Issue Brief 6

The Mobility Transition

How will megatrends affect energy supply and demand in Washington?

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Mobility is expected to dramatically transform in the coming decades, with rapid and ongoing changes in fuel, mode, and mechanism. The dominant trend is electrification of the transportation system, with corresponding increases in electricity demand for the sector, although the extent depends on relative rates of adoption, the types of alternative fuel vehicles that become available, and active transportation and shared mobility trends. Many of these trends are unfolding inequitably, as high-income, urban, White households are currently the primary beneficiaries.

Public Transit

Prior to the COVID-19 pandemic, Seattle was one of the only cities in the US where transit ridership continuously increased year-over-year,[1] with Washington state residents commuting by public transit at a rate higher than the US average.[2] The COVID-19 pandemic may have permanently shifted travel patterns and preferences, particularly with regards to public transit ridership. Transit shutdowns during the early period of the pandemic caused many to use alternative modes of getting around, including active transportation and private vehicles, particularly in urban areas.[3] [4] In rural areas, transit agencies quickly pivoted to providing socially distanced meal and grocery drop-offs, and grappled with potential funding shortfalls.[5]

Many avoided the crowded, enclosed environment of public transit due to fears of COVID-19, a trend which may continue as the possibility of future pandemics continues to represent a real threat.[6] The pandemic also greatly increased the number of people working from home: 6.5% of Washington residents worked at home in 2019, but that percentage rose to nearly 21% in 2020.[7] This increase caused weekday residential electricity use to increase 20-30% in some parts of the country. Ongoing reduced ridership levels, coupled with personnel shortages, could reduce fare revenue and levels of service for transit for years to come.[8]

At the same time, public transit fleets are rapidly electrifying across the United States, particularly in western states such as Washington and California.[9] Electric buses are usually more cost-effective than diesel buses over their lifetime, but are more expensive to purchase. Additionally, transit agencies must invest in costly charging infrastructure and figure out how to maintain or expand transit service when using electric buses. In states with policy environments that support and incentivize fleet electrification, transit agencies have overcome these challenges.[10]

Funding from the federal government and Washington state is supporting efforts to electrify transit. The Federal Low or No Emission Vehicle Program has awarded almost $430 million to transit agencies for electric buses and charging infrastructure since 2015. In 2022, $33 million of these funds went to cities, transportation authorities and departments, and Tribes across Washington for projects to replace diesel buses with electric ones and improve maintenance facilities.[11] With the passage of the federal Infrastructure, Investment and Jobs Act, funding for the "Low-No" program has increased tenfold to $1 billion per year through 2026.[12]

Washington's Department of Ecology used $13.3 million of funds from a federal settlement with the automaker Volkswagen to support transit agencies in purchasing 50 zero-emission electric buses.[13] Move Ahead Washington, a comprehensive transportation budget passed by the Washington State Legislature in early 2022, provides nearly $3 billion in funding for public transportation in Washington over the next 16 years. Funded by Move Ahead Washington, WSDOT's Green Transportation Capital grant program provides funding to transit agencies for the electrification of vehicle fleets, including necessary supportive infrastructure. WSDOT allocated $16.5 million for the 2021-2023 biennium to entities including King County Metro Transit and Spokane Transit Authority for purchases of electric buses.[14]

Active Transportation and Shared Mobility

Walking, Cycling, and Rolling

Active transportation is any form of human-powered transportation such as walking, cycling, or using a wheelchair, to get to a destination or to public transit. Fewer Americans use these getting around than driving, particularly to get to work. More than three-quarters of Americans drove to work alone in 2019,[15] and approximately a third of Americans spend fewer than 10 minutes per day engaging in light to moderate physical activity .[16] Washington residents are more physically active than the average American. In 2019, 3.4% of Washington residents reported walking to work and 0.87% commuted by bike, compared to national averages of 2.6% and 0.5%, respectively.[17] In Seattle, Washington's largest city, the rates of active commuting were even higher with 11.3% walking to work and 3.5% biking to work—figures that have been slowly increasing over the past decade.[18] WSDOT's Commute Trip Reduction program, among other initiatives, has contributed to these trends. The program requires worksites (in the state's 9 most populous counties) with 100 or more full-time employees who

begin their shifts on weekday mornings to promote and incentivize commuting through modes other than driving alone.[19]

Bicycling rates have generally increased in North American cities over the past 20 years, partly thanks to greatly expanded bike infrastructure programs in many cities, including Seattle, since the 1990s.[20] Most of the growth in bicycling has been among men 25-64 years old, while bicycling rates among women have remained relatively stable and fallen sharply for children.[21] Move Ahead Washington provides funding for complete streets programs that improve safety for people walking, biking, and using wheelchairs, as well as safe routes to school and specific bicycle and pedestrian infrastructure improvement projects.[22] These improvements could increase the rates of active transportation in Washington in the coming years.

The pandemic sparked a shift away from car dominance in the core of many cities, as governments sought to increase opportunities for social distancing while promoting economic activity such as shopping and dining. Cities took measures like creating pop-up bike lanes, expanding the bike network, closing streets and intersections to cars, reducing speed limits, and encouraging bike-sharing.[23] In 2020, the Seattle Department of Transportation created 25 miles of "Stay Healthy Streets," closed to car traffic and open to people walking, rolling, and cycling. The Department intends to keep some of the streets permanently closed to car traffic as part of the "Keep Moving Streets" initiative.[24] Other Washington cities such as Bellingham and Bellevue created similar programs during the pandemic. These actions helped to increase the length of cycling trips, in addition to increasing the number of trips taken for leisure and at midday. Average daily kilometers cycled increased in many jurisdictions.[25]

Bikes exploded in popularity in the US over the past two years. Bicycle sales increased nearly 60% between April 2020 and April 2021.[26] E-bikes may be changing the market for active travel, as they appeal to new customer segments and are more practical for those with longer, hillier trips. Import data suggests that approximately 790,000 e-bikes were sold in the US in 2021, more than the 652,000 electric cars sold that year.[27] The Washington House of Representatives passed HB 1330, a bill exempting electric bikes and accessories from state sales taxes, in the 2021 regular session;[28] the bill was not passed by the State Senate but is being considered by the body again in the 2022 regular session.[29]

Shared Mobility

Shared mobility includes anything from ridesharing with strangers (i.e., Uber, Lyft), peer-to-peer car sharing (e.g., driving a stranger's private car or a car from a commonly shared fleet), to shared electric scooters and e-bikes. Such services have become increasingly popular over the

past decade, although driving privately-owned vehicles remains the most popular form of transportation in the US.[30] Ride hailing is most popular among higher-income, urban and suburban Americans.[31]

Researchers have observed that shared mobility use tends to result in a net decrease of public transportation use as many people use shared mobility as a substitute for public transit, although these effects vary widely across different metro areas.[32] Research also indicates that the use of ride hailing services significantly increased household vehicle miles traveled (by as much as 83% in one study) and associated energy demand.[33]

Though the future of these technologies is uncertain, they are likely to remain on the landscape, at least in the short term; they are backed by global investment totalling more than $100 billion as of 2020. The City of Seattle's Department of Transportation developed a New Mobility Program that proactively engages with and creates governance frameworks for shared mobility, autonomous vehicles, and other emerging transportation technologies. Like many public entities, SDOT seeks to leverage shared mobility to address transit and other service gaps.[34] WSDOT's Zero Emission Access Program, open to nonprofit organizations and local governments in Washington, provides grant funding for zero-emissions carshare pilot programs in underserved and low- to moderate-income communities.[35] Grants awarded for the 2021-2023 biennium include carshare programs in Klickitat, King, San Juan, Kitsap, Benton, Pierce, and Jefferson counties.

A McKinsey & Company report predicts that across the globe, e-hailing, car rentals, and car sharing will decrease in popularity over the next decade, and new technologies such as autonomous taxis, shuttles, and shared micro mobility will all dramatically increase in popularity.[36] Autonomous vehicles are those which have some safety critical control functions (steering, throttle, braking, etc.) that can occur without the driver controlling or activating them. Though predicted for many years, they have yet to emerge as a common form of transportation.

Local and national regulations, fuel source, and urban design will all affect the energy demand and GHG impact of autonomous vehicles. There isn't a clear consensus among researchers as to how autonomous vehicle adoption will affect GHG emissions. For example, one analysis indicates autonomous vehicle adoption might reduce road transport GHG emissions and energy use by up to 50% compared to current vehicle use; a contrasting analysis found autonomous vehicle adoption could nearly double GHG impacts, depending on policy choices, behavioral patterns, and energy trends.[37] Another study suggests that if autonomous vehicles are electric, they could satisfy current US passenger trip demand with only 9% of today's

vehicle fleet and 2.6 million chargers, potentially reducing vehicle-related GHG emissions by 70% (assuming a clean grid).[38] Other research indicates that widespread adoption of autonomous vehicles could moderately reduce the number of vehicles per household but dramatically increase unoccupied VMT per day on major highways and local roads.[39]

Alternative Fuel Vehicles

Electric Vehicle Adoption

Electric vehicle use is rising. According to the Washington Department of Licensing, EV sales in Washington increased by 40% in 2021 compared to the previous year.[40] According to the International Energy Agency, sales of EVs across the US could more than double again by 2025 (with 11% of cars sold being EVs), and increase to 21% of cars sold by 2030. This would result in EVs representing 8% of all vehicles on US roads by 2030.[41]

Demand for personal electric vehicles is expected to continue to increase in the coming years and decades, with rising gas prices and inflation driving an uptick in consumers seeking EVs since early 2022.[42] However, higher demand, coupled with supply chain bottlenecks largely due to the ongoing effects of the pandemic, is causing supply shortages and raising prices, limiting EV adoption in the short term, among both higher- and lower-income households.[43]

In absolute numbers, electric vehicle purchases in Washington lags behind other states such as California and Florida. However, as a percentage of market share, EV purchases in Washington make it a leading state, second only to California.[44] As of July 2022, more than 100,000 EVs were registered with WA's Department of Licensing, the majority of which are battery electric vehicles, representing approximately 1.3% of passenger vehicle registrations.[45] [46] These registrations are concentrated in Washington's western and urban counties. King County, where Seattle is located, accounted for more EV registrations than the state's remaining 38 counties combined.[47]

Federal and state incentives are supporting electric vehicle purchases. President Biden's administration announced a goal for 50% of light-duty passenger vehicles to be EVs by 2030.[48] The Infrastructure, Investment, and Jobs Act provides federal funding to support the buildout of charging infrastructure across the country. A federal tax credit of up to $7,500 applies to new EVs and plug-in EVs, which will begin to be limited to those manufactured in North America in 2023.[49] Non-refundable tax credits such as these typically allow households with higher incomes and tax liabilities to benefit more easily than low-income households.[50]

Washington State is aiming for all light-duty vehicles sold, purchased or registered within the state to be fully electric by 2030.[51] In November 2021, Washington's Department of Ecology adopted California's Zero Emission Vehicle Standards, requiring 8% of new personal-use and light-duty commercial vehicles to be electric by 2024 and 100% to be electric by 2035.[52] Washington provides incentives for vehicle purchases as well as local infrastructure development. Purchases of new electric or alternative fuel passenger cars, light-duty trucks, and medium-duty passenger vehicles priced under $45,000, and used vehicles under $30,000, are exempt from the state's motor vehicle sales and use taxes. Sales tax exemptions are generally a more equitable strategy than tax credits because they reduce the price of the EV at the time of purchase.[53] [54]

Local governments may apply to WSDOT's Zero-emission Vehicle Infrastructure Partnerships grant for funding to install new or upgrade electric vehicle charging equipment and hydrogen fueling infrastructure along priority transportation corridors across the state, including the West Coast Green Highway.[55] New commercial and multi-unit residential buildings with parking must be constructed with wiring that accommodates Level 2 (240 volt, 40 amp)[56] charging stations for at least 10% of parking spaces.[57] With the passage of Move Ahead Washington, a comprehensive transportation budget bill, electric utilities are able to adopt electric transportation plans (including consideration of impact of electrification on utility's load, and the development of incentive programs for transportation electrification), as well as offer battery charging facilities using ratepayer funds (subject to UTC approval).[58] [59]

Hydrogen Fuel-Cell Vehicles

Hydrogen fuel cell vehicles are a type of electric vehicle powered by hydrogen, an abundant element found in 75% of normal matter. They are a nascent consumer product, and infrastructure to support them is not widely available. Emitting only water vapor and air, hydrogen fuel cell vehicles are more efficient than conventional internal combustion engines; however, hydrogen is a secondary fuel, requiring large amounts of energy to produce.[60] Very few hydrogen fuel cell vehicles are in use worldwide, and few fueling stations exist in the United States.[61] Currently, all public hydrogen fueling stations for private vehicles in the United States are located in California, with the exception of one station in Hawaii; there are no hydrogen fuel cell vehicles registered in Washington state.[62]

The use of hydrogen for transportation applications, compared with other uses such as industry, is controversial due to the high amount of emissions currently caused by producing it. "Gray" hydrogen is produced by steam reforming of methane, "blue" hydrogen uses carbon

capture and storage to theoretically reduce process emissions, while "green" hydrogen is produced via the electrolysis (using renewable electricity) of water into hydrogen and oxygen. Currently, nearly all hydrogen is produced through energy- and emissions-intensive processes , usually as a by-product of oil refining.[63]

However, the International Energy Agency predicts that use of hydrogen fuel cells will increase across the transportation sector; many countries, including the US, have recently adopted policies that support hydrogen vehicles for public transit, commercial use, railways, trucking, and aviation.[64] The federal Infrastructure Investment and Jobs Act provides $8 billion for four hydrogen hubs to produce, store, and use hydrogen, to be located in different regions, with Washington identified as a strong possibility.[65]

With the intent of becoming a national and global leader in the production and use of hydrogen, Washington has established an Office of Renewable Fuels to provide incentives and financial assistance in the deployment of hydrogen fuel infrastructure. A high-profile example of hydrogen research and development in Washington includes recent trials of a hydrogen ferry vessel in Bellingham, developed with funding from the California Air Resources Board.[66]

Other Alternative Fuels

In addition to electric and hydrogen vehicles, other types of alternative fuel vehicles are being adopted across the US. They are powered by more than a dozen alternatives to gasoline and diesel, including biodiesel and ethanol, as well as other types of fossil fuels such as natural gas, and propane. These vehicles are mainly used by governments, but increasingly of interest to consumers. Washington has two public biodiesel fueling stations, four public compressed natural gas fueling stations, three public ethanol fueling stations, one public liquefied natural gas fueling station, and seventy-four public propane fueling stations. As of 2021, 59,000 biodiesel vehicles, 369,700 ethanol/flex (E85), 600 compressed natural gas (CNG), and 100 propane vehicles were registered in Washington state, compared with nearly 6 million gasoline and diesel vehicles.[67]

The federal Renewable Fuels Standard (RFS) requires fuel suppliers to blend renewable fuels into transportation fuels in increasing amounts each year; renewable fuels must emit fewer greenhouse gas (GHG) emissions compared to the petroleum fuels they are replacing.[68] The RFS has increased the annual production of biodiesel from about 500 million gallons in 2010 to nearly 2,000 gallons in 2019. Changes to export rules have meant that most of the biodiesel produced in the US is used within its borders.[69]

Along with many neighboring states and provinces (California, Oregon, and British Columbia), Washington has adopted a Clean Fuel Standard that requires fuel suppliers to reduce the carbon intensity of transportation fuels (gasoline, diesel, and their substitutes, but excluding marine and aviation fuel) to 20% below 2017 levels by 2038; the program will begin in 2023.

Fuel suppliers can achieve carbon intensity reductions by improving the efficiency of their fuel production processes, producing and/or blending low-carbon biofuels into the fuel they sell, and purchasing credits generated by low-carbon fuel providers and EV charging providers.[70] Fuels with high carbon intensities generate deficits and fuels with low or no carbon emissions generate credits; at the end of each compliance year, entities with deficits must retire a number of credits that equals their deficit balance.

Due to such laws and standards, as well as a post-pandemic rebound in travel, experts predict that global demand for biofuels will grow 28% between 2021 and 2026, although many factors contribute to ongoing uncertainty of this prediction. Demand for biodiesel, renewable diesel, and sustainable aviation fuels are all expected to increase; ethanol demand could decrease as demand for gasoline decreases.[71]

The US Department of Energy's Sustainable Aviation Challenge sets a goal for the industry to use 11 billion liters of sustainable aviation fuel (SAF) by 2030, approximately 15% of current jet fuel demand. SAF is supported by a tax credit.[72] The IEA predicts that "biojet technology is ready to fly but policies to stimulate demand lag behind," and that global demand will only be 2-6 billion liters by 2026 (equivalent to 7% or less of current US demand), with demand rising in the second half of the decade.[73] The National Renewable Energy Laboratory is actively investigating sustainable aviation fuel from wet waste (food waste, manure, sewage, indelible fats, oils, and greases), marine biofuels from biomass, and bioblendstocks for heavy-duty trucks, among other technologies.[74] Alaska Airlines, based in Washington, has been working with the Northwest Advanced Renewables Alliance to develop jet biofuels made of wood waste from Washington (in a 20% blend), indicating local industrial interest in demonstration projects.[75]

Conclusion

Washington's transportation system is undergoing dramatic shifts. Fewer people are riding public transit than before the pandemic, but agencies are rapidly electrifying their fleets. Getting around by bike, walking, and rolling, as well as shared cars and scooters, will likely continue to be popular alternatives to driving. Thanks to subsidies and incentive programs, more and more people and governments are purchasing light-duty electric cars. Other

alternative fuel vehicles, such as hydrogen fuel cell, and biodiesel vehicles, have not yet been widely adopted; however, this could change in the coming decades. Industry research and development, combined with government support, could increase the use of electric and alternative fuel ferries, trucks, and airplanes. Many variables, including market conditions, technological advancements, social preferences, and grid emissions intensities, will influence whether these shifts in the transportation sector result in increased or decreased energy demand over the coming decades.

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