2030 and 70% below 1990 levels by 2040. In addition, the state has 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[21] 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.

For the purpose of modelling for this strategy, we assume that all of the greenhouse gas emissions in 2050 will be in the non-CO_2 category and that these residual emissions 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 3 shows the trajectory of limits to be achieved by 2050 based on Washington State's 2018 greenhouse gas emissions.

[21] Chapter 70A.45.020 RCW

Figure 3. 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[22]

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. It 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.

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

[22] Chapter 70A.45.020 RCW.

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 (DDP) 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.[23] The modeling 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 DDP modeling can be found in Appendix X. 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 1. 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 the state's emissions reductions limits.

[23] "Deep Decarbonization | Governor Jay Inslee," accessed November 2, 2020, https://www.governor.wa.gov/issues/issues/energy-environment/deep-decarbonization.

Table 1. Scenarios Analyzed, Reference Scenario and Five Decarbonization Scenarios

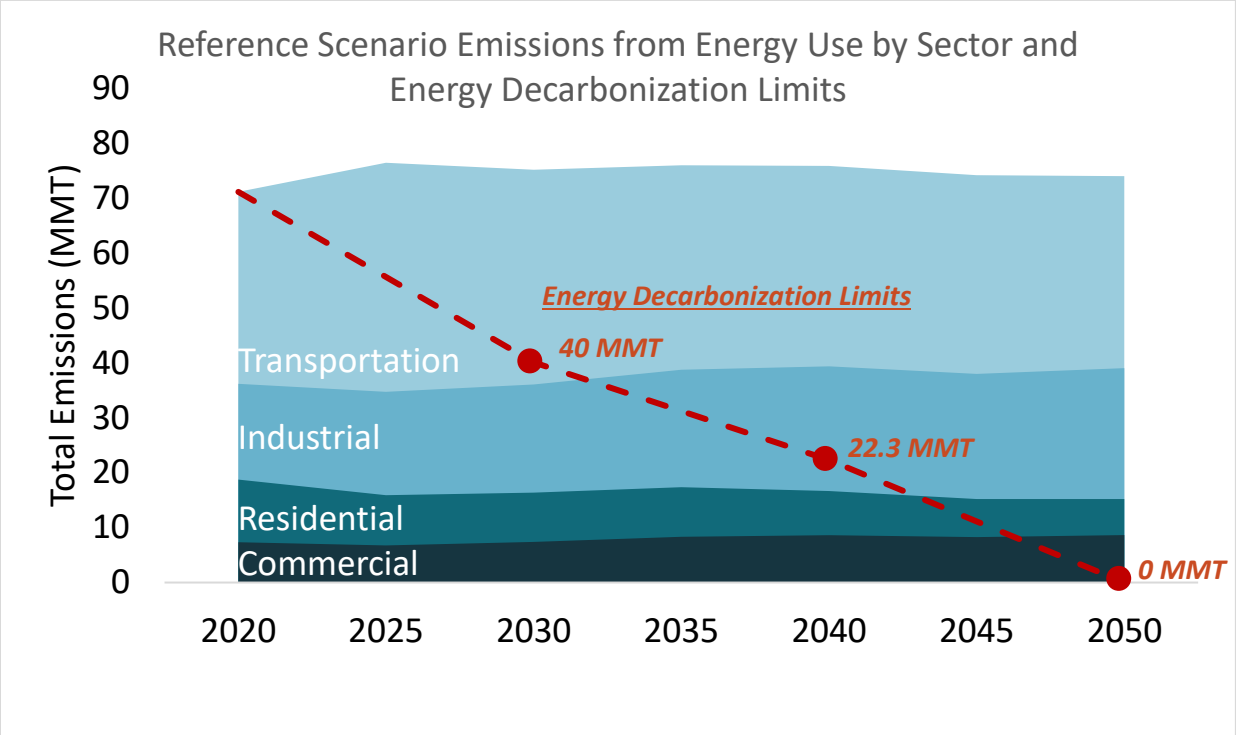
Scenario	Summary	Key Question	Policy Mandates
Reference	Business as usual	Assumes current policy is implemented and no emissions target	No constraints on emissions.
Electrification	Investigates a rapid shift to electrified end uses	What if energy systems achieved aggressive electrification and aggressive 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 alternative investments are needed when larger quantities of primary fuels remain in the economy?	
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. In this way policies and actions with more low-cost opportunities take greater and earlier action to decarbonize than those with fewer.

Projected Reference Scenario emissions from energy use and the energy emissions limits for the decarbonization scenarios are shown in Figure 4.

Figure 4. Washington State Trajectory to 2050, by energy consumption in each sector



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 outcome 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 achieving 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.

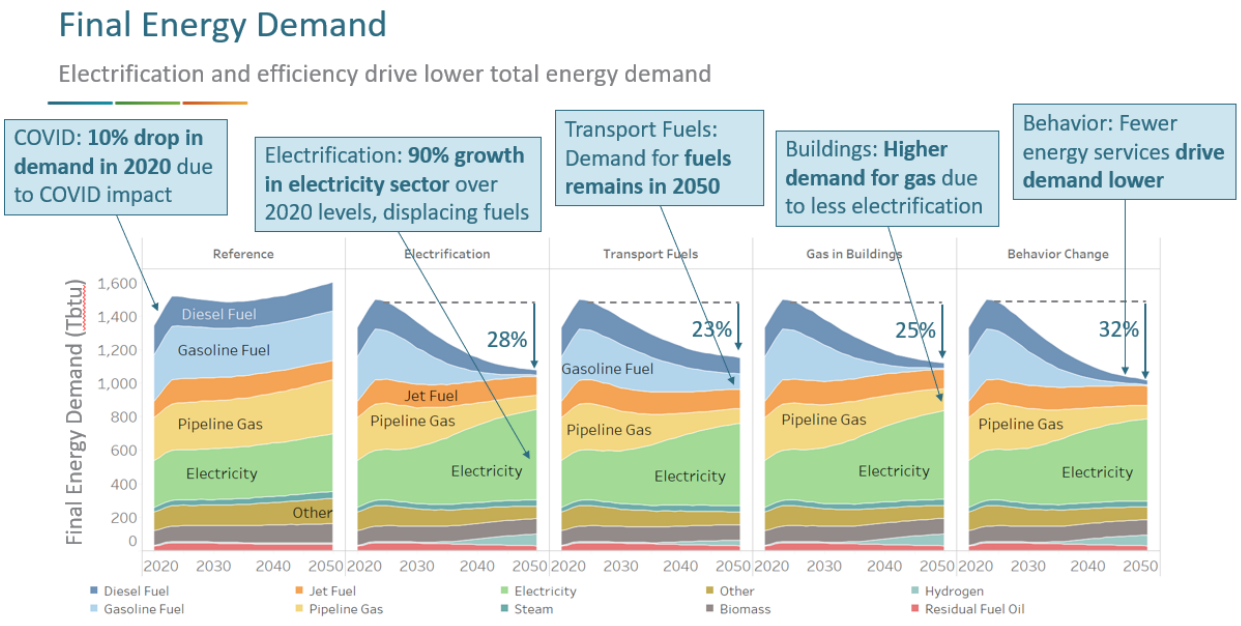
The Gas in Buildings Scenario models a future where demand for gas in the built environment, such as for heating and cooking, remains through 2050. Gas supplied through the pipeline can include a blend of different types of gas. This blend is referred to as "pipeline gas" in the remainder of the strategy. Pipeline gas can be partially or even fully decarbonized by replacing fossil gas with clean 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 technical report that accompanies the strategy.[24]

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 increases 6% over 2023, the year we assume the economy has recovered from the COVID-19 pandemic (see Figure 5). 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 5. 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

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

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.

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 with 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.[25]

The Behavior Change Scenario achieves the greatest drop in demand for energy (32%) with less use of, and therefore need for, energy in transport and buildings. This scenario illustrates the benefits available if policymakers act to encourage driving cars less and using less energy 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,

[25] Ibid, page 29

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. The limits on how fast equipment can be replaced with these more efficient options mean that reaching the target also requires 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 its significant hydro resource, however we assume there is no opportunity to expand hydroelectricity supply in the future.

Wind and solar resources provide the additional energy needed. In 2020, Washington is a net exporter of energy. As fossil generation retires and 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 X. 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. [26]

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 solar and offshore wind is 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. [27]

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

[26] Ibid, p. 37
[27] Ibid, p. 36

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.[28]

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.

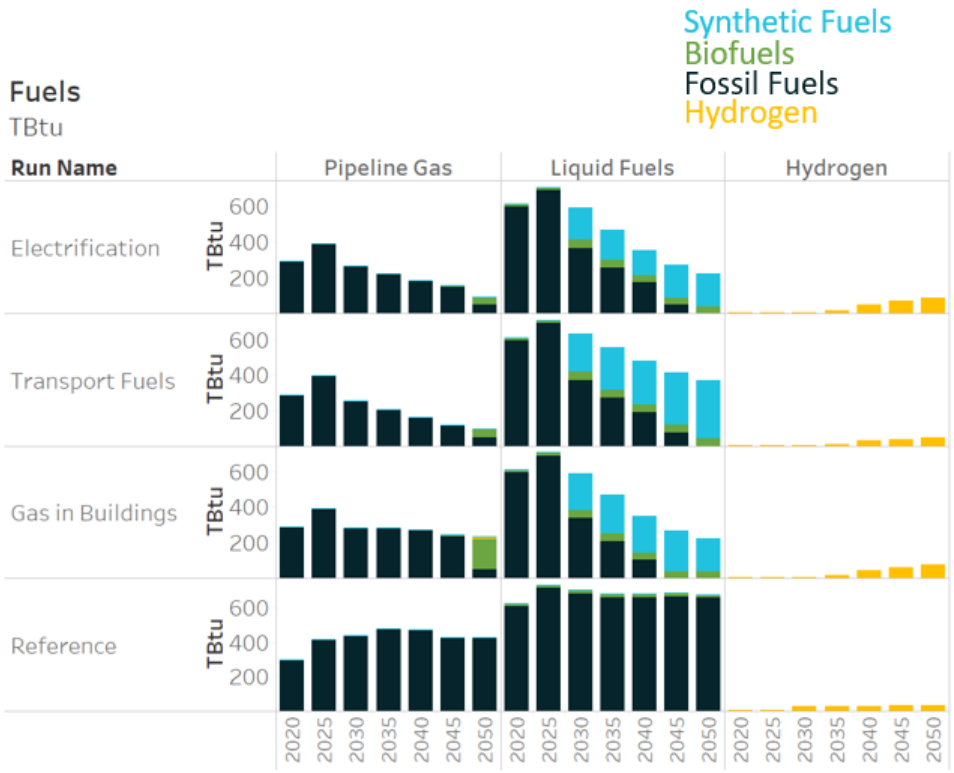
2.3.2. Decarbonizing Fuels to Meeting the Emissions Limits

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 limits on the rate at which both the transportation fleet can be converted to battery electric or hydrogen vehicles, and end uses in buildings can be electrified. The 2030 limit requires significant expansion of the clean fuels industry to reduce emissions from transportation. Figure 6 shows how fossil fuels are decarbonized in three of the decarbonization scenarios compared to the Reference Scenario.

Figure 6. Clean Fuels are Important to Reach Decarbonization Limits.

[28] Ibid, p. 40



Source: Washington State Energy Decarbonization Modeling 2020, Evolved Energy Research, page 34.

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.

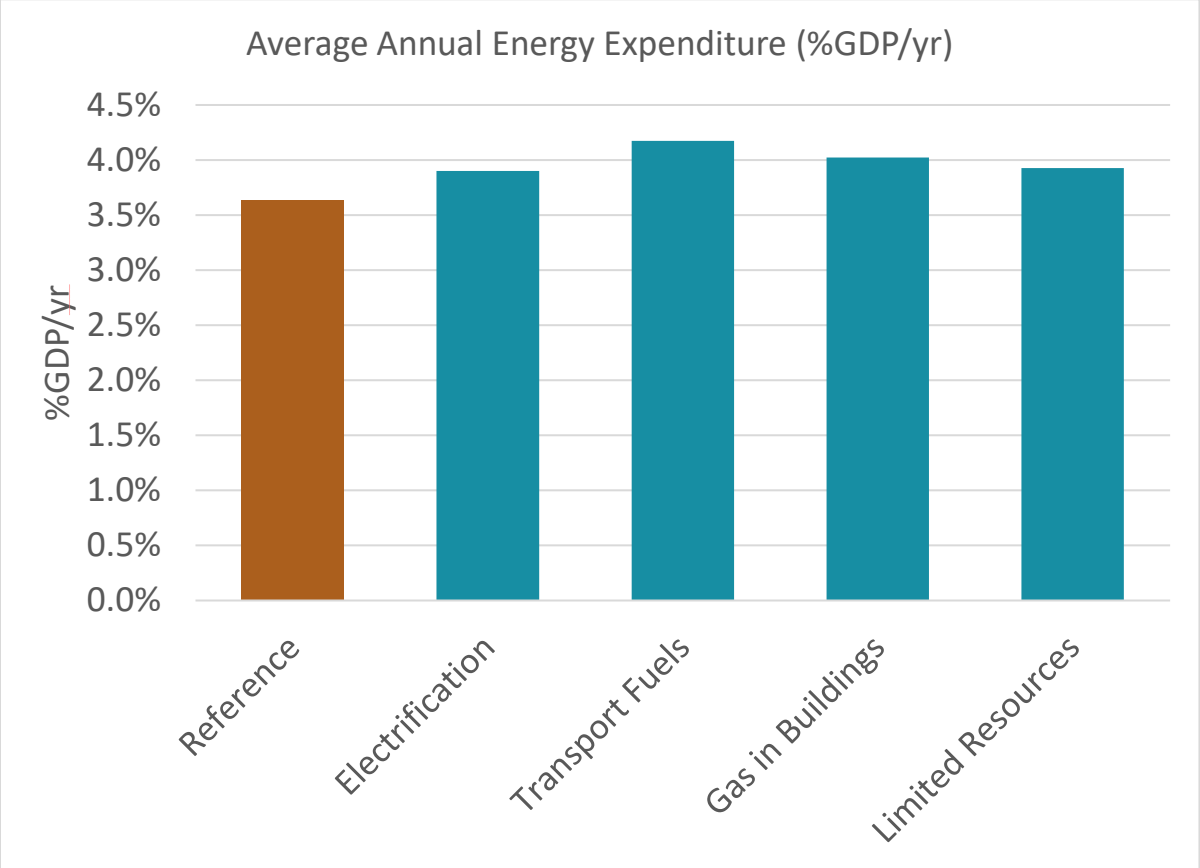
Annual energy spending[29] as a percentage of GDP averaged over the 30-year period from 2020 to 2050 is only slightly higher than the Reference Scenario for the decarbonization scenarios as Figure 7 shows. Rapid electrification and efficiency measures, transmission expansion, and access to out-of-state 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 based on forecasted prices.

[29] Annual energy spending is reported in this section as the levelized investment in infrastructure plus operating costs such as for fuels and O&M.

Figure 7. On Average, Spending for Decarbonization is Slightly Higher than the Reference Scenario



Source: Washington State Energy Decarbonization Modeling 2020, Evolved Energy Research, page 44.

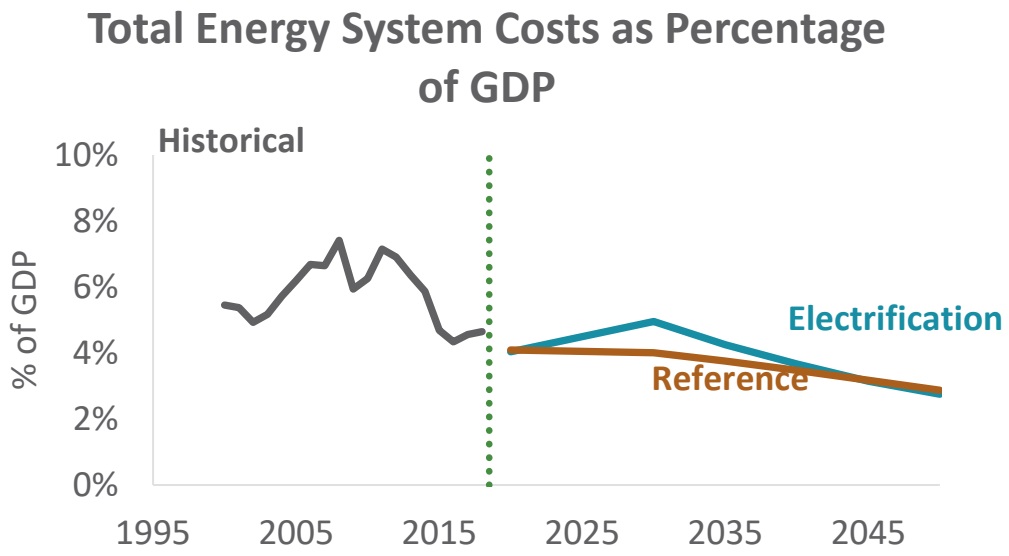
2.4.1. Decarbonization Spending across the Scenarios

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, as shown in Figure 8. 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.[30]

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 are caused by fuel price volatility and the 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.

[30] Ibid, p. 54

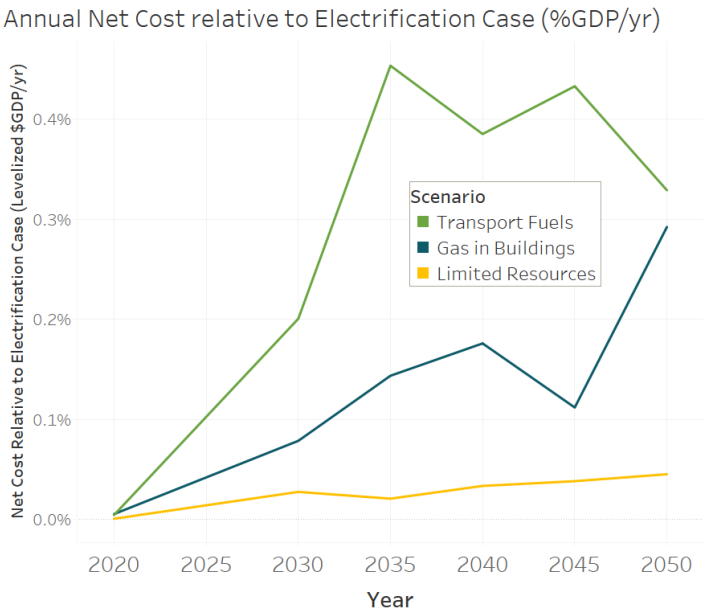
Figure 8. Total Levelized Energy System Cost as a Percentage of Washington GDP relative to Historical



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

Relative to the Electrification Scenario, spending in the other decarbonization scenarios is higher, as shown in Figure 9. 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.

Figure 9. Annual Net Cost of the Other Decarbonization Scenarios relative to the Electrification Scenario

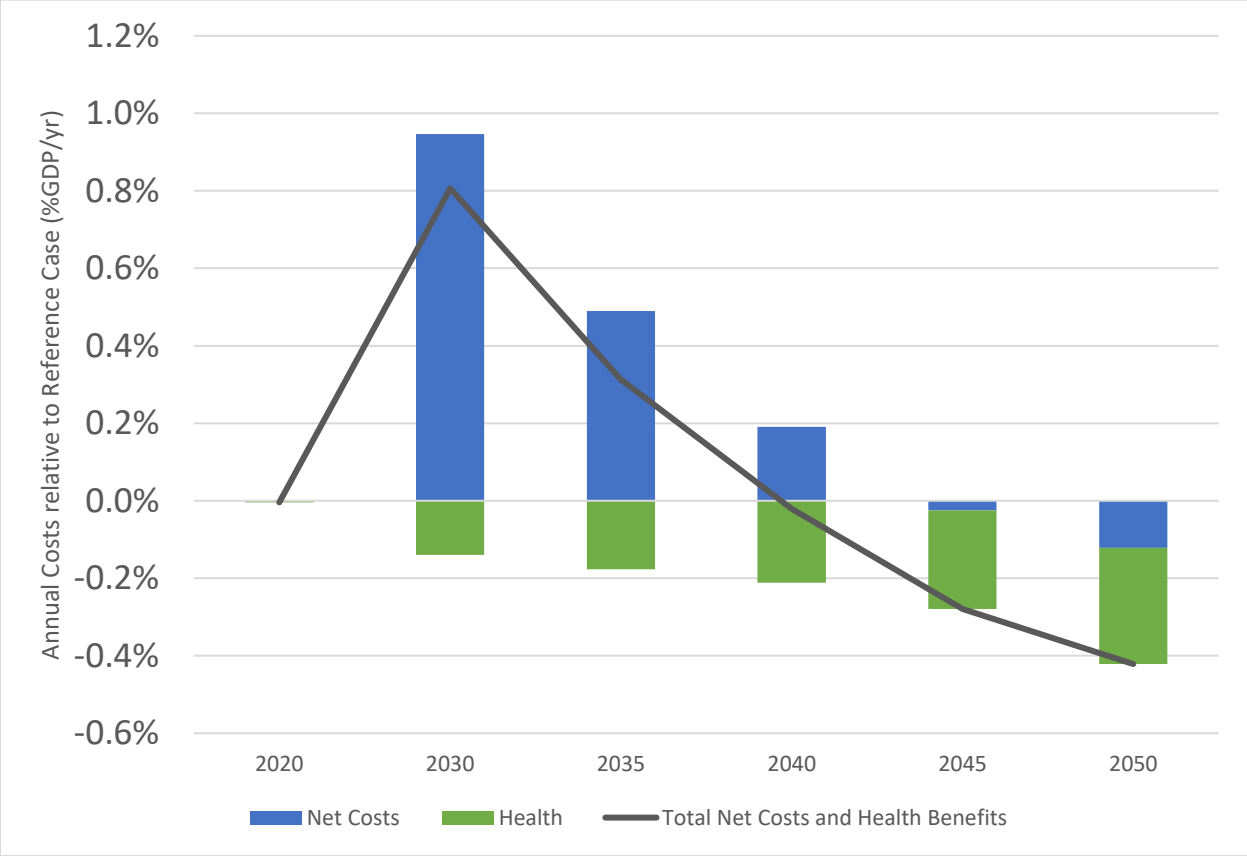


Source: Washington State Energy Decarbonization Modeling 2020, Evolved Energy Research, page 44.

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.[31]

When incorporating health benefits, such as fewer pollutants due to cleaner air, we see net benefits by 2040 as seen in Figure 10. However, this does not include climate benefits. **[Placeholder health benefits prior to economic modeling]**.

Figure 10. Incorporating Health Benefits [Placeholder health benefits prior to economic modeling]



Source: Washington State Energy Decarbonization Modeling 2020, Evolved Energy Research, page 50.

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. 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.

[31] Ibid, p. 57.

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, and in regional markets.

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.[32]

[32] Ibid, p. 30

- 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.[33]

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.
- With electrified technologies deployed for residential heating by 2050 in the Electrification Scenario, there is 56% drop in energy use in buildings, but only 16% of that drop takes place by 2030. When gas is retained in buildings, the drop in energy demand in buildings is 40% by 2050, and 11% lower by 2030.[34]

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, in the long-term 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.

[33] Ibid, p. 30
[34] Ibid, p. 31

- 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. Electrification and other efficiency measures in industry will also 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 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. Though 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 minimus 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, environmental protection.

C. Use Energy More Efficiently and Decarbonize Transportation Energy

Transportation is Washington State's number one source of greenhouse gas emissions and a major source of local air pollution that disproportionately impacts public health in communities living near roadways, port facilities, industrial activity and railways. These same communities are where many low-income, or Black, Indigenous, and People of Color (BIPOC) reside. These populations are particularly vulnerable to transportation pollution due to health and other environmental factors. Meeting the state's emission limits will require a transformational shift in how people move from place to place. It will also require implementing better and cleaner ways to import, export, and move goods around the state while maintaining Washington's economic competitiveness.

Reducing transportation emissions has the potential to lower costs, improve public health due to reduced co-pollutants, and improve quality of life in both urban and rural areas. Converting to electric vehicles (EVs)[35] and low-carbon fuels will be an essential part of this transition. But this conversion by itself will not address traffic congestion, reduce injuries and accidents, or eliminate local pollution.[36] Nor will such a switch address disparities in Washingtonians' access to affordable transportation options. To address these concerns, the State will need to improve the efficiency and equity of Washington's transportation system–reducing both the need for vehicles and the distances those vehicles travel.[37]

In short, the State's energy strategy must adopt a comprehensive approach to transportation that focuses first on *using energy more efficiently* and second on *decarbonizing the energy* that is used. The following recommendations are therefore organized into two main sub-strategies: (1) moving people and goods more efficiently and equitably (section 0); and (2) electrifying vehicles and switching to low-carbon fuels (section 0).

While Washington State has clear targets for reducing greenhouse gas emissions in the power sector with the Clean Energy Transformation Act (CETA), the same is not true for the transportation sector. A key first step for transportation sector strategies is to provide a roadmap–with clearly defined targets–for how the State will achieve an equitable transition to a zero-carbon transportation sector.

1. Moving People and Goods More Efficiently and Equitably

People and goods are 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.

[35] EVs refer to both battery electric vehicles (BEVs) and fuel-cell vehicles (FCVs).

[36] 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.

[37] The multi-university Transportation, Equity, Climate and Health (TRECH) initiative (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/.for example, evaluated five transportation policy scenarios with different investment allocations between vehicle electrification, zero and low-emission buses and trucks, public transit, and active transportation. They found that the scenario with the highest allocations of investments to public transit and active mobility led to the greatest health benefits measured in reduced mortality and reduced childhood asthma rates. In addition, the same scenario results in the greatest reduction (though not elimination) in air pollution exposure disparity by race/ethnicity, delivers more balanced benefits among rural and urban communities, and achieves the largest GHG emission reductions from on-road sources.

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

Strategies for improving efficiency and equity fall into two categories:

- **Improving the design and operation of Washington's transportation networks.** The State has considerable leverage over how Washington's transportation systems are developed, operated, and connected. A range of different measures can be deployed to improve transport system efficiency and reduce vehicle-miles traveled (VMT) – see Box 1. Although responsibilities for different modes and sectors are spread across multiple jurisdictions, the State can take important steps to improve coordination, set priorities, and enable local and regional actions (sections 0 - 0).
- **Improving vehicle fuel economies.** Here, the State 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 (see section 0).

Box 1. Strategies for improving the design and operation of Washington's transportation networks

Transportation system efficiency can be improved by reducing the number of vehicle-miles that have to be traveled 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*, e.g., public transit, which can move more passengers per vehicle, or rail and maritime freight transport, which can carry more goods. A range of strategies can be used to advance these objectives, sometimes both at the same time. Although many of these approaches are most relevant for reducing urban (or suburban) VMT, they are often applicable to rural travel as well and should be pursued as comprehensively as possible for both equity and efficiency reasons. Nearly all of these approaches require coordination across multiple jurisdictions in order to be effective.

Note that 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.[38] An important goal of State policy, therefore, should be to promote the combined application of complementary approaches in local and regional transportation planning, development, and operation.

Important general strategies include:

- Promoting more efficient land use and residential development co-located with employment opportunities and essential services. Land use policies can encourage compact growth and infill

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

development around transit corridors and active transport networks and allow for greater proximity and accessibility between places of work, services, shopping and other amenities.

- Increasing the attractiveness, availability, and affordability of public transit, including ride sharing, paratransit, and van pools. Expanding transit services and making them more attractive, affordable, and easier to use–especially in a post-pandemic world–will be essential for improving transportation efficiency and equity in Washington. Although most applicable in urban areas, rural transit services – including ride sharing and van pool options – are also important. Inter-urban mass transit, like high-speed rail, could reduce the need for high-emitting air travel.

- Providing complete, safe, and accessible walking and cycling networks, along with the community engagement to support their adoption. Although not everyone's travel needs can be met through "active transport" like walking and cycling, ensuring ample opportunity to use these modes–by providing complete networks that interconnect with transit and other mobility options–can significantly reduce the VMT of motorized vehicles. Use of active modes can be enhanced through promotion of e-bikes and other electricity-assisted "micromobility" options.

- Managing travel demand. Travel demand management (TDM) policies encompass a wide range of measures that collectively change travel behavior in order to increase transport system efficiency.[39] Appropriate TDM measures will vary by community, but can include vehicle usage charges (e.g., congestion pricing) that discourage use of single-occupancy vehicles, encourage more efficient travel (e.g., by optimizing freight delivery), and help shift travel to more efficient modes. TDM measures need to be carefully designed to ensure they are not regressive and instead promote equity.

- Enabling people to stay local. One risk with enhancing transportation (and other) amenities in a community is that it can drive up housing demand, as more people recognize the benefits of living there. When the cost of living rises, existing residents can be displaced, often to suburban communities where they have to commute long distances to work and access shopping and services. This kind of displacement can undermine the VMT benefits of any transportation amenities. Urban planning and transport policies must be designed and implemented in ways that minimize displacement and allow people to stay in their communities.

- Enhancing access to telework & other remote service options. Telecommunications and broadband services are not traditionally considered part of the "transportation" sector, but as the Covid-19 pandemic has unfortunately revealed, the use of these services can significantly reduce VMT. Ensuring that Washingtonians are able to telecommute and access certain services remotely (i.e., medical, banking, legal, government, or other services, where appropriate) should be part of a comprehensive strategy for making our transportation system more efficient.

- Improving freight logistics and intermodal connections. In many localities, there is substantial potential for improving "last mile" freight logistics, including the movement of goods from ports

[39] "TDM Encyclopedia," n.d., https://www.vtpi.org/tdm/tdm12.htm.

and rail depots to warehouses and distribution centers, as well as the delivery of goods to businesses and households. Appropriate interventions will depend on the locale but can include solutions such as dedicated freight lanes and optimizing the location of fueling and EV-charging infrastructure.

- Transporting more goods by rail or ship. Although the State of Washington does not have much power to influence long-haul freight mode choice and efficiency, it can still take steps to complement national or regional efforts through in-state land-use planning and infrastructure development, including the improvement of local connections that support the economics of rail and shipping transport, when doing so improves efficiency and environmental outcomes.

The following recommendations should be implemented as part of Washington's State Energy Strategy:

1.1. Set Clear and Ambitious Targets

While Washington State has clear, enforceable targets for reducing greenhouse gas emissions in the power sector via the Clean Energy Transformation Act (CETA), the same is not true for the transportation sector. To achieve the greenhouse gas limits, the state must establish targets and milestones that provide clear direction and authority to state agencies, regional and metropolitan planning organizations, and county and local governments about land-use planning and infrastructure investments required 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.

1.1.1. Update VMT reduction targets

In 2008, the state established long-term targets for reducing the VMT of light-duty vehicles statewide[40] . These targets call for an 18% reduction in VMT *per capita* by 2020, a 30% reduction by 2030, and a 50% reduction by 2050. However, these targets are pegged to a statewide baseline of 75 billion VMT per year, which is substantially higher than Washington's actual annual VMT since 2008. In 2019 – the highest year yet – statewide VMT was 62.5 billion.

Moreover, although Washington is nominally close to achieving the 2020 target, growth in the state's population has meant that VMT continues to grow in absolute terms, even as VMT per capita has declined. This has led to steadily increasing greenhouse gas emissions from the transportation sector.

Action: Adjust and update statewide VMT reduction targets to reflect existing VMT levels and the state's greenhouse gas limits. Key updates should include:

- Establishing a new baseline for VMT based on 2019 total VMT for the state (62.5 billion VMT).[41]
- Setting new targets for statewide VMT per capita for all on-road vehicles, including freight.

[40] Chapter 47.01.440 RCW.

[41] "Annual Mileage and Travel Information," accessed October 23, 2020, https://wsdot.wa.gov/mapsdata/travel/hpms/annualmileage.htm.

- Setting geography-specific targets consistent with the statewide VMT per capita targets for urban, suburban, small city, and rural areas.
- Setting accompanying targets for associated health and safety outcomes, including reduction in traffic fatalities and local air and water pollution.

1.1.2. Set discrete near- and long-term targets for transit and active transport infrastructure development, transit service expansion, and broadband access

Explicit targets are important for VMT reduction alignment with Washington's climate, health, equity, and economic goals. Realizing these targets requires specific measures for land-use planning, infrastructure investment, transit service, and broadband access.

The decentralized structure of Washington's transportation system makes the development and oversight of targets very challenging. 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."[42] 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. Furthermore, developing broadband infrastructure, which could avoid the need for travel by enabling telecommuting and remote service provision, is often disconnected from transportation planning.

The state already engages in planning exercises that consolidate information about what is needed at the local level to inform decisions about state-level policies and investments. WSDOT's Active Transportation Plan,[43] 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.

Action: To help ensure that VMT targets are met, the state must set discrete numerical targets for transit and active transport infrastructure development, transit service expansion, broadband access, and other related goals (e.g., high-speed rail development). Such targets could help inform more coordinated transportation planning efforts (see subsection 0) and provide important context for state policy decisions and investments related to local transportation needs. Specific metrics should be determined in consultation with local and regional jurisdictions, with input from frontline communities, and in alignment with VMT reduction targets for different geographies.

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

One challenge for achieving statewide VMT reductions is that the transportation system is not centrally managed. Furthermore, 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. Pronounced planning and reporting gaps exist for pedestrian and bicycle infrastructure.

[42] 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.
[43] Washington State Department of Transportation, "WSDOT Active Transportation Plan 2019," October 23, 2020, https://wsdot.wa.gov/travel/commute-choices/bike/plan.

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. It is important to note that 73% of Washington's VMT are in urban areas.[44]

1.2.1. Establish criteria for state transportation funding linked to system efficiency and equity

To achieve statewide greenhouse gas limits, the state will need to set clear priorities for local jurisdictions to follow. One way they can do this is for the Legislature to adopt evaluation metrics for funding proposals based upon key policy goals (including VMT reduction and other targets discussed in subsection 0). Efficiency-related metrics could include, for example:

- VMT reductions
- Greenhouse gas reductions
- Accessibility improvement
- Mobility improvement
- Alignment with land-use and transit-oriented development plans

Increased development around transit areas, however, can drive up land values and decrease the availability of affordable housing options. Higher income households choosing to live near transit have been shown to use public transit less, and drive more, than the people they displace.[45] Thus, without anti-displacement measures, the VMT reduction and emissions benefits will decrease. Equity-related metrics could include:

- Accessibility improvements for under-resourced communities (including criteria that reflect the travel patterns and needs of BIPOC communities, rural areas, people with low-incomes, and people with disabilities)
- Incorporation of anti-displacement measures (e.g., zoning for mixed-use development, requirements for affordable housing, protections for existing tenancies, development amenities reflecting local community priorities)
- Health and safety outcomes, including expected reductions in local pollution and traffic injuries or fatalities

Action: When informing and implementing funding allocations enacted by the Legislature, the state Department of Transportation (WSDOT), in collaboration with other agencies, should adopt and apply metrics for state transportation funding linked to key efficiency and equity outcomes. Metrics should be developed and prioritized through collaboration with multiple stakeholders, including local governments, planning authorities, tribal nations, port districts, transit authorities, chambers of commerce, and frontline and underrepresented community groups.

[44] US Department of Energy, "Fact #902: December 7, 2015 Rural versus Urban Vehicle Miles of Travel by State," accessed October 23, 2020, https://www.energy.gov/eere/vehicles/fact-902-december-7-2015-rural-versus-urban-vehicle-miles-travel-state.

[45] John Hersey, Michael A Spotts, and Melinda Pollack, "Promoting Opportunity through Equitable Transit-Oriented Development (ETOD): Making the Case" (Enterprise, 2015), https://atltransformationalliance.org/wp-content/uploads/Promoting-Opportunity-through-ETOD.pdf.

1.2.2. Remove barriers to state-led transit-oriented development projects

Transit-oriented development (TOD) encourages the co-location of transit services with affordable and market rate housing, commercial development, and institutional facilities. TOD can improve mobility and reduce VMT.

Through a pilot project at the Kingsgate Park and Ride in Kirkland, Washington, WSDOT identified multiple barriers to advancing TOD in Washington State.[46] In particular, the state constitution and numerous statutes limit innovative uses of WSDOT properties and facilities, narrowly prioritizing uses that support the highway system. Additionally, state laws requiring WSDOT to receive fair market value compensation for its property make it challenging to develop affordable housing as part of a TOD project. Affordable housing is a key part of TOD and can increase the ridership of nearby transit service.

Other agencies face similar barriers. Barriers to developing TOD should be removed to support holistic, multimodal transportation solutions such as transit-oriented development that can both improve mobility and reduce VMT.

Actions: The State and other jurisdictions should take steps to incentivize and remove barriers that restrict the adoption of transit-oriented development.

1.2.3. Require cross-jurisdictional coordination and local community engagement as a condition for state funding of VMT-reduction projects

Effective inter-jurisdictional coordination is essential for the success of TOD and other VMT-reducing measures, including the development of transit systems, walking and cycling infrastructure, and intermodal connections. Too often, these projects are undertaken with insufficient coordination, leading to gaps between transit networks, active transport infrastructure, and "last mile" mobility services. 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 its efforts by adopting funding criteria for transit and alternative mobility projects. In addition, while building out transit and active transport infrastructure is an important goal, ensuring uptake of these options requires active local engagement to ensure they meet community needs.

Action: The state should require 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. Criteria for funding should address:

- Coordination processes among relevant jurisdictions, both local and regional
- Engagement with local economic development organizations, local and regional chambers of commerce, and local community representatives
- Steps to ensure active collaboration between local communities and engineers, planners, and other involved parties, including measures to solicit input from historically underrepresented community members (e.g., outreach and information in multiple languages)

[46] Washington State Department of Transportation, "Kingsgate Park and Ride: Transit Oriented Development Pilot," 2020, https://wsdot.wa.gov/sites/default/files/2020/01/30/Kingsgate-Transit-Oriented-Development-Report.pdf.

To support effective community engagement, state funding should make funding available to support participation in equity advisory groups involved in transportation planning and implementation.

1.2.4. Provide a clearinghouse for model code related to corridor planning, "smart growth" zoning and land use policies, transit-oriented development, and related infrastructure development

Housing developments that are located near services, amenities, and transportation can result in a 20 - 40% reduction in vehicle miles travelled, resulting in a corresponding decline in greenhouse gas emissions and congestion.[47] 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 VMTs 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.[48]

Smaller communities, in particular, may lack resources needed to engage in 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.

Sound Transit, for example, is developing a model rule for corridor planning that will help to align local efforts with regional objectives.[49] The Puget Sound Regional Council has developed similar model codes and policies. Materials could also include elements related to implementation and administrative procedures. For example, a standard checklist for lane-widening proposals could facilitate evaluation of alternatives and ensure consistency and coordination with other transportation system elements.

Action: The state should establish 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 when developing or updating local comprehensive plans and development codes. 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.

1.2.5. Invest in livable communities with accessible essential services and affordable housing

Investment in and preservation of low-income housing, community-serving businesses, and cultural centers near transit ensures core riders continue to have access to transit and creates more opportunities for those with the fewest choices to live near high-capacity transit.

Actions: Encourage land uses that co-locate different destination types near transit (e.g., childcare, grocery stores, schools, employment), centering equitable development outcomes. Create a land bank

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[47] "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.

[48] 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.

[49] "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

that focuses on the conversion of vacant, abandoned, and tax-delinquent properties into productive uses such as affordable housing, urban gardens, local businesses, and parks. Example: Genesee County Land Bank in Michigan.[50]

1.2.6. Provide standard education and outreach materials, along with technical advisory services, to complement local planning efforts

One frequent barrier to local planning and zoning efforts is the need to educate community members and decision-makers about how planning processes work and the relative benefits of density, TOD, the accommodation of active transport options, and various types of TDM measures. For community members, the challenge is often to understand the benefits of alternative roadway designs and other system improvements.

For local elected officials and decision makers, knowledge gaps may include how and where to obtain additional funding support for "smart growth" projects and policies. The state could help to address these barriers through the development of educational outreach materials, along with the provision of technical advisory services, to help guide communities through local planning processes.

Actions: The state should develop and make available educational outreach materials – for example, building off resources already provided for growth management[51] – explaining zoning and land-use planning processes and the benefits of transit- and active transport-oriented development options. In conjunction, the state should provide technical advisory services through dedicated staff or a funding pool for qualified consultants to assist local jurisdictions with education and outreach, securing necessary funds, and local adaptation of model codes and rules (subsection 0). Advisory services could include review of local transportation master plans, in line with reviews performed by the state's Metropolitan Planning Organizations (MPOs) and Regional Transportation Planning Organizations (RTPOs), to ensure consistency with statewide VMT reduction targets.

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 may also require a reprioritization of funding to align investments with VMT reduction and equity targets (subsection 0) and to support the coordination needed for building efficient, interconnected transportation networks (subsection 0).

1.3.1. Diversify and stabilize transportation funding

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] Existing funding is less than half of what is needed for maintenance, preservation, and capital upgrades, leading to deferred maintenance, higher lifecycle costs, and a patchwork of system improvements.[53]

Closing this funding gap should be a key priority for meeting the greenhouse gas limits in the transportation sector. Current transportation funding derives from unreliable revenue sources (primarily gasoline taxes and vehicle fees) that fluctuate significantly according to macroeconomic conditions. The

[50] "Genesee County Land Bank," accessed October 23, 2020, http://www.thelandbank.org.
[51] "New Approaches: Testing a New Community Engagement Model."
[52] BERK Consulting, "Statewide Transportation Needs Assessment: July 2020 Phase I Report."
[53] Ibid.

JTC report explores a range of alternative revenue sources that could be adopted and/or directed toward transportation. Each option presents tradeoffs in terms of revenue potential, applicability to different jurisdictions, equity, and practicality.

One important funding consideration is how Washington will replace lost gas tax revenues as more drivers adopt electric vehicles (See subsection 0). The Washington State Transportation Commission (WSTC) recently identified a road usage charge (RUC) as one possible substitute, and concluded that a RUC for state highways would be a fiscally sustainable and fair approach to addressing transportation funding needs.[54] The WSTC recommended that the Legislature enact a per-mile RUC, starting with "alternative fuel" vehicles and state-owned vehicles and phasing in all vehicles over time.

Action: Through legislation and/or other means, the state must identify and establish diverse funding mechanisms for transportation maintenance, preservation, and system improvements. The funding must be stable, equitable, accessible to all jurisdictions, and sufficient to cover programmatic and capital needs. Proposed funding mechanisms could include carbon fees or road usage charges, so long as they were designed to avoid regressive impact on lower-income households.

1.3.2. Make VMT reduction, efficiency, and equity explicit priorities for transportation funding

Current transportation system policy goals for Washington include economic vitality, preservation, safety, mobility, environmental protection, and stewardship.[55] Although several of these goals intersect with improving transportation efficiency, reducing VMT, and enhancing equity, none explicitly target the outcomes or approaches needed to achieve them.

Gas taxes and vehicle fees collected by the state account for a large portion of the transportation budget and are subject to the 18th Amendment of the Washington State Constitution, which requires that revenue collected through gas taxes and some vehicle fees be used for "highway purposes." 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 energy and climate goals.

Action: Through legislation and/or executive action, the state should expand transportation system policy goals to expressly include VMT reduction, including development of transit systems and active transportation options, with an emphasis on providing equitable mobility for all Washington communities.

1.3.3. Ensure sufficient funding to cover planning, coordination, engagement, implementation, and evaluation

As noted in section 1.2.4, 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 requirements. In addition, one challenge with existing state and federal funding mechanisms is that they too often emphasize upfront planning, project, or policy design, and do not provide sufficient funding for implementation. In some cases, this means important "last mile" connections between

[54] 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
[55] Chapter 47.04.280 RCW.

transportation network elements go unfinished (e.g., street designs accommodating pedestrian or bicycling access to transit systems).

Action: To strengthen implementation of transportation system improvements, the state should fully fund efforts required for inter-jurisdictional coordination and community engagement (section 1.2.4). 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 for the implementation of approved plans rather than in a single tranche covering planning and implementation. Funding should also be expressly allocated to evaluation efforts that inform and improve subsequent project stages or policy revisions.

1.3.4. Provide a dedicated pool of funding for realizing synergies, completing networks, and capturing external benefits

Washington's current transportation planning and funding models can result in responsible jurisdictions failing to consider 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.

Development of transit corridors can often be expanded to include pedestrian and cycling amenities, improving connections between different modes. Freight transport efficiency could be improved if development of distribution networks is coordinated with port, rail, and other infrastructure development. Allocating more funding to implementation efforts (subsection 0) could help to address these gaps, but funding restrictions can limit jurisdictions from considering indirect "external benefits" in both the planning and implementation phases.

Action: To further realize transportation system efficiencies, the state should establish a funding pool expressly for use in supporting opportunistic consideration – and incorporation – of connections between different transportation system elements, and between these systems and other beneficial infrastructure. Where appropriate, funding should be allocated to ensure effective coordination among different jurisdictions and agencies, and to capture "external benefits," Including the reduction of greenhouse gas emissions.

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.

Action: Adopt incentive programs that reduce the relative cost of transit and other alternative travel modes.

1.4.1. Update commute-trip reduction policies, with a focus on more comprehensive engagement and compliance

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.[56] When the CTR law was passed in the 1990s it was a pioneering effort to reduce VMT, congestion, and pollution across the state.

After the law was amended by the 2006 Commute Trip Reduction Efficiency Act,[57] 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.[58] The CTR program could be updated and expanded, for example by including through measures to make it enforceable in areas of high congestion and transit availability.

Action: The state, including WSDOT, should explore ways to expand the reach of Washington's CTR program, including by making participation mandatory in certain circumstances. For example, the state could require 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.

1.4.2. Ensure universal transit affordability

Washington's public transit providers face budget challenges under their current funding models. Shifting transit funding away from local fare revenues would add funding stability, help to expand access and maximize the public benefit value of transit services.

Public transit service is a universal need, not limited to urban and suburban areas. Rural and tribal communities benefit from public transit, including van pools,[59] paratransit, and ridesharing programs, which typically operate on minimal budgets. These services could be enhanced and expanded, including through adoption of EVs for providing service.[60]

Action: Along with increasing and stabilizing transportation funding (subsection 0), the state should explore options to make transit universally affordable, including creating a statewide transit pass option, with providing means-tested transit subsidies for low- and no-income riders, or establishing fare-free transit statewide.

1.4.3. Invest in public transit operations and infrastructure

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.[61] On average, light rail systems produce 62% less and bus transit 33% less greenhouse gas emissions per passenger mile than private vehicles.[62] Making public transit safer and more accessible will reduce emissions.

Action: Transit improvements should be designed around the people most dependent on transit. The most effective way to maximize our public investment in transportation is to center racial equity and

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[56] Washington State Department of Transportation, "Commute Trip Reduction," October 23, 2020, https://wsdot.wa.gov/transit/ctr/home.

[57] 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

[58] Ibid.

[59] "Farmworkers," accessed October 23, 2020, https://calvans.org/farmworkers.

[60] 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/.

[61] "2016 Biennial Transportation Attainment Report" (Washington State Department of Transportation, 2016), https://wsdot.wa.gov/publications/fulltext/graynotebook/AR2016.pdf. p.33

[62] "2016 Biennial Transportation Attainment Report." P. 35

ensure that BIPOC, people with low incomes, and people with disabilities are the most direct beneficiaries of these investments.[63] Improved bus speed and reliability will help buses compete with car travel times. Invest in transit infrastructure including security, lighted streets, covered stops, and pedestrian crossings.

1.4.4. Provide incentives for e-bikes and other "micro-mobility" options

Electric bicycles (e-bikes) or scooters can reduce transportation-related congestion, local air pollution, and greenhouse gas emissions. However, e-bikes typically cost more than traditional bikes and are not affordable for many people.

Many countries, states, and cities have explored incentives for e-bikes to reduce their upfront costs and accelerate adoption, including state-funded rebates or discounts offered through electric utilities.[64] Additionally, e-bike incentives could be paired with a vehicle buyback program as described in subsection 1.9.2.

Action: The state should explore options for providing statewide incentives for e-bike and other e-ride devices, including:

- Offering up-front cash rebates
- Approving utility-funded discounts
- Including e-bike incentives in a vehicle buyback program

1.5. Ensure Universal and Equitable Access to Telework and Remote Service Options

Telecommunications and broadband services have the potential to significantly reduce the need for travel, which can play a part in reducing overall energy use and emissions in Washington. Maximizing this potential will require that all Washingtonians have affordable access to these services when and where they need them – in effect, treating broadband access as a public good and an essential service. It will also require active steps to boost participation in teleworking and commute trip reduction programs (subsection 0).

1.5.1. Expand broadband access, especially in under-resourced areas

Access to modern telecommunications and broadband services is not equally distributed across Washington. In 2019, the Washington State Legislature enacted legislation creating a new statewide broadband office charged with promoting the development of affordable, quality broadband, including in rural and unserved or under-served areas. These efforts should be supported and expanded.

Action: Building on the existing efforts of the state Broadband Office, the state should ensure that minimum levels of broadband service are available to all Washingtonians at an affordable price, especially in under-resourced urban and rural areas. Measures could include additional funding or subsidies for broadband deployment in under-resourced areas, and setting statewide standards requiring the incorporation of broadband infrastructure in new commercial and residential buildings.

[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] 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.

1.5.2. Remove barriers to teleworking and remote service options

The COVID-19 pandemic has created an unanticipated and uninvited incentive for Washingtonians to work from home and remotely provide services. Going forward promoting and enabling telework options could be an important part of Washington's energy strategy.

Action: The state should expand incentives (e.g., tax incentives or a subsidy program) for teleworking and remote service provision, targeting both employers and employees. In conjunction, the state should examine whether there are barriers to teleworking – particularly for lower-income occupations – and take steps to remedy or remove them.

1.6. Support Measures to Reduce Freight VMT

Directly reducing freight VMT can be a challenge given that there may be few opportunities to avoid freight travel or switch to more efficient modes. In addition, the state may lack influence over key changes to the freight transportation system needed for greater system-wide efficiency. Policies to induce mode-switching for long-haul freight – for example, using rail instead of trucks – are best implemented at the national level. Given projected growth in freight demand, however, the state should take steps to mitigate the number of vehicle-miles needed for transport and delivery.

1.6.1. Support the study, planning, and implementation of measures to improve short-haul freight logistics around ports and urban areas

Across Washington, there is substantial potential for 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.

Researchers at the University of Washington have extensively studied these kinds of options.[65] In conjunction with accelerated electrification of short-haul delivery and drayage vehicles, these measures could also significantly reduce health and pollution impacts in frontline communities.

Action: To help improve the efficiency of local freight logistics and reduce pollution in Washington's frontline communities, the state should provide funding to help local jurisdictions study freight travel reduction opportunities, plan for infrastructure improvements, and implement optimization measures. Local measures should be planned and implemented in coordination with broader efforts and in collaboration with other agencies and jurisdictions, as well as impacted communities.

1.6.2. Support national or regional efforts to rationalize long-haul freight and switch to more efficient modes (rail or maritime)

Although there is limited authority at the state level to influence long-haul freight mode choice and efficiency, Washington can still take steps to complement 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.

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

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

1.7. 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 directly or significantly improve average fuel economies. However, by continuing to join with other states in following California's "clean car rule"[66] (which regulates greenhouse gas tailpipe emissions for passenger vehicles) and "clean truck rule"[67] (which sets 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.[68] The state may also be able to accelerate fuel economy improvements through vehicle purchase and retirement programs or similar measures.

1.7.1. Continue to follow California's vehicle emission and electrification standards

Adopting California vehicle emission standards, as long as allowed under federal law, will be a critical measure for reducing statewide transportation greenhouse gas emissions over the next 10 years.

Action: The state must continue to enforce 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 (see subsection 0).

1.7.2. Explore options for accelerating average fuel economy, including a vehicle buyback program

Vehicle buyback programs can help improve statewide fuel economies by taking older, less efficient vehicles off the road, including trucks and drayage vehicles. Although typically expensive, 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 goals (see Section B - Achieving Our Carbon Emissions Goals).

A vehicle buyback program could provide 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.[69]

Action: The state should explore whether a state-run vehicle buyback program could cost-effectively meet near-term greenhouse gas reduction targets, and, if feasible and appropriate, implement such a program.

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[66] 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.

[67] 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.

[68] 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

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

2. Electrifying Vehicles and Switching to Low-Carbon Fuels

Technology for electric vehicles (EV) that rely on batteries (BEVs) or hydrogen fuel cells (FCVs), and development of low-carbon liquid and gaseous fuels, continue to rapidly advance. 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 from carmakers. BEVs are expected to reach cost parity across passenger vehicle classes by the mid-2020s.[70]

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.[71]

Despite these advantages, the pace of BEV and FCV adoption will need to accelerate rapidly to meet Washington's greenhouse gas reduction goals. Achieving this acceleration will require policy action to expedite adoption. A range of policies are needed to ensure that all transportation modes are electrified to the extent feasible, and that there is universal access to charging and fueling infrastructure (See Figure 11). These policies must synchronize with broader clean and accessible mobility policies the state pursues, 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 (subsection 0).

Figure 11. Approaches for increasing demand and supply for electrification and low carbon fuels

Approaches		Supports electrification	Supports use of low/zero-carbon fuels
	Ensure equitable, affordable access to passenger ZEVs and electricity/fuels		
LCFS	Enhance demand for ZEVs		
	Develop charging infrastructure (all modes)		
	Support development of electricity supply to serve EV load		
	Develop low/zero-carbon fueling infrastructure (all modes)		
	Support development and production of low/zero-carbon fuels		

Legend

	Passenger transport

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

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

	Freight transport				
					
On-road		Rail	Maritime	Air	Off-road

BEVs, and increasingly FCVs, are not just strategies for on-road transportation. Rail and off-road transportation (e.g., construction equipment, farm equipment, warehouse and port vehicles) can also be cost-effectively electrified. 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. Washington State Ferries (WSF) is the largest consumer of diesel fuel in Washington State, burning more than 18 million gallons each year, and it's the largest generator of greenhouse gas emissions within the state transportation system. In 2019, Washington state ferries submitted their 2040 Long Range Plan to the Governor and the Legislature. Due to increasingly aging ferry vessels and the need for relief vessels, the plan calls for building 16 new ferry vessels over the next 20 years.

The plan goes on to recommend 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 and for a large investment in the electrification of the fleet by 2040. Also, to realize the benefits of plug-in electric-hybrid propulsion, the electrification of 17 terminals is proposed.

Electrification is also a promising option for decarbonizing short-haul air travel (see Chapter E). Policies to accelerate BEV and FCV adoption generally should include measures such as charging and fueling infrastructure development (subsection 0) to address these transportation segments as well.

Not all segments of the transportation sector can be readily electrified through onboard battery storage. As the Deep Decarbonization modeling presented in Chapter B suggests, 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 - Promoting Clean and Competitive Industries discusses policy approaches for fostering the development of an in-state clean fuels industry.

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

One way for Washington to advance these 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 played a critical role in incentivizing clean fuel production and development of charging and fueling infrastructure, and accelerating adoption of electric-drive 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 Chapter E for discussion of LCFS).

2.1. Set Clear and Ambitious Statewide Targets

Phasing out the use of gasoline- and diesel-powered vehicles by mid-century is crucial to achieving Washington's emissions goals 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.

It is very challenging to arrive at targets that are consistent with the state's emissions limits but are realistic in light of market and legal constraints. As challenging as this is, the need for specific targets is clear, as is the need to establish accountability and responsibility. Just as the Legislature did this for electricity, it is appropriate that transportation targets be established by statute.

2.1.1. Set targets for EV and FCV adoption, differentiated by vehicle class

For Washington's passenger cars to be fully zero-emissions by mid-century, nearly all new car sales will need to be EVs by 2035.[73] Moreover, the faster this transition occurs, the less costly it will be to meet the state's greenhouse gas emissions goals (see Section B). To keep Washington on track for meeting these goals, the state must set explicit near- and long-term targets for BEV and FCV adoption. 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).

Action: To ensure a cost-effective transition to meeting the Washington's greenhouse gas emission reduction goals, the state must set explicit targets for BEV and FCV adoption. Official targets should be aligned with ambitious targets in memoranda of understanding that Washington has agreed to with other states.[74] Recommended targets are:

- For light-duty vehicles (cars and trucks): a minimum of 22% of new vehicle sales by 2025, 85% of new vehicle sales by 2030, and 100% of new vehicle sales by 2035
- For medium- and heavy-duty vehicles: a minimum of 30% of new vehicle sales by 2030, and 100% of new vehicles sales by 2050
- For drayage trucks, and off-road vehicles: 100% of new vehicle sales by 2035

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

[74] 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.

2.1.2. Set targets for charging and hydrogen fueling infrastructure, by year and geography

To accelerate adoption of BEVs and FCVs, charging infrastructure and hydrogen fueling infrastructure must be widely available, affordable and accessible to communities and vehicle classes. To ensure that infrastructure development keeps pace with BEV and FCV penetration, the state must set explicit targets for infrastructure development. Rural areas outside the reach of mass transit systems will require BEV and FCV options to achieve low-carbon transportation.[75] In Washington State, electric vehicles save rural drivers more on fuel – up to twice as much – than urban drivers.[76,77]

Action: To establish infrastructure targets, the state should first conduct a comprehensive BEV charging and FCV fueling infrastructure needs assessment linked to both community needs and targeted sales and penetration rates. The needs assessment should be undertaken in collaboration with the state's public and private utilities, the Utilities and Transportation Commission, RTPOs, MPOs, Tribal Nations, port districts, public transit authorities, and other local governments.

The assessment should be aligned with broader transportation system planning and coordination efforts (see subsection 0). It should identify where charging or fueling infrastructure is needed to support BEVs and FCVs across all transportation modes. The use of cumulative impacts analysis tools should also be integrated into the needs assessment to determine optimal health, environmental and economic benefits for frontline communities.

In particular, the needs assessment should identify: (1) where, and how much, infrastructure is needed to ensure equitable access to BEV charging and FCV fueling across all Washington communities, including low-income, rural, and frontline communities; and (2) where and when large capital projects will be needed to support EV and FCV needs across multiple modes, including freight corridors, public transit agencies, ferries, port districts, rail, and aviation – taking into account opportunities for co-location and integration of needed infrastructure.

Based on the finding of this needs assessment, the state would set explicit targets for the development of BEV charging and FCV fueling infrastructure, by geographic location and year, and identify capital needs or projects that are priorities for state funding and support.

2.1.3. Publicly track progress on BEV and FCV adoption, infrastructure deployment, and transportation-related pollution

To ensure that the state is making progress toward BEV and FCV targets, annual metrics on EV adoption and infrastructure deployment should be provided to the public. The locations of infrastructure deployment would also be reported to track progress in ensuring equitable access for all Washingtonians.

In addition, the state should explore options for increased community-scale air quality monitoring,[78] especially in areas that are close to major roadways, freight depots, ports, and other facilities that produce substantial transportation-related air pollutants. Improved access to air quality data will

[75] White, S., Dresser, L. & Rogers, J., *Greener Reality: Jobs, Skills, and Equity in a Cleaner U.S. Economy* 2012
[76] Labor Network for Sustainability & Synapse Energy Economics, *The Clean Energy Future*, 2015
[77] Union of Concerned Scientists, *Electric Vehicle Benefits for Washington*, 2019
[78] Environmental Defense Fund, *Making the Invisible Visible: A guide for mapping hyperlocal air pollution to drive clean air action, 2019, https://www.edf.org/airquality/roadmap-cleaner-air-and-healthier-communities* EDF. Making the invisible visible: A guide for mapping hyperlocal air pollution to drive clean air action

empower communities and ensure that the areas with the highest pollution burden are realizing the health benefits of vehicle electrification and clean fuels.

Action: Develop and publicly track annual metrics on BEV and FCV adoption and infrastructure deployment. Support expanded deployment of community-scale air quality monitoring in highly burdened communities.

2.2. Ensure the Rapid Development of BEV Charging and FCV Fueling Infrastructure

In addition to setting targets for deployment of BEV charging and FCV fueling infrastructure (subsection 2.1.2), the state should take additional steps to ensure that these targets are met.

2.2.1. Establish a permanent state-level EV charging and FCV fueling infrastructure planning and development body

Although the state has worked to coordinate development of BEV charging infrastructure for the past 10 years, these efforts could be expanded and bolstered. To ensure the equitable, efficient, coordinated, and timely implementation of capital projects needed to provide BEV charging and FCV fueling infrastructure at a rapid pace, the state should establish a permanent planning and development body. This planning body should be in charge of conducting statewide needs assessments (section 2.1.2), and work with state agencies and the legislature to cover infrastructure gaps that other public entities and the private sector may not address.

Action: The state 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. 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 and 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 that can be identified through a cumulative impacts analysis tool.

2.2.2. Enact and enforce "EV-ready" building codes

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

Action: To enable widespread access to EV-charging equipment, the state 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 Section D - Decarbonizing the Built Environment.)

2.2.3. Provide state funding support for major, multi-modal charging and fueling infrastructure projects and EVSE deployment in underserved areas

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 – including urban and suburban neighborhoods and rural areas – that are underserved by private actors. The state's electric utilities should also be supported in making investments in EVSE that in the near term would have marginal profitability.

Action: As part of state efforts to ensure statewide transportation needs are fully funded (section 0) and coordinate infrastructure planning and investment (section 2.2.1), the state should identify major BEV charging and FCV fueling infrastructure projects with significant public benefit and provide these with direct public investment. The state should also directly support, or 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 achieve Washington's greenhouse gas limits. A range of parallel and complementary actions will push the market further and ensure equitable and affordable access.

2.3.1. Target conversion of public and private fleets to EVs and FCVs

Converting public and private vehicle fleets to BEVs and FCVs can be a highly effective way to catalyze market transformation. Fleet owners can achieve economies of scale when purchasing new BEVs and FCVs, helping to drive greater market demand and potentially lowering costs across the market. The same dynamic can work for BEV charging and FCV fueling infrastructure. Large-scale, centralized fleet charging facilities can achieve scale economies and be leveraged to expand charging options for the public at large. In addition, converting fleets helps expose large numbers of drivers to these vehicle technologies, building awareness and confidence and contributing to greater uptake for personal use.

The state should continue and expand efforts to convert its own vehicle fleets beyond the current goal of at least 50% of new state passenger vehicle purchases being EVs (state law requires state and local governments to purchase EVs based on a total cost of ownership assessment). Tax incentives or direct funding should be used to further the conversion of other public and private fleets, including transit, school bus, and van pool fleets, and fleets owned or managed by freight and drayage companies, shared mobility companies, and transportation network companies (TNCs). Where relevant for private fleet conversion, such as with TNCs and trucking companies, assistance should be targeted to those drivers bearing the direct costs of vehicle operation and ownership.

Actions: The state should:

- Update and expand targets for new EV purchases for state-owned vehicle fleets, including trucks and off-road vehicles, with the goal of achieving 100% EV purchases: (1) by 2025 for

[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.

light-duty vehicles; and (2) by 2030 for all other vehicle types. Technical support and oversight by the state is also needed.

- Update the existing tax credit for commercial vehicles (RCW 82.04.4496 (3)) to focus on emissions-free vehicles and eliminate the cap.
- Work with the State Treasurer to incorporate public fleets into the LOCAL funding program as a mechanism to provide low- (preferably no-) cost short-term loans to bridge the gap between higher upfront capital costs and long-term operational savings.
- Provide financial incentives for conversion of other public and private vehicle fleets, including transit vehicles, van pools, school buses, trucking company fleets, shared mobility fleets, Transportation Network Company (TNC) fleets, and others. Where relevant for trucking, delivery, drayage and TNC fleets, financial incentives should be targeted at drivers bearing the direct costs of vehicle operation and ownership. Incentives could include subsidies for vehicle lease or loan programs operated by fleet companies, or direct rebates to vehicle owners.
- Prioritize planning, development, and funding for BEV charging and FCV fueling infrastructure projects (subsection 0) that support fleet conversions.

2.3.2. Enhance existing and restore expired electric vehicle and low carbon fuel incentives, and reduce disincentives

Over time EVs can offer significant operational savings over internal combustion engine vehicles, but the initial purchase price can be prohibitive for many car buyers. To accelerate market penetration of EVs, Washington State should continue to provide and expand financial incentives supporting the purchase of EV freight and passenger vehicles. In doing this, policy makers should address a fundamental equity concern with incentive-based approaches. These approaches easily can and usually do result in inequitable outcomes because they bypass people who cannot afford to purchase and finance a new car.

The state currently offers a sales and use tax exemption for new and used EV purchases or leases costing less than $42,500. The tax could be waived at the point of sale, making the incentive more effective. Because the value of the tax exemption increases with the cost of the vehicle, customers who choose more expensive vehicles receive a greater incentive.

To make ZEV incentives more equitable, a uniform incentive amount should be considered. Other states provide increased savings for low-to-moderate income households. Washington could pursue a similar policy by creating a separate grant program for low-to-moderate income buyers.

Incentives should be proportionally greater for high-priority vehicle classes or market segments, including short-haul medium- and heavy-duty freight and service vehicles, and targeted classes of off-road vehicles, for which conventional engines have greater local air pollution impacts.

The state should also pursue a range of other indirect or non-financial incentives, and eliminate any current disincentives to EV ownership, including the measures to address the access to and operation of EVSE.

In addition to expanding state-led incentive programs, the state should enlist the support of electric utilities in providing incentives for EV adoption, expanding current programs limited to charging

equipment. Utilities have extensive experience administering energy efficiency incentive programs for buildings. This history could be leveraged and expanded to include targeted incentives for EV purchases.

Finally, the state should stop using EV registration fees to compensate for failures in Washington's transportation funding mechanisms. The state's fees are currently the highest in the nation,[80] and discourage EV ownership. Instead, the state could replace EV registration fees with a per-kWh tax on EV charging.

Actions: The state should:

- Improve coordination around vehicle funding programs currently administered by the Departments of Ecology and Commerce, and WSDOT
- Provide or enable additional financial incentives for ZEVs, including by:
    - Offering additional incentives – including cash rebates and/or low-cost financing – for low-to-moderate income households
    - Providing additional or enhanced graduated incentives targeting freight, service, and off-road vehicles that contribute the most to local air pollution
    - Enabling utility-sponsored incentive programs for EV purchases (e.g., modeled on energy efficiency programs)
- Adopt or support non-financial incentives for EVs, e.g., ferry access, reserved parking, license plates, etc.
- Explore mechanisms to increase the installation of charging infrastructure at Washington workplaces and commercial establishments not otherwise subject to "EV-ready" building code requirements (subsection 0).
- Repeal burdensome EV registration fees as part of a broader reform of transportation funding mechanisms
- Eliminate disincentives to EV ownership, including the measures to address the access to and operation of EVSE (e.g., ease of access, interoperability, and downtime requirements)
- Make electric motorcycles eligible for existing tax exemptions

2.3.3. Support EV outreach & education

Rapidly accelerating EV adoption in the near-term will require acquainting as many consumers as possible with the features and advantages of EVs, while allaying potential concerns (e.g., "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 state should:

- Update and maintain auto sales force education and outreach materials on EV "basics," including how EVs work, available incentive programs, charging and fueling requirements, and full costs of ownership
- Establish customized dealership education programs
- Support local "ride and drive" events

[80] "States Evaluating EV Registration Fees and Alternatives to Support Transportation Infrastructure Funding," *DSIRE Insight* (blog), May 27, 2020, https://nccleantech.ncsu.edu/2020/05/27/states-evaluating-ev-registration-fees-and-alternatives-to-support-transportation-infrastructure-funding/.

- In conjunction with enabling utility EV purchasing incentive programs and continuing utility-sponsored EVSE incentives, support additional development and enactment of utility-led EV education and outreach programs, including in partnership with auto dealers

3. Ensuring an Equitable Transition for Washington's Transportation System

The transition to a more efficient, decarbonized transportation system will succeed only if all Washingtonians have a stake in its success, and the transition benefits all Washington communities. The following actions will be essential for ensuring that the transition occurs in an equitable way and produces just and equitable outcomes.

Structural

- Evaluate accessibility as well as mobility in transportation planning.
- Attach explicit conditions to state transportation funding that require (subsection 0):
    - Enhanced accessibility and service for under-resourced communities
    - Active and meaningful collaboration between local communities and engineers, planners, and other involved parties, including measures to solicit input from historically underrepresented community members (e.g., outreach and information in multiple languages)
    - Inclusion of anti-displacement measures in the design and implementation of transportation systems, e.g., zoning and affordable housing policies, protection of existing tenancy, development amenities reflecting current local community priorities, and land-use planning that co-locates different destination types near transit (e.g., childcare, grocery stores, schools, jobs)
    - Evaluation of health and safety outcomes/benefits
- For state-led coordination, planning, and development of BEV and FCV infrastructure, incorporate explicit criteria prioritizing communities disproportionately impacted by air pollution, including diesel emissions, especially around ports and distribution centers (subsection 0)

Procedural

- Provide model policies, education and outreach resources (including funding and meeting space) to help local communities envision changes and the positive benefits that will come from them (subsections 0 and 0)
- Provide funding to support paid (rather than volunteer) equity advisory groups engaged in transportation planning and implementation (subsection 0)
- As conditions for state funding of BEV charging and FCV fueling infrastructure, require (subsections 0 and 0):
    - Local community engagement, including active and meaningful collaboration between local communities and engineers, planners, and other involved parties, input from historically underrepresented community members, and outreach and information in multiple languages
    - Inclusion of anti-displacement measures (e.g., zoning and affordable housing policies, protection of existing tenancy, and development amenities reflecting current local community priorities) in the design and construction of charging and fueling infrastructure
    - Evaluation of local health and safety outcomes and benefits

Distributional

- Make transit universally affordable, including creating a universal, statewide transit pass option and, in conjunction with: (1) providing means-tested transit subsidies for low- and no-income riders; or (2) establishing fare-free transit statewide (subsection 0)
- Ensure that revenue mechanisms used to diversify and stabilize transportation funding are equitable, or are applied in ways that mitigate regressive impacts (subsection 0)
- Support universal, affordable broadband access through funding and/or regulation (subsection 0)
- Support rural van-pool, paratransit, and ride-sharing programs (subsection **Error! Reference source not found.**)
- Offer cash rebates for new and used EVs (subsection 0)
- Means-test and scale EV rebates for low-income car buyers (subsection 0)
- Prioritize electrification of medium- and heavy-duty freight and service vehicles, as well as off-road vehicles, that contribute the most to local air pollution (subsection 0)

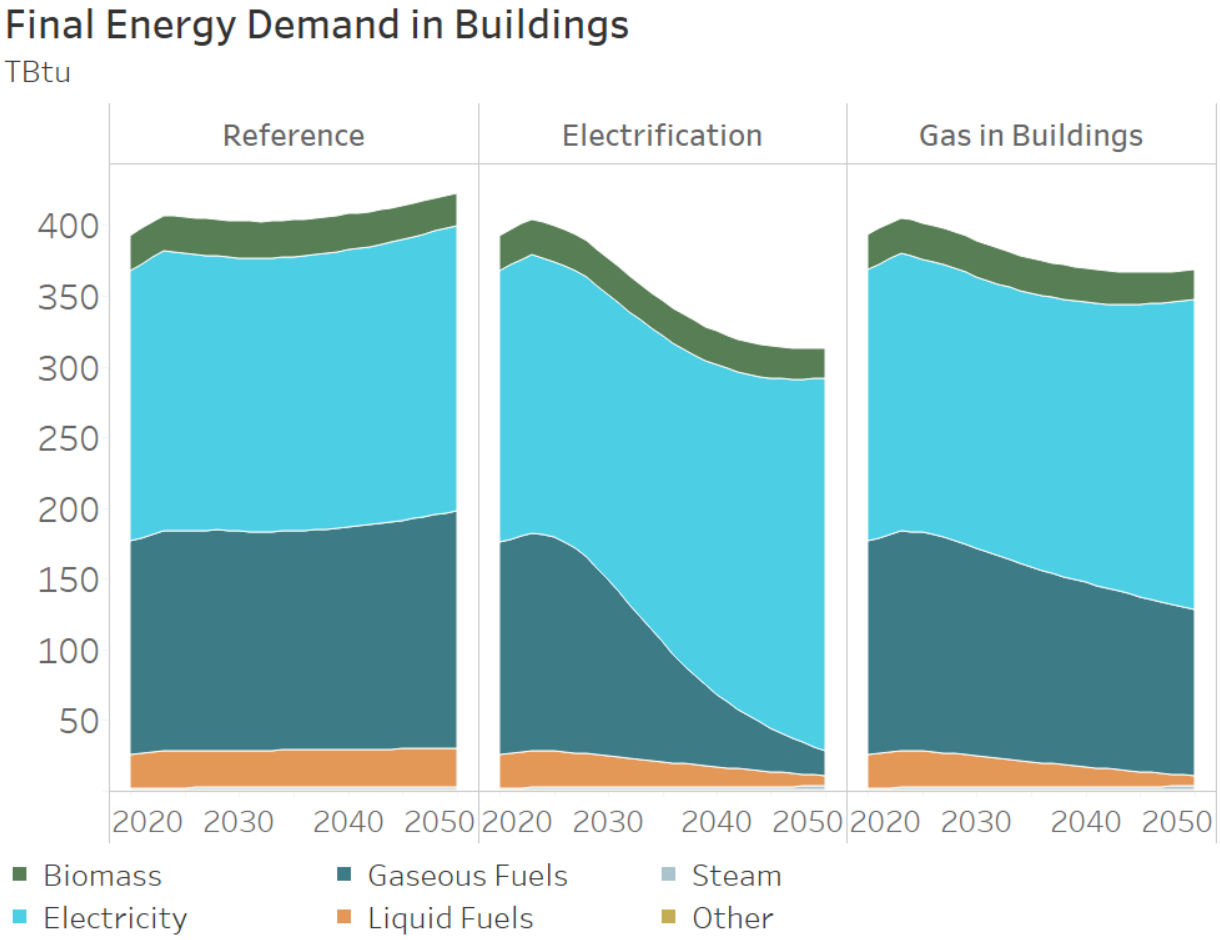
D. Reduce Energy Consumption and Emissions in the Built Environment

Buildings represent approximately one-fifth of Washington's greenhouse gas emissions. Some are emissions associated with the generation of electricity used in buildings, but most are from the direct combustion of natural gas and other fossil fuels in buildings for space heating, water heating, and cooking. Reducing energy waste in buildings with efficiency and shifting away from fossil fuels supports achievement of the state's greenhouse gas limits while improving comfort and safety for occupants and reducing energy costs for residents and businesses. In addition, the building sector can act as a resource for supporting decarbonization in the other three energy sectors.

Analysis in Chapter B shows that electricity is the lowest cost option to decarbonize Washington's space and water heating end uses when high efficiency heat pump technologies are used. Even with this strategy, in the near term, there will continue to be buildings that utilize fossil fuels. Some of these loads may eventually be served by renewable natural gas (RNG). In all cases, least-cost approaches will require buildings to include efficient building envelopes and distribution systems. This requires much of the existing building stock to pursue comprehensive upgrades.

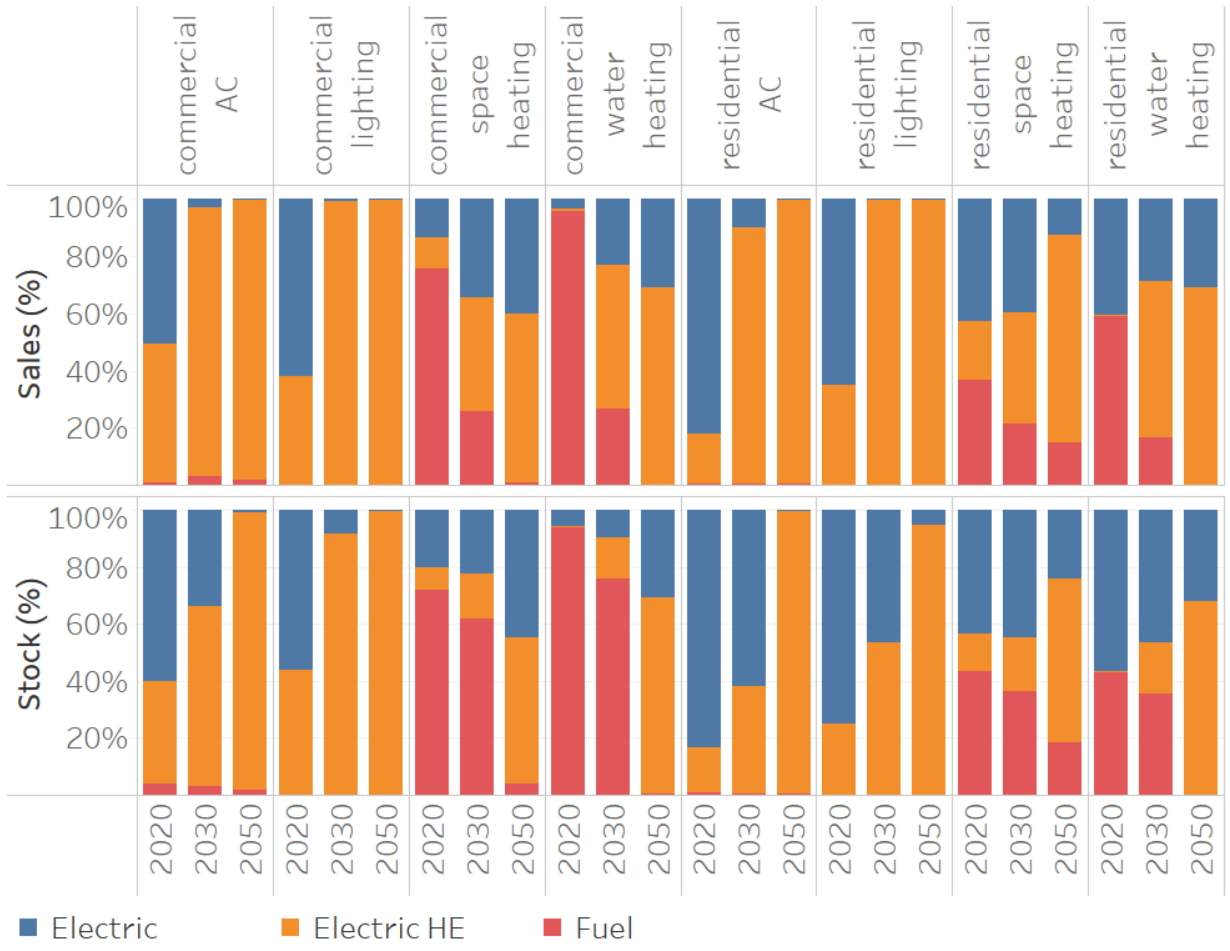
To meet economy-wide greenhouse gas limits, the Electrification Scenario shows that the building sector can reduce all loads by 26 % with energy efficiency actions. This will be a combination of building improvements and upgrading existing electric resistance space and water heating to heat pump technologies. The loads currently served by fossil fuels must be converted to high efficiency electric. This results in an increase in electricity requirements of 30 percent compared to the reference case. (See Figure 12.)

Figure 12. Scale and Pace of Energy Use Reductions Required to Meet Economy-Wide Emissions Limits



In the Electrification Scenario, the sales share of high-efficiency and/or electric technologies must reach approximately 80-100% across key commercial and residential building end uses by 2030. Because buildings are updated and equipment is replaced over time, it is critical for the state to achieve market transformation, in terms of standard practice and market capacity, by 2030 to gradually transition the building stock by 2050. (See Figure 13.)

Figure 13. Sales and Stock Shares Driving Energy and Emissions Reductions in the Electrification Scenario



Achieving this level of transformation in the building sector requires an intentional, large-scale, well-coordinated strategy. To date, Washington has adopted some of the nation's most cutting-edge building energy policies.[81] Aligning these policies with the state's greenhouse gas limits requires rapidly installing high efficiency and electric equipment in buildings. Building envelope improvements and efficiency retrofits will also need to accelerate. With new smart technologies, buildings will be used as a grid resource by generating and storing energy and helping to manage demand.[82] Finally, steps will need to be taken to account for and reduce the carbon embodied in building materials and refrigerant emissions.

These actions will require a suite of coordinated regulatory, programmatic, and market development strategies. A comprehensive long-term plan is needed to capture the cost savings, comfort, and health co-benefits of building decarbonization and avoid adverse economic, workforce, and equity impacts.[83]

[81] See Appendix X for a list of detailed building energy policies.

[82] See Chapter F for more information on proposed strategies for distributed energy resources (DER) and demand response (DR).

[83] "California's Gas System in Transition: Equitable, Affordable, Decarbonized and Smaller" (Gridworks, n.d.), https://gridworks.org/initiatives/cagas-system-transition/.

This section lays out a high-level vision for critical institutional and market capacity building, interagency coordination, accelerated mandates, and strategically aligned programmatic support. These steps are required to meet Washington's 2030 greenhouse gas emission limits and provide a foundation for meeting the 2050 limits.

The goals of the building sector strategy are to:

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

1. Establish a Building Decarbonization Policy Framework

Washington State building policies need to directly address the state's greenhouse gas emissions limits. Over the last 40 years the 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. To reduce emissions from Washington's building sector, a new framework is required. This framework will build on and learn from the drivers, goals, design, development, achievements, and limitations of the existing efficiency-oriented system. The new framework will recognize the long lifecycle of buildings, implement efficiency retrofit measures and include policies to ensure stock replacements meet greenhouse gas emissions limits.

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 begin to adopt the basic structure of the building sector transition now so policies, codes and standards can be put in place on a timeline that provides predictability in the form of clear signals that building owners and market forces can respond to.

Energy efficiency as an overarching model and framework for energy reductions has dominated the Northwest energy landscape for four decades and transformed resource planning. Initiated in the 1970s as an innovative response to resource constraints and goals, energy efficiency has met load growth cost effectively offsetting the need for new generating resources. Energy efficiency will continue to be a resource, but other steps are needed to decarbonize Washington's economy.

The state needs more than innovative policies. It needs a new framework to allow policies to harmonize and deliver deep energy and greenhouse gas savings. A framework focused on optimizing energy rather than just reducing it will create flexibility to leverage the full spectrum of solutions needed across the building stock such as onsite renewables, demand response, grid optimization, and microgrids.

Optimizing energy to decarbonize the building sector will be best served by a whole building and performance-based approach at every level. This means switching from a system that values measure-based outcomes focused solely on reducing energy use, to one that values outcomes based on a range of whole-building solutions. There needs to be a shift to standardized performance-based metrics and labeling across all policies and programs.

1.1. Expand Building Decarbonization Leadership Capacity

Washington state government will need to increase its role in energy planning, energy code development and program implementation for the state to meet greenhouse gas limits. A large degree of the leadership, research, analysis, and planning for the current Northwest energy efficiency industry is conducted at the regional level in connection with the regional power planning process required by the 1980 Northwest Power Act.[84] Energy efficiency in buildings is evaluated as a least cost resource. The regional efficiency framework is not designed around a rapid decarbonization imperative. Washington State needs to significantly augment its institutional infrastructure and funding to decarbonize its building stock.

For example, in some other states a state energy office, such as the California Energy Commission (CEC) or the New York State Energy Research and Development Agency (NYSERDA), plays a substantial role in energy planning, energy code development, program implementation, etc. This work is funded through public benefit charges added to utility rates rather than using state general funds.

Actions:

- To support the design and development of a building decarbonization policy framework, the state should expand and clarify roles and responsibilities for a state energy office, other state agencies, and work with regional organizations to align energy efficiency research, planning, and market transformation efforts.
- To further augment institutional decarbonization capacity, the state should fund and align with efforts of existing organizations and alliances, including workforce and equity organizations. Additional resources are needed to engage communities and workers in the state energy strategy recommendations, so that those stakeholder groups can identify how to best engage in subsequent regulatory processes.
- The state should support a regional assessment of the effectiveness of utility energy efficiency investments in measure-based programs and explore strategies for how utilities can deliver deeper energy and emissions reductions with similar levels of rate-based funds.

1.2. Establish Clear Energy Utilization and Greenhouse Gas Emissions Limits for Buildings

To operationalize the 2050 and interim building sector greenhouse gas emission limits, the state should legislatively establish clear building greenhouse gas emission limits for all building use types. The limits should include a general phased timeline for achieving low-energy, zero-greenhouse gas standards for existing buildings, and zero-energy, zero greenhouse gas standards for new buildings. This must be supported by research and development of mandates, programs, and market transformation efforts.

Energy efficiency is a prominent feature of all carbon reduction strategies. Establishment of energy utilization targets for all buildings should be developed to inform least cost approaches. This combined with DER resources will enable the zero-energy standards.

For example, to achieve the market transformation and retrofits required to meet state greenhouse gas limits, zero-energy expectations should be programed for all applicable buildings, which is most new

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

construction and targeted existing buildings that support grid resources at the least cost. Most new buildings must operate at zero-energy and carbon by 2030. Existing buildings must meet low-energy and, to the extent they provide a least cost resource, zero energy standards by 2050Distributed Energy Resource standards could be developed for buildings that are not programed to meet zero energy but could incorporate onsite generation. It is critical that the state provide a simple and clear zero-energy building framework to guide the transition of Washington's overall portfolio buildings.

Action:

- To provide clarity on the end state for most buildings, zero-energy energy use intensity (EUI) and greenhouse gas intensity (GHGI) endpoints should also be developed for all building sector segments — single-family, multifamily, and various commercial building types. The first round of EUI targets the state has developed for commercial buildings above 50,000 square feet for Washington's building energy performance standard (BPS) is a major step in this direction and provides the basis for subsequent editions of the standard.

Standards recognize the efficiency of groups of buildings. Geographically coordinating these standards and limits can enable more efficient, networked approaches to reducing energy use and emissions. For example, if buildings with complementary energy profiles (i.e., one requiring heating while the other requires cooling) in close proximity are obligated to meet the same stringent building performance standard in the same time period, networked solutions such as thermal microgrids, centralized heat pumps, or other district solutions can be used.[85] This approach is applied in the state building energy performance standard. Such networked solutions can reduce overall costs while creating demand for skilled workers, including plumbers and pipefitters who might otherwise be at risk of losing jobs as buildings reduce gas use.[86]

1.3. Develop a Detailed Washington Building Decarbonization Plan

This state energy strategy lays out a high-level framework and set of policy recommendations for the building sector. But the state needs a building decarbonization plan to identify a more detailed strategy. For example, California's Assembly Bill 3232[87] requires the CEC to develop a detailed strategy to reduce building sector emissions by 50% by 2030. The California plan must include detailed building characterization, segmentation, technical and fiscal analysis.

Action:

- Washington State should develop a state decarbonization plan for buildings. The plan should include details for reaching each county in the state with a focus on equity and inclusion. The plan can leverage regional planning efforts by the Northwest Power and Conservation Council's (Power Council) regional power planning analysis and should be revised every five years in conjunction with the regional power plan schedule.

[85] Amazon headquarters in Seattle, Stanford SESI project, and others

[86] Betony Jones and Nikki Luke, "District Energy Decarbonization: Addendum to California Building Electrification Workforce Needs and Recommendations" (UCLA Luskin Center for Innovation, Inclusive Economics, November 2019), https://innovation.luskin.ucla.edu/wp-content/uploads/2019/11/California_Building_Decarbonization-Addendum.pdf.

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

- In addition to a building decarbonization plan, Washington should develop an electrification and heat pump program to electrify the building sector. A plan must be developed to design such a program using the least cost and most strategic approach, while addressing equity and market capacity considerations.

1.4. Align Mandates, Programs, and Market Transformation around Performance Outcomes

Transformational change in the building sector will require utility rate-based funds to be leveraged in service of more simplified, performance-based decarbonization programs designed to interconnect with a comprehensive suite of state building performance standards (BPS) and energy codes. An approach to interlocking the design of mandates, programs, and market transformation should be at the heart of Washington's building decarbonization policy framework. Since mandates can apply to an entire subsector, such as the residential or commercial sector, they can act as the key levers for reducing energy use and emissions on a schedule.

Action:

- Performance-based mandates should be structured as the critical path for each building segment to meet the state's zero-energy and zero-carbon building targets. Utility programs and market transformation efforts should then be designed to directly align with and support the success of the mandates in drawing down energy use and emissions, while prioritizing support for low-income and other vulnerable customers.
- Adopt a common "language" across policies and programs for determining baselines, attribution, energy/greenhouse gas reductions, and determination of least cost approaches. Standardized definitions of energy use intensity (EUI), greenhouse gas intensity (GHGI), targeted end states for net zero energy and greenhouse gas emissions, and other metrics will support interconnectivity across codes, standards, programs, and market-support strategies.
- Include specific energy and greenhouse gas emissions limits in each state building energy statute and/or rule.

For example, if the energy code and the BPS are designed to achieve zero-energy and zero-carbon commercial buildings on a specific timeline across the new and existing commercial building stock, all related energy efficiency programs should be supporting achievement of the BPS, including commercial utility programs and market transformation and strategic energy management programs. Programs that do not support achievement of the BPS, or conflict with it, should be discontinued.

This policy framework responds to the scale of structural change in the building sector required to meet the state's greenhouse gas limits. Currently mandates, programs, and market transformation are not driven toward zero-energy, carbon-neutral endpoints and are therefore fragmented and lack the capacity for transformational change or for correcting for historic inequities. With 10 years to completely transform the market, all mandates, incentive programs, and market transformation efforts must be marching in unison toward a specific goal.

By aligning program and market transformation design with the greenhouse gas limits, the rest of the policy ecosystem can develop a natural gravity toward building decarbonization. This level of alignment provides a solid foundation for planning for economies of scale, predictability, market and workforce development, and equity. Subsection **Error! Reference source not found.** includes a more detailed d escription of how to apply this approach in policy and program design.

1.5. Center Equity in Building Efficiency and Electrification Policies

To ensure that environmental and social justice (ESJ) communities do not continue to experience the brunt of climate change impacts, policies designed for the building sector must prioritize transition for those communities. Historically, clean energy solutions, including rooftop solar and energy efficiency have focused on benefitting higher income communities, placing less importance in investing in ESJ communities' transition.[88] Promoting the development of affordable, quality broadband in areas or households without access is critical.

ESJ communities have not only suffered from disinvestment and lack of decision-making power, the inaccessibility of clean energy opportunities and benefits results in an effective market subsidy for the wealthier residents who do access such opportunities like incentives or net-metering. Due to policies such as redlining and other racist 20th century housing policies, communities of color often live in older housing stock that poses health, adaptability, and resiliency implications and are often more energy intensive. Therefore, centering equity for building decarbonization must focus on reducing future harm and redressing past harms in ESJ communities by prioritizing opportunities and benefits for low-income households and ESJ communities.

Energy efficiency programs have focused primarily on reducing energy use or costs, while in many cases ignoring the co-benefits of improved resiliency and climate adaptability. Building electrification (BE) and energy efficiency policies and programs should enable equitable outcomes for ESJ communities, including improvements in public health outcomes, increases in energy affordability, and making homes more comfortable.

Action:

- Washington's building decarbonization strategy must include equitable distribution of benefits to ESJ communities. They are required to couple non-energy policy with energy policy, such as energy efficiency mandates that protect against increases in rent leading to displacement and support workforce development efforts to ensure equitable access to career-track jobs in and beyond building decarbonization. The state's Weatherization Plus Health (Wx+H) program is a prime example of an initiative that couples energy and health policy to improve home environments for low income households. This program partners with community health education partners to recruit clients and provide follow up assessment.[89] The pilot program served mostly single-family households with children with asthma through eight agencies across the state. The state should expand this successful 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. Building decarbonization efforts should operationalize the three dimensions of equity during the policymaking process, i.e., structural, procedural, and distributional (See section A-Building an Equitable and Inclusive Clean Economy). The first step

[88] 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.

[89] "Weatherization Plus Health (Wx+H)," Washington State Department of Commerce, n.d., https://www.commerce.wa.gov/growing-the-economy/energy/weatherization-and-energy-efficiency/matchmaker/weatherization-plus-health-wxh/.

of this process must be understanding the specific needs, barriers to accessing decarbonization programs, and the current level of knowledge held by ESJ communities.[90]

1.6. Create a Building Decarbonization Data and Communication Platform

All technical change is social change at its heart, requiring human beings and human systems to interact and organize in new ways to deliver new outcomes, hence the Washington building decarbonization framework must recognize the primacy of learning and communication in transformational social change.

Support for the different actors in the residential and commercial sector ecosystems requires an explicit change management lens with an emphasis on the data, analysis, learning, and communication infrastructure necessary to adapt and truly align around common goals. Creating a building decarbonization data and communication platform including standardized nomenclature, metrics, and a central website for research, analysis, planning, tracking, and evaluation would support the state greenhouse gas reduction goals by providing state agencies and other stakeholders with a common source of information. This platform would make it easier for state agencies, policymakers, utilities, and local governments to align mandates, programs, and market transformation efforts.

Actions:

- The state should implement a building energy data platform to inform state building policy. As a starting point the state should consider collaborating with the Power Council and the Northwest Energy Efficiency Alliance (NEEA) on building energy, greenhouse gas, and characteristics data. For example, baseline data from state benchmarking and performance standard mandates could feed into regional market characterization and power planning efforts. In turn, the data assembly and analysis from the power planning process could be structured so that Washington State as well as local governments can draw on it for decarbonization planning and policy design.
- In addition, Washington State needs an accessible tool for assessing the energy and greenhouse gas impacts of various policies. This type of resource assessment tool is used by utilities to conduct conservation potential assessments and is based on the Power Council methodology and inputs. The 2021 Northwest Power Plan is currently under development and the 2026 plan will be released in five years. Washington State should align the development and maintenance of its building decarbonization data and communication platform with the development of the regional power plans.

1.7. Regulate Utility Performance Outcomes

Washington utilities are in a unique position to play a significant role in taking building decarbonization to scale. They work within an existing energy and conservation planning framework and have programmatic mechanisms for reducing energy use. And, by virtue of their customer base they also have direct relationships with every residential and commercial building in the state.

As part of its building decarbonization policy framework, the state should develop new utility regulation and program requirements that incentivize utilities to achieve economies of scale to get whole buildings,

[90] "Equitable Building Electrification: A Framework for Powering Resilient Communities" (Greenlining, Energy Efficiency for All, 2019).

neighborhoods, and cities in their service territories on a path to carbon neutrality and grid optimization. Potential policy options for accomplishing this in the building sector include:

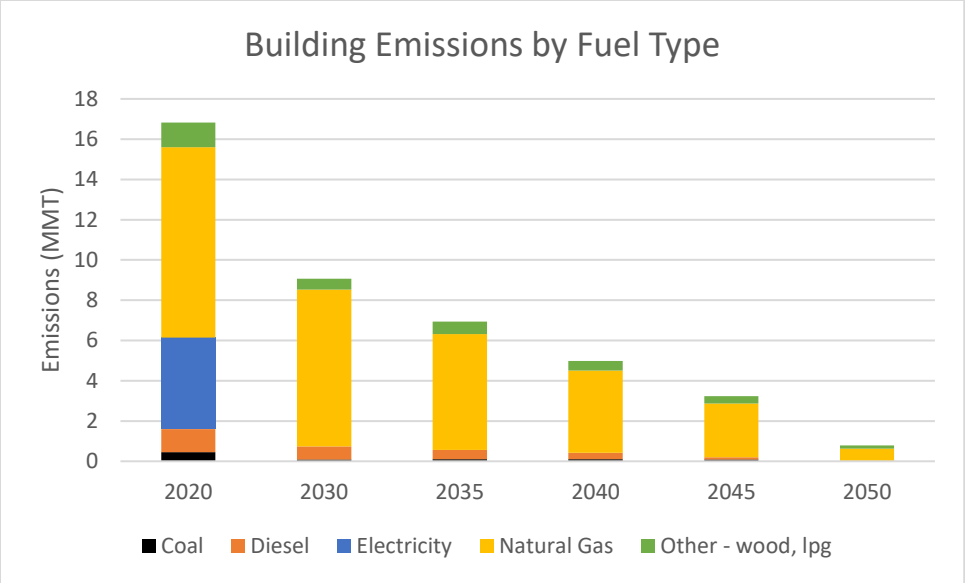
- Use performance incentive mechanisms to align utility investments with social policy goals and incentivize innovative, scaled-up program designs for outcome-based, zero energy, whole-building, and electrification programs. Develop strategies for achieving similar outcomes with publicly owned utilities, for example as part of CETA implementation.
- Revise cost-effectiveness tests to account for higher social costs of carbon and cross-sector avoided costs — for expensive alternatives such as bio and synthetic fuels for transportation and industrial sector applications — and to encompass a fuller range of other benefits associated with electrification, distributed energy resources DERs, and health impacts.
- Work with regional organizations to establish decarbonization as a central framework for pursuing deeper energy efficiency savings and ensuring a reliable regional power supply within a context of policy-driven electricity load growth and expansion of cost-effective efficiency.
- Require utilities to include a larger ratio of performance-based whole building programs and strategic energy management programs focused on meeting 2050 zero energy and carbon targets in alignment with the state energy code and BPS and electrification efforts.
- Extend the planning horizon of integrated resource plans and conservation potential assessments through 2050 and ensure that utilities identify a long-term approach to using utility programs to achieve portfolio-level building decarbonization goals established by the Washington Utilities and Transportation Commission (UTC).

2. Maximize Energy Efficiency and Electrification in Buildings

The economy-wide decarbonization path with the least societal costs requires a 95% reduction in building sector emissions and a 26% reduction in overall energy use by 2050. If Washington accomplishes these goals, the building stock in 2050 will be mostly zero emissions with little onsite combustion of fossil or renewable fuels. This change will translate into healthier, more resilient homes and businesses.

Currently, electricity contributes 27% of building emissions, natural gas contributes 56%, with a combination of diesel oil, propane, and other fuels contributing the remaining 17% (Figure 14) based on the assumptions in the decarbonization model.

Figure 14. Distribution of Building Sector Emissions by Fuel Type



Implementation of CETA will reduce the electricity emissions to carbon neutral by 2030. The DDP modeling forecasts that in the business as usual case natural gas will contribute 86% of building sector emissions in 2030, with the remaining emissions stemming from liquid fossil fuels and biomass.

Washington's core strategy for meeting its greenhouse gas limits must focus on retiring and replacing equipment in buildings and achieving deep energy efficiency savings to reduce electric loads and offset the need for expensive RNG. With existing policies, such as the energy code and building energy performance standard, Washington has a good foundation for making this transition. However, these policies, along with existing utility programs, are not designed to deliver the level of market transformation in terms of the increased sales share of high efficiency technologies and electrification implied by the DDP modeling and will not be enough to meet the 2030 and 2050 greenhouse gas limits.

To meet these limits, Washington will need a comprehensive suite of revamped and new policies that put each building sector on a trajectory to meet 2030 and 2050 limits. Policies should uniquely address the challenges this transition poses for single-family, multifamily, various sizes of commercial buildings, private/public ownership, rural/urban locations, and ESJ communities. This strategy flows from the proposed building decarbonization policy framework described above and is designed to reduce the risk of locking in carbon emitting technologies that may impact Washington's ability to meet greenhouse gas limits. The strategy includes the following key components to support the development of a robust policy and market ecosystem for each sector: performance disclosure, mandates, complementary utility programs, accelerated market transformation, and financing.

To increase the resiliency of the building stock for the people who inhabit these buildings, it is imperative that there is consideration of coupling of energy policy with affordable housing, public health and anti-displacement policies. In one example, New York City's Local law 97, Climate Leadership and Community Protection Act is a building electrification law that has provisions for affordable housing by

allowing buildings to "install prescribed energy conservation measures instead of meeting the caps"[91] With this provision, the law ensures that building owners do not increase rents to meet the high upfront costs of meeting energy caps with deep retrofits. Additional options for maximizing implementation efforts while minimizing rent increases should be explored.

Energy efficiency and electrification programs need to be focused on developing metrics, such as public health outcomes to track the progress on increasing equitable outcomes for ESJ communities, especially since there is a known gap in data available showcasing the efficacy of building electrification efforts in these communities.

2.1. Adopt Commercial and Residential Statewide Benchmarking/Transparency Program

Benchmarking and transparency programs require building owners to measure and report their energy use, and in some cases greenhouse gas emissions. Current Washington policies require transparent benchmarking for public buildings and commercial buildings and point-of-sale disclosure to potential buyers. In addition, buildings above 50,000 square feet will be required to report energy performance data to the state every five years in compliance with the building energy performance standard.

Action:

- The state should rapidly adopt a more comprehensive statewide benchmarking and transparency policy with annual reporting requirements for commercial and multifamily buildings greater than 10,000 square feet. Transparent benchmarking and disclosure will bring a large majority of commercial and multifamily buildings within an energy management framework that can be fortified in the future with expanded building energy performance standards and utility program incentives.
- The state should also adopt a residential performance policy with disclosure at point-of-sale and at time of lease to tenants for rental properties. The residential disclosure policy should be combined with future retrofit requirements via a performance standard. The state can also use energy use performance datasets to track progress against decarbonization targets, to support more data-driven decision making, and to inform regional power planning and decarbonization measure development.
- The state should disseminate information to be operationalized through training programs for local and tribal governments, so they are able to use their knowledge and relationships to ensure comprehensive compliance.
- To ensure that affordable housing units in Washington are able to comply with the building performance disclosure policies, there should be flexibility in compliance timelines, a no rent increase clause, and targeted education and training programs. Funding options specific to the needs of affordable housing should also be developed.
- Furthermore, it is highly recommended that education and training programs be designed to be delivered in multiple languages.

[91] Alexis Saba and Jeffrey Gracer, "New York City Council Considers Amendment to Local Law 97 Affordable Housing Provisions," June 1, 2020, https://sprlaw.com/new-york-city-council-considers-amendment-to-local-law-97-affordable-housing-provisions/.

2.2. Strengthen and Expand Energy Codes and Standards

Energy codes and standards should be the core elements of Washington's building efficiency and electrification policies. With less than 10 years to transform the market, they must be strengthened, accelerated, and extended to most segments of the Washington building stock. Voluntary state and utility programs are supportive policies that can help pull and develop the market, but mandates like the energy code and building energy performance standards are better positioned to deliver complete transformation of the building sector on a predictable schedule. For example, the energy code applies to almost the entire new construction stock and most retrofits across all building sectors and segments.

Washington's current BPS should be extended to a majority of the remaining square footage for buildings less than 50,000 square feet. With the addition of a residential performance standard, a large majority of Washington's new and existing building stock would be on a coherent, stepped path to zero energy and carbon by 2050. The market would benefit greatly from the predictability afforded by carefully structured, funded, and implemented mandates coupled with comprehensive market capacity support in the form of design guidelines, technical training and assistance, and manufacturer and supply chain development.

Both the energy code and the BPS should be revised to achieve explicit greenhouse gas emission limits and energy use intensity targets for residential and commercial buildings. During the develop of each new edition of the energy code and the BPS, the energy and greenhouse gas emission reductions should be evaluated to estimate the impact of proposed revisions in terms of overall reductions against building sector targets and market development implications. Code and standards rulemaking bodies should be required to adhere to the performance objectives.

2.2.1. Energy Code

In 2009, the Washington State Legislature passed a law requiring residential and commercial buildings built to the 2031 code to achieve a reduction of 70% in net energy use compared to the 2006 energy code.[92] In 2014, the Governor issued an executive order requesting the State Building Code Council (SBCC) to accelerate this timeline.[93] The SBCC has made steady progress, but has not fully achieved the required reductions, let alone accelerated code development. Residential energy code development is simply on track, but commercial energy code adoption is behind schedule.[94] Relative to zero carbon emission, codes have just begun to address greenhouse gas emissions. A concentrated effort to move more buildings to high efficiency space and water heating will be required to meet this requirement. Incremental improvements in code for fossil fuel buildings will not achieve the greenhouse gas emissions limits.

The current code trajectory will not deliver zero-energy, fossil-free new construction by 2030. The first reason for this is that the 70% mandate includes both efficiency and onsite renewables, making it essentially a net-30, not a net-zero code endpoint. In addition, due to the two-year duration between the edition year and the effective date of the code, plus a typical three to five year timeframe from

[92] "Residential and Nonresidential Construction—Energy Consumption Reduction," 19.27A.160 § (2009), https://apps.leg.wa.gov/rcw/default.aspx?cite=19.27A.160.
[93] Jay Inslee, "EXECUTIVE ORDER 14-04: Washington Carbon Pollution Reduction and Clean Energy Action," Pub. L. No. 14–04 (n.d.).(Executive Order 14-04, 2014)
[94] "Modeling the Washington State Energy Code - 2006 & 2018 Baseline Energy Consumption" (Ecotope), accessed November 2, 2020, https://sbcc.wa.gov/sites/default/files/2020-10/SBCC-BaselineStudy_Revised_FINAL_Report_2020-10-08.pdf.

commercial building design to construction and operation, buildings built to the 2031 code will not meet building decarbonization targets until the mid- to late 2030s.

Local jurisdictions in Washington State have expressed interest in adopting energy code requirement that provide greater energy savings than the state code. Known as stretch codes, this option is used by local jurisdictions in Massachusetts to advance energy codes where markets are ready.

Action:

- To achieve the 2030 greenhouse gas emissions targets, the energy code should be accelerated to become zero energy, zero-carbon and all-electric no later than the 2027 code.
- Provide a tiered path with local options for stretch codes starting with the 2021 code. As a part of this change, the state should remove the residential maximum code policy restricting jurisdictions from adopting more stringent residential codes. Washington allows jurisdictions to adopt more stringent commercial codes and this flexibility should be extended to the residential code. This change is also critical for existing buildings because the maximum residential code policy can be interpreted by some jurisdictions to restrict the adoption of residential performance standards and retrofit requirements for existing homes.
- Modify the statute to assure the SBCC adopts codes meeting the energy efficiency and greenhouse gas emission requirements. Create binding interim targets for the SBCC.
- The state should also make changes to the energy code development process to make it more inclusive, holistic, and synchronized with equity policies.
- Fund the Department of Commerce to lead the technical research and development of the energy code, including a stepped framework and manuals to achieve zero energy, all-electric construction by 2027, including significant stakeholder engagement and workshops for the framework and in the year leading up to the SBCC adoption process for each code cycle.
- Ensure sustainable state funding for energy code design and implementation, including research, analysis, technical road mapping, code design and development, technical and fiscal impact analysis, training for compliance, enforcement, and technical assistance.
- Enhance energy code enforcement through direct support to local government or through alternative enforcement mechanisms such as third-party plans examiner and inspectors or Labor and Industry energy code inspections for commercial buildings. Create state qualification and certification procedures for these professionals.
- Change the energy code development timeline to allow at least one year between the adoption of the code and the effective date so that utility programs, compliance and enforcement trainers, and the market can adequately prepare for and support the code rollout. To meet greenhouse gas reduction timeline this requires moving up the code development period, rather than extending it.

2.2.2. Building Performance Standard

The Department of Commerce is scheduled to complete the rulemaking in 2020 for the nation's first statewide BPS for commercial buildings.[95] The mandate applies to commercial buildings greater than 50,000 square feet. This standard requires building owners to develop and implement an energy

[95] Doglio et al., "Concerning Energy Efficiency," Pub. L. No. 1257 (n.d.), https://app.leg.wa.gov/billsummary?BillNumber=1257&Chamber=House&Year=2019.

management plan and an operations and maintenance plan and when the building performance exceeds a specified energy use target, adopt all cost effective efficiency measures. This standard will be updated in 2029 and must be updated every five years thereafter. The BPS will be the first edition of the mandate with a 2026 compliance year for the first cohort of buildings. This is preceded by an early adoption incentive program beginning in July 2021.

First priority is to continue to ramp up support for implementation of the BPS. This includes continued development of education and deployment support actions. Further, considering the long-term nature of commercial building capital improvement planning, the state should provide additional information to set expectation for future editions of the BPS and encourage early adoption of more rigorous work.

Actions:

- Continue to support program development and implementation efforts of the existing BPS.
- Continue to develop funding opportunities for both public and private building owners through enhanced state or utility programs, CPACER financing or other identified methods.
- Modify the standard to deliver more certain and robust outcomes. Require the cost effectiveness test to include the social cost of carbon as a building owner cost or require the energy use intensity targets be met regardless of cost effectiveness. Add greenhouse gas intensity targets consistent the greenhouse gas limits.
- Develop a stepped 2050 BPS framework including targets for all subsequent BPS cycles, a technical roadmap, and a market transformation strategy for getting existing commercial buildings to zero energy, zero carbon by 2050.
- Incorporate mandatory greenhouse gas intensity reporting and targets into the 2030 BPS and require heating, hot water and cooking equipment replacements to be zero carbon.
- Extend the BPS of covered buildings to include multifamily buildings and all buildings greater than 10,000 square feet. Adoption of the energy management or operations and maintenance requirements could be adopted soon, with energy use intensity targets and implementation of measures following in 2030.
- Require BPS energy management plans to include a "2050 strategy" to become zero-energy and zero-carbon by 2050 or sooner, including an assessment of life-cycle costs associated with delaying plan implementation.
- For newer buildings, ensure BPS energy use intensity targets are consistent with energy use outcomes for each code development cycle. Support this with good analysis of projected code outcomes.
- The state should design training programs for energy audits with requirements to hire from ESJ communities

2.2.3. Residential Performance Standard

Voluntary utility programs in Washington have made incremental improvements to the state's residential building stock mostly via measure-based programs. However, after nearly 40 years of utility-driven upgrades, there are still many homes that do not meet reasonable efficiency standards. Existing homes across the state still have significant air leakage, poor ventilation, low levels of insulation. Residential occupancies predominantly use either inefficient electric resistance or natural gas-fired equipment for space and water heating.

The 2017 Residential Building Stock Assessment (RBSA) of single-family homes, 52% of Washington homes use natural gas space heating, 4% liquid fossil fuels, 2% wood and 42% use electricity. Only 15% of single-family homes use heat pumps as a primary heating source. Even after 40 years of utility efficiency program efforts, opportunities to improve efficiency and reduce carbon emissions remain. This is particularly true for gas heated homes and rental properties. Washington must build a high-performing residential ecosystem of policies and market forces for all residential segments, with the capacity to deliver deep transformation of homes across the state.

Action:

- The state should adopt a mandatory residential performance standard as a catalyst to scale up the residential retrofit market and meet this challenge. The standard should be developed with comprehensive equity and workforce provisions to focus heavily on both rental and owner-occupied homes. In addition, the standard will need to identify and take into account the unique opportunities and challenges faced by various residential segments such as manufactured housing and multifamily buildings.
  - The state should customize the 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[96]
    - For example, New York City has standards that are weaker for buildings with rent-regulated apartments due to concerns that performance standards would lead to higher rents.[97]

With equity and workforce provisions, the standard would be a key strategy for reducing the energy burden and improving health outcomes of Washington citizens and must be structured to drive economic development in every county in Washington. The significant scale of the effort could be particularly helpful in rural parts of the state where historically the demand from voluntary retrofit programs has often been too low to build up an effective contractor base and supply chains.

The residential performance standard would build upon the residential performance disclosure discussed above by adding in a retrofit requirement designed to progressively transition homes to low energy, all-electric operation. The retrofits should be triggered by home sale and lease events and should be tightly integrated with ramped up utility labeling and retrofit program offerings. The standard will significantly drive demand for utility programs which, along with third party implementers, should take on the bulk of the technical assistance and enforcement necessary for compliance.

The metrics for asset-based performance labeling from the residential performance disclosure should be determined and standardized within the energy code and the residential performance standard as well as across utility programs, real estate transaction structures, and financing mechanisms so the policies, programs, and market actors can speak the same language and synchronize to rapidly transition the building stock.

[96] Andrea Krukowski and Andrew Burr, "Energy Transparency in the Multifamily Housing Sector: Assessing Benchmarking and Disclosure Policy" (Institute for Market Transformation, 2012).
[97] Steven Nadel and Adam Hinge, "Mandatory Building Performance Standards: A Key Policy for Achieving Climate Goals" (ACEEE, June 2020).

At a programmatic level, the state should support the development of residential technology hubs, education and training opportunities, and manufacturing and supply chains in strategic areas across the state to ensure effective implementation of the standard in terms of market acceptance, adaptation, and delivery of performance outcomes. The state should partner with real estate and lending organizations to develop industry-targeted technical assistance and training, system integration, and turnkey financing mechanisms. Financing mechanisms should include zero interest loans, energy transition tax credits, and low-income loans with state repayment guarantees.[98] In addition, lending mechanisms should take deferred maintenance into consideration. This is a significant issue in the low- and moderate-income markets.

2.3. Lead by Example with State Capital Projects and enhance Energy Management and O&M Programs

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 non-profit institutions. The state legislature has placed numerous requirements on capital budget recipients to improve energy efficiency and reduce greenhouse gas emissions. Given the service life of new buildings, major renovations and most minor works projects, every current project has the potential to help meet the 2030 greenhouse gas limits.

Executive Order 20-01 created the State Efficiency and Environmental Performance (SEEP) Office. SEEP works with state agency partners to achieve reductions in greenhouse gas emissions and eliminate toxic materials from state agency operations. The SEEP Office should continue to be leveraged to:

- Support and guide state agency efforts related to electric vehicles (EVs), energy efficient and zero energy facilities, sustainable purchasing and clean electricity.
- Identify and pursue opportunities to fund cost-effective improvements in state agency environmental performance.

The state should further develop requirements for all state capital funds for buildings within the constraints of meeting greenhouse gas emissions limits. This includes achieving zero energy and zero carbon emissions targets for new construction, very efficient outcomes for renovation, and electrification of space heating, water heating and commercial cooking applications when they are part of major or minor projects. Renovation of district heating and cooling systems will need to be implemented with long-term greenhouse gas limits in mind.

Further, to assure all facilities and sites have a plan for operations, maintenance and renovation consistent with the greenhouse gas emissions limits, energy plans and operations and maintenance plans should be developed and implemented consistent with the requirements of the state BPS. The BPS energy management and O&M provisions could be adopted for smaller buildings.

Early adoption of these actions will be the least-cost approach to meeting the greenhouse gas emissions limits. It is far less expensive to build within the greenhouse gas constraints as projects are developed than to adapt systems later. To achieve savings, action need to be incorporated into the capital budget early.

[98] Nadel and Hinge.

Capital funds allocated to school districts, local or tribal governments, low-income housing organizations should include requirements for construction consistent with achieving greenhouse gas emissions limits. The state Energy Services Performance Contracting office at DES and the State Treasure's Local Fund could also be used to enhance local participation.

State and local government lease a substantial amount of building space. Expectations for performance should be established and implemented. For the following actions, assume all capital expenditures will be made to buildings and systems that are in operation well into the future, and that they will be served with clean electricity or other zero-carbon fuels:

Actions:

- Design all news public buildings to be all electric and zero carbon.
- Existing building renewal which includes minimizing building energy loads through building improvements and converting from carbon-based fuel systems to all electric/zero-carbon emission systems.
- For district heating and cooling systems, address the total efficiency and carbon emission of the systems and the buildings they serve. Determine whether to renew or abandon them. Achieve zero greenhouse gas through efficiency and fuel choice.
- Include this approach in each unit of state government's capital planning requirements with schedules for achieving the requirements that state government meet the statewide greenhouse gas emission targets. Avoid lost opportunities by implementing a rigorous approach on all projects, large and small. Provide the funding necessary to implement these requirements.
- Implement robust energy management and operations and maintenance programs for each building or site consistent with the state BPS. Energy management plans should include maintenance and renewal action that will result in zero greenhouse gas emissions.
- Pursue building efficiency in all parts of the state to ensure decarbonization for rural public buildings through funding allocations
- Prioritize decarbonization of public buildings, specifically public schools and hospitals in ESJ communities

2.4. Align Utility Programs with State Mandates

The state energy strategy envisioned here would result, by 2030, in the bulk of Washington's building stock being covered by state mandates, including policies such as performance disclosure requirements, the energy code, and the BPS. In addition, the mandates will be structured to progressively reduce energy use and carbon in buildings with an ultimate endpoint of carbon-neutral and zero to low-energy buildings by 2050. Utility programs and regulation must be reimagined to dramatically reduce energy and emissions within this new whole building, endpoint driven context.

2.4.1. All Programs Become "Early Adopter" Versions of Mandates

As discussed above, the energy code should be accelerated and strengthened to hit zero-energy by the 2027 edition. This leaves only three additional, three-year code cycles (2021, 2024, and 2027) for utilities to help drive new construction emissions and energy use to zero. Although, the energy code does not exclusively focus on whole buildings, the BPS includes more stringent EUI targets for newer

construction. These BPS targets complement the energy code with outcome-based performance requirements enforced at the state level.

As a result, the design and construction of commercial buildings, and the utility programs that support them, will need to be increasingly tied to outcomes. Commercial new construction programs should be structured to exclusively provide incentives, along with design and technical assistance, for the development of all-electric, zero-energy buildings. Residential new construction programs should also shift away from incremental measures toward whole-building, all-electric, zero-energy programs.

Similarly, existing commercial building utility programs will be increasingly out of sync with state standards if they do not start to focus almost exclusively on strategic energy management coupled with whole-building, EUI and GHGI-driven, outcome-based program designs.

Action:

- To encourage a shift from measure-based programs to whole-building, performance-based programs, the state should require utility conservation potential assessments to include whole-building programs that achieve a progressively higher percentage of the utility's portfolio of savings, and require utilities to demonstrate targeted reductions in average residential and commercial EUIs across their service territories. Measure-based programs will continue but will be applied consistent with a building's comprehensive energy and greenhouse gas emissions reduction plan.

2.4.2. Create and Fund a High Efficiency Electrification Program

A funding plan for an electrification program should be developed and implemented. It should include funding by all building energy end uses, electric, gas and liquid petroleum through a public benefits charge, carbon fee, or economy-wide cap and trade program. Funds will be allocated to end use customers installing high efficiency heat pumps for space and water heating, converting gas cooking to electric cooking, and other identified electrification opportunities.

A program that implements high efficiency electric space and water heating will impact the majority of building energy customers in the state. The majority of electric heating uses electric resistance heating equipment. Gas heating and hot water systems will need to be replaced by heat pumps. Liquid petroleum fuels will also be required to adopt heat pump technologies. All will need to convert to electric heat pumps.

Current utility efficiency programs are siloed by fuel source. There are regulatory constraints that limit funding cross-sector fuel conversions in many cases. Liquid petroleum and transportation-only electric and gas customers fall outside of utility efficiency program scope. This program would overcome these constraints by consolidating funds assigned for this purpose. This may result in an independent customer distribution plan, or a program that operates through existing utility programs. Funding distribution plans would include full consideration of low-income and ESJ community needs.

Program implementation should occur as quickly as feasible. A least-cost approach to meeting the GHG emissions limits includes replacing systems when equipment fails and is in need of replacement. Other program requirements would be considered for funding, including program administration, marketing, workforce training, and quality assurance. Implementation could be designed to complement the strategy for phasing out gas distribution systems discussed in the subsection below.

2.4.3. Incorporate Greenhouse Gas Limits in Gas Utility System Planning

This state energy strategy projects that residential and commercial buildings will transition away from natural gas to all-electric space and water heating. RNG will primarily be reserved to serve industrial customers with very high temperature heating requirements and periodically peak electric generating resources. Much of the existing gas distribution system infrastructure will no longer be needed.

As buildings gradually transition away from the gas system, it will create challenges for gas utilities and the remaining customers. The cost of maintaining vast distribution systems will be placed on the remaining customers. This will have disproportionate impact on gas customers without the financial means to electrify existing gas end uses.

To the extent RNG becomes viable, gas system planners will need to create plans for acquisition and distribution, and identify which customers are best candidates for RNG and how the system will be developed and maintained to serve these customers. The cost of providing service with 100 percent RNG should be compared to all electric service in making these determinations.

Gas utilities under the direction of the UTC should be required to develop plans to meet the state GHG limits. This may incorporate variety of actions, resulting in measurable reductions in greenhouse gas by customers served by gas.

- Halting expansion of the gas system
- Adopting additional energy efficiency program requirements for load reduction
- Strategic retirement of the gas distribution system over time to lower operating cost
- Targeted electrification efforts to safely reduce gas distribution system size and support customers, with an emphasis on protecting customers in ESJ communities.
- Creation of zones for RNG distribution and preservation of safe pipeline resources
- Workforce training and transition support for gas system workers

The UTC should adopt structures that value greenhouse gas emissions reductions in the gas system and create enforceable standards for adoption.

2.4.4. Provide More Flexibility on Incentives and Savings Attribution

There are several additional ways the state could encourage deeper utility program energy and emissions savings. Currently, utilities claim some savings from the energy code but take a less direct role in training, enforcement, and evaluation than in some other states such as California. This is a disincentive for the utilities to play a more significant role in the roll out of new editions of the energy code. They should be required to offer incentives and technical assistance for code compliance for a transition period, which would encourage them to play a more active role and increase participation in the code programs described above.

The energy code is also used as the baseline for most existing building retrofit measures. California Assembly Bill 802 allows utilities in that state to use existing conditions as the baseline for calculating energy savings from retrofit measures.[99]

[99] "Energy Assistance for Low-Income Households," RCW 19.405.120 § (n.d.), https://www.commerce.wa.gov/wp-content/uploads/2020/03/Guidelines-for-19.405.120.pdf.

Action:

- Washington should explore allowing utilities to use existing conditions as baselines for retrofit programs, which will remove barriers to retrofit measures and remove confusion around baseline calculations for whole-building programs.
- The legislature should authorize publicly owned utilities to finance electrification in existing buildings. Washington utilities, NEEA, and the Regional Technical Forum should develop fuel-neutral efficiency measures for thermal loads such as space and water heating. This fuel-neutral approach should also be applied to whole-building programs which, along with creating a technical framework for electrifying whole buildings, would also create an avenue for optimizing all distributed energy resources within a coherent value and cost-effectiveness structure.

2.4.5. Align Gas Utility Efficiency Programs with State Greenhouse Gas Limits

Gas utility efficiency programs mostly focus on increasing gas-fired equipment efficiency. Other measures such as improving building envelopes are included in programs but are often not seen as cost-effective when compared to the price of fossil fuel. Conversion to high-efficiency electric heat pump equipment is not included. However, within a policy context where the energy code and BPS are moving toward zero-energy, carbon-neutral buildings, high-efficiency electric heat pump equipment represents the main technical pathway to achieving these endpoints. Gas equipment efficiency programs increase the likelihood of locking in carbon emitting equipment that is relatively inefficient compared to heat pump alternatives.

Action:

- The UTC should examine the consistency of existing gas equipment efficiency programs with state greenhouse gas limits. For example, gas efficiency programs could focus on existing buildings and could be limited to envelope improvements rather than equipment replacements.

2.5. Broaden Scope and Increase Sustainability of Low-to Moderate Income Energy Efficiency Programs

Washington households with incomes of below 50% of the federal poverty level (FPL) pay 21% of their annual income simply for their home energy bills. According to the most recent five-year American Community Survey, nearly 148,000 Washington households fall on or below the FPL. Additionally, more than 173,000 additional Washington households live with incomes between 50% and 100% of the Federal Poverty Level and face a home energy burden of 12%.[100]

Existing sources of energy assistance do not adequately address the Home Energy Affordability Gap in Washington. The Low-Income Home Energy Assistance Program (LIHEAP) is the federal fuel assistance program designed to help pay low-income heating and cooling bills. "The gross LIHEAP allocation to Washington was $57.9 million in 2019 and the number of average annual low-income heating and cooling bills covered by LIHEAP was 76,183 out of 526,262 households under 150% of federal poverty line."[101] There is a substantial gap in the amount of funding available to meet the needs of low income households.

[100] "Home Energy Affordability Gap" (Fisher, Sheehan & Colton: Public Finance & General Economics, n.d.), http://www.homeenergyaffordabilitygap.com/03a_affordabilityData.html.
[101] Ibid.

Washington state also has access to funds through the Weatherization Assistance program (WAP), a federal program that provides funding for weatherization for low-income households. The Department of Commerce also uses LIHEAP and funding from Bonneville Power Administration (BPA) for weatherization assistance. For the year 2020, Washington has been granted $5,918,599, of which only 4 percent will be allocated to Tribal weatherization programs.[102] "All clients that are eligible for LIHEAP are categorically eligible for WAP."[103]

Since WAP and LIHEAP share eligibility requirements, there is a chance that WAP similarly fails to meet the needs of low to moderate income (LMI) households. Therefore, although the current state of low-income weatherization is a good model where the energy affordability needs are matched with weatherization programming, it needs to be expanded to accommodate more measures and more people in the bottom half of the income spectrum, especially to ensure that the building decarbonization does not exacerbate poor conditions for LMI households and ESJ communities. Public grants alone are clearly insufficient to provide the scale of financing needed for building decarbonization.

The eligibility requirements and funding available are not the only barriers to access to weatherization and energy efficiency improvements for LMI HHs. Weatherization programs are limited and do not include provisions for improving, increasing access to renewable energy resources, which would lower household energy burden and energy inefficiency. The state has the Renewable Energy System Incentive Program (RECIP, which offers incentives for community solar programs and was updated in 2017 to include renter occupied HHs as eligible.

However, the program has not successfully improved accessibility for low income HHs. As reported by Department of Commerce, fewer than 15 community solar projects have received certification for RECIP funding of which none were specifically targeted to serve lower-income HHs, and due to high upfront costs, these programs continue to have poor inclusion of low-income HHs."[104] The state should consider including carve-outs for LMI HHs in the RECIP, Furthermore, there is an opportunity for the state to consider incorporating community solar, rooftop solar projects into the low-income weatherization programs, so the existing community networks can be leveraged through the existing implementation partners -- local agencies.

On broadening the scope of energy efficiency and weatherization programs, the state initiated the Weatherization plus Health program in 2016, which is briefly described in subsection 1.5. The program has successfully proven that energy efficiency improvements have linkages to long-term health outcomes.

Action:

- The state should expand the Weatherization plus Health program to include multifamily households and renters. It should increase funding to address minimum 10% of eligible

[102] Lisa Brown and Michael Furze, "Washington State Low-Income Weatherization Assistance Plan 2020" (Washington State Department of Commerce, 2020), https://www.commerce.wa.gov/wp-content/uploads/2020/08/2020-State-Plan-FINAL-4.2.20-.pdf.
[103] Ibid.
[104] "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.

households. Furthermore, the state should decouple this program's eligibility requirements from federal requirements to increase flexibility, allow for re-weatherization, and target the gap in households who fall below the income threshold to acquire low income services.

- The state needs to add innovative financing models that can be used to provide LMI households the access to capital needed to decarbonize their homes. California's Building Initiative for Low-Emissions Development Program (BUILD) program serves as an example for how programs can be built with funding and program outcome carveouts for LMI households. BUILD is dedicated to new all-electric housing with a focus on housing for low-income families, with a minimum of 75% of these funds set aside for low-income projects and active technical assistance provided to low-income housing developers.[105]

2.6. Drive Market Transformation Toward Greenhouse Gas Limits

Like many other states seeking to decarbonize their economies, Washington is facing a massive market transformation imperative that calls for a strong state role and accountability for the market transition, as well as broad strategic collaboration with state, regional, national, and global partners. As shown in the DDP modeling, meeting 2030 building energy and emissions reductions goals will require a shift to 100% sales share of high efficiency equipment by 2030.

In practice, by 2030 all engineering, architecture, contractors, relevant education and training, etc., must be focused on 100% high-efficiency and mostly electric designs, materials, and equipment. More specifically, achieving these levels of efficiency and electrification implies a near universal and rapid deployment of high-performance building materials, passive building design, high efficiency electric appliances, innovative zero energy and carbon design strategies, and demand response and other grid integration strategies.

2.6.1. Advance a Mandate-Driven Market Transformation Model

The state should assume more direct accountability for funding, coordinating, and implementing a mandate-driven market transformation model. This model would build upon the success of the existing market transformation model that has been used in the Northwest and across the country for more than two decades.

Moving forward, market transformation must focus more exclusively on decarbonization and explicit endpoints associated with 2030 and 2050 energy and emissions limits. A state focus on technologies and market capacity development will also support more effective cross-sector collaboration with clean energy labor and industrial policies.

Action:

- The state should develop a market transformation team within the Department of Commerce that coordinates efforts with organizations like NEEA to ensure that each state mandate has a clear and funded market transformation plan for building market capacity and removing technical and financial barriers. A key market transformation objective should be to develop a decarbonization technology roadmap and a strategy to dramatically reduce the costs of high-performing materials and equipment.

[105] Steven Nadel, "Programs to Electrify Space Heating in Homes and Buildings" (ACEEE, June 2020).

- The state should ensure market transformation programs have carveouts for LMI households and tribal nations, with direct funding allocated.

With the gradual onset of state mandates, combined with complementary utility programs, the costs for complying with the mandates must decrease rapidly. For mission-critical equipment like heat pumps, rapid costs reductions will require an organized effort to identify key cost drivers and work with market actors to drive costs down while ramping up adoption. Ensuring a pipeline of cost-neutral innovation at all levels, geared specifically in service of zero-energy, carbon-neutral buildings, will be critical to the success of state mandates.

2.6.2. Develop a Statewide Zero Carbon Building Program

With a 10-year market transformation timeline and a 30-year physical transformation timeline, there is no time to waste on uncoordinated end-use or technology-specific programs, such as heat pumps, weatherization, demand response, or onsite solar.

Action:

- The state should develop a statewide zero-carbon building program as a mechanism for identifying the technical path and aligning mandates, utility programs, and market transformation toward zero-energy, carbon-neutral endpoints.

The main statewide market transformation program should focus on how these technical strategies can be optimized to deliver a zero-energy, zero-carbon building stock by 2050 to the greatest extent possible for all building types. The statewide zero-carbon building program should apply to new and existing residential and commercial construction. It should be heavily informed by the electrification and gas transition strategies discussed above; developed in conjunction with NEEA, the RTF, and other Northwest organizations, such as the New Buildings Institute, the Carbon Leadership Forum, and Shift Zero; and should be implemented by all Washington electric utilities.

2.6.3. Authorize Residential Property Assessed Clean Energy Programs

The Washington State Legislature recently authorized commercial property assessed clean energy and resilience (C-PACER) programs. Property assessed clean energy programs allow property owners to obtain financing for up-front costs of clean energy systems and energy efficiency, paying the costs back over time on their property tax bill.

The new law provides counties the authority and guidance to create C-PACER programs for commercial, industrial, or agricultural property owners. Enabling the creation of R-PACER programs would extend these low-cost financing opportunities to residential property owners as well.

Action:

- Consider authorizing R-PACER programs.

3. Minimize Embodied Carbon and Refrigerant Emissions

3.1. Adopt Embodied Carbon and Refrigerant Emissions Requirements

3.1.1. Buy Clean Washington

Embodied carbon — carbon emissions attributed to construction materials — accounts for 11 percent of annual global emissions and 28 percent of building sector emissions.[106] The policy precedent for tracking these emissions is limited to California's Buy Clean Act, which was passed in 2017, requiring facility-specific environmental product disclosures (EPDs) and global warming potential (GWP) thresholds for materials used in public infrastructure projects.[107] To establish embodied carbon standards for the building stock, there needs to be a statewide focus on building industry capacity coupled with products that meet those low embodied carbon standards, which needs to be linked with an effort to incentivize EPD for specific, eligible materials and life cycle assessments (LCA).

For the building stock, Washington could also follow the example of the City of Portland, which requires contractors bidding on City construction projects to disclose product specific EPDs and use these to lower the greenhouse gas emissions of concrete. Another model Washington could follow is that of Marin County, California, which has approved a low-carbon code that adds a low-carbon concrete specification to the Marin County Building Code. The code includes pathways for compliance with either reduced cement levels or lower-emission supplementary cementitious materials, such as fly ash.[108]

3.1.2. Develop a Refrigerant Management Program with Financial Assistance for Low-Income Residents and Businesses

Under the Montreal Protocol, it was agreed that ozone-depleting substances (ODS) would be phased out with low GWP alternatives. Hydrofluorocarbon (HFCs) are the current choice for replacing ODS in the US air conditioning industry. Although compared with hydrochlorofluorocarbons (HCFCs), HFCs are more energy efficient, these refrigerant gases have a relatively high GWP. Refrigerants can have a GWP that is 9,000 times stronger than carbon dioxide.

Therefore, Washington state, passed the bill HB 1112, which was signed by Governor Inslee into law on May 7, 2019 and adopts the Environmental Protection Agency (EPA)'s Significant New Alternatives Policy (SNAP) Rules 20 and 21. "EPA's SNAP rules determine what chemicals may be used to replace ODS for specific end uses, such as vending machine refrigeration. EPA determined that specific HFCs may no longer be used to substitute ODS for several end uses, such as motor vehicle air conditioning, retail food refrigeration, aerosol propellants, and vending machines."[109]

In addition, the bill requires the Department of Ecology to report by December 1, 2020 on the methodology for "increase in usage of refrigerants with low GWP in mobile sources, utility equipment,

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

[107] "Buy Clean Washington Study" (University of Washington College of Built Environments, WSU Architecture and Engineering School, Central Washington University Construction Management Program, September 2019).

[108] Amy Cortese, "The Embodied Carbon Conundrum: Solving for All Emission Sources from the Built Environment," *Building Innovation* (blog), February 26, 2020, https://newbuildings.org/embodied-carbon-conundrum-solving-for-all-emission-sources-from-the-built-environment/.

[109] Russell K. LaMotte, Felicia H. Barnes, and Aron H. Schnur, "Washington State Passes Climate Bill to Restrict Certain Uses of HFCs," *The National Law Review* IX, no. 143 (May 23, 2019), https://www.natlawreview.com/article/washington-state-passes-climate-bill-to-restrict-certain-uses-hfcs.

and consumer appliances, and reduction of other uses of HFCs in Washington"[110,111] The timeline for the effective dates varies by commercial and residential product usage.

Within the building sector, the issue of refrigerant pollution can first be tackled by integrating low GWP requirements for residential and commercial HVAC appliances in the building code.[112] The Washington State Building Code Council has voted to fully adopt ASHRAE 15-2019[113] and the 3rd edition of UL 60335-2-40.[114] Adoption of these codes will allow the use of mildly flammable A2L refrigerants in refrigeration and air-conditioning including the use in occupied dwellings."[115] A2L refrigerants are classified as low GWP, therefore adopting this code would allow the building stock to lower its greenhouse gas emissions.

However, the availability of the equipment for A2L refrigerants will determine how seamless and rapid the transition to them might be. Furthermore, the state will need to ensure that the transition to low GWP refrigerants is managed with programs and funding available for affordable housing, rental, and mobile home dwellers. Similarly, the state should incentivize through financial assistance and training minority- and women-owned businesses, rural entities, and public buildings to transition first.

Another important aspect of reducing refrigerant pollution within the building stock is preventing leakage from the systems and handling proper disposal of old equipment. According to Project Drawdown, 90 percent of refrigerant leakage is caused by poor and or improper disposal. [116] Therefore, policy focused on managing refrigerant pollution should have guidelines for proper disposal and training programs for reducing leakage in the existing building stock.

As the policy applications for embodied carbon and refrigerant are limited, it is difficult to discern the equity implications that may arise. However, it can be established that funding and programmatic capacity should be prioritized for low-income, multi-family, affordable, and mobile housing, and the county, city governments, and grassroots organizations serving those communities. Furthermore, capacity building and training for minority- and women-owned construction businesses and contractors should be highlighted for policy development.

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[110] Ibid.

[111] House Committee on Appropriations, "Reducing Greenhouse Gas Emissions from Hydrofluorocarbons," Bill Report, n.d., http://lawfilesext.leg.wa.gov/biennium/2019-20/Pdf/Bill%20Reports/House/1112-S2.E%20HBR%20FBR%2019.pdf?q=20200930093030.0

[112] The Washington State Building Code Council has voted to fully adopt ASHRAE 15-2019[112] and the 3rd edition of UL 60335-2-40[112]. Adoption of these codes will allow the use of mildly flammable A2L refrigerants in refrigeration and air-conditioning including the use in occupied dwellings."[112] A2L refrigerants are classified as low GWP, therefore adopting this code would allow the building stock to lower its GHG emissions.

[113] ASHRAE Standard 15 establishes safeguards for life, limb, health, and property and prescribes safety requirements. This standard is directed toward the safety of persons and property on or near the premises where refrigeration facilities are located.

[114] Standard for Household and Similar Electrical Appliances - Safety - Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers.

[115] Alex Ayers, "WA Code Council Paves the Way for Use of A2L Refrigerants," November 13, 2019, https://blog.hardinet.org/wa-code-council-refrigerants.

[116] "Technical Summary: Refrigerant Management" (Project Drawdown, n.d.), https://drawdown.org/solutions/refrigerant-management/technical-summary.

4. Ensuring an Equitable Transition for Washington's Built Environment

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. The following actions will be essential for ensuring that the transition occurs in an equitable way and produces fair and equitable outcomes.

Structural

- To further augment institutional decarbonization capacity, the state should strategically amplify, fund, and align with efforts of existing organizations and alliances, including workforce and equity organizations, including by providing intervener compensation for organizations to engage substantively in regulatory proceedings.(subsection 1.1)
- 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 workforce development efforts to ensure equitable access to career-track jobs in and beyond building decarbonization. (subsection 1.5)
- Dissemination of information should be operationalized at the state level through training programs for local and tribal governments, so they are able to use their knowledge and relationships to ensure comprehensive compliance. (subsection 2.1)
- To ensure that affordable housing units in Washington are able to comply with the building performance disclosure policies, there should be flexibility in compliance timelines offered, in addition to targeted education and training programs. (subsection 2.1)
- Education and training programs should be designed in multiple languages. (subsection 2.2.2)
- Capacity building and training for minority- and women-owned construction businesses and contractors should be highlighted for policy development. (subsection 4.1.1,4.1.2)

Procedural

- Customize codes and standards for affordable housing and rent-stabilized units to reduce displacement and enable streamlined compliance (subsection 2.3)
    - Integrate benchmarking requirements into qualified allocation plans (QAPs) that determine low income housing tax credit (LIHTC) allocations[117]
    - For example, New York City has standards that are weaker for buildings with rent-regulated apartments due to concerns that performance standards would lead to higher rents.[118]
- Ensure inclusion of local and tribal government representatives during the process for development of the energy code and building performance standards framework and strategy (subsection 2.2)

Distributional

- Design training programs for energy audits with requirements to hire from ESJ communities (subsection 2.2.2)

[117] Krukowski and Burr, "Energy Transparency in the Multifamily Housing Sector: Assessing Benchmarking and Disclosure Policy."
[118] Nadel, "Programs to Electrify Space Heating in Homes and Buildings."

- Ensure decarbonization for rural public buildings through funding allocations (subsection 2.3)
- Prioritize decarbonization of public buildings in ESJ communities (subsection 2.3)
    - Prioritize decarbonization of public schools and hospitals in ESJ communities

Ensure market transformation programs have carveouts for LMI households and tribal nations, with direct funding allocated. (subsection 2.6.1

E. Promote Clean and Competitive Industries

In pursuing a holistic approach to industrial decarbonization, Washington can accentuate areas in which it enjoys a strong competitive advantage. With its low-carbon electricity, highly skilled workforce, and established advanced manufacturing industries, Washington can gain early traction in the global race to reduce the carbon intensity of energy-intensive products and materials.

1. Decarbonize the Industrial Sector

Washington's industrial sector comprises 26% of the state's total energy demand. Greenhouse gas emissions do not correlate exactly to energy demand, and industrial sector emissions represent about 28% of the statewide inventory. The highest energy-consuming industries are:

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

In addition to these seven, many other Washington industries will also need to reduce emissions in order to meet the state's greenhouse gas limits. Hence, 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.

Industry creates three different types of greenhouse gas emissions: (1) *direct emissions* are the dominant form of industrial greenhouse gas emissions and are the result of fossil fuel combustion for process heat, steam and hot water, on-site electric generation, or space heating; (2) *indirect emissions* derive from grid electricity consumption; and (3) *process 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 types of greenhouse gas sources — direct, indirect and process — are interdependent and managing them presents challenges unique to each industry.

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

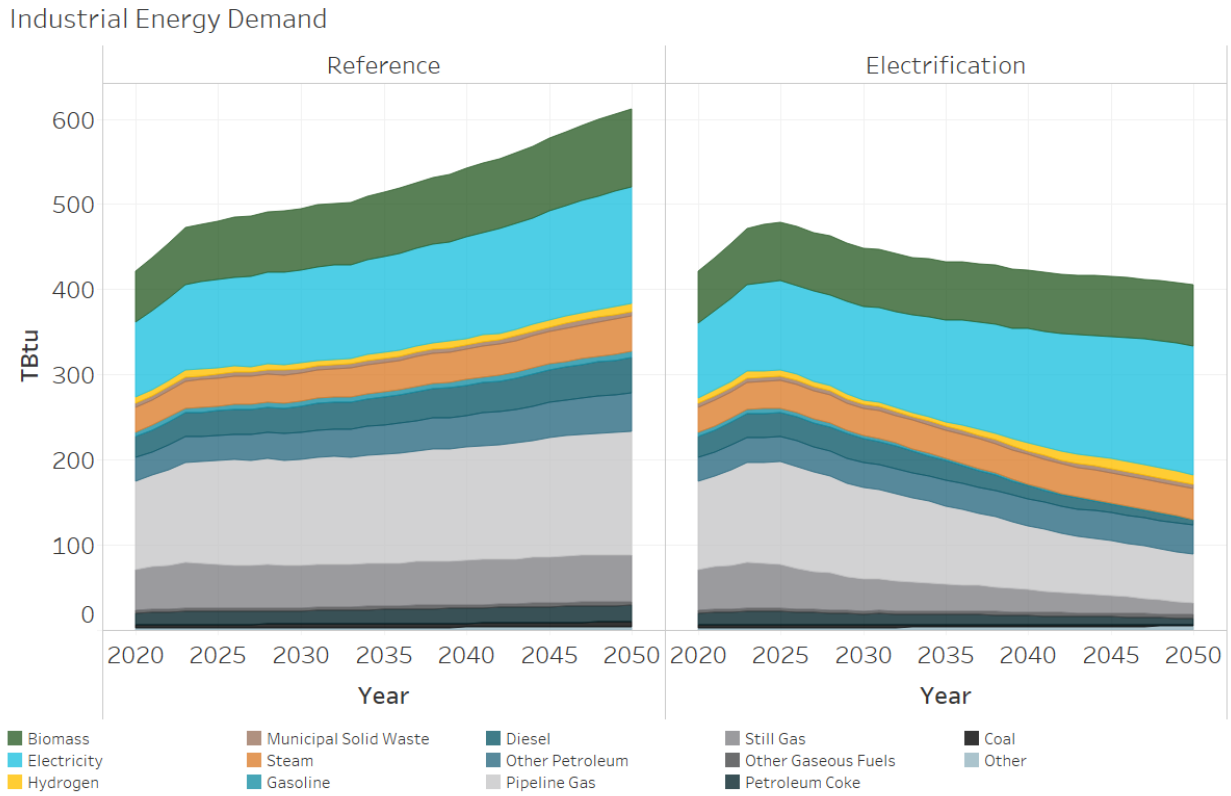
Examples of industrial decarbonization roadmaps that can inform Washington's efforts include:

- **Decarbonization of the industrial sectors: the next frontier** (McKinsey & Co.)[119] *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):[120] *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):[121] *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):[122] *Economy-wide study on California with one chapter focused on industrial sector that offers quantitative pathways to targets, albeit only on an "illustrative" level.*

In the DDP modeling performed for the state energy strategy that underlies the state energy strategy, the industrial sector energy efficiency is assumed to improve by 1% each year and includes electrification measures switching to electricity in 50% of process heating, 100% of machine drives, and 75% of building heating and cooling by 2050. The result is a changing portfolio of energy carriers to the industrial sector as depicted in Figure 15. As with the transportation and buildings sectors, electricity plays an expanding role in the sector over time, while the consumption of liquid and gaseous fuels decreases. Figure 15 shows the break-out of liquid and gaseous fuels and electricity for the industrial sector in the Reference and Electrification cases.

Figure 15 – Fuels in the Industrial Sector in the Reference and Electrification cases.

[119] 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.
[120] 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).
[121] "Manufacturing Agenda: A National Blueprint for Clean Technology Manufacturing Leadership and Industrial Transformation" (BlueGreen Alliance, 2020).
[122] Ernest J. Moniz, "Optionality, Flexibility & Innovation: Pathways for Deep Decarbonization in California" (Energy Futures Initiative (EFI), 2019).



Even in the industrial sector, where heat is often the most important form of energy, electrification will be a critical part of the picture. In the DDP results, electricity fills in reductions of 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.

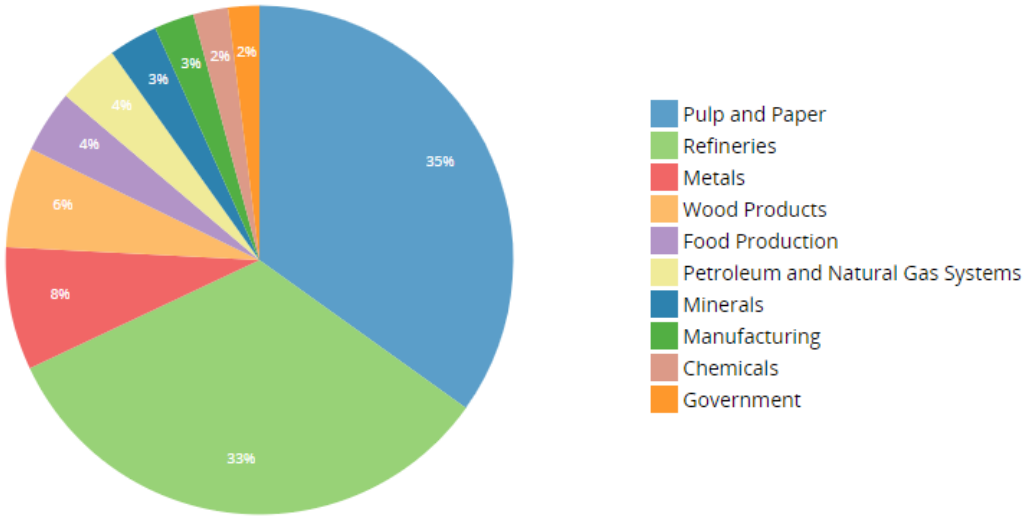
To help industrial entities achieve the reductions necessary to meet the state's greenhouse gas limits, Washington needs to develop a quantitative, industrial decarbonization roadmap with the following actions.

1.1. Build the Supporting Datasets

From an economic standpoint, Washington State's industrial sector is dominated by aerospace and data processing activities, which account for over 54% of state industrial GDP.[123] However, highly reliant on electricity, these industries directly emit only a small fraction of the state's emissions. (Figure 16)

Figure 16-Distribution of greenhouse gas emissions from facilities that emitted more than 10,000 tCO2e/year in 2018, by subsector.

[123] In calendar year 2018 industrial sectors (including agriculture) had a combined gross product of $84.2 billion, of which $45.7 billion were in the aerospace & data processing sectors.



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 excluded)

From a greenhouse gas emissions standpoint, a few, energy- and emissions-intensive industries dominate. Most notably, as shown in Table 2, refineries and pulp and paper facilities each accounted for about a third of 2018 emissions reported by major facilities to Ecology. Most of the emissions from the pulp and paper facilities are due to combustion of biomass, which is considered less climatically intensive than fossil fuel combustion since new carbon sequestration may be occurring on the harvested land.

Aluminum and steel production (metals) accounted for another 8%, while lumber mills (wood products), food production and petroleum and natural gas systems account for another 4 to 5% each. These facilities, generally energy-intensive and trade-exposed (EITE), produce carbon dioxide 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 PFCs from aluminum production. Furthermore, the industrial sector accounts for 28% of electricity consumed in the state.[124]

However, the Washington Department of Ecology's mandatory greenhouse gas reporting program (Figure 16) captures only large, stationary, direct emitters, providing a partial, and possibly misleading, picture. Table 2 shows that from a financial perspective, Washington's industrial sector might be a little more varied than the survey of major emitters would imply:

Table 2. Washington State's 12 largest industrial sectors, in order of 2018 gross domestic product (GDP).

[124] U.S. Energy Information Administration, State Electricity Profile: Washington, 2018. "Table 8. Retail sales, revenue, and average retail price by sector, 1990 through 2018."

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

Furthermore, the large contribution of biogenic (biomass) emissions in Washington's industrial profile deserves a more nuanced treatment with regards to climate impact, along the lines of the biogenic CO_2 accounting framework developed by the U.S. EPA.

Actions

- The Department of Ecology should increase 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 policy.[125]
- The Department of Commerce should provide detailed industrial sector energy data (following a coordinated taxonomy with Ecology) using federal Energy Information Administration forms data, or new state reporting requirements if required.

1.2 Assess the Potential for Industrial Sector Greenhouse Gas Reduction Measures

The suite of commercially viable technologies for increasing efficiency or reducing carbon intensity is well understood and well documented. Not well understood, however, is how much potential there is in Washington's industrial sector to bring down energy consumption, or to displace direct fossil fuel combustion with electricity. Creating an inventory of the technical potential associated with different technologies will give Washington and its industrial entities the ability to calculate and commit to appropriate industry-sector decarbonization targets. There are four decarbonization approaches for the industrial sector:

Energy efficiency has been and continues to be the highest form of industrial environmental performance, bringing 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 HVAC solutions drawn from the building sector. In the industrial sector specifically, energy efficiency also includes efficient generation of heat and process efficiency, such as high-

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

temperature waste heat recovery; low-temperature waste heat recovery smart manufacturing;[126] variable-speed drives;[127] and compressed air efficiency.[128]

Electrification is a particularly powerful tool for industrial decarbonization in Washington. As the state's utilities comply with the Clean Energy Transformation Act, the electricity supply will gradually become cleaner and benefit the industrial sector's decarbonization efforts. According to the American Council for an Energy Efficient Economy (ACEEE), typically only about 15% of the energy consumption in the more energy-intensive industries is electricity. Ample opportunities for expansion of electric consumption exist:

- *Fuel-switching boilers* allow an industrial installation to generate steam either with a fossil fuel or with electricity;
- *Microwave or radiofrequency assist* uses 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* can deliver low-temperature process heat more efficiently than steam;
- *Membrane separation technologies* displace boiling and distillation with the much lower-energy approach of forcing a liquid against a sufficiently fine membrane. This technology is mostly applicable to petroleum refining;
- *Ultrasound-assisted, electromagnetic, or ohmic drying* are technologies specific to food processing and displace conventional oven-drying; and
- *Pulsed electric field, ultra-sonification, pulsed light, UV, or microwave pasteurization/sterilization* are technologies specific to food processing that displace conventional pasteurization and steam autoclave sterilization.

Combined heat and power (CHP). Most industrial facilities need significant amounts of both electricity and heat. Conventionally, electricity is purchased from the grid and heat is generated by combusting fossil fuels or biomass at the plant. CHP is a method for providing both, on-site. It is the use of low-grade heat exhausted by combustion-fired electric generation, for industrial purposes.[129]

Heat sharing involves the transportation of heat among multiple facilities. Heat is more difficult to transport than electricity but 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.

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

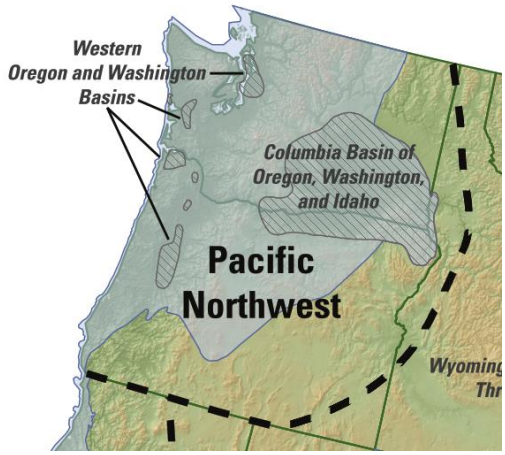
Smokestacks — large, fixed point sources of CO_2 emissions — are one unifying feature of the otherwise heterogeneous industrial sector and are convenient collection points of CO_2 that otherwise enter the

[126] Ellen McKewen, "What Is Smart Manufacturing? (Part 1A)," n.d., https://www.cmtc.com/blog/what-is-smart-manufacturing-part-1a-of-6.
[127] "Variable Speed Drives," ScienceDirect, n.d., https://www.sciencedirect.com/topics/engineering/variable-speed-drives.
[128] "Compressed Air Systems," Office of Energy Efficiency and Renewable Energy, n.d., https://www.energy.gov/eere/amo/compressed-air-systems.
[129] 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.

atmosphere as a greenhouse gas. Captured this way, there are at least three fates the CO_2 can undergo that all 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. Though Washington State has not been the subject of a detailed assay, initial investigations by the United State Geological Survey show meaningful potential for geological storage in our state (**Error! Reference source not found.**17).

Figure 17 – Potential CO_2 storage basins available in the Pacific Northwest



Source: U.S. Geological Survey.[130]

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.[131]

Carbon Reuse. CO_2 captured from smokestacks can be used as a source for carbon used to produce synthetic fuels (see 2.3 *Build a Clean Fuels Industry* below). 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, but the average duration of storage in construction materials might be lower than in the case of geological storage. Depending on the conventional building materials displaced, use in the built environment can also encourage displacement of more emissions-intensive materials.

Actions:

[130] "National Assessment of Geologic Carbon Dioxide Storage Resources - Results," *U.S. Geological Survey*, Circular, 2013, https://doi.org/10.3133/cir1386.
[131] 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.

- Enhance the public and policymakers' understanding of Washington's geological storage potential, by continuing to support research in this area.
- Incorporate carbon use and reuse technologies in the portfolio of Centralized Technical Assistance (see 1.6 *Provide Centralized Technical Assistance*).

1.4. Use a Technology-Neutral Regulatory Framework

While much is known about technologies that are available to help the industrial sector reduce emissions, the great diversity of operating requirements within the industrial sector means a one-size-fits-all, technology-specific prescription will not fit. Instead, a technology-neutral regulatory framework should set requirements associated with the primary desired outcome of reducing greenhouse gas emissions. A pair of policy mechanisms would be most effective, a low carbon fuel standard to reduce the carbon intensity of fuels used in mobile sources, and a regulatory program to reduce emissions from stationary sources, such as the Department of Ecology's Clean Air Rule to address stationary sources. An economy-wide cap & trade program is also a proven strategy for reducing emissions in the industrial sector in many countries around the world, and in California, Quebec, and the Northeast states participating in the Regional Greenhouse Gas Initiative (RGGI).

1.4.1. Low Carbon Fuels Standard

California, Oregon, and British Columbia have all promulgated relatively similar low carbon fuel standards (LCFS).[132,133,134,135] An LCFS displaces conventional gasoline and diesel fuels with low-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 can be extended to include off-road diesel, aviation fuel, and/or marine fuels to expand its impact on industrial sector emissions even further.

Revenue from LCFS credit sales could help fund zero emission vehicle charging and fueling infrastructure and could improve the economics of carbon capture and clean fuels production in the state. 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 should have the following features:

- The price signal should be sufficient to encourage clean fuels production in the state and achieve parity with similar standards in Oregon and California.
- Standards for different fuel and fuel production pathways should account for co-benefits, including:
    - Feedstocks that use waste products or limit impacts on food crops

[132] 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.
[133] Chapter 754, Oregon Laws 2009, An Act, HB 2186, Relating to greenhouse gas emissions; and declaring an emergency.
[134] Consolidated Statutes of British Columbia, Chapter 16, Greenhouse Gas Reduction (Renewable and Low Carbon Fuel Requirements) Act.
[135] Julie Witcover, "Pacific Coast Collaborative Low Carbon/Clean Fuel Standard Program Comparison" (UC Davis PIEEE, June 2018).

- Low-coproducts of biofuel manufacturing processes[136]
- Reduction of wildfire risk by using waste biomass from forest management

Action: Enact into law and implement the proposed Low Carbon Fuel Standard to establish a market and funding mechanism for clean fuels production.

1.4.2. Clean Air Rule

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

In March 2018, Thurston County Superior Court ruled parts of the Clean Air Rule invalid, which prevents the state from implementing the Clean Air Rule regulations and compliance with the rule is currently suspended. On Jan. 16, 2020, the Washington State Supreme Court ruled that the portions of the rule that applied to stationary sources were upheld, but that the portions that applied to indirect sources, such as natural gas distributors and fuel suppliers, were invalid. The Supreme Court remanded the case to Thurston County Superior Court to determine how to separate the rule.

The original CAR was based on the greenhouse gas limits that were in place prior to 2020 (25% below 1990 levels by 2035). A new rule designed to meet the new 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.

1.5. Ensure EITEs Face a Level Playing Field

Energy-intensive trade-exposed industries (EITEs) face a unique but clear set of pressures. "Trade exposure" means that competitors offering the same product will gain market share if the EITE's local operating costs increase. "Energy-intensive" means that those operating costs are tied particularly strongly to energy prices (versus labor or materials). The risk of leakage is genuine for some industrial sector companies because policies to restrict emissions within the state may shift those emissions to other locations.

Since EITEs transport goods over medium to long distances in geographically large markets, an EITE that finds its energy prices too high in one location can move and continue selling its products nationally or globally regardless of the manufacturing location. But the state's emission limits will require industry to do its part. Policy must neither push industrial activity out of the state nor exempt industry from compliance.

It is possible through engineering and economic analysis to measure the actual risk of leakage for individual industries and plants, and the results are likely to change over time. The state should undertake this analysis as part of an ongoing regulatory program for direct emitters.

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,

[136] *e.g.,* 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.

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,[137] continues to be the best solution to these issues. Just as a geographically large energy economy creates market efficiency, a geographically large policy environment accommodates niche markets, experimental policies, or staged policy implementation.

Actions:

- The Department of Commerce should monitor the costs of doing business for the primary EITE industries important to Washington and compare them with surrounding states.
- The Governor's Office and cabinet agencies should continue to engage with and strengthen the Pacific Coast Collaborative, with a continued focus on advancing coordinated climate and industrial policies along the West Coast.
- The state can achieve further emissions cuts and grow competitiveness by increasing incentives and support for industrial efficiency and emission control upgrades. For example, Washington could establish and capitalize an industrial transformation bank to fund the retooling and upgrading of Washington's EITEs and low-carbon fuel pilot projects. Eligibility and selection criteria should include strong labor and equity standards.

1.6. 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. Access to 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. Because Washington contains only a few entities within each given major industrial subsector, partnering regionally with multiple states to provide centralized technical assistance could be an especially effective approach.

A few 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 New York State Energy Research & Development Authority (NYSERDA) 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 needs:

- **Strategic Energy Management**, focused on identifying, implementing, and measuring energy optimization opportunities to reduce costs;
- **Flexible Technical Assistance**, offering objective, site-specific technical assistance on energy efficiency measures; and
- **On-site Energy Manager**, helping industries actively manage energy use and lower costs.[138]

[137] "Program Design and Implementation," WCI, Inc., n.d., https://wci-inc.org/our-work/program-design-and-implementation.
[138] "NYSERDA Industrial Programs," New York State, n.d., https://www.nyserda.ny.gov/All-Programs/Programs/Industrial-Programs.

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.[139]

The U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) also houses industrial technical assistance programs that the state could replicate, such as the Superior Energy Performance certification program that "provides industrial facilities with a transparent, globally accepted system for verifying energy performance improvements and management practices."[140]Although not the primary goal of these technical assistance programs, these efforts can also help to improve environmental, social, and economic conditions in communities with a focus on energy efficiency and lower energy consumption.

Actions:

- Expand the Department of Ecology's *Efficiency Services for Manufacturing and Industrial Facilities* program.
- Task the WSU Energy Program with assessing the quantitative potentials for efficiency, electrification, CHP, and heat sharing technologies in Washington's industrial sector (in conjunction with 1.2 *Build a Stakeholder Platform and Roadmap Process*).

1.7. Prepare for an Industrial Transition

Even with policy intention and intervention to maintain existing industry and grow new clean industries, some 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 accelerate decarbonization, and necessary to establish support for communities and workers who face an uncertain future, due to no fault of their own (see Chapter G-Workforce).

Steps to enable rapid decarbonization (e.g. expedited permitting or siting) should be thoughtfully implemented so as not to create environmental damage or economic disinvestment in local communities, referred to as "sacrifice zones," often through locally unwanted land use. The state could use an approach, such as the Washington Environmental Health Disparities Map tool[141] to identify the communities most impacted by siting a certain industry, and to determine the priorities of those frontline communities. The permitting and siting processes must ensure meaningful participation of and representation by those most impacted in decision making.[142]

Action:

- Identify the industries that are likely to experience transition early and make a transition plan for the workers well in advance of closure.

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[139] "Wisconsin's Focus on Energy," Focus on Energy: Partnering with Wisconsin Utilities, n.d., https://focusonenergy.com/.
[140] "About Industrial Technical Assistance," Office of Energy Efficiency and Renewable Energy, n.d., https://www.energy.gov/eere/amo/about-industrial-technical-assistance.
[141] "Washington Tracking Network: A Source for Environmental Public Health Data," n.d., https://fortress.wa.gov/doh/wtn/WTNIBL/.
[142] "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/.

- Ensure that policies promote labor standards, shared benefits and long-term support for Washington industries and jobs.
- Engage industry leaders, frontline community representatives, and labor unions from the outset in mapping the priorities of each group impacted by industrial policy.

2. Develop a Clean Energy Industrial Policy

Emissions from the industrial sector add a complex layer to an already challenging task for policy makers who 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 around the world.[143,144,145] 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 simultaneously reducing the environmental impacts of existing industries in the state.

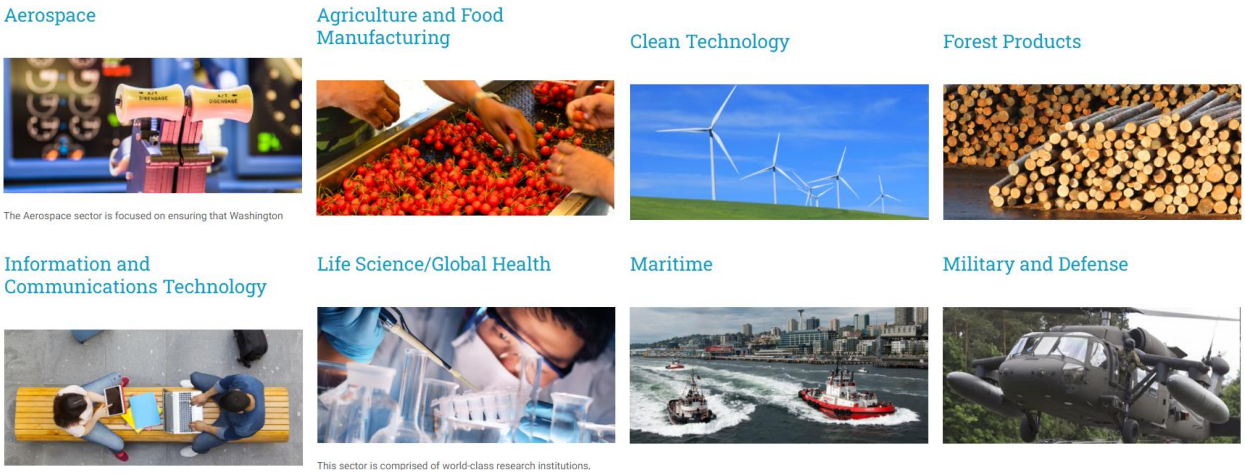
For example, Washington possesses significant advantages to attract the manufacturing supply chains of solar, storage and microelectronic technologies that will be key to driving our low carbon economy, particularly as it relates to polysilicon-based technologies.

2.1. Launch a Comprehensive Clean Energy 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. (See box Implementing an Industrial Policy) Washington's Department of Commerce currently focuses on eight such clusters:[146]

[143] "Investment and New Industrial Policies: World Investment Report 2018" (UNCTAD, Division of Investment, 2018).
[144] 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).
[145] 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.
[146] "Key Sectors Bring Focus to High Growth Industries," Washington State Department of Commerce, n.d., https://www.commerce.wa.gov/growing-the-economy/key-sectors/.



Washington has a long history of attention to international trade, including recent, state-organized trade missions to Japan, Korea, Norway, Germany, and China, and coordinated Washington manufacturers' presence at trade shows around the world. Industrial policy frameworks are rare in the United States, but the depth of experience in industrial policy is far greater overseas.

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 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, frontline community representatives, and labor unions must be engaged from the outset in mapping the priorities of those impacted.

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.
- 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.
- Ensure that any industrial policy promotes labor standards, shared benefits and decreases the likelihood that industries and jobs will leave Washington for other states.
- 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 and minimize risks for people who live or work where a project or manufacturing hub may be located.
- The state should use an approach, such as the Washington Environmental Health Disparities Map tool[147] to identify the communities most impacted by industries, and to determine the

[147] "Washington Tracking Network: A Source for Environmental Public Health Data."

priorities of those frontline communities. The permitting and siting processes must ensure meaningful participation of and representation by those most impacted in decision making.[148]

2.2. 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 one of the nation's 17 U.S. Department of Energy National Laboratories, Pacific Northwest National Laboratory. The Clean Tech Alliance represents over 1,100 members facilitating the growth of clean technology companies and jobs through education, research, and services.

Meanwhile, Washington has some of the nation's top public universities, and many already include centers of excellence in topics germane to the state energy strategy. For example, the Climate Impacts Group at the University of Washington, Washington State University's Energy Program, and the Institute for Energy Studies at Western Washington University. All entities are producing groundbreaking research and developing new products. An industrial policy only needs to continue to nudge Washington's strong culture of technology research and development toward clean energy technologies.

Washington's Maritime Blue Strategy was created in 2019 to accelerate innovation and create the nation's most sustainable maritime industry by 2050. The DDP modeling for the state energy strategy (see Chapter B) suggests that the maritime sector would remain a significant source of fossil fuel consumption in our state. 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 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.[149]

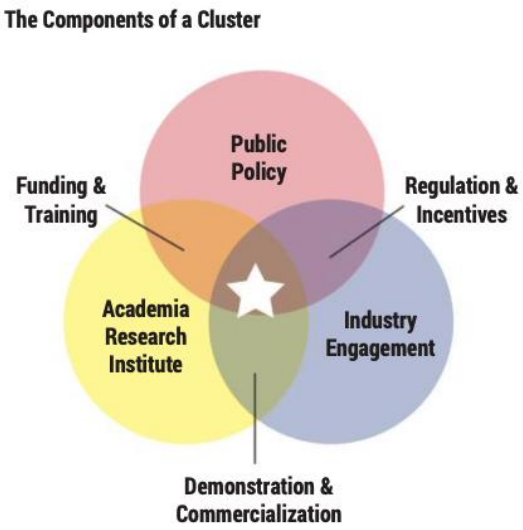
The strategy is grounded in deep decarbonization and focused on pursuing technological innovation, infrastructure, and incentives to transition local, coastal, and international maritime activity to a low-carbon future. Pilot projects to date include:

- Electrification of state and regional ferries
- Creation of the Maritime Innovation Center for convening stakeholders and incubating and supporting startups
- Youth outreach and career education programs to build a robust and inclusive workforce for the future

[148] "Front and Centered Approach to Equitable Greenhouse Gas Reduction in Washington State."
[149] "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,"[150] 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.

In addition to nurturing industry clusters, there are opportunities for state government to partner with individual companies. This can result in carbon reduction to help the state achieve its emission reduction 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.[151] Alaska Airlines plans to reduce carbon emissions with flights powered by sustainable aviation fuel in key routes.[152] Skanska, a construction firm, pledged to eliminate emissions from both direct operations and its supply chain.[153] Amazon has pledged to be zero net carbon by 2040 and announced an initiative to electrify its delivery fleet.[154] 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.[155]

Actions:

[150] "World Class Cluster," Washington Maritime Blue, n.d., http://maritimeblue.org/cluster-2/.
[151] 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.
[152] "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/.
[153] "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/.
[154]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.
[155] "Paccar: Sustainability," n.d., https://www.paccar.com/about-us/environmental-and-social/environmental/.

- Replicate Maritime Blue for other centers of research and development that would accelerate and support emerging low-carbon industrial opportunities (See 2.3, Build a Clean Fuels Industry).
- Create a knowledge center on public-private collaboration to help firms make and meet broader climate commitments through capacity buildings and knowledge sharing. This collaboration could also yield technical tools that may benefit the state's emissions reduction goals and should be organized in conjunction with the regional technical assistance program (see 1.6 Provide Centralized Technical Assistance).

2.3. Build a Clean Fuels Industry

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. (See Chapter B.) There is a need to develop and deploy technologies that can provide decarbonized fuels economically.

New technologies being researched, developed and deployed include "green hydrogen"[156] 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 $C0_2$. 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.

2.3.1 Synthetic Liquid Fuels

As discussed in the Chapter on transportation, 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 pressure to produce low carbon, liquid fuels to replace higher carbon fossil fuels. The industrial sector, and especially Washington's robust petroleum refining industry, could play an important role in meeting the demand for low carbon, liquid fuels during the next decade and beyond.

Petroleum fuels are hydrocarbons, molecules built primarily from carbon and hydrogen. The technologies available to synthesize petroleum substitutes are well known and most of those synthetic fuels will be hydrocarbons too. The petroleum industry in Washington has the equipment and the know-how to become a leading innovator and producer of synthetic fuels. [157,158] 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 the energy paradigm Washington will choose.

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

[157] 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.

[158] 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.

2.3.2. 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 a decade ago in creating the Sustainable Aviation Fuels Northwest (SAFN) initiative,[159] 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,[160] 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)[161] with the Massachusetts Institute of Technology to create science-based solutions for the aviation industry's most difficult environmental challenges. ASCENT released a study[162] on October 23, 2020 looking at the availability of sustainable biomass in the region.

In addition, while early efforts to develop short-haul electric airplanes have met challenges, Washington is home to two electric aviation companies, MaginX and EviationAero. Washington's Green Economy report notes that "WSDOT was directed to identify up to six airports in Washington that may benefit from a pilot program once electrically propelled aircraft become available for commercial use. The six sites will allow for performance evaluations as electric aircraft technology matures and may offer communities the opportunity to restore, expand or establish commercial air service."[163]

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 the building a testing facility in Washington for electric aircraft; and invest in upgraded infrastructure for testing electric aircraft.

2.3.3. A New Hydrogen Economy

Twenty years ago, a vision for the "hydrogen economy" took hold, in which a nontoxic, odorless, gaseous fuel whips around the country in shiny new pipelines and speeds fuel-cell-powered "hypercars."

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

[160] "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.

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

[162] 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.

[163] "Washington's Green Economy" (Washington State Department of Commerce, 2020), https://deptofcommerce.app.box.com/s/jpy44m0svj05sfxp8353khsceq42lfss.

[164] 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. Like electricity, you can only get as much energy out of hydrogen as you put in to manufacture it. Further, hydrogen, like electricity, is only as clean as the energy you put into it. Hydrogen is useful as a directly consumed power source for fuel cells. Hydrogen also can play an important role in 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.

The industrial sector will be the source of hydrogen because it is a manufactured commodity. Petroleum refineries already include systems to produce and handle hydrogen, so are likely starting points for increasing production. Current practice is to strip hydrogen from fossil petroleum feedstocks, resulting in greenhouse gas emissions. To help meet emissions limits hydrogen must originate from biomass or be extracted from water via electrolysis using zero- or low-carbon electricity.

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.[165]

2.3.4. Biomass as a Foundational Resource

Fossil fuels are ancient vegetation. The plants growing now (biomass) contain both carbon and hydrogen, just as fossil fuels do. No matter whether the state's liquid fuels are fossil fuels or synthetic fuels derived from biomass (biofuel), in both cases there are the same two combustion products: carbon dioxide and water. The difference between the two is what happens *after* the fuel has been extracted. After biomass is harvested, new biomass can grow at the harvest site, extracting carbon dioxide from the atmosphere while it is being emitted by the biofuel.

Biomass can also be combusted directly as a solid fuel. Whether in liquid or solid form, biomass can support those industrial processes most in need of heat, or most in need of the dispatch made served by liquid or gaseous fuels. In this way, biomass can supplement the role of electricity.

Managing the state's biomass resource is a complex assignment physically, economically, and politically. The extent of biomass available for energy is highly uncertain and depends on the quality of biomass needed; cost to harvest, transport, and replant; and the impact of environmental protections needed.

Action:

- The Departments of Natural Resources, Agriculture, Fish & Wildlife, and Commerce should collaboratively assess Washington's biomass resource to provide a foundation of information on which the state can base future policies.

[164] *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.
[165] European Commission, "A Hydrogen Strategy for a Climate-Neutral Europe," 2020, https://ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf.

2.3.5. Support research and demonstration projects for emerging clean fuels

Fostering a market for clean fuels is essential for driving innovation. At the same time, a strong price signal may not be enough to accelerate innovation at the pace and scale needed to rapidly reduce greenhouse gas emissions. A key part of the state's strategy must be to support continued clean fuels innovation across multiple sectors important to the state's economy.

Action: The state should support the development of new clean fuels through targeted research, development, and demonstration efforts. These could include:

- Investing resources from the Clean Energy Fund in the support of the development of biomass, renewable, and electro-fuel technologies.
- Establishing an innovation cluster for clean fuels within Commerce's Office of Economic Development, replicating the Maritime Blue model as described above in Strategy 2.1.
- Expanding research and development for new fuels and technologies to reduce industrial emissions.
    - Engage with utilities, national labs, federal agencies, and potential private sector investors to assess the feasibility of establishing a renewable hydrogen program in the state and determining whether Washington should lead in developing and deploying the technologies necessary to manufacture, transport, and store it.
    - Create an interagency working group to inventory the state's biomass resources and to assess the opportunity to build a market for forest and wildfire management by using woody biomass for in-state biomass production and, potentially, carbon sequestration.
    - Develop a state policy on carbon capture, use, and storage (CCUS), support efforts by PNNL to fully characterize the potential for basalt storage in Washington and Oregon and identify actions to facilitate the permitting of CCUS facilities.
- Conduct a detailed assessment of post-consumer organic waste streams as feedstocks for biorefining.

3. Expand Policy Scope to Embrace Consumption

Washington has some of the most sophisticated manufacturing technology capabilities in the world and is home to some of the best-in-class facilities on the planet in terms of embodied carbon in building and manufacturing materials such as steel rebar[166] and aerospace aluminum products.[167,168]

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 an in-state and global decline in greenhouse gas emissions. In addition to decarbonizing existing industry, Washington is emerging as a leader in the global clean tech industry[169]

[166] 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/).

[167] 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/.

[168] 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.

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

and green building,[170] thus 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 complementary and both essential strategies. Washington's Center for Sustainable Infrastructure[171] and the University of Washington Carbon Leadership Forum[172] are laying important groundwork in this area by developing standardized approaches for measuring embodied carbon.

Action: Washington should establish labeling requirements and use procurement to support low-carbon intensity producers.

3.1. Conduct a consumption-based Inventory

Emissions associated with the manufacture and transport of consumer products are referred to as "upstream emissions," "embodied emissions," or "embodied carbon." Emission inventories that include the embodied carbon of goods and services purchased by consumers are called "consumption-basis" inventories.[173]

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.[174]

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.[175]

It is important to understand the emissions associated with Washington's consumption patterns and the extent to which emissions from consumptions differ from production emissions. While the Oregon and King County examples result in 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

[170] 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.
[171] https://www.sustaininfrastructure.org/
[172] "EC3 Tool Methodology," Carbon Leadership Forum, accessed October 26, 2020, https://carbonleadershipforum.org/projects/ec3-methodology/.
[173] 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.
[174] 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.
[175] "Consumption-Based Greenhouse Gas Emissions Inventory for Oregon," accessed October 26, 2020, https://www.oregon.gov/deq/mm/pages/consumption-based-ghg.aspx.

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.[176]

Action: To equitably allocate the costs and benefits of economy-wide decarbonization Washington should take steps to understand the distribution of both production-based and consumption-based emissions and consider doing a consumption-based inventory.

3.2. Develop Environmental Product Declarations (EPDs) for products and 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 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.[177] Without regulatory requirement, the disclosure of life-cycle emissions is left to voluntary private sector action. Increasingly, however, private companies are requiring EPDs for their construction projects. State and local governments are funders and purchasers of many of these products and could play a significant role in 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.

3.3. Buy Clean and Buy Fair Policies

Public procurement is an effective way to demonstrate government's commitment to environmental and social standards and support in-state industry. The fundamental premise behind procurement policy is that taxpayer dollars are spent bolstering, rather than undermining, public policy goals. When the state spends money on infrastructure, buildings, and other products and services, it can require certain emissions and workforce conditions. Buy Clean and Buy Fair policies ensure that materials purchased by the state are manufactured under high environmental and labor standards, thus supporting industrial decarbonization and job quality.

In 2018, HB 2412 proposed that Washington state agencies award construction contracts that require EPDs for an eligible list of materials. [178] While the bill did not move forward in the Legislature that year, the capital budget authorized a Buy Clean study to develop embodied carbon policy options and

[176] 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.
[177] The International EPD® System, "What Is an EPD? - The International EPD® System," accessed December 28, 2018, https://www.environdec.com/What-is-an-EPD/.
[178] Washington State Legislature, House Bill 2412 (2017-2018), "Relating to creating the buy clean Washington act; and adding a new chapter to Title 39 RCW."

recommendations for the state.

While there is foundational work required to ensure transparency in emissions disclosure, tracking, and reporting, the eventual goal of a Buy Clean, Buy Fair policy is to eliminate the unfair advantage enjoyed by manufacturers that are not investing in emission reductions and a skilled workforce. In this way, Buy Clean, Buy Fair policies help stimulate private sector investment in industrial decarbonization while supporting competitiveness of in-state manufacturers.

Action:

- Washington should collaborate with labor and industry organizations to actively grow Washington's manufacturing of low-carbon materials and advanced technologies and leverage its purchasing power to level the playing field for low-carbon producers with responsible business practices.
- The state should adopt Buy Clean and Buy Fair policies that promote spending public dollars on materials that are manufactured with high environmental standards and labor standards, similar to the Buy Clean California Act.[179]

[179] "Buy Clean California Act," DGS Procurement Division, n.d., https://www.dgs.ca.gov/PD/Resources/Page-Content/Procurement-Division-Resources-List-Folder/Buy-Clean-California-Act.

4. Implementing an Industrial Policy in 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 agency leadership could feature more frequent energy planning, increased data gathering authority, or increased regulatory authority.

A headquarters for industrial policy. States in the U.S., including Washington, have not typically stewarded 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.

Industrial sector intelligence. 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.

Mid-course correction. An increased frequency of, or attention to, energy planning allows for greater control of the pathway 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 long in the tooth 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.

Institutional knowledge. Increased attention to energy planning also means that the agency expertise built during each energy strategy exercise remains intact, rather than fading away.

Regulatory streamlining. 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.

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 loads to meet the increasing demand from buildings, industry, and transportation. With its 69% clean grid,[180] ambitious clean electricity

[180]"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.

requirements, and deep expertise in electricity Washington is poised to be a leader in the transition to an electrified, decarbonized economy in the coming decade.

The electricity sector strategies complement those proposed for the other sectors – particularly the transportation and buildings sectors, where end uses must be electrified where possible. The strategies are designed to:

- Achieve Clean Energy Transformation Act (CETA) mandates for greenhouse gas neutral electricity by 2030 and 100% carbon free electricity by 2045 while addressing equity, reliability and resource adequacy concerns.
- Meet energy and capacity requirements for increased electricity use by the transportation, buildings, and industrial sectors.
- Increase grid resiliency and satisfy community demands for electricity services.[181]
- Advance an equitable clean energy economy and create living-wage jobs.

Building on CETA

CETA provides a comprehensive framework for achieving 100% clean electricity in Washington. The recommended strategies presented below build on the law's policy foundation and regulatory reforms.

To achieve a 100% clean electricity supply by 2045, CETA establishes milestones for all electric utilities serving retail customers in the state. The first milestone is 2025, when coal generation must be eliminated from utility portfolios. By 2030, electricity must be 100% carbon-neutral, with offsets allowed for up to 20% of utility portfolios.[182] By 2045, utilities must supply 100% carbon-free electricity, with offsets no longer allowed as a compliance alternative.

In addition to these milestones, CETA requires that a social cost of carbon be factored into utility planning. The law identifies a role for performance incentive mechanisms, grid modernization, continued investment in energy efficiency, demand response, and distributed energy resources.

CETA also expands the public interest objectives of utilities to include consideration of: the equitable distribution of energy and benefits, and reduction of burdens to vulnerable populations and highly impacted communities; long-term and short-term public health, economic, and environmental benefits and the reduction of costs and risks; and energy security and resilience.

Finally, CETA promotes family wage jobs and high labor standards. The law provides tax incentives for clean energy projects that meet explicit labor guidelines, such as employing a diverse workforce, paying prevailing wages, and allowing collective bargaining.

[181] 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. 11/4/2020 1:31:00 PM

[182] Offsetting actions include unbundled renewable energy credits, energy transformation projects, alternative compliance payments, and - potentially - electricity generated at the Spokane municipal solid waste incinerator. Source: Chapter 19.405 RCW.

Transformational Role of Electricity

The deep decarbonization pathways analysis performed for this strategy, and a review of decarbonization plans and independent analyses from organizations and other jurisdictions all point to a transformational role for the electricity sector in a decarbonized future.

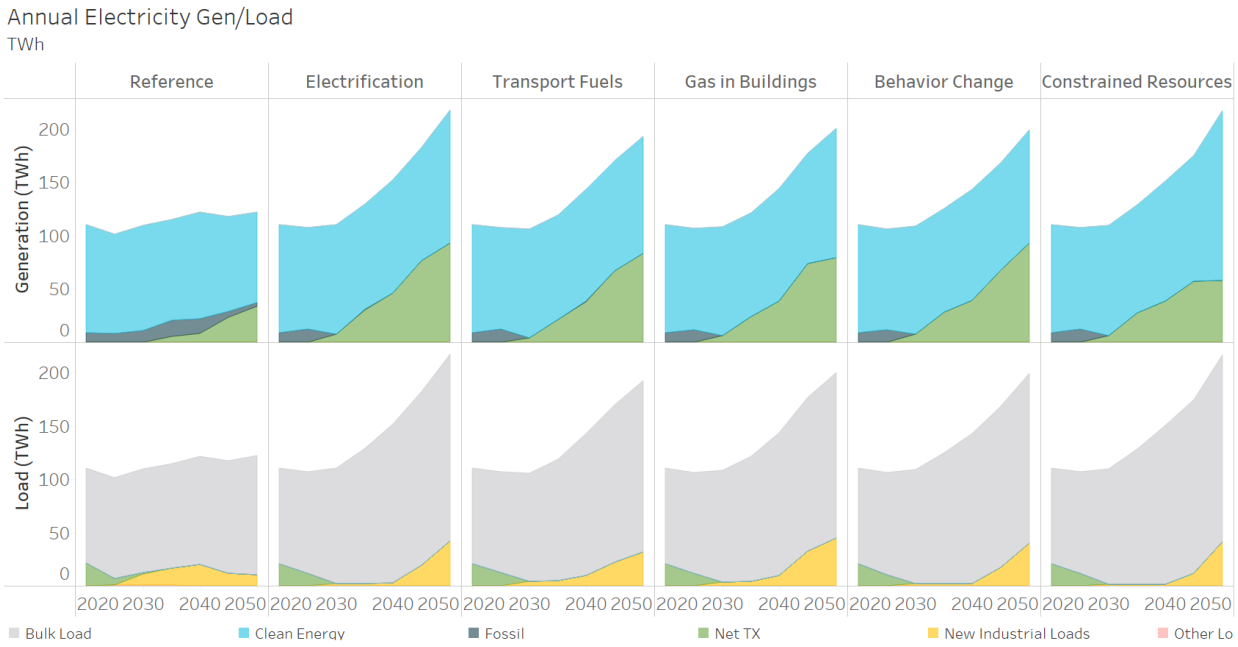
As the transition to clean energy takes hold, demand for electricity will rapidly increase, Modeling developed for this strategy suggests that electricity demand in Washington could grow from 13 to 20% over 2020 levels by 2030 and from 70-92% by 2050 as shown in Figure 18. This translates into 10-16 TWh of additional load by 2030. By 2045, electricity could be powering 42-50% of the state's energy needs, 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.

> In a decarbonized future, clean electricity is expected to become the primary energy source for the economy, powering most of transportation and industry and providing virtually all energy for heating and cooling buildings – in addition to serving the traditional loads of lighting, appliances, and space heating.

Modelling indicates that much of this need can best be met by drawing on new capacity resources outside of Washington, such as wind from Montana and Wyoming and solar from the Southwest, along with in-state renewables, demand-side solutions, storage, and other non-emitting resources.

These new or expanded resources will require expanded transmission capacity along with a modernized flexible grid and robust communication systems to manage loads and maintain reliability. Non-wire solutions such as demand response, automated load control, grid-interactive efficient buildings, and distribution level storage and energy systems will also play a vital role. In addition, a low- or zero-emission liquid and gaseous fuels are likely to be required in limited quantities to cost-effectively maintain reliability.

Figure 18. Potential Future Energy Mix in DDP Modeling



The approach to achieving CETA's goals and meeting increased electricity demand requires of a suite of policies and actions falling into three interrelated strategies:

1) Accelerating investment in renewable generating resources and transmission

2) Modernizing the electricity grid to maximize flexibility, efficiency and resilience

3) Facilitating equitable deployment of renewable generation resources and grid services to promote community resilience

Ingredients for Success: Policy Alignment and Bold Action

Implementing these electricity strategies will help put Washington on the path to electrify and decarbonize its economy rapidly and equitably. The strategies require policy alignment; new market mechanisms; collective action; new financing methods; public/private partnerships; programmatic initiatives; and other institutional, operational, and systemic changes.

While implementation requires bold, collective action, success will mean enormous benefits to Washingtonians. The promise is for a future economy powered by carbon-free electrons at a cost that is competitive with today's energy system. At the same time, the state will virtually eliminate greenhouse gas emissions, improve air quality, and deliver health, community, resilience, and equity benefits.

The strategies and associated policies and actions are designed to be pursued in parallel, but with specific policies and actions sequenced within and across the different strategies. For example, regulatory changes will facilitate utility investments in grid modernization and optimization, and deployment of distributed energy resources (DERs). These are needed to enable rapid, affordable electrification.

In general, the state and its utilities need to pursue all three strategies aggressively over the next 10 years to transition to 100% clean energy and meet expected future growth in demand from

electrification while ensuring reliability and achieving equity goals. As the strategies are implemented, policy makers will need to monitor progress and adjust as needed depending upon issues and challenges encountered, to ensure that goals and targets are met. Key variables and uncertainties include:

1) how much new renewable generation can and should be built in Washington considering environmental, economic, and community factors;

2) whether barriers to building new transmission facilities can be overcome in a timely fashion; and

3) what will be required to realize the potential for a modernized, smart grid with non-wire alternatives, including distributed energy resources to effectively manage a system characterized by ever-increasing variability on both the supply and demand side.

1. Accelerate Investment in Renewable Generating Resources and Transmission

As discussed above and in the deep decarbonization pathways analysis, even with enhanced efficiencies and behavior changes Washington will require significant quantities of new clean generation to meet the future energy requirements of its businesses and households. CETA requires a shift from coal and gas-fired power generation to renewable and non-emitting sources. There will be additional demand for electricity to replace fossil fuels in transportation, buildings, and industry.

The resource requirements include not just new power generation facilities, but also expanded transmission capacity, demand response resources, end use energy efficiency, and modernization of the electric distribution grid. Washington's utilities have the opportunity to choose among multiple types of generation resources. The model results suggest wind and solar will be the most cost-effective, but under CETA nuclear generation has the opportunity to compete as well. More specific resource decisions will be informed by the 2021 Northwest Power Plan[183] and individual utility integrated resource plans.

These investments represent an important economic and financial opportunity for workers and businesses. However, after almost 30 years of stable electricity demand,[184] electric resource acquisition of this scale and pace will be an unfamiliar challenge for utilities, project developers, the financial community, regulators, and siting agencies. The Legislature anticipated this in CETA with additional planning requirements[185] and authority for the UTC to use alternative regulatory approaches.[186]

Recommended approaches to meet this challenge successfully focus on a stronger power grid across the West, 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.

[183] "The 2021 Northwest Power Plan," November 1, 2020, https://www.nwcouncil.org/2021-northwest-power-plan.
[184] 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.
[185] Chapter 19.280.030 RCW.
[186] Chapter 80.28.401 RCW; Chapter 80.04.250 RCW.

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

A highly renewable power system needs more transmission capacity than a fossil-based system. Enhanced transmission capacity would improve Washington's 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.

The Western Interstate Energy Board concluded that the increased regional grid integration and market coordination would lower future electricity costs and significantly reduce the potential for renewables curtailments. Under baseline business-as-usual assumptions, renewable curtailments could approach 20% of total renewable energy production by 2035. In contrast, with regional coordination, curtailments would be less than 10% and production costs would be $2.2 billion lower than in the baseline case. Limited regional coordination (with no day-ahead market) results in the highest increase in costs ($11.3 billion in 2035) and leads to renewables curtailment of 50%.

1.1.1. Pursue opportunities for enhanced planning and integration across the Western grid

A regional approach involves increased planning, collaboration, and integration across the Western grid — the region overseen by the Western Electric Coordinating Council (WECC) and encompassing 14 states and portions of Western Canada and Northern Mexico**.**

Regional integration can directly benefit Washington, support reliability, and enable Washington's clean grid to help other states achieve their own decarbonization goals.

Through regional integration, each state will be able to decarbonize faster, further, and at lower cost. A study by the Western Interstate Energy Board found that regional coordination could reduce renewable curtailments and lower regional energy production costs by $2.2 billion annually by 2035 compared to business as usual.[187]**Action:**

- Continue to engage in and provide support for regional integration dialogues, planning, and initiatives

1.1.2. Evaluate the need for joint development of new and upgraded transmission capacity

While it is clear that Washington will need more transmission capacity with a decarbonized energy system, it is less clear who will, or should, take the lead in acquiring that capacity. BPA operates core elements of the Northwest transmission system and regularly upgrades its system to meet the needs of utilities and resource owners.[188] Utilities acting individually or collectively, may elect to invest in transmission capacity. More direction from state policy makers may be required if needed transmission expansion appears to stall. A logical forum for this is the transmission corridors workgroup created by the Legislature as part of CETA.[189] The primary focus of this workgroup is to ensure adequate transmission capacity and appropriate environmental review of transmission projects within the state.

[187] Energy Strategies, "Western Flexibility Assessment" (Western Interstate Energy Board, 2019).

[188] "2018-2023 Strategic Plan Progress Update" (Bonneville Power Administration, 2020), https://www.bpa.gov/StrategicPlan/StrategicPlan/2020-Strategic-Update.pdf.

[189] Chapter 19.405.150 RCW.

In addition to new capacity, some experts believe that additional capacity can be made available within the existing system through reforming transmission pricing and contract structures.[190]

Actions:

- Support efforts to evaluate the need for and expand transmission capacity
- Engage the transmission corridors work group in evaluating progress and recommending changes as needed

1.2. Encourage and Monitor Development of a Rigorous Resource Adequacy Program

One of the core requirements of CETA is that the power system continue to provide reliable service. Each utility must address resource adequacy in its planning[191] and provide a mechanism to suspend the clean energy transition as necessary to preserve reliability.[192] Commerce is directed to lead an evaluation of the impact of CETA's requirements on system reliability and other values, starting in 2023.[193]

The Northwest Power Pool (NWPP), composed of major generating utilities serving the Northwestern U.S., British Columbia and Alberta, has proposed a program in which individual utilities would adopt consistent standards for the amount and type of resources needed to serve customers reliably. A resource adequacy (RA) standard and program not only reduces the risk of a shortage of electricity supply, but also lowers the amount of resources needed to achieve any particular level of reliability.[194] The NWPP Resource Adequacy Program development process includes a Stakeholder Advisory Committee (SAC) consisting of representatives from 21 organizations, including Washington State. Members of the SAC are carefully evaluating and discussing each phase of the program design.

The NWPP RA initiative should be encouraged by policy makers. It is important that the UTC, Commerce, and legislators monitor its progress because success is not assured. If necessary, policy makers should be prepared to adopt more specific requirements by rule or statute. Two elements are of particular concern. First, participation by electric utilities will be voluntary, though utilities that opt into the standard will be subject to mandatory performance standards. If some utilities choose not to participate, it will be important to understand the reasons for that decision and to ensure that non-participants are not jeopardizing the reliability of either their own customers or the customers of other utilities. Second, the resource adequacy program will require complex analysis of resource requirements and the reliability contributions of diverse resources, such as hydro, wind, solar, storage, and demand response.[195] The analytical methods must be consistent and transparent, and they must account for the

[190] Stakeholder/experts interviewed for the strategy explained that, under current arrangements, some transmission paths show that they are "full" or "constrained," even though physical capacity is available - but is being reserved for peak times, which only occur a few hours of the year. Thus, current practices do not always optimize full use of existing transmission assets at all times.

[191] Chapter 19.280.030 RCW.

[192] Chapter 19.405.090 RCW.

[193] Chapter 19.405.080 RCW.

[194] "Resource Adequacy Program – Conceptual Design" (Northwest Power Pool, 2020), https://www.nwpp.org/private-media/documents/2020-07-31_RAPDP_PublicCD_v2.pdf. The NWPP started a voluntary interim resource adequacy program in July 2020 that focuses on a day-ahead time horizon.

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

diverse capabilities of these resources to ensure that renewables, storage and hybrid resources compete on an equal footing with thermal resources.

Actions:

- Continue to engage in and support the NWPP resource adequacy initiative
- Review the progress and outcomes of the NWPP initiative and evaluate the need for additional state action if goals are not met.

1.3. Reform and Expand Wholesale Electricity Markets

Wholesale markets are important for maintaining reliable service and affordable prices for Washington's electricity supply. Invisible but beneficial to individual customers, they 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 having to build or separately procure 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.[196] 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 of the utilities serving Washington customers will participate directly or indirectly in the EIM.[197] These markets have saved customers billions of dollars, compared to the cost for each utility to run its own power plants to serve its own customers every hour.[198]

Expansion and reform of wholesale electricity markets, as described below, is key to decarbonization of the electricity grid and the entire energy economy.

1.3.1. Establish markets for capacity and demand response resources

Electric utilities require both energy and capacity sufficient to meet their customers' demand. Energy, expressed in mega-watt hours, is measured over time. Capacity, expressed in megawatts, is measured at a point in time. A utility must have energy to supply the electricity that customers use over a month or year, but it also must have capacity to meet load when demand is at its highest as well as when intermittent renewable resources are limited. The electricity markets described above allow trade in energy, but there is no organized market to identify and allocate the least cost combination of capacity resources to provide reliable service during peak demand periods. Without a capacity market that trades separately from electric energy, resource portfolios that provide sufficient capacity at peak times are likely to provide surplus energy at other times. Wholesale electric energy prices may become lower and more volatile. Without adequate compensation for capacity contributions, these changes could threaten the financial position of power plant owners who currently rely on revenue from market

[196] "Wholesale Electricity and Natural Gas Market Data," November 1, 2020, https://www.eia.gov/electricity/wholesale/.
[197] "Western EIM Factsheet" (California ISO, 2020), https://www.westerneim.com/Documents/WesternEIMFactSheet.pdf.
[198] "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.

transactions. Conversely, with the region potentially facing capacity shortages in the future, the need for new resources and effective capacity markets is increasing.

Accordingly, as capacity requirements play an ever-increasing role in balancing electricity supply and demand, it will be important that the region have a market where capacity resources can be traded to minimize costs. There are multiple resources that can provide dispatchable capacity, including generating resources, storage, flexible loads such as hydrogen production, and demand response devices such as smart water heaters and EV chargers. However, in the absence of effective markets for clean supply and demand-side capacity resources, utilities are likely to default to building natural gas peaking plants to meet their capacity needs making it more difficult to meet CETA requirements and emission reduction targets.

The electric industry itself should take the lead in establishing the needed market structure to support the development of clean capacity resources. This is a complex undertaking and will take time. Other regions have struggled to get the details of capacity market design right.[199] The resource adequacy standards discussed above must be established before a successful capacity market will be feasible. In the meantime, utilities should develop distributed energy resources within their service territories as discussed in section 2 below.

Actions:

- Utilities should collaborate to establish and deploy the market mechanisms needed for clean energy capacity resources, including demand-side resources.
- Commerce should review progress towards establishing these markets and developing the needed resources as part of its assessment of system reliability and CETA to be conducted in 2023[200] and be prepared to take additional action as needed.

1.3.2. Develop market rules to allow trade in renewable, fossil-free resources

The existing wholesale electricity markets also require reform to ensure that market rules do not 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 do not always differentiate between electricity from renewable sources and electricity from natural gas or coal-fired plants. While the market traders have the option to specify that the electricity will be renewable, the vast majority of trades currently are for "unspecified electricity." This market rule is the result of industry practice rather than any legal requirement.

CETA provides that unspecified electricity cannot be claimed as clean electricity to meet the 2030 greenhouse gas neutral requirement. A utility could use unspecified electricity for up to 20% of its resources only if the utility pairs that electricity with renewable energy certificates or other compliance instruments.[201] In 2018, the aggregate resource mix of Washington utilities included 13% unspecified electricity, and the highest use for an individual utility was 63%.[202]

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[199] Federal Energy Regulatory Commission, "Order No. 2222: Participation of Distributed Energy Resource Aggregations in Markets Operated by Regional Transmission Organizations and Independent System Operators," 2020, 222, https://www.ferc.gov/sites/default/files/2020-09/E-1_0.pdf.

[200] Chapter 19.405.080 RCW.

[201] Chapter 19.405.040 RCW.

[202] "Washington State Electric Utility Fuel Mix Disclosure Reports: For Calendar Year 2018."

To address the potential conflict between market practices and clean electricity requirements, CETA requires that Commerce and the UTC establish a carbon and electricity markets workgroup to provide input into rules to address the use of market purchases to serve retail customers.[203] The agencies established this workgroup in November 2019 and are required to adopt rules by June 2022.

Action:

- Through the carbon and electricity markets workgroup, adopt rules to facilitate trade in renewables and other non-carbon emitting resources. Identify and address conflicts between market practices and CETA clean electricity requirements.

1.3.3. Expand the organized market to trade longer term resources

In addition to the market changes discussed above, Washington utilities and regulators should be encouraged to continue efforts to expand the scope of the short-term energy market operated by CAISO. This should include increased participation by Washington utilities in the Western EIM and establishing a mechanism to select the lowest cost portfolio of resources to meet expected demand in the day ahead market.[204]

Successful development of a day-ahead market 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.[205] Public power utilities in the Northwest have published a set of principles for appropriate governance of an expanded market.[206] 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.

Actions:

- Continue efforts now being undertaken by utilities and regulators to establish day-ahead markets and create a governance structure and system that will work for all participants.
- Once these markets and systems are in place, evaluate the potential for and, if viable, establish longer term, forward capacity markets (e.g. 6-month forward contracts).
- Encourage and facilitate the movement towards a fully integrated regional market.

1.4. Assess Potential for and Facilitate Deployment of New Clean Energy Resources in State

As Washington's utilities develop their CETA implementation plans and identify resource requirements, they will need detailed information about potential locations for clean energy resources. Accurate site information could speed the resource development process, reduce duplication of efforts, and head off conflicts among competing uses of resources, including military uses.

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[203] Chapter 19.405.130 RCW.

[204] "Extending the Day-Ahead Market to EIM Entities" (California ISO, 2019), http://www.caiso.com/InitiativeDocuments/IssuePaper-ExtendedDayAheadMarket.pdf.

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

[206] "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.

A statewide clean energy potential assessment to identify and qualify sites that meet environmental, social, technical, and economic criteria for the location of new renewable and non-emitting energy resources, including generation, associated transmission, and storage, could help inform planning and siting decisions. [207] An assessment should engage diverse stakeholders and communities, apply a robust equity lens to ensure sharing of burdens and benefits, and incorporate public health and environmental health as a component of the review.

This assessment should include existing proposed storage projects and potential new sites. The study should quantify the feasible amount of new capacity that can be built across the state and assess the extent to which distributed energy resources, such as rooftop solar, can reduce the amount of land needed for utility-scale generation in Washington.

This study should also identify the need for and potential location of new transmission facilities.

A thorough and balanced clean energy resource potential assessment could serve as the basis for public policy initiatives to encourage development on preferred sites. For example, this assessment might serve as the basis for designated projects under the statewide significance statute[208] or comparable mechanisms to allow for expedited environmental review.

Actions:

- Conduct a statewide clean energy potential assessment study
- Use the results of this study to identify priority locations for new generation, storage, and other related clean energy facilities as well as associated transmission projects.
- Through EFSEC, facilitate the siting and permitting of projects located in these priority locations and essential for decarbonization.

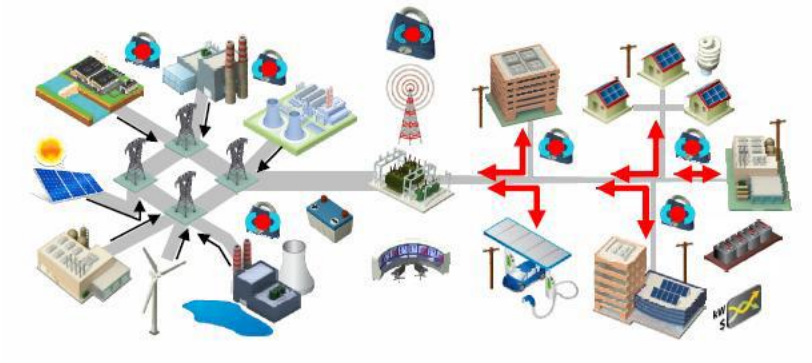
2. Modernize the Electricity Grid to Maximize Resilience, Flexibility, and Efficiency

A modern smart grid is a foundational investment to meet CETA goals and enable a decarbonized economy. The future grid will need to be resilient, containing the size and spread of potential outages reducing impacts on customers and increasing the speed of recovery. A modern grid must also be more flexible, able to maintain reliability while integrating variable renewable clean generation and managing centralized, utility-scale power plants together with distributed resources such as rooftop solar, residential battery storage, and smart appliances.

Developing a modern grid will require new planning processes, infrastructure, software solutions, and other tools. 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 to a range of possible scenarios including seismic, wildfire, and cyber-attacks:[209]

A Modern Grid

[207] Grace Wu et al., "Power of Place: Land Conservation and Clean Energy Pathways for California" (The Nature Conservancy, 2019), https://www.scienceforconservation.org/products/power-of-place.
[208] Chapter 43.157 RCW.
[209] Ref Appendix for PNNL presentations



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 modernized grid may not always need to start with new transmission build out. Supported by new markets for firm capacity and other essential grid services[210], the deployment of flexible capacity through demand response programs and other "non-wires" strategies such as microgrids will reduce 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 for ongoing and peak demand.

This system must allow for two-way energy flows and management of the entire grid using information and digital technologies. Enabling tools include:

- Software to link transmission and distribution level planning and operations, enable predictable and responsive loads, and coordination with storage
- Energy controls that allow large numbers of smart DERs to respond automatically to economic signals and provide flexibility needed to maintain grid reliability.
- Advanced metering infrastructure (AMI) and related smart meter devices to enable flexible retail rates and demand-side management
- Robust data and metrics to support decision making and provide signals to utilities and customers
- Advanced energy storage systems, located on the distribution system (e.g., at substations) and beyond the meter (e.g., EV batteries), potentially including utility-scale storage (e.g., pumped storage)
- Software for cyber-security
- Integrated planning and coordination of the electricity and gas distribution systems

A modern, flexible, and smart grid is required to enable DER investments across sectors at scale and facilitate rapid electrification. The integration of new sources of generation and load must not compromise reliability or the costs of infrastructure. This coordinated and holistic planning will require

[210] These include frequency response, regulating, contingency, and ramping reserves, and 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.

clear policy guidance from regulators and data from utilities to identify the regional potential for DER impact. The changes must also correspond with expanded investment in enabling tools such as universal broadband and flexible grid architecture.

Washington ranks 17th in the nation in grid modernization in an index that tracks state support, customer engagement, and grid operations.[211] Continuing support from the Clean Energy Fund grid modernization program, and similar state efforts, will be critical to leveraging funding from both private and federal sources. In addition to utilities conducting distribution system planning, the state and utilities should establish and implement policies and actions to facilitate the equitable and beneficial deployment of DERs.

2.1. Pursue Universal, Statewide Deployment of Broadband

The State Energy Strategy envisions a smart, flexible electric grid capable of supporting 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.[212] 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.[213]

The industry-specific need for a universal communications network exists with a broad societal need for universal broadband deployment. It has become obvious during the COVID-19 pandemic that broadband access was essential. Education was an early example, as expressed by Chris Reykdal, state superintendent of public instruction:

> If there's anyone today who does not see telecom and connectivity as an essential utility, much like water and clean air, then I would challenge them to think about our history. Right now, we must sow the seeds of complete innovation in connectivity for families. It is the way we will learn. It is the way of the future.[214]

[211] "Grid Modernization Index 4" (GridWise Alliance, November 6, 2017), https://gridwise.org/grid-modernization-index-4/.
[212] "Appliance Standards," Washington State Department of Commerce, November 1, 2020, http://www.commerce.wa.gov/growing-the-economy/energy/appliances/.
[213] 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).
[214] "Internet Should Be an 'Essential Utility,' WA Schools Chief Says as State Pulls Plug on Rest of Term," GeekWire, 2020, https://www.geekwire.com/2020/washington-state-taps-telecom-tech-expand-broadband-access-schools-close-rest-term/.

There are substantial disparities in access to broadband services, and the lack of access hurts low-income households and those living in rural areas.[215] The state has undertaken both comprehensive and stopgap measures, focused primarily on education,[216] to address these disparities.[217]

The societal need for universal broadband provides an opportunity for the electric industry to meet its own requirements and contribute to universal access. A number of 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.[218] Utilities also can contribute as users of a public network where feasible, rather than investing in proprietary solutions.

Action:

- Adopt a state policy to mandate universal broadband access mandate would provide electric utilities with both the opportunity to meet their own needs for smart grid services and the opportunity to expand the use of their telecommunications assets to achieve an important public policy.

2.2. Prepare State for Widespread Deployment of DERs

The grid of the future will have a mix of utility-scale resources and DERs coordinating to provide affordable, clean, and reliable energy services. Utility-scale generation and storage often remains economically favorable, but DERs can be easier and faster to permit, site, and install.

DERs represent a non-wires alternative to new utility-scale generation and transmission facilities. They can serve an array of purposes, including for generation, capacity, ancillary grid services, and reduced line losses. At the community level, DERs can support resilience, enable local ownership and control, reduce customer energy burden, and create local job opportunities (See Appendix X for more on DERs).

DER planning involves analyzing the potential contribution of demand-side resources to meeting energy needs and resource adequacy while factoring in the grid upgrades needed to realize that potential. In 2019, the Legislature adopted policy and practices that utilities must address in distributed energy resource planning (see RCW 19.280.100). However, DER planning remains voluntary for Washington utilities. The state should continue to assess whether utilities are sufficiently engaged in DER planning and determine if more guidance and enabling policy is needed.

2.2.1. Issue policy guidance on the value of DERs including a framework for demand response

Providing clear guidance on a methodology for quantifying the value of DERs - especially the value of ancillary services to the grid - will help utilities and regulators understand the full impact and opportunity of these assets. After recognizing the barriers[219] to this technology, the UTC conducted

[215]Mia Gregerson & and Sabrina Roach, "The Pandemic Shows Why Washington Needs Universal Internet Access," Crosscut, 2020, https://crosscut.com/2020/05/pandemic-shows-why-washington-needs-universal-internet-access.
[216]"Drive-in Wi-Fi Hotspots Launch Statewide Push for Universal Public Access Broadband," Washington State Department of Commerce, 2020, https://www.commerce.wa.gov/news-releases/community-programs-facilities/drive-in-wi-fi-hotspots-launch-statewide-push-for-universal-public-access-broadband/.
[217] "Broadband in Washington," Data.WA.gov, November 1, 2020, https://data.wa.gov/stories/s/Broadband-in-Washington/irv9-b275/.
[218] "PUDs Providing Telecommunications Services," Washington Public Utility Districts Association, November 1, 2020, https://www.wpuda.org/telecommunications.
[219] "Modeling Energy Storage: Challenges and Opportunities for Washington Utilities," Docket UE-151069 (Washington Utilities and Transportation Commission, May 18, 2015).

foundational work[220] to understand how to enable energy storage as an asset in long term utility planning. Further work to support storage deployment was supported through five different pilot projects across three utility partners funded in part by grants from the state's Clean Energy Fund (CEF).[221] The Pacific Northwest National Laboratory (PNNL) spearheaded data analysis to help understand how these difference storage use cases storage could provide a range of services to the grid, such as energy shifting, grid flexibility and improved distribution system efficiency.[222] This work continues to advance to inform new use cases, such as the CEF supported transactive grid project in Spokane.[223]

While these technical achievements are critical for DER deployment, additional guidance supported by data would further encourage utilities to give more consideration to DERs in planning processes and could ease regulatory barriers to grid investments that enable DER deployment. Regulators should build off work presented during CETA rules development and research at national labs to develop a framework that 1) determines a technical and economic means for demand response to participate in electricity markets; and 2) defines and quantifies the value of all potential demand response services, including capacity, flexibility to support grid balancing and renewables integration, ancillary services, and line loss reduction.[224]

Actions:

- Through the UTC and Commerce, develop and require adoption of a standardized methodology for quantifying the value of DERs in utility planning, including benefits for the grid, and non-energy energy benefits such as reductions in local air pollution and increased resilience.
- With support from UTC, Commerce, national labs and the Northwest Power and Conservation Council, create a regulatory framework for demand response, flexible load management, non-wires alternatives, demand flexibility and other related concepts.

2.2.2. Develop and make available hosting capacity analysis to support deployment of DERs

Hosting capacity is the amount of DERs that can be added to the distribution system at a given time and location without requiring infrastructure upgrades to preserve power quality and reliability. Requiring utilities to proactively perform hosting capacity analysis and to publicly report data on grid constraints can make interconnection processes easier and more transparent. Reduced uncertainty and risk in the interconnection process can make DERs cheaper and more accessible. Recent rulemaking in California

[220] "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.

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

[222] 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.

[223] B Akyol et al., "Transactive Campus Energy Systems" (Pacific Northwest National Laboratory, 2017), https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-26866.pdf.

[224] Ryan Hledik and Ahmad Faruqui, "The Potential for Load Flexibility," https://www.naseo.org/Data/Sites/1/ue-190698-ue-191023-demand-response-potential-and-target-setting-workshop.pdf.

directs utilities to use hosting capacity analysis to allow accelerated interconnection for resources shown to have little impact on the distribution grid.[225]

With appropriate planning and preparation, widespread deployment of DERs is less likely to strain the grid. Further, a better understanding of current hosting capacity and critical loads can help inform utility and local planning for DER integration. For example, a 2018 Solar Siting Survey in San Diego used "integration capacity analysis" of feeders in combination with potential sites to identify optimal locations for commercial scale solar.[226] And in Rhode Island, National Grid has created a collection of publicly available maps[227] showing details on distribution lines and feeders to support customers and assist developers in identifying potential project sites. This data has been used to deploy distributed solar in the state with support from the Clean Energy States Alliance.[228]

Project developers can use data from hosting capacity analysis to make interconnection processes faster and more transparent, identify the optimal locations to deploy DERs, and avoid costly distribution grid upgrades.[229] Hosting capacity data can also be used to optimize the operation of DERs and maximize their benefits for the grid.

Action:

Enact legislation and policies requiring utilities to:

- Perform hosting capacity analysis.
- Publicly disclose hosting capacity data.
- Use hosting capacity data to fast track beneficial use of DERs

2.2.3 Evaluate how DERs can increase resilience by protecting critical loads

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 analysis can protect communities during natural disasters and other blackout events. This type of data would also help in identifying priority restoration facilities and coordinating with the utility before major events.

Understanding the amount of critical load will help prevent overbuilt projects and provide support for community planning. This analysis should be done in concert with stakeholders, including local emergency management officials, utilities and state entities. These types of planning efforts can

[225] Public Utilities Commission of the State of California, "Order Instituting Rulemaking to Consider Streamlining Interconnection of Distributed Energy Resources and Improvements to Rule 21," 2020, https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M345/K380/345380320.PDF.

[226] "San Diego Solar Siting Survey" (Clean Coalition, 2018), https://www.sandiego.gov/sites/default/files/san-diego-solar-siting-survey-final-summary-report-07_wb-11-jan-2019.pdf.

[227] "National Grid - Rhode Island System Data Portal," November 2, 2020, https://www.arcgis.com/apps/MapSeries/index.html?appid=36c3c4ba3f92493a8d81aea4fae22d9d.

[228] Maria Blais Costello, "Exploring the Benefits of Distributed Solar in Rhode Island," *Clean Energy States Alliance* (blog), July 5, 2016, https://www.cesa.org/exploring-the-benefits-of-distributed-solar-in-rhode-island/.

[229] 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/.

leverage federal funds that increasingly seek to promote resilience, such as FEMA Building Resilience in Communities (BRIC) funding[230] and DOE Grid Modernization Lab Consortium (GMLC) efforts.[231]

To support statewide outage situational awareness the state should build a public facing system to be shared with participating utilities and local emergency management agencies, such as the Washington Energy Infrastructure Assessment Tool (WEIAT). The WEIAR is a GIS dashboard system managed and developed by the state. The system supports situational awareness during emergencies, weather events, or other incidents. The dashboard has a variety of relevant data including energy infrastructure, weather radar, wildfire status, road closures, public facilities, and government and special purpose district boundaries. WEIAT is also home to the Outage Data Initiative National (ODIN) pilot supported by the U.S. Department of Energy and Oakridge National Lab. This portion of the dashboard has the currently participating electric utilities' outage management displays on one state map. The program is expanding as more utilities voluntarily participate in sharing their outage information.

Actions:

- Through the Energy Emergency management Director at the Department of Commerce, coordinate with utilities and local, state and federal emergency management offices about data uses and opportunities.
- Using the existing Washington Energy Infrastructure Assessment Tool work with local emergency management agencies to identify key public facilities for emergency response and recovery activities including emergency operation centers, hospitals, 911 dispatch centers, reunification locations, shelters, and other key community hub facilities.
- Document facilities that have emergency backup power, those that do not, and those that would be best suitable for more resilience emergency power (e.g. solar + storage, solar + genset)
- Work with local emergency management officials to include assessment data in local hazard mitigation plans, and support applications for FEMA BRIC funding.
- Set up a system for the coordination of energy resilience data and efforts with other infrastructure planning groups, such as the Washington Infrastructure System Improvement Team (Sync)[232], Public Works Board[233] and the Infrastructure Assistance Coordinating Council.[234] This will allow the inclusion of energy resilience in other critical infrastructure projects and planning such as water and transit.

[230] "Building Resilient Infrastructure and Communities (BRIC)," FEMA.gov, November 2, 2020, https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities. 11/4/2020 1:31:00 PM
[231] "Research for a Modern Grid," Pacific Northwest National Laboratory, November 2, 2020, https://energyenvironment.pnnl.gov/gridmod.asp.
[232] "Sync - System Improvement Team," Washington State Department of Commerce, November 2, 2020, http://www.commerce.wa.gov/building-infrastructure/sync-systems-improvement-team/.
[233] "Public Works Board - Home Page," Washington State Department of Commerce, November 2, 2020, http://www.commerce.wa.gov/building-infrastructure/pwb-home-page/.
[234] "Infrastructure Assistance Coordinating Council (IACC)," November 2, 2020, https://www.infrafunding.wa.gov/.

2.3. Ensure an accessible and secure smart grid

A smart, modernized grid requires open standards while also ensuring cybersecurity.[235] In the Pacific Northwest, PNNL is leading this effort to deliver a new grid architecture that can incorporate new technologies and maintain reliability. This architecture is founded on existing national and international standards to ensure that the grid can support new clean energy technologies and can communicate with energy management and other platforms that will be critical to ensure its successful development and operation.

2.3.1. Increase deployment of advanced metering infrastructure

Strengthening and updating the electric grid with new technology can prevent outages, improve cybersecurity, and permit real-time data sharing to increase system-wide efficiency. Advanced metering infrastructure is one of the key components of a smart grid, but its progress has been delayed in Washington and elsewhere by concerns about security. To overcome this barrier, political and regulatory support is needed to ensure that technologies are secure while enabling new capabilities. Washington lags among states in its deployment and use of advanced metering infrastructure[236], The UTC recently issued rules about AMI[237], following earlier policy guidance[238] addressing issues such as customer security concerns by offering an "opt out" mechanism. However, there is still a need for an intentional approach to deploying AMI to enable a smart grid, while also maintaining important security standards.

Action:

- Engage with utilities on their current plans and programs to deploy AMI. Provide support for new deployment and programs which should include incentives for customer participation and include opt-out provisions. Utility plans and regulatory oversight should ensure continued value from AMI to advance decarbonization (rather than just one short-term value proposition)

2.3.2. Ensure an accessible grid through open standards

Open-source based platforms can ensure that a modernized grid is accessible to all parts of Washington and flexible enough as needed to support future technology innovation. Open-source platforms support an accessible grid by reducing costs to develop, integrate, and maintain future applications and by improving distribution system reliability. Avista Utilities and Duke Energy have been jointly working on an open source platform for grid edge application called OpenDSP[239] and DOE has included this research on open source platforms as part of their Energy Storage Grand Challenge roadmap[240].

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[235] "Washington's Green Economy" (Washington State Department of Commerce, 2020), https://www.commerce.wa.gov/about-us/research-services/green-economy/.

[236] 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.

[237] Dockets U-180525, adoption order 7/29/2020.

[238] Dockets U-180117, policy guidance issued on 4/10/2018.

[239] "What OpenDSP Means to the Future," T&D World, March 18, 2019, https://www.tdworld.com/smart-utility/article/20972353/what-opendsp-means-to-the-future.

[240] "Energy Storage Grand Challenge Draft Roadmap" (U.S. Department of Energy, 2020), https://www.energy.gov/sites/prod/files/2020/07/f76/ESGC%20Draft%20Roadmap_2.pdf.

The state must find a way to support the adoption of statewide open standards that will successfully and safely enable integration of DERs onto the grid.

Action:

- Pursue statewide use of open standards, such as IEEE 1547,[241,242] for DER deployment on the grid

2.2.3 Develop statewide cybersecurity standards

Cybersecurity is essential for transitioning to and maintaining a flexible, smart grid. Currently, the state is working with the National Association of State Energy Offices (NASEO) to develop and review best practices for the security of solar installations. The capacity to support energy emergency management in the state is, however, limited. There are many foundational aspects of a secure electricity system that still need to be addressed.

Actions:

- Expand the Energy emergency management program at the Department of Commerce to create 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)[243].
- Support continued coordination with NASEO on cybersecurity best practices and implement those practices in Washington
- Review current industry standards for demand response equipment, and 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 by coordinating with key partners in the government and private sectors.

2.4. Direct Clean Energy Fund Investments to Grid Modernization to Build Resilient and Flexible Electricity Projects

In the coming years, the state's 100% clean electricity, electrification and building efficiency goals, combined with greenhouse gas reduction targets, will cause a major shift in Washington's energy landscape and transform an essential service: electricity. At the same time, the economy has been dramatically impacted by COVID-19. A strategy to invest in grid modernization and clean energy projects to recover from the current economic downturn can yield multiple benefits, as occurred after the 2008 recession.

Back then, clean energy funding and policies implemented by local and state governments, combined with federal resources, yielded significant positive outcome for Washington's economy. Today, we can

[241] "IEEE 1547-2018 - IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces," IEEE Standards Association, November 2, 2020, https://standards.ieee.org/standard/1547-2018.html.
[242] Thomas Basso, "IEEE 1547 and 2030 Standards for Distributed Energy Resources Interconnection and Interoperability with the Electricity Grid" (National Renewable Energy Laboratory, December 1, 2014), 1, https://doi.org/10.2172/1166677.
[243] "Office of Cybersecurity, Energy Security, and Emergency Response," Energy.gov, November 2, 2020, https://www.energy.gov/ceser/office-cybersecurity-energy-security-and-emergency-response.

quickly recover and repower our economy in ways that make it cleaner, more resilient and better positioned for continued growth.

Investing in grid modernization and resilience is one such pathway. Many of the technologies and information systems to modernize and optimize operation of the grid are still in the research, development, and initial deployment phases. Research labs including PNNL, cloud computing companies, the clean tech sector, and the state's universities are involved in this emerging field. Utilities are exploring applications and considering investments, but some level of government support is needed to coordinate the different players and "buy down" risk to accelerate deployment.

As recommended by the Energy & Climate Policy Advisory Committee (ECPAC) created under CETA, the Clean Energy Fund (CEF) should be used to invest in the new technology and infrastructure required for a successful and equitable transition to clean electricity. As stated in the ECPAC report,[244] "the CEF should continue to be used to incentivize the development of cost-effective technologies that advance innovation, demonstration and deployment or accelerate decarbonization. These investments should be additive or accelerative, not directed towards actions that are already required or are otherwise going to happen. The CEF should continue to be used to leverage potential federal and private funding."

2.4.1. Target CEF funding for flexible load management and resilience

According to the National Institute for Building Science, every $1 invested in resilience funding through federal agencies saves $6 in averted disaster costs.[245,246] These figures represent the savings to physical infrastructure in the face of natural disasters. CEF funding can be used to enhance the resiliency and flexibility of our state's energy infrastructure, to reduce the threat of natural and human caused disasters and to address the risks posed by climate change.

Targeted funding for electricity could include programs that:

- Increase resilience through microgrid and transactive projects
- Deploy demand response or load flexibility, especially with large industrial customers
- Deploy clean energy solutions for critical load centers (see Resilience Hubs in Section 3.1.4.)

Action:

- Use the CEF to invest in projects that enable flexible load management and/or increase grid resilience. Ensure that CEF funding is additive or an accelerant and leverages private, federal, or other funding.

2.4.2. Provide state support for flexible and resilience project development

There are several avenues through which the state supports clean energy planning on public infrastructure, such as the Energy Efficiency and Solar grants from Commerce that provide competitively awarded grants for state public higher education institutions, local government facilities, state agencies,

[244] "Energy and Climate Policy Advisory Committee," Washington State Department of Commerce, November 2, 2020, http://www.commerce.wa.gov/growing-the-economy/energy/energy-and-climate-policy-advisory-committee/.
[245] "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.
[246] "Every $1 Invested in Disaster Mitigation Saves $6," The Pew Charitable Trusts, November 2, 2020, http://pew.org/2D2JuLb.

kindergarten through 12th grade (K-12) public school districts and federally recognized tribal governments.[247,248]

There is also a long history of supporting infrastructure planning assistance through the Infrastructure Assistance Coordinating Council,[249] which helps local jurisdictions understand grants and funding available to them. However, local planning efforts do not often include technical support on grid modernization planning. By creating a mechanism for more institutional support for local clean energy infrastructure planning, flexible and resilient solutions like DERs can be introduced much further upstream in the planning process.

Action:

- Create a new cluster within Commerce's Office of Economic Development and Competitiveness to focus on utility grid optimization and DER deployment. This would facilitate connecting utilities with labs and universities and increase engagement from the clean tech sector.
- Leverage the ongoing work of PNNL and the U.S. Department of Energy (DOE).

3. Facilitate Equitable Deployment of Renewable Generation Resources and Grid Services to Promote Community Resilience

CETA requires the transition to a clean, reliable, and affordable electricity system.[250] CETA also mandates that electric utilities ensure an equitable distribution of benefits and reduction of burdens for vulnerable populations and highly impacted communities.[251]

At the same time as utilities are incorporating equity into their planning, the state too must address access and equity in its own programs and funding. The legislature has begun to signal this change through updated budget instructions for CEF[252] and by funding efforts like the state Environmental Justice Task Force.[253] The task force report details ways that state agencies can incorporate environmental justice priorities into agency work.

Historically, Washington has provided numerous incentives for DERs including net metering,[254] the Renewable Energy System Incentive Program (RESIP),[255] low-income solar grants,[256] sales tax exemptions[257] and limited utility community solar programs.[258,259] These incentives have helped grow

[247] "Energy Efficiency & Solar Grants," Washington State Department of Commerce, accessed November 1, 2020, http://www.commerce.wa.gov/growing-the-economy/energy/energy-efficiency-and-solar-grants/.
[248] "Energy Efficiency," Washington State Department of Commerce, accessed November 1, 2020, http://www.commerce.wa.gov/growing-the-economy/energy/energy-efficiency/.
[249] "Infrastructure Assistance Coordinating Council (IACC)," accessed November 1, 2020, https://www.infrafunding.wa.gov/.
[250] Chapter 19.405.010 RCW.
[251] Chapter 19.405.040(8) RCW.
[252] "Substitute Senate Bill 6090" (2018), http://leap.leg.wa.gov/leap/budget/lbns/1719Cap6090-S.SL.pdf.
[253] "Environmental Justice Task Force Information," Governor's Interagency Council on Health Disparities, accessed November 1, 2020, https://healthequity.wa.gov/TheCouncilsWork/EnvironmentalJusticeTaskForceInformation.
[254] Chapter 80.60 RCW.
[255] Chapter 82.16.165 RCW.
[256] "Clean Energy Fund Solar Program - Clean Energy Fund," Washington State Department of Commerce, accessed November 1, 2020, http://www.commerce.wa.gov/growing-the-economy/energy/clean-energy-fund/clean-energy-fund-solar-program/.
[257] Chapter 82.08.962 RCW.
[258] Chapter 82.16.165 RCW.
[259] "Clean Energy Fund Solar Program - Clean Energy Fund."

the market for DERs in the early stages of development. Since RESIP was renewed in 2017, over 100 MW of new solar capacity has been installed in Washington by program participants.[260]

However, these investments have not always been accessible to community scale projects. RESIP data show that state support for DERs has predominantly benefited mainly rooftop solar. Over half of the solar installed was for residential scale solar, while community solar accounted for just one percent of projects.[261]

Other policies have lacked accessibility for multifamily housing. Net metering laws limit meter aggregation and do not have specific requirements for virtual net metering, which limits access for multifamily projects. In addition, low-income households have difficulty taking advantage of incentives,[262] and a significant gap in adoption of distributed solar technologies exists for communities of color.[263]

To address the inequities created by these previous efforts, the state must prioritize community engagement and understand opportunities for local wealth building as it seeks to accelerate deployment of DERs. Public processes like the King County Climate Equity Task Force and community based participatory research provide good models of equitable and accessible approaches to this work.

Programs such as the CEF can continue to play a key role in DER adoption and should prioritize innovative use cases in locations where community benefits are greatest or where access to DERs has been more limited. A first step in this work is the Washington State Department of Commerce's Low-Income Community Solar Deployment (LICSD) program, which seeks to prioritize investment in community solar projects that reduce energy and environmental burden to low-income communities and vulnerable populations.

The state can ensure that priority communities are identified by developing and using statewide energy equity indicators (see section 3.2.1) and environmental health and cumulative impact analysis tools such as the Environmental Health Disparity Map.[264] This and other recommendations are supported by the Environmental Justice Task Force. These tools can also be used in partnership with direct service providers like community action partnerships[265] who have a rich history of working with state agencies and are well situated for qualifying and engaging with low income and vulnerable communities.

[260] "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.
[261] "The Renewable Energy System Incentive Program: Legislative Report: October 2019."
[262] 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.
[263] Sunter, Castellanos, and Kammen, "Disparities in Rooftop Photovoltaics Deployment in the United States by Race and Ethnicity."
[264] "Washington Environmental Health Disparities Map" (Washington Department of Health, n.d.), https://www.doh.wa.gov/DataandStatisticalReports/WashingtonTrackingNetworkWTN/InformationbyLocation/WashingtonEnvironmentalHealthDisparitiesMap.
[265] "Washington State Community Action Partnership > Home," accessed November 1, 2020, http://www.wapartnership.org/.

3.1. Increase Opportunity for Community Ownership of DERs and Management of Programs that Create Local Economic Development and Energy Sovereignty

In addition to new and enhanced state-level incentives and funding programs, expanded ownership and financing options can further reduce costs and drive beneficial adoption of DERs. The state should seek also seek to support the creation of energy districts and lean on models such as the work in Iowa.[266] An energy district is an independent, voluntary, nonprofit structure modeled after the Soil Conservation Districts established as part of the New Deal. Energy districts are aimed at empowering people to provide their own power locally, primarily through reduced energy use and solar power production. In the Iowa model, each district serves one county. These districts also seek to fortify local economies by creating jobs and directing utility bill payments into the community. Today, the Winneshiek Energy District in northeastern Iowa is a collaborative community energy district that aims for 100% locally owned, efficient, renewable energy by midcentury and could serve as a model for Washington.[267]

3.1.1 Develop resources for expanded outreach, technical assistance, and education

Often capacity issues and limited funding options can make it difficult for communities to pursue clean energy infrastructure projects. To help projects get off the ground, the state should develop a more direct pipeline to support feasibility studies, enhanced community engagement and other educational aspects of projects.

By providing enhanced technical assistance as part of energy program delivery, the state can facilitate the involvement of smaller communities, organizations, utilities and companies and ensure the system has the capacity to consult with and include stakeholders in designing programs and selecting projects.

Actions:

- Allocate resources to fund community-centered feasibility studies and other outreach and education for flexible and resilient energy projects.
- Provide training resources including sample project plans, design standards, sample past projects and templates. Streamline applications and eligibility as much as possible to eliminate redundancies and complexity

3.1.2 Promote community ownership of DERs

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 can be difficult to pencil out when competing with the economies of scale that utility-scale projects provide. In addition to providing local jurisdictions with the data to help understand the value of resilience on their grid (see Section 2.1.3) the state can also promote investment opportunities for communities, which will ensure a more equitable clean energy future. These projects might include:

- Systems deployed through community-ownership models or with community budgeting
- Systems deployed at brownfields and landfills that provide revenue on marginal land
- Systems owned by community organizations to lower energy burden

[266] Karen Uhlenhuth, "In Iowa, Grassroots Energy Districts Aim to Spur Local Clean Energy Conversations," Energy News Network, 2019, https://energynews.us/2019/11/21/midwest/in-iowa-grassroots-energy-districts-aim-to-spur-local-clean-energy-conversations/.
[267] "Winneshiek Energy District," accessed November 1, 2020, https://energydistrict.org/.

Energy districts — entities modeled after Conservation Districts (established as part of the New Deal and authorized in Washington in 1939 through RCW 89.50) — are community institutions that plan for and promote locally-owned clean energy, including energy efficiency, EVs, and renewables.[268] If DERs are owned and operated locally, communities can have more involvement in ensuring that benefits are received by those who need them most.

Actions:

- The state should further evaluate the feasibility and potential for energy districts in Washington. Subsequent legislation could authorize them and provide a framework for their activities.

3.1.3. Promote Tribal energy sovereignty

Tribes are often located at the end of line and in remote areas. On the west side, Tribes like the Quinault[269] and Makah[270] have been exploring how to relocate Tribal villages out of areas susceptible to earthquake and tsunami while also increasing resilience through microgrids and clean energy. On the east side, the Spokane have been addressing the devastating blackout threats from wildfires and working towards a master plan[271] that includes increased local resilience. Tribes have long participated lead these sustainability and climate adaption planning efforts, many of which have been funded by federal agencies like Housing and Urban Development and Department of Energy.

Policies must recognize the individual needs of each Tribe across the state and help leverage their local energy resources, such a bioenergy, or support projects that promote energy independence, such as microgrids. Program design must account for the unique tax status of Tribes and structure of land ownership that may prevent Tribes from taking advantage of products like loans. For example, the Commerce Low-Income Weatherization program currently includes a 4% carve out for Tribal Weatherization.[272]

Action:

- Create specific programs for Tribal energy projects, or provide carve outs in existing programs, that help leverage funding from the DOE Tribal Energy office

3.1.4. Support the development of community resilience hubs

A resilience hub program[273] would support deployment of solar generation, storage, and microgrids at community centers to provide the surrounding community free access to essential services, such as

[268] "A Geography of Change" (Winneshiek Energy District, 2019), https://energydistrict.org/wp-content/uploads/2019/01/A-Geography-of-Change-full.pdf.
[269] "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.
[270] "Makah Tribe – 2017 Project," accessed November 1, 2020, https://www.energy.gov/indianenergy/makah-tribe-2017-project.
[271] "Sustainable Community Master Plan" (Spokane Tribe of Indians, 2013), https://spokanetribe.com/wp-content/uploads/2020/03/FINAL_2015_SCMP.pdf.
[272] "Washington State Low-Income Weatherization Assistance Plan" (Washington State Department of Commerce, 2020), https://www.commerce.wa.gov/wp-content/uploads/2020/08/2020-State-Plan-FINAL-4.2.20-.pdf.
[273] Kristin Baja, "Resilience Hubs" (Urban Sustainability Directors Network, 2018), https://www.usdn.org/uploads/cms/documents/usdn_resiliencehubs_2018.pdf.

heating, cooling, device charging, and internet in the event of a grid outage. A grant program for resilience hubs was recently piloted in Maryland.[274]

Resilience hubs could provide co-benefits in the form of education and outreach for DER financing options and electric vehicles, public electric vehicle charging, access to community solar, and space for community gardens. Projects may also provide important insights into community focused resilience metrics.

Actions:

- Provide grants and technical assistance to community centers for the development of resilience hubs in both rural and urban areas of need.
- Use metrics from projects to design a "value of resilience" to be incorporated into regional planning.

3.1.5. Support clean energy projects that are beneficial to agricultural 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. Solar panels may be able to be installed on degraded or marginal farmland, potentially allowing the land to be restored over the lifetime of the project.[275] Co-location of solar panels and crops can provide benefits for both, including reduced plant drought stress, greater food production and reduced PV panel heat stress.[276]

Solar projects can also be designed to be pollinator-friendly. In addition to benefiting nearby pollinator dependent agriculture, pollinator-friendly ground cover at solar installations can also increase solar efficiency by cooling the panels. Concerns over pollinator health in Washington State have been increasing recently, leading to the recent formation of the Pollinator Health Task Force in 2019 and opening of Washington State University's Honey Bee and Pollinator Research, Extension, and Education Facility. A pollinator-friendly solar program could be aligned with these existing efforts.

Actions:

- Establish statewide standard for pollinator-friendly solar (see Maryland[277] and Minnesota[278])
- Fund research on agrivoltaics and pollinator-friendly solar in Washington
- Provide funding for pilot projects

[274] "October 2018 Notice of Grant Availability for the FY19 Resiliency Hubs Grant Program" (Maryland Energy Administration, 2018), https://energy.maryland.gov/Documents/Notice%20of%20Grant%20Availability%20(rev%203)%2010-11-2018%20(updated%204-15-2019).pdf.
[275] Katie Siegner and Genevieve Lillis, "The Evolution of Rural Solar: From Panel Monocrops to Multiple Land Uses," *Rocky Mountain Institute* (blog), 2020.
[276] Greg A. Barron-Gafford et al., "Agrivoltaics Provide Mutual Benefits across the Food–Energy–Water Nexus in Drylands," *Nature Sustainability* 2, no. 9 (September 2019): 848–55, https://doi.org/10.1038/s41893-019-0364-5.
[277] "Department of Natural Resources - Solar Generation Facilities - Pollinator-Friendly Designation," Pub. L. No. SB1158 (2017), http://mgaleg.maryland.gov/2017RS/chapters_noln/Ch_372_sb1158E.pdf.
[278] "An Act Relating to Agriculture; Establishing Voluntary Solar Site Management Practices for Solar Sites; Proposing Coding for New Law in Minnesota Statutes, Chapter 216B.," Pub. L. No. HF3353 (2016), http://wdoc.house.leg.state.mn.us/leg/LS89/HF3353.1.pdf.

3.2. Focus Incentives and Grants on Promoting Equitable Distribution and Innovative Deployment of DERs

Washington should continue efforts to increase the deployment of DERs by focusing incentives and grants on applications that address disparities in adoption, provide significant community benefit and support innovative models of clean energy development.

To facilitate equitable adoption, an audit of existing renewable energy system incentives and solar grant programs should be completed to review baseline assumptions and revamp policy outcomes.

3.2.1. Perform an equity assessment of existing programs related to renewable energy

The starting point for a conversation about future strategic policy recommendations is to understand how well the design of past programs has been in achieving intended goals. Given that the state wants to prioritize an equitable distribution of funding and provided access to DERs, agencies must produce a geographic mapping of renewable energy projects supported by public dollars. The state must also look across the programs and funding that have been historically available and assess the demographics of those that have received support. These results much be transparently communicated to the public and used to support work in the follow subsequent recommendations.

Action:

- Review past and existing programs to understand current inequities associated with disbursement of funds and incentives.
- Map locations of projects supported by public programs, using the overall Environmental Health Disparities Map rank 9 and 10 as a starting point to identify highly impacted communities.
- Use data to identify gaps in service to those communities and use cases (i.e. multifamily housing).
- Create a public report with next steps

3.2.2. Develop and track state-level equity indicators

Developing energy equity indicators in Washington State could uncover opportunities to make impactful investments in clean energy solutions in low-income and highly burdened communities. Indicators could also track progress on addressing inequity and realizing community benefits over time. Such energy equity indicators have been used successfully in California to track progress in making clean energy more accessible and beneficial for communities.[279]

Energy equity indicators could identify opportunities for and track performance on:

- Reducing energy burden
- Increasing access to DERs such as rooftop solar, electric vehicles and charging, weatherization and energy efficiency
- Identifying community assets where DERs could be deployed, including churches, nonprofits, schools, public housing, and public spaces
- Growing local clean energy jobs

[279] "Energy Equity Indicators Tracking Progress" (California Energy Commission, 2018), https://www.energy.ca.gov/sites/default/files/2019-12/energy_equity_indicators_ada.pdf.

- Issuing low-income clean energy grants
- Enhancing community resilience to grid outages

Actions:

- Provide Commerce funding and staffing for the development of energy equity indicators, data collection, and maintenance of a publicly accessible energy equity dashboard.
- Use existing equity toolkits for goal development, such as the GARE Framework Guidance, help with creating agency-specific and program-specific, theories of change, metrics, and indicators.
- Coordinate to create both agency-specific goals as well as find opportunities for enterprise-wide goals.
- Create both outcome and process measures. Outcome measure, such as increasing renewable energy in communities, must be supported by community engagement goals which will also require a set of process metrics that hold state agencies accountable for increasing meaningful engagement with communities.
- Publish progress toward goals. Agencies should regularly report their progress and contribution toward enterprise wide EJ and environmental health goals.
- Address data gaps in the state. To address data gaps, collect additional local data and engage with communities for local knowledge to learn more about current and past conditions and

3.2.3. Use an equity and environmental justice lens for CEF program structure and participation

The CEF can play a key role in supporting equitable deployment of clean energy projects and promoting investment in vulnerable or highly burdened communities. The ECPAC report[280] provides several recommendations for improving program access. Several of these elements have been used in existing CEF programs for electrification of transportation systems[281] and low-income community solar deployment[282]. However, data should continue to be gathered to understand the effectiveness of each design requirement.

Action: Continue using and evaluating the following design elements for CEF programs:

- Set a lower or no match requirement based on applicant type.
- Require applicants to identify how their research or investment will lead to more equitable outcomes.
- Require or incentivize the inclusion of underrepresented communities or organizations on project teams.
- When appropriate link CEF outcomes to non-energy programs and policy goals (e.g., low-income housing, public health, broadband access, workforce and economic development).
- Use the Department of Health's Environmental Health Disparities map, energy burden data, and energy equity indicators to inform decisions and guide CEF investments.
- Ensure community-driven outreach and participation in program design and implementation.

[280] "Energy and Climate Policy Advisory Committee," Washington State Department of Commerce, accessed November 1, 2020, http://www.commerce.wa.gov/growing-the-economy/energy/energy-and-climate-policy-advisory-committee/.
[281] "Electrification of Transportation Systems Program - Clean Energy Fund (CEF)," Washington State Department of Commerce, accessed November 1, 2020, http://www.commerce.wa.gov/growing-the-economy/energy/clean-energy-fund/electrification-of-transportation/.
[282] "Clean Energy Fund Solar Program - Clean Energy Fund."

3.2.4. Encourage collaboration and creative community partnerships

Community partnerships and increased collaboration among stakeholders can help identify and advance diverse and innovative use cases. Several large research centers in the state have used their resources to promote collaboration between many types of stakeholders and bridge the gap between policy and technology research and development. Examples include the Joint Center for Deployment and Research in Earth Abundant Materials (JCDREAM), Washington Clean Energy Testbeds, and the Centers of Excellence.

Across state government, the disbursement of funding for clean energy projects should encourage project teams with a variety of members such as large and small businesses, non-profit organizations, small and large research institutions and local and Tribal governments. Programs can be designed to encourage the clustering of smaller, similar or identical projects under a single applicant or project manager.

Actions: Prioritize grant funding for diverse clean energy project teams.

G. Grow High-Quality Clean Energy Jobs

[Text pending incorporation of economic analysis]