Policy Briefs

The primary purpose of the Biennial Energy Report is to inform local, state, regional, and federal energy policy development, energy planning, and energy investments, and to identify opportunities to further the state's energy policies.

Energy policy has implications for nearly every aspect of society. It influences our economy, infrastructure investments, land use choices, human health, air and water quality, and our pocketbooks. Understanding these influences is the purpose of the policy briefs in the Biennial Energy Report. These topics provide a comprehensive and statewide view of energy issues and policy discussions. "Energy" includes many intersecting systems that generate and distribute electricity to end-users, and that store and distribute fuels for home-heating, industrial processes, and transportation. It also includes the critical infrastructure, facilities, planning, and energy management that support these systems. A key consideration in analyzing the energy system is providing an assessment on how energy policy choices affect the equitable distribution of benefits and burdens to Oregonians.

This section of the report provides insights on energy topics that are being discussed in legislatures, city councils, communities, and homes. This year's report includes a review of the effects of data centers on Oregon, highlights some of Oregonians' concerns, and analyzes options to address them. It also includes a deep dive on transportation electrification for large trucks and buses, and how these could also support electric grid reliability, as well as a discussion about the potential in Oregon for sustainable aviation fuel to help reduce greenhouse gas emissions from the aviation sector. These policy briefs can be read as standalone documents, and there are cues in each discussion to point the reader to information and data found in other parts of this report or others that can provide additional background and insight.

ODOE has produced many policy briefs in previous Biennial Energy Reports and other standalone studies. You can find links to these and other data and analysis on ODOE's website.

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Data Centers and Oregon's Energy System

Data centers have become a major electricity load and one of the largest new sources of demand driving projected load growth for the Pacific Northwest.[1] Oregonians are seeing rapid development that is raising questions about energy, water use, land impacts, and effects on communities. This interest is shown in public meetings, media coverage, and direct inquiries to the Oregon Department of Energy. The pace and scale of this growth, combined with limited accessible Oregon-specific information, makes this an important and timely topic.

Bring Your Own Generation



Bring Your Own Generation[2] refers to the construction or procurement of electricity generation facilities specifically to serve a data center campus. These energy facilities can be located on-site at the data center, adjacent to the data center campus, or elsewhere on the grid.

This type of arrangement can protect retail customers from potential adverse reliability impacts associated with supplying power to large data center loads. However, it may also increase costs for retail customers when data centers outbid utilities for new generation projects, driving up market prices for those resources.

Data center developers find benefits in this strategy because it can enable them to begin operations more quickly than if they had to wait for the local utility to supply electricity. It also provides more independence from grid outages and direct control over the types of generation built, which can include distributed energy resources, microgrids, battery storage and fuel cells.

Data Center Basics

Data centers are the engines of the digital world. Every search query, streamed movie, online purchase, satellite image, virtual meeting, and artificial intelligence model depends on rows of computers running inside data center facilities. At its core, a data center is a physical building designed to house thousands of servers operating continuously every hour of the day.[3]

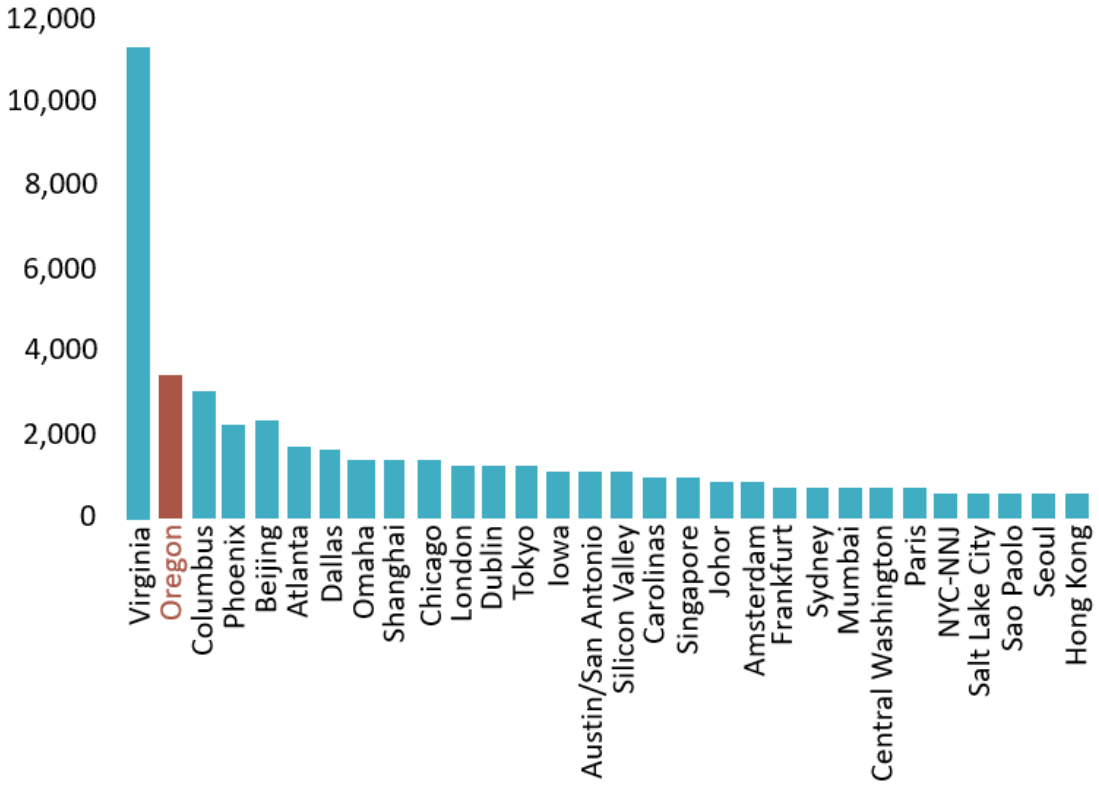
A modern data center is a fully engineered ecosystem. The computing equipment is only one piece. These facilities also depend on an intricate network of electrical systems, cooling technologies, and fiber-optic connections that all must work in lockstep.[4]

Even though they usually have large, often diesel-powered, backup generators, the daily operations of data centers rely on the electric grid. Generators are a safety net, used during testing and maintained for outages, but are not responsible for serving the continuous load of the facility.

Data centers come in several distinct forms; each built for a different purpose and scale of computing. While they share the same core function —to run digital infrastructure — their designs, sizes, and impacts vary widely. The U.S. Department of Energy groups them into five common categories, though other organizations may define data centers slightly differently:[5]

- **Modular/container** data centers are portable, factory-built units that can be deployed quickly in remote, temporary, or emergency scenarios. They typically use 0.1-2 megawatts of power and allow the addition of computing capacity in scalable increments.
- **Edge/micro** data centers are small, local facilities placed close to users or data sources to improve internet speed. These units often support telecommunications, emergency services, and real-time applications. Their power needs are typically under 1 MW.
- **Enterprise** data centers are medium-to-large facilities built and operated by a single organization for its internal IT needs. These sites are designed for security and customization and generally range from 1-10 MW.
- **Colocation** data centers provide shared space where multiple businesses lease racks or rooms while the operator provides power, cooling, and connectivity. These are large, multi-tenant buildings typically consuming 5-50 MW.
- **Hyperscale** data centers sit at the far end of the spectrum. These facilities support massive cloud, AI, and storage operations. They are engineered for high efficiency, extremely large computing footprints, and heavy power demand — often 50-200 MW per site or more.

Figure 1: Top Data Center Markets by Operational IT Load (2026)[6]



Source: Cushman & Wakefield Research, datacenterHawk , DC Byte

Why Oregon Attracts Data Centers

Table 1: Data Center Markets from Largest to Smallest by Total Megawatts[6]

Operational Market Size	Under Construction
Virginia	Virginia
Oregon	West Texas
Columbus	Atlanta
Phoenix	Dallas
Beijing	Columbus
Atlanta	Phoenix
Dallas	Reno
Omaha	Oregon
Shanghai	Iowa
Chicago	Austin

Data centers did not arrive in Oregon all at once, and their footprint in the state is the result of gradual expansion. Oregon's role in the sector began in earnest in 2006, when Google built its first facility outside California in The Dalles.[7] At the time, data centers often drew between 20 and 50 MW of electricity. New facilities now routinely require 50 to 250 MW, and next generation data centers proposed in Morrow County exceed 1,000 MW.[8] [9] This scale of electricity use is creating additional pressures on grid operators when preparing for future infrastructure buildout.

Oregon is becoming well-known as a state with an established presence of data centers.[10] Global rankings show Oregon in the upper tier of localities with data centers. Estimates of market size range from 2,200 MW – 3,600 MW of operational data centers.[11] This capacity places the state firmly as the second operational market in the United States, behind Virginia, which now exceeds 11,000 MW of active load.[6] [12] While Oregon's current position is significant, its long-term standing is likely to shift: several emerging markets are seeing expanding data center capacity at a much faster pace.[6] As these regions scale rapidly, Oregon's relative position may transition to a more mid-sized market over time, shaped by changes in energy availability, infrastructure constraints, and opposition from local communities.

Several conditions have made Oregon an attractive location for data center development:

- Affordable, reliable hydropower and access to new renewables that helps companies meet climate commitments[13]
- A relatively mild climate that supports energy-efficient cooling
- A tax structure without sales tax, combined with enterprise zone property tax incentives that can reduce operating costs[14]
- Strong fiber networks and access to subsea cables that provide high capacity, low-lag connectivity
- An established ecosystem, often described as "data gravity," that encourages companies to expand where infrastructure, expertise, and supply chains are already in place.

Oregon's Data Center Advisory Committee

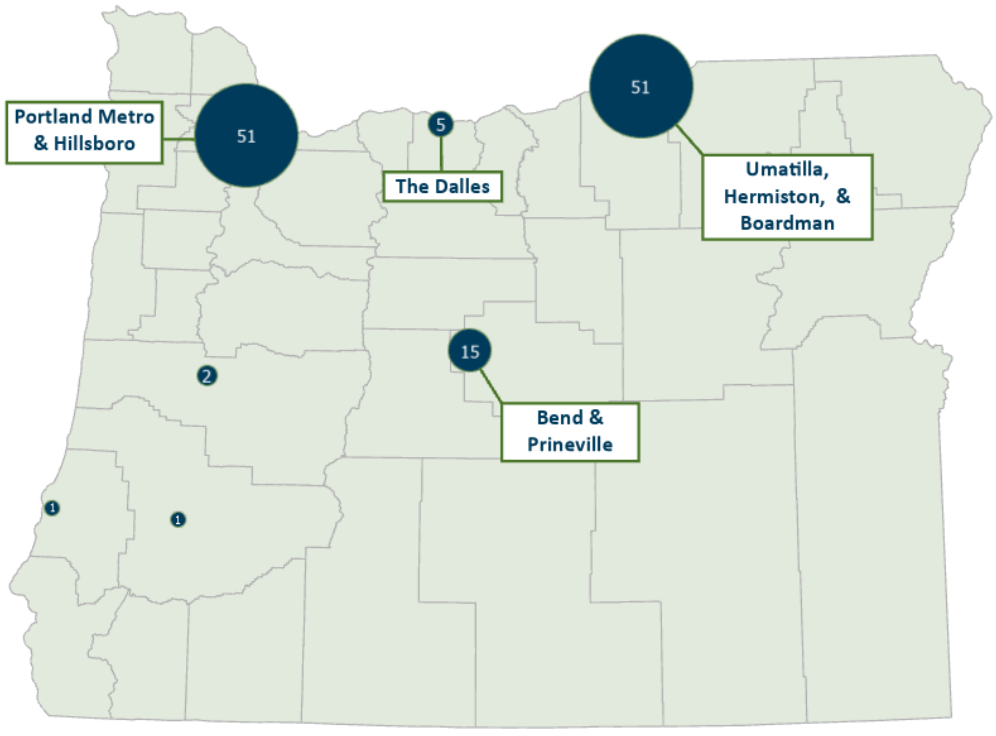
Governor Tina Kotek established the Data Center Advisory Committee in 2026 to develop recommendations for a comprehensive regulatory framework to guide data center development in Oregon. The committee's charge is to identify strategies that support economic opportunities while ensuring that utility costs, infrastructure investments, and environmental impacts remain sustainable and equitable for all residents, including low-income and working families.

Geography of Oregon's Data Center Growth

Over the past 25 years, Oregon's data center landscape has expanded in ways that reflect both the evolution of the industry and the constraints of the state's own infrastructure.

In 2000, Oregon hosted just eight known data centers, nearly all concentrated in the Portland metro area. As the industry matured and power-intensive hyperscale development took hold, growth shifted eastward to regions with more available land.[15]

Figure 2: Map of Data Center Locations in Oregon



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Hyperscale Facilities in Oregon in 2025

By the early 2010s, the Umatilla Basin emerged as the state's primary hub for large-scale development. This shift accelerated as hyperscale operators sought sites where utilities could support clustered loads and where local land use conditions were more compatible with large campus footprints. Central Oregon followed a similar trajectory by 2020, becoming a major development center as operators expanded beyond land-constrained metro areas. As of the publication of this report, Oregon hosts more than 120 facilities statewide, including 61 hyperscale installations concentrated in three regions: the Umatilla Basin, Prineville, and the Portland Metro area.[15]

Community Responses Across Oregon

Oregon communities are experiencing data center growth in very different ways, weighing opportunities for economic benefits, job creation, and infrastructure improvements alongside questions about land use, energy demand, and environmental impacts.

Perspectives from Tribal Governments:

Some Tribal Nations and Inter-Tribal organizations have emphasized the deep cultural and ecological impacts of data center expansion, particularly on water systems, fish habitat, and treaty rights. In a May 2026 presentation to the Oregon Data Center Advisory Committee, the Columbia River Inter-Tribal Fish Commission (CRITFC) expressed concerns over the potential that rapid increases in electricity and water demand from data centers could threaten instream flows and groundwater levels that are crucial for salmon and steelhead. They warned that surging peak loads can destabilize the grid, triggering emergency protocols that may suspend fish protections at federal dams. CRITFC called for holistic management of groundwater and surface water, and energy planning that prioritizes efficient cooling and wildlife-friendly hydropower to prevent further degradation of salmon habitat.[16]

Hillsboro: Halting Data Center Expansion

In response to growing community concerns over rapid data center expansion, Hillsboro City Council unanimously adopted a 120-day moratorium on land use applications for data centers and battery energy storage development starting July 27, 2026.[17] This was the first city council in the state to enact such measures.[18] The pause is intended to allow staff to research economic and environmental impacts, gather public input, and develop code updates addressing where and how such facilities should be sited.[17]

Umatilla Basin: Embracing Data Centers

Since Amazon Web Services (AWS) first arrived to Eastern Oregon in 2011, it has emerged as a mobilizer of economic development for the local economy.[51] Between 2012 and 2025, AWS invested approximately $54.8 billion in Morrow and Umatilla Counties, adding over $15.4 billion to the local GDP and supporting nearly 2,500 direct full time jobs.[20] Local leaders, such as former Mayor of Hermiston, Dr. Dave Drotzmann, noted that the Amazon payments added community assets, including a water tower and new city hall, without the use of additional taxpayer dollars.[21]

Perspectives from State Leadership

In late July 2026, Governor Tina Kotek directed the cancellation of a proposed $5 billion sale of 32 acres of state land for a data center project in Salem, emphasizing that state actions must reflect Oregon's values and serve the public interest.[22] The decision came amid significant backlash at a Salem City Council meeting where hundreds of residents joined hours-long testimony raising alarms over water usage, land use, and environmental consequences.[23] Shortly afterward, Governor Kotek publicly supported locally enacted moratoriums on new data center projects and has called for a statewide pause on new data center development until standards are put in place.[24]

In October 2026, Governor Kotek directed the Oregon Department of Environmental Quality to pause air and water discharge permit processing and issuance for new or expanding data centers until July 1, 2027 to allow time to "digest recommendations forthcoming from the Advisory Committee, and to

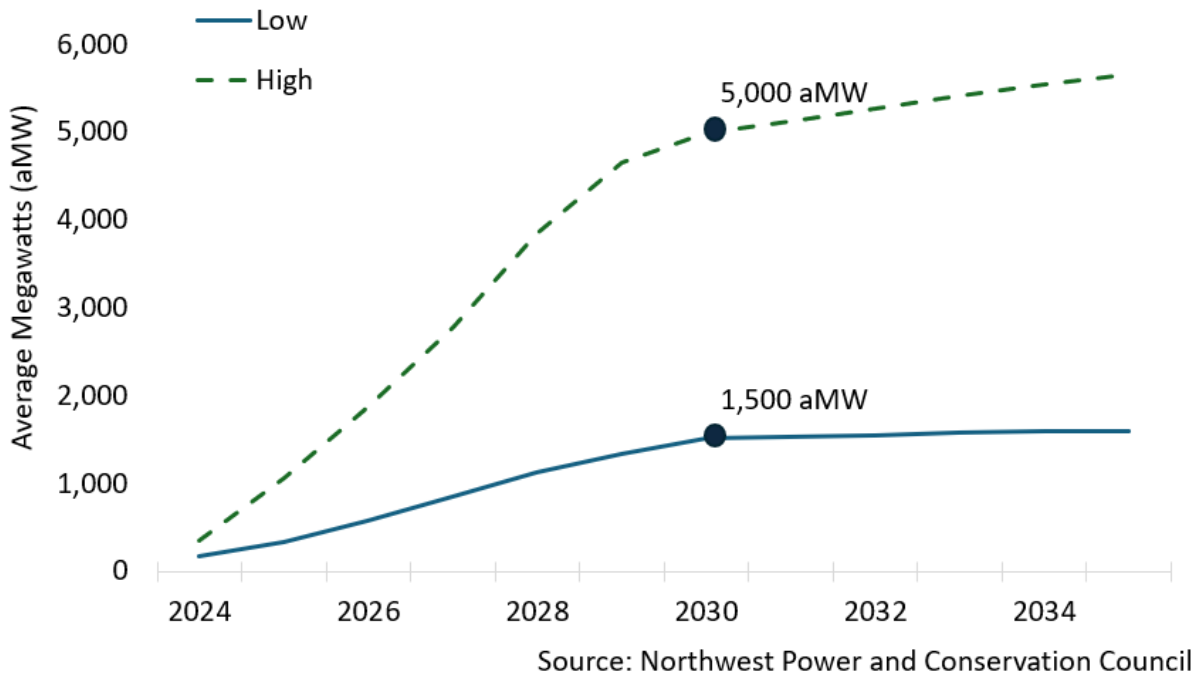
provide space for policy and/or regulatory reforms that may be considered in the upcoming 2027 session of the Legislature."[60]

Future Electricity Demand from Data Centers

Oregon is entering a new phase of data center development, and the amount of electricity these facilities may need in the coming years is significant enough to reshape how the region plans its future power system. Even though the exact number is uncertain, the trend is unmistakable: data centers are, and are likely to remain, one of the largest sources of new demand on the grid.

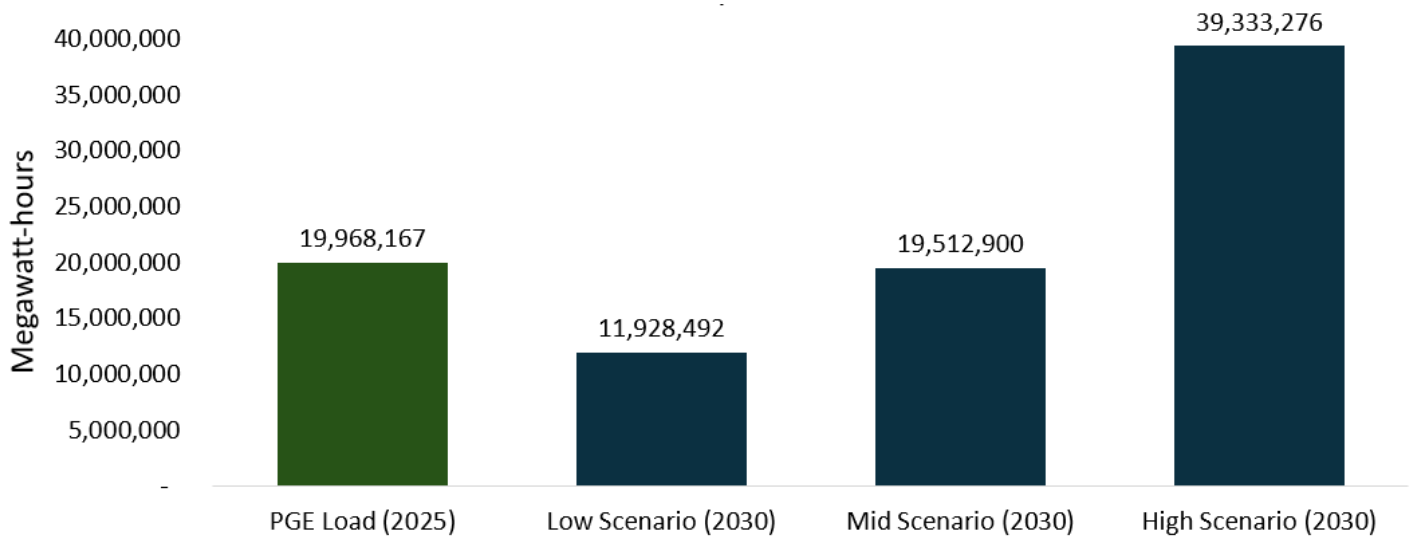
Forecasts from the Northwest Power and Conservation Council indicate that by 2030, new data centers across the Pacific Northwest could require **1,500 and 5,000 average MW** of continuous electricity.[25] Several factors contribute to this wide range of forecasted demand. Companies often submit interconnection requests in multiple jurisdictions when seeking a location to site but don't end up building in all of those locations.[26] Utilities also lack clear visibility into how quickly AI-related computing needs will grow, or whether and to what extent hardware efficiency improvements might offset rising consumption. At the same time, cooling technologies and facility designs are evolving rapidly, making it difficult to predict facility-level loads a decade ahead.

Figure 3: Data Center and Semiconductor Incremental Load Growth in the Pacific Northwest[25]



To illustrate the scale of this potential growth, the Council's forecast can be compared with Oregon's largest electric utility, Portland General Electric, and its total electricity sales in 2025.[27] Since the Council's projection are expressed in average megawatts, the value must be converted to annual megawatt-hours, the standard measure of annual energy use, for an apples-to-apples comparison. A 90 percent utilization rate was also applied. Under this conversion, the forecasted range of 1,500 to 5,000 average megawatts becomes approximately 11.9 million to 39.3 million megawatt-hours per year. For comparison, PGE delivered 19.9 million megawatt-hours in 2025.

Figure 4: Portland General Electric Load Compared with Data Center Forecasts (in megawatt-hours)



This means that, by 2030, the lower end of the data center forecast represents roughly two-thirds of PGE's current annual electricity sales, while the upper end is about double PGE's annual demand. Put simply, the electricity required to power new data centers alone could grow to an amount comparable to, or twice as large as, the total electricity needs of PGE's system today.

Because of this potential scale, regional energy planners, utilities, and policymakers are increasingly treating data center growth as a defining factor in Oregon's long-term energy outlook. To account for these emerging needs, ODOE incorporated the Council's mid-range load estimates into the Oregon Energy Strategy modeling.[28]

Oversight of Oregon's Data Centers

As data center development accelerates, Oregon's response is shaped by a multi-layered governance system that includes state agencies, local governments, community-owned and investor-owned utilities, and regional federal authorities, like Bonneville Power Administration. These institutions collectively determine how large new loads are evaluated, permitted, regulated, and integrated into the power grid.

Key Institutions and their data center-related activities

Oregon Department of Energy: Provides statewide energy analysis, implements the Oregon Energy Strategy and Building Performance Standard, and permits large-scale energy facilities that could be used to power data centers.

Oregon Public Utility Commission: Regulates investor-owned utilities, including resource planning, reliability requirements, cost allocation, monitoring progress toward clean electricity targets, and large-load interconnection approval. The OPUC also administers Oregon's POWER Act, which requires data centers served by investors-owned utilities in Oregon to be treated as a distinct customer class and ensures the new customer class pays for their proportionate share of the costs incurred to serve them.[28] [29]

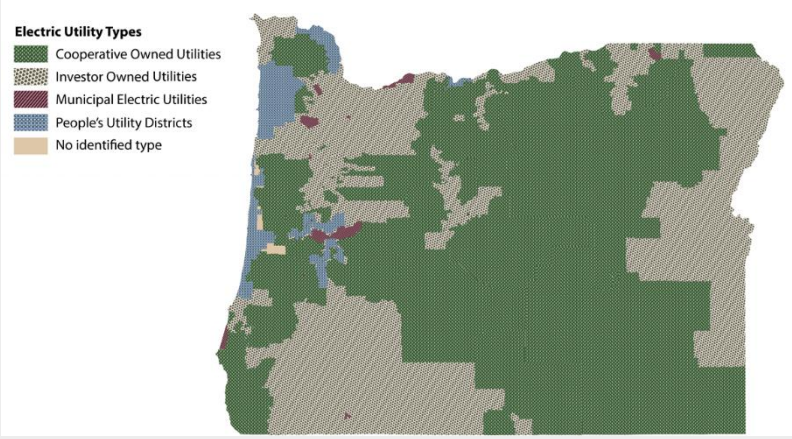
Oregon Department of Environmental Quality: Regulates air quality and emissions from stationary sources, including diesel backup generators at data centers and water quality for discharged wastewater. DEQ administers air and water quality permits and tracks greenhouse gas emissions from electricity suppliers.[31]

Oregon Department of Land Conservation and Development: Oversees statewide land use planning and monitors development trends, including the rapid expansion of data centers in Oregon.[32]

Local Governments: Evaluate and approve data center siting through zoning, land-use permitting, infrastructure impact review, and community-based planning processes. They provide critical on-the-ground perspectives on how new developments fit within local infrastructure capacity and land-use goals.[33]

Oregon's Utility Structure

Oregon is served by both investor-owned utilities (regulated by the OPUC) and consumer-owned utilities such as public utility districts, cooperatives and municipal utilities (regulated locally). This split results in different planning, cost-allocation and clean-energy requirements depending on service territory.



Consumer-Owned Utilities[i]: Specifically, Umatilla Electric Cooperative and Northern Wasco County PUD manage large loads through distinct rate classes, cost-allocation studies, and infrastructure investments.

Bonneville Power Administration (BPA): Oversees transmission planning within their territory, interconnection processes, and major grid-expansion initiatives that serve transmission and electricity demand across the region. BPA's transmission decisions shape siting feasibility and long-term capacity for data center regions in Oregon.[34] Additionally, BPA manages the sale and distribution of hydropower from federal dams, although much of the data center power needs are served by individual utilities.[35]

Northwest Power and Conservation Council: Develops a regional power plan that guides Bonneville and the broader Northwest on meeting future electricity needs with an adequate, efficient, reliable, and cost-effective resource mix. The 9th Power Plan responds to rapid load growth and increasing uncertainty by outlining a balanced portfolio of conservation, renewables, storage, and flexible generation to maintain system adequacy while supporting clean-energy and fish-and-wildlife objectives.[1]

[i] This includes electric cooperatives, municipal utilities, and people's utility districts.

Examples of Statewide Policies and Planning Tools

Building Performance Standard: Statewide program designed to reduce energy use in large commercial and public buildings by improving operational efficiency over time.[36]

HB 2021 (2021): Establishes clean electricity targets for large investor-owned utilities and electricity service suppliers, requiring 100 percent zero-carbon electricity sales to customers in Oregon by 2040 and prohibiting siting of new fossil fuel emitting power plants 25 MW or larger.[37]

HB 3546 POWER Act: Directs the Oregon Public Utility Commission to establish a dedicated service classification and tariff schedule for large energy users (i.e., data centers). It also directs OPUC to require investor-owned utilities to assign infrastructure costs and contractual obligations directly to those large new loads, unless broader system benefits are proven.[30]

Oregon Energy Strategy: Establishes pathways for meeting future load growth through efficiency, clean electricity, electrification, low-carbon fuels, and resilience. It provides recommended actions the state can take to meet its energy objectives and climate goals.[38]

Transformational Integrated Greenhouse Gas Emissions Reductions (TIGHGER) Project: Evaluates progress toward statewide greenhouse gas goals and identifies potential "gap measures" if emissions reductions are not expected to meet state goals. [39]

Emerging Pressures & Opportunities for the Energy System

Oregon's energy system is complex and interconnected. Every part of it, including generation and transmission to distribution, reliability planning, and clean energy policy, depends on the others functioning in balance. The scale of today's data center growth has the potential to stress multiple points of this ecosystem at once. Understanding the most significant risks requires looking across the full system to identify where strains are likely to appear first and what they mean for planning.

The key areas of concern include:

- **Significant electricity demand:** Very large, continuous loads that exceed historical planning assumptions and reshape long-term resource needs.
- **Rapid increases in system peak load:** Higher peaks that require utilities to accelerate capacity additions to maintain reliability.
- **Transmission and interconnection constraints:** Limited transmission capacity and long lead times for building out infrastructure create bottlenecks for resource development to serve new loads.
- **Reliance on on-site diesel backup generators:** Localized air quality, permitting, and community impact challenges tied to large fleets of backup engines.
- **Alignment with statewide clean-energy and climate goals:** Rising load that outpaces existing emissions-reduction trajectories and creates policy gaps.

Significant Electricity Demand

The continued expansion of data centers introduces a scale of electricity demand growth that is unprecedented in Oregon's history. Individual facilities routinely exceed 50 to 250 megawatts, and the next generation includes proposals surpassing 1,000 megawatts.[9] These developments exceed the

levels of infrastructure growth utilities have planned for in the past and can pose reliability risks. The Oregon Public Utility Commission has underscored this noting that "a load of 100 MW or more places unique burdens on the system and thus on other customers… [including] raising costs across the region by utilizing relatively scarce clean energy generation projects or limited transmission capacity," making these impacts difficult to isolate.[40]

Although rapid growth presents challenges for system planning and reliability, the steady, predictable baseload demand associated with data center facilities can also create opportunities for utilities to procure and develop new clean energy resources at scale. This type of sustained demand can support investments not only in clean generation, but also in the transmission and distribution infrastructure required to deliver that power. The passage of the POWER Act further ensures that the industries driving these infrastructure needs contribute their fair share.[41]

Emerging Best Practices in Data Centers

Several emerging operational practices offer opportunities to reduce energy use, water consumption, and local environmental impacts in data centers. Examples include:

- **Liquid Cooling**: Refers to a number of different cooling approaches, including direct-to-chip cooling, immersion cooling, etc., that transfer waste heat to a fluid at or near the point the heat is generated instead of transferring it to room air.[31] This method reduces the size and power consumption of fans serving the data center and has been shown to produce energy savings of 10-20 percent.[41] [42] In areas where water is scarce, best practices are emerging that optimize both water use and energy efficiency.
- **Battery Energy Storage Backup Power:** Backup power is essential for data center power continuity in the case of a grid outage.[33] Traditionally, data centers use diesel generators.[34] However, without additional environmental control equipment, diesel generators create measurable noise pollution for nearby communities and local wildlife, as well as air pollution such as nitrogen oxides and fine particulate matter that can increase rates of respiratory diseases, cardiovascular conditions, and cancer.[35] These outcomes can be minimized by using other technological solutions, such as replacing diesel generators with battery energy storage systems. Microsoft successfully implemented a pilot with Saft, a TotalEnergies subsidiary, to replace its diesel generators with four groups of 4 MWh batteries (16 MWh total) that provide 80 minutes of backup power at a Sweden Central data center.[44,47,48]
- **Demand Flexibility:** Refers to shifting or adjusting certain computing tasks in response to grid conditions, reducing electricity demand during peak periods, or moving workloads to locations with cleaner or low-cost energy. This operational approach increases grid stability and reduces stress on local distribution systems. Google has signed 1 gigawatt of data center demand response with utilities across the United States including, but not limited to, Tennessee Valley Authority, Entergy Arkansas, and Minnesota Power to shift non-urgent computing tasks, such as processing YouTube videos, when the grid is strained.[49]
- **Heat Reuse:** Refers to the practice of capturing low-grade waste heat from data center operations and upgrading it for beneficial use such as district heating or building heat.

This practice enables water savings and offsets fossil fuels used for heating.[42] As of 2024, Google's Hamina, Finland data center supplies approximately 80 percent of the local district heating demand by exporting upgraded waste heat to the municipal network.[50]

These practices represent actionable opportunities that policy, incentives, and collaboration can help advance lower-impact data center operations.

Rapid Increases in Peak Load

Peak electricity demand, or peak load, is the highest demand for electricity from all customers across a specific service area during a specified period of time (such as an hour, a month, or a year). It is one of the key metrics utilities and transmission providers track and forecast to assess future electricity demand — and plan for adequate levels of generating resources needed to keep the lights on.

In addition to their substantial overall consumption, data centers contribute significantly to system peak demand. Utilities build their system so that it is prepared to meet peak load on the hottest day and during a winter cold spell. As peak loads rise, utilities must accelerate the timelines for adding new generation and capacity resources to maintain grid reliability and meet regulatory obligations.

At the same time, data centers may offer emerging opportunities to support grid flexibility. For example, Portland General Electric and GridCARE completed a project in Hillsboro that uses advanced forecasting and flexible resources to accelerate large-load interconnections for data centers, allowing more than 80 MW of new demand to be integrated. This approach, which optimizes on-site resources, batteries, and flexible operations, shows how coordinated demand-management approaches, load-shifting strategies, and participation in demand-response programs can help reduce peak burdens.[51]

Transmission and Interconnection Constraints

Large data center campuses also require extensive upgrades to surrounding transmission and interconnection systems. Meeting these loads often depends on the construction of new high-voltage transmission lines, substation expansions, and dedicated interconnection facilities, all of which take a long time to build, need substantial capital investment, and require close coordination between developers and utilities. While the transmission and distribution systems are constantly being modernized, the speed of the load increases from data centers is occurring, in some cases, more quickly than the planning and permitting processes can accommodate.

While these infrastructure needs can shape regional development patterns and place pressure on existing utility planning processes, emerging national analyses point to consumer-side pathways that could complement traditional grid expansion to help meet rising demand.[52]

Recent analysis by Rewiring America suggests that hyperscalers could meaningfully strengthen grid capacity by investing in household-level electrification upgrades. The analysis found that replacing electric resistance heating with heat pumps in Oregon and other states, along with replacing less efficient air conditioning and water heating with efficient heat pump technologies across the US, could offset roughly one-third of the additional grid capacity associated with U.S. data center growth. Pairing these measures with solar-ready home investments could fully meet or even exceed projected hyperscale load growth nationwide over the next decade.[52] [53]

These ideas are already emerging in practice. For example, in July 2026, New Jersey passed the Data Center Fair Share Act, which incentivizes data centers to secure clean capacity by reducing demand on the grid elsewhere.[43] These voluntary demand reduction trade programs will help investment in customer-sited energy resources.[44]

In parallel with exploring new distributed solutions to relieve near-term pressures on the grid, Oregon has strengthened its regulatory framework to ensure that the costs of serving large new loads are allocated fairly and transparently. For investor-owned utilities, the POWER Act (HB 3546) provides new tools to manage these challenges by requiring facilities that use large amounts of energy to be treated as a distinct customer class and by enabling utilities to require contracts that ensure data centers pay for the infrastructure needed to serve them, unless broader system benefits can be demonstrated. This framework helps align infrastructure investment with cost accountability and supports more transparent planning for large, energy-intensive developments.[19]

The state's consumer-owned utilities have developed their own mechanisms to ensure that large new loads are integrated in ways that safeguard existing customers and the power system. At Umatilla Electric Cooperative, large industrial users are served through dedicated power-supply and transmission arrangements that directly pass wholesale costs to those customers.[56] Northern Wasco County PUD takes a similar approach by maintaining a distinct rate class for major energy users and requiring detailed engineering and cost-allocation studies to ensure 100 percent of customer-specific upgrade costs are recovered through dedicated contracts to prevent subsidization by residential or small commercial customers.[57]

On-site Diesel Backup Generators

Although data centers operate primarily on grid supplied electricity, they maintain large fleets of diesel backup generators to meet reliability and redundancy requirements. As of 2025, Oregon has more than 40 data center campuses either permitted or proposed that include 6,000 MW of backup electric generating capacity.[58] The testing and maintenance cycles for these engines, as well as their use in emergencies, creates localized air quality and noise impacts.

Oregon has responded to these concerns through the Oregon Department of Environmental Quality's Tier 4 streamlined data center air permit, which includes emissions limit requirements and encourages adoption of advanced pollution controls, providing a more efficient permitting pathway for facilities meeting higher standards. This framework reduces administrative burden while maintaining environmental and public health protections. Continued exploration of cleaner backup systems such as batteries, fuel cells, renewable diesel, or hybridized solutions, could in some cases reduce these localized impacts and better align data center operations with Oregon's climate goals.[58]

Alignment with Statewide Clean Energy and Climate Goals

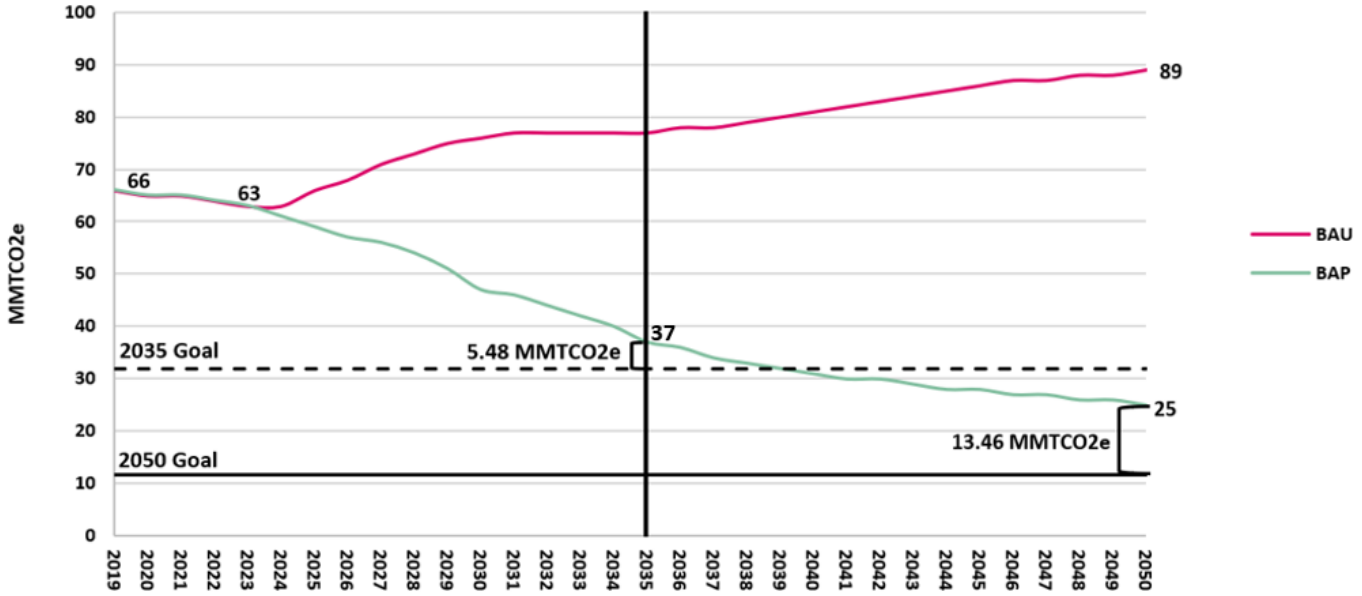
Finally, this growth trajectory has direct implications for Oregon's statewide energy and climate goals.

The TIGHGER (Transformational Integrated Greenhouse Gas Emissions Reductions) project found that under a high technology sector load scenario,[ii] Oregon is no longer on track to meet its 2035

[ii] The TIGHGER analysis is based on data provided by the Northwest Power Conservation Council (NWPCC). The NWPCC aggregates data related to data centers and chip fabrication facilities as part of its "Technology Sector." The baseline forecast completed under the TIGHGER project uses the "High" load forecast identified in the NWPCC's 9th Power Plan.

emissions reduction target through existing policies and programs alone. The chart below shows a gap of 5.48 million metric tons of carbon dioxide equivalent by 2035 and 13.5 MMTCO2e by 2050 between Oregon's greenhouse gas emissions reduction goals and the emissions reductions associated with programs and regulations currently in place. If all new technology sector loads in Oregon were sourced with 100 percent clean energy, the gap between forecasted emissions reductions and the state's 2035 emissions reduction goal would shrink by 3.90 MMTCO2e, or about 71 percent. However, additional emissions reduction measures or significant energy efficiency improvements will likely be required to close the gap entirely.[59]

Figure 5: Business-as-Planned Emissions versus Statewide Goals [59]



The state currently lacks a policy mechanism to address emissions from data center load growth across the state. The 100 percent clean electricity targets established under HB 2021 apply only to investor-owned utilities and electricity service suppliers. A substantial share of new and proposed facilities are located in parts of the state that are served by utilities not covered by 100 percent clean electricity targets, meaning that electricity procured to meet their demands may increase greenhouse gas emissions. While most consumer-owned utilities meet much of their electricity needs with zero-carbon hydropower from Bonneville Power Administration, the absence of greenhouse gas reduction requirements on new loads introduces uncertainty around future resource procurement and emissions trajectories.

The Oregon Building Performance Standard established in HB 3409 (2023) plays an important role in this area by requiring data centers over 35,000 square feet to report energy use, conduct energy audits, and implement cost-effective efficiency measures beginning in 2028. This is one of the few regulatory levers that influence behind-the-meter decisions and can help mitigate overall electricity demand growth, while improving operational efficiency.

Conclusion

Data center expansion is no longer a marginal issue but a central factor shaping Oregon's energy future. The state's existing policies provide an important foundation, yet the magnitude and

geographic distribution of anticipated loads will require additional and adaptive strategies to ensure the energy system can keep pace.

With some ingenuity, Oregon can capitalize on emerging opportunities, from grid-flexibility programs and distributed energy investments to clean energy procurement approaches that scale alongside these loads. By understanding the pressures and intentionally harnessing the benefits of this rapidly growing sector and adopting policies to safeguard limited resources, Oregon can ensure that future data center developments support reliability, protect affordability, and advance the state's long-term clean energy and climate vision.

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Sustainable Aviation Fuel: Benefits, Risks, Challenges, and Opportunities

Sustainable aviation fuel is a low-carbon, drop-in substitute for conventional jet fuel that presents an opportunity to advance Oregon's clean energy, resilience, and economic growth objectives. The Oregon Energy Strategy found that the least-cost path to meeting greenhouse gas reduction goals includes transitioning jet fuel to SAF by 2050, and recommended expanding access to low-carbon fuels like SAF, including developing a strategic roadmap to guide Oregon's fuel decarbonization actions. SAF is currently the only viable low-carbon fuel option for commercial aviation. As SAF demand grows, limited supply will heighten competition among states, making regional coordination critical for Oregon to secure and scale SAF for its long-term energy and aviation needs.

Fundamentals

What is Sustainable Aviation Fuel?

Sustainable aviation fuel is a jet fuel produced from non-petroleum sources such as seed or waste oils, agricultural or forest residues, municipal waste, renewable electricity, or captured carbon dioxide. SAF is compatible with existing aircraft and airport fuel systems but it must be blended up to 50 percent with petroleum jet fuel to be used without equipment modifications. Fuel innovation, testing, and greater supply are needed to meet international aviation fuel standards and achieve blends of higher percentages of SAF in commercial flights.[1]



Aviation Fuel Consumption in Oregon (2024)[2]

3.3 million gallons of aviation gasoline

241 million gallons of jet fuel

How is Sustainable Aviation Fuel Made?

Sustainable aviation fuel can be produced through several technology pathways that use a range of renewable or waste-based feedstocks. The most commercially mature pathway is the hydroprocessed esters and fatty acids process, or HEFA, which converts soybean and canola oils, used cooking oil, or animal tallow from agricultural or seafood processing into jet fuel. HEFA benefits from its similarity to existing petroleum refining and is the most common production pathway, but supply constraints for waste oils remain a challenge. There are also concerns about using agricultural land to produce fuel oils and that growing crops specifically for fuel production can diminish the greenhouse gas reduction benefits.

Hydrogen is required to produce almost all sustainable aviation fuel. In the HEFA process, high pressure hydrogen removes oxygen from oil-based feedstocks and reshapes their molecular structure to meet aviation fuel specifications. Most hydrogen used in refining is produced through steam methane reforming from natural gas.[3] Expanding access to renewable hydrogen, generated through electrolysis powered by renewable electricity or produced from biogas, could further reduce the carbon intensity of SAF and represents a potential opportunity for in-state production in Oregon.

Additional sustainable aviation fuel pathways are in varying stages of development and commercialization and use a broader variety of feedstocks, including some that are available in the Pacific Northwest. The feedstocks and the process determine what energy inputs are needed for production, which has implications for the lifecycle GHG emissions, not only for the production method but also the specific feedstocks used and how they are collected and transported. Table 1 shows different production pathways for SAF creation that are currently operating or are in the planning stages for commercial plants in the U.S. and includes the feedstock(s) for each production pathway. This includes pathways in early stages of commercial-scale development that are not operating at the same scale as HEFA facilities.

Table 1: SAF Production Pathways

Production Pathway	Potential Feedstocks	Benefits	Challenges
Hydroprocessed Esters and Fatty Acids (HEFA)	Vegetable or animal oils and fats, waste cooking oils or other waste lipids	Mature, commercial, refinery-ready	Limited waste oils available in Pacific Northwest, energy crop land use, GHG emission reductions are highly variable
Fischer–Tropsch (FT)	Biomass, municipal solid waste, forestry residues	High-quality drop-in SAF, versatile	High infrastructure development costs, complexity, feedstock processing needed
Alcohol-to-jet (ATJ)	Ethanol, butanol, methanol (bio or drop-in)	High feedstock availability, scalable	Higher cost, energy crop land use, nascent technology
Power-to-Liquid (e-SAF)	Renewable electricity, water, carbon dioxide	Unlimited feedstock potential, high emission reductions	High production costs, high energy intensity, requires significant clean energy development, challenging to scale

Fuel Consumption and Emissions

Sustainable aviation fuel has the potential to reduce lifecycle greenhouse gas emissions by 70 to 90 percent compared to conventional jet fuel.[4] In 2024, Oregon consumed almost 241 million gallons of jet fuel, resulting in over 2.3 million metric tons of carbon dioxide emissions.[2] Transportation is the largest source of economy-wide GHG emissions in Oregon, accounting for about 35 percent of total emissions. Aviation contributes roughly 3 percent, driven primarily by the combustion of commercial

jet fuel, commonly referred to as Jet A or Jet A-1.[i] [5] Emissions estimates are from the U.S. Department of Energy's Energy Information Administration and are calculated based on the combustion of the fuel and not the lifecycle emissions of extracting, processing, and transporting the fuel to Oregon airports. Aviation fuel used in smaller piston-engine aircraft represents a much smaller share of emissions and cannot be replaced by SAF.

How Much Fuel Does a Commercial Airplane Actually Use?[6]

Small commercial jets like a Boeing 737 or Airbus A320 consume 750 to 900 gallons per hour.

Large long-haul jets like a Boeing 777 or Airbus A350 consume 1,500 to 2,200 gallons per hour.

Sustainable aviation fuel delivers a wide range of lifecycle greenhouse gas emissions outcomes, influenced by feedstock type, production pathway, and blending level. While SAF produces carbon dioxide during combustion at levels comparable to conventional jet fuel, its overall climate impact is determined by the full lifecycle of the fuel rather than just at the point of combustion. When SAF is derived from renewable or waste-based feedstocks with lower carbon intensity, it can significantly reduce lifecycle emissions relative to conventional petroleum-based jet fuel. In addition, SAF combustion generally results in lower particulate matter and sulfur emissions, offering potential air quality benefits for communities near airports.

Aviation Gasoline Decarbonization

Fully decarbonizing Oregon's aviation sector will require a combination of fuel and technology innovation to meet the state's long-term clean energy goals. Smaller piston-engine aircraft rely on aviation gasoline or avgas, a high-octane fuel used for shorter flights, lower altitudes, and frequent landings. An estimated 3.3 million gallons of aviation gasoline were consumed in Oregon in 2024, emitting 27,000 metric tons of CO2.[7] Emissions estimates only include the combustion of the fuel and not the lifecycle emissions of extracting, processing, and transporting the fuel to Oregon airports. Electrification and low-carbon fuels such as hydrogen are the most viable long-term alternatives for short-haul, small aircraft that use aviation gasoline.[89]

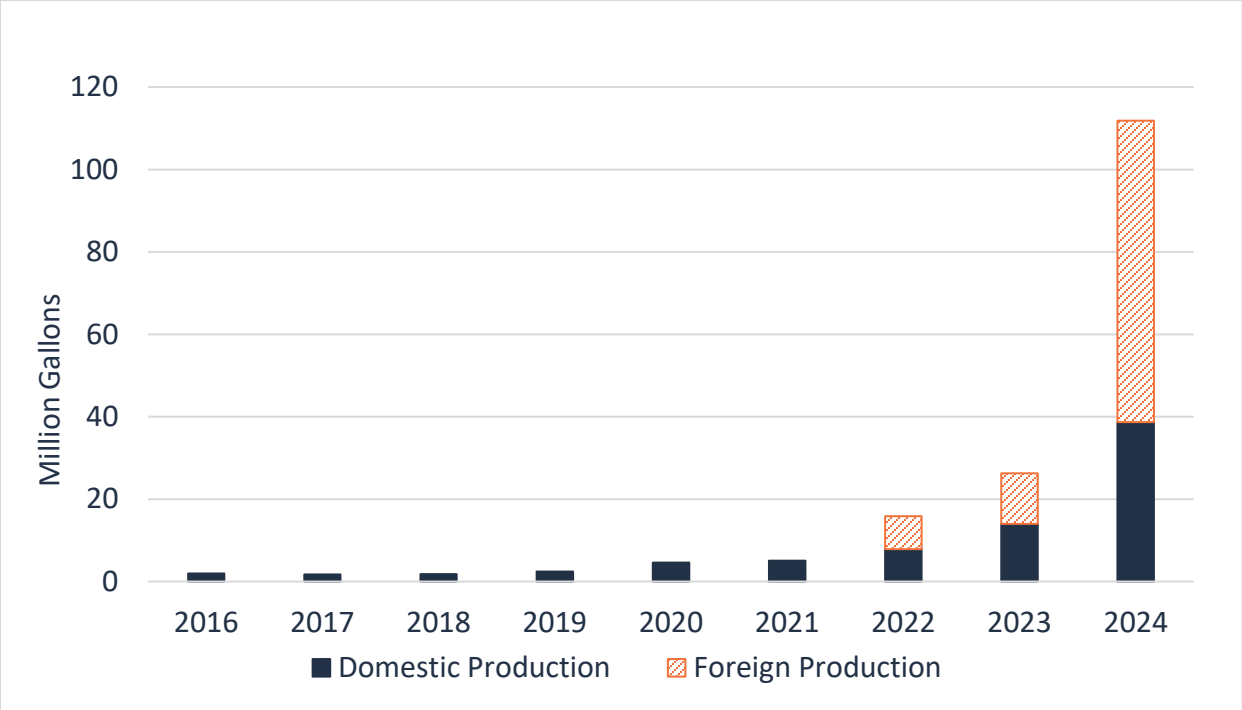
Regional and National Production

Sustainable aviation fuel production in the United States has increased in recent years, rising from 5.08 million gallons in 2021 to 38.7 million gallons in 2024, as shown in Figure 1 below. Nationally, sustainable aviation fuel represents about 2 percent of the roughly 71.4 million gallons of jet fuel consumed each day. Demand continues to outpace domestic supply, and in 2024 the United States imported more than 73 million gallons of sustainable aviation fuel, accounting for about two-thirds of total consumption.[10] U.S. airlines are investing in SAF as part of broader corporate climate commitments, and market activity indicates demand will continue to grow. Several major airlines have

[i] Aviation GHG emissions are based on state fuel consumption at Oregon airports. It is not a reflection of specific airline activity or a tracking of flights landing in or flying out of Oregon, or where the aircraft is when fuel is combusted.

established fuel-switching targets or invested in supply chain development. For example, American Airlines has set a target to replace 10 percent of its jet fuel consumption with sustainable aviation fuel by 2030 and used 2.9 million gallons in 2024.[11] United Airlines created a dedicated investment fund to support technology and feedstock development, with more than $200 million committed.[12] In 2025, the fund announced an investment in Twelve's first commercial production facility, AirPlant One, in Moses Lake, Washington.[13] Alaska Airlines, the first U.S. airline to use SAF in 2011, continues to identify it as a primary pathway for meeting its 2040 net-zero emissions goal.[14] With a premium fuel cost and without mandates, airlines are reluctant to invest more in market changing long term SAF offtake agreements that may put them at a competitive disadvantage.

Figure 1: Sustainable Aviation Fuel Estimated Global Production and Consumption[10]



International Markets

Sustainable aviation fuel availability, standards, and pricing are deeply affected by international policy and markets. The European Union is enforcing a 2 percent SAF fuel blending requirement for large airports as of January 2025. It will increase to 6 percent in 2030, 20 percent in 2035, 34 percent in 2040, and 70 percent in 2050. The United Kingdom has a similar SAF mandate of 1.5 percent SAF now, rising to 10 percent in 2030, 16 percent in 2035, and 22 percent by 2040. Japan, India, and Brazil have published 2030 targets of 5 to 10 percent. These mandates could drive global demand for SAF.[15]

Federal incentives have the potential to influence market development. The Inflation Reduction Act created a federal tax credit for sustainable aviation fuel, which was subsequently extended at a reduced level through 2027 under H.R. 1 (2025). Eligible producers can receive up to $1.00 per gallon.[16] Several federal grant programs that previously supported SAF production, transportation, blending, and storage are paused, creating uncertainty for project developers. Prior to this change in federal laws, the International Energy Agency forecasted in its *2023 World Energy Outlook* that the

U.S. would achieve 3 billion gallons of production by 2030 and was on a path to meeting 100 percent of domestic aviation demand in 2050.[17] Although federal targets and interagency coordination remain in place, reduced federal funding and shifting priorities have contributed to revised projections for national production. Updated estimates suggest the United States may reach approximately 2.1 billion gallons of annual SAF production by 2030, falling short of the federal goal of 3 billion gallons.[18] These trends underscore the need for stable state policy support and coordinated investment to scale SAF production and meet long-term decarbonization objectives for the aviation sector.

SAF Grand Challenge

Federal policy has been a significant driver in the development of sustainable aviation fuel, though the level of federal support has varied over time. In 2021, the U.S. Departments of Energy, Transportation, and Agriculture, together with the Environmental Protection Agency and the Federal Aviation Administration, launched the SAF Grand Challenge. This coordinated effort established national goals to reduce SAF lifecycle GHG emissions by at least 50 percent relative to petroleum jet fuel, expand SAF production to 3 billion gallons per year by 2030 (roughly 10 percent of projected U.S. jet fuel demand), and scale production to 35 billion gallons annually by 2050 to meet all domestic commercial aviation fuel needs. Federal agencies aligned financial assistance, information sharing, and engagement with agricultural producers, industry partners, and researchers to advance market development.[19] Some of this work was put on hold in 2025 but SAF demand and production continues to grow. The SAF Grand Challenge has since transitioned to the SAF Initiative, which remains a guiding federal policy framework intended to support the scale-up of SAF production, even as funding for market intervention has been reduced.[20]

In 2024, two facilities in the United States produced sustainable aviation fuel: Montana Renewables in Great Falls, Montana, and World Energy in Paramount, California, with a combined production capacity of approximately 84,000 gallons per day. Although World Energy ceased SAF production in 2025, additional facilities in Nevada, California, and Texas began operations that year, increasing national output to about 1.26 million gallons per day.[21] In June 2026, Twelve launched AirPlant One, a commercial-scale SAF facility in Moses Lake, Washington, using the power-to-liquids production pathway. This facility is capable of producing about 50,000 gallons, of SAF annually.[22] Although relatively small in scale, emerging projects such as AirPlant One demonstrate continued innovation in production technologies and highlight the diverse pathways under development as the SAF industry matures.

Interest in expanding domestic sustainable aviation fuel production continues to grow with eight facilities in various stages of planning and development in the Pacific Northwest and an expansion of the Montana Renewables facility in Great Falls, Montana to 200 million gallons annually by 2028.[23] NEXT Renewable Fuels, a subsidiary of NXTClean Fuels, is seeking permitting and siting approval to construct a renewable diesel and SAF facility at the Port Westward Industrial Park near Clatskanie, OR with a potential production capacity of up to 1.58 million gallons per day.[24] SKYNRG is pursuing

development of a SAF and renewable diesel facility at the Port of Walla Walla in Washington, with the potential to produce 50 million gallons annually.[25]

NXT Clean Fuels Plant

NXT Clean Fuels intends to construct a renewable diesel and sustainable aviation fuel production facility at the Port of Columbia County's Port Westward Industrial Park near Clatskanie, Oregon. The project would use the HEFA pathway to produce up to 1.58 million gallons per day of low-carbon fuels from used cooking oil, fish byproducts, and animal tallow.[24] The facility would produce renewable diesel and SAF and could adjust the production ratio in response to market demand. With an estimated cost of $2.5 to $3 billion, the facility would operate on approximately 145 acres and distribute up to 750 million gallons of low-carbon fuel annually. The project is expected to generate approximately 3,000 construction jobs, 250–300 long-term operational positions, and more than $45 million in annual tax revenue for state and local governments.[26] [27] Oregon currently has no in-state production for renewable diesel or SAF, and regional availability remains limited.

Some local farmers, Columbia Riverkeeper, and 1,000 Friends of Oregon have expressed doubt about the safety of the project and risks to the surrounding community, including concerns about the plant's natural gas use, feedstock availability, and potential impact to land, water, and air quality.[28] [29] Governor Kotek and the Oregon Department of Energy recognize the potential net benefit in decreasing GHG emissions from transportation fuels and have expressed support. The project would advance the low-carbon fuel pathway and policies identified in the Oregon Energy Strategy by increasing the availability of low-carbon fuels and building the associated infrastructure in the state.[27] [86] The NXT Clean Fuels Project has received all required local county and State of Oregon permits and is undergoing National Environmental Policy Act review administered by the U.S. Army Corps of Engineers.[30] Concerns about the financial health of NXTClean Fuels and the facility have also been raised by opponents of the project and have yet to be resolved at time of publishing.[31]



Figure 2: U.S. Sustainable Aviation Fuel Production Facilities[32]

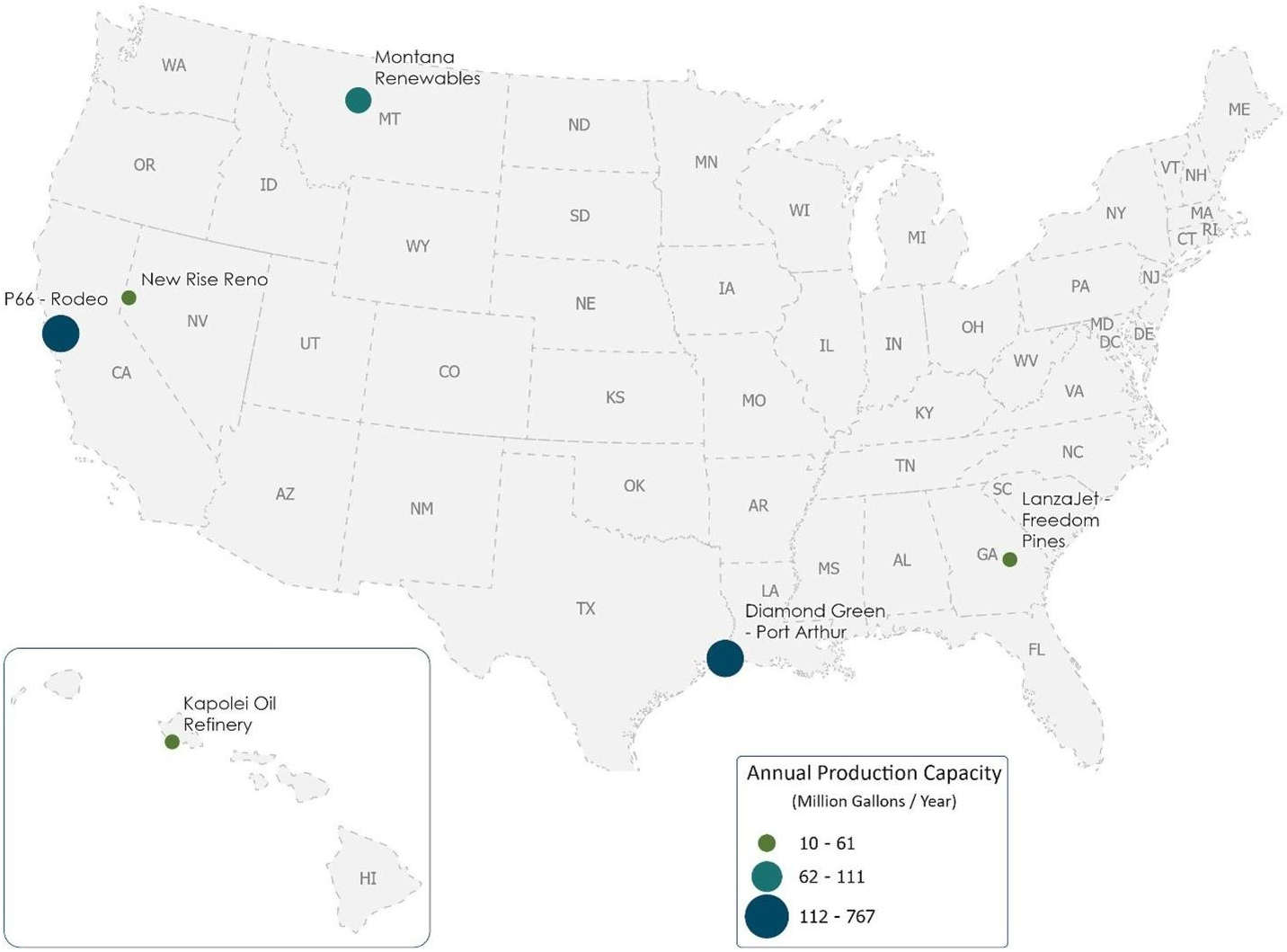


Table 2: Planned SAF Northwest Regional Production[32]

Producer	Location	Announced Annual Production Capacity of SAF & RD (million gallons)
NXTClean Fuels	Port Westward, OR	750
Montana Renewables	Great Falls, MT	facility expansion to 300
SkyNRG	Walla Walla County, WA	50
Twelve	Moses Lake, WA	0.5
Tidewater Renewables	Prince George, BC	96
Dimensional Energy	Richmond, BC	40
7 Mile Renewable Fuels	Kamloops, BC	306.6
Expander Energy Inc.	Mackenzie, BC	4.8-19
NWABF	Hoquiam, WA	60

The Port of Portland, which operates Portland International, Hillsboro, and Troutdale airports has established a goal of achieving net-zero carbon emissions by 2050. Efforts include upgrading building

systems and equipment at Portland International Airport, supporting renewable electricity development, reducing waste, and enabling the use of SAF by airlines.[33] The Port is a member of the Sustainable Aviation Fuels Coalition, a nonprofit organization of airlines, fuel producers, manufacturers, technology developers, and airports focused on accelerating sustainable aviation fuel deployment nationwide.[34] The Port completed a SAF Infrastructure Study in 2018 to identify potential barriers to accessing consistent and affordable supplies, and continues to coordinate with airports that share a common jet fuel distribution hub, developers, airlines, and other supply chain partners to assess demand and logistics.[35] In 2025, the Port collaborated with Delta Air Lines and Shell to facilitate the first commercial-scale delivery of sustainable aviation fuel to Portland International Airport.[36]

Delta Airlines, Shell, and Port of Portland Partnership

In September 2025, Delta Air Lines, Shell USA Inc., and the Port of Portland completed the first commercial-scale delivery of sustainable aviation fuel to Portland International Airport, marking a significant milestone for SAF deployment in Oregon. Montana Renewables in Great Falls, Montana produced 400,000 gallons of SAF using waste-based feedstocks sourced within the United States. The fuel was transported by rail to the Zenith terminal in Portland, where it was blended with conventional jet fuel by Shell and then delivered by barge to the Kinder Morgan terminal and sent by pipeline to PDX for use in Delta aircraft. The multi-step transport and blending process required for this delivery highlighted the infrastructure and logistical challenges that will need to be addressed to enable broader SAF use in Oregon.[36]

Oregon does not have a policy framework to guide the long-term decarbonization of aviation fuel consumption, but there are state policies supporting sustainable aviation fuel adoption. The Department of Environmental Quality's Clean Fuels Program is a market-based standard that reduces lifecycle GHG emissions from transportation fuels. Petroleum jet fuel is excluded from the program, so jet fuel suppliers are not required to participate and do not generate deficits. However, SAF generates credits for producers and importers when it meets certified carbon-intensity benchmarks. In 2025, over 982 thousand gallons received credits and this increased to over 2.8 million gallons in the first quarter of 2026. Monetization of these credits can help offset the higher cost relative to petroleum jet fuel.[37]

Aviation Industry

Sustainable aviation fuel is significantly more expensive than conventional jet fuel, typically costing two to four times more.[4] Periods of higher petroleum jet fuel prices, driven largely by global crude oil markets, could narrow this price gap, but sustainable aviation fuel continues to be a premium product. Jet fuel generally represents between 15 and 40 percent of airline operating costs, and price volatility directly affects ticket prices and overall financial stability.[38] U.S. market demand for sustainable aviation fuel depends on reducing the cost premium relative to conventional jet fuel. Federal funding has been helpful in addressing the higher cost for SAF, but recent changes in federal policy have canceled or reduced funding for programs and policies that supported SAF production and use. Several planned infrastructure projects have been canceled, and some existing producers have shifted focus toward renewable diesel production, where market margins and policy support are

comparatively stronger with better federal tax incentives, state-level policies, and corporate and consumer willingness to pay for lower-carbon fuels.[39]

Benefits and Concerns

Replacing petroleum jet fuel with sustainable aviation fuel can provide Oregonians with many benefits, including improving air quality and public health, supporting growth and access to more sustainable low-carbon fuels, and making progress toward state clean energy objectives. In-state production of SAF could extend these benefits further by supporting energy resilience, enhancing fuel supply security, and contributing to economic development and job growth in Oregon by converting waste streams into value-added fuel products.

These potential benefits should be considered alongside the risks and tradeoffs associated with using or producing sustainable aviation fuel in Oregon. Higher-cost fuels may increase passenger travel expenses or the cost of shipping goods by air. Limited supply means Oregon will compete with neighboring states to secure consistent access to sustainable aviation fuel. Additional production, distribution, and storage infrastructure may be needed at Oregon's fuel terminals and airports, requiring capital investment. Production facilities for low-carbon fuels are industrial operations that generate emissions and may pose risks to local air and water quality. Environmental justice communities located near industrial facilities are more likely to experience adverse effects and may not receive proportional economic benefits. New fuel infrastructure is required to meet the requirements of state and federal permitting designed to mitigate some of these risks. Developing an approach that maximizes the benefits of sustainable aviation fuel while mitigating potential harms can ensure strategic alignment of state efforts and serve as a signal of intent when federal funding is available.

Oregon Aviation Industry

Expanding access to sustainable aviation fuel could support Oregon's aviation sector while expanding economic development. While airline investments, offtake agreements, and dedicated funding mechanisms indicate strong industry interest, achieving broader market adoption will require expanded production capacity, cost-reducing technological advancements, and continued federal and state policy support.



Oregon Aviation[40]

96 public-use airports

90 general aviation airports

6 commercial service airports

21.5 million annual travelers

250,000 tons of cargo

Aviation plays an essential role in Oregon's economy, supporting commercial passenger travel, cargo movement, wildfire response, law enforcement, medical transport, agricultural applications, and emerging uncrewed aircraft systems and advanced-air mobility. The sector contributes an estimated

$24.2 billion in economic activity and supports approximately 73,000 jobs.[41] Oregon's aviation system includes 96 public-use airports, six of which provide commercial service, along with private, military, and general aviation facilities that support statewide transportation and emergency response needs. Commercial airports such as Portland International Airport, Eugene Airport, Redmond-Central Oregon, and Rogue Valley International in Medford serve as critical gateways for regional commerce, tourism, and access to national and international markets.[42] The state has a role in ensuring that policies that encourage SAF uptake in Oregon are weighed against any potential effects on the economic benefits of the aviation industry.

Cascadia Sustainable Aviation Accelerator

The Cascadia Sustainable Aviation Accelerator (CSAA) is a newly established regional coalition designed to advance sustainable aviation fuel production, deployment, and adoption, with the goal of positioning the Pacific Northwest as a global hub. It is funded by public and private investment, including $10 million from the State of Washington and $10 million from a philanthropic organization.[43] [44] CSAA is organized around four primary focus areas:

1. Policy, Education, and Advocacy: Introduce or revise policy measures that enable SAF production and deployment.
2. Feedstocks: Leveraging Pacific Northwest feedstock supply chains like woody biomass and agricultural feedstocks.
3. Research and Development: Reducing technological and market uncertainty through the newly opened Cascadia Sustainable Aviation Institute at Paine Field in Snohomish County, Washington.
4. Financing Production and Offtake: Implement financial tools and offtake agreements that support economic development through new fuel production and distribution.
5. Infrastructure: Improve fuel distribution and storage to ensure access of SAF throughout the region.[45]

CSAA brings together public agencies, academic institutions, aerospace leaders, industry, Tribal Governments, and community advocates to coordinate a comprehensive regional strategy. The coalition aims to help scale production to approximately one billion gallons of SAF annually by 2035, which would replace roughly 59 percent of current annual jet fuel consumption across Oregon, Washington, Idaho, Montana, and British Columbia, Canada.[2] [46] In May 2026, the Oregon Department of Energy joined Washington State Department of Commerce's Office of Renewable Fuels as state agency members. ODOE's participation will help ensure Oregon's interests and perspectives are integrated into regional planning and collaboration efforts as the SAF market continues to develop.

Sustainable aviation fuel currently carries a price premium relative to petroleum jet fuel, and costs are not expected to decline in the near term. Without government funding, these costs will likely translate into higher costs for traveling and shipping, which would have a disproportionate effect on low- and

moderate-income Oregonians and small businesses. One option to mitigate this economic consequence is to initially encourage low blend rates, limiting the potential for economic price shocks that negatively affect the industry. Blend levels could then increase as production expands, supply grows, and costs come down.[47]

Delivering sustainable aviation fuel to Oregon would require substantial investment in fuel distribution infrastructure. All jet fuel supplied to Oregon typically comes from the Olympic Pipeline or barge to the Kinder Morgan Willbridge Terminal, where it is filtered, stored, and certified as meeting fuel quality standards before being transported to PDX via a pipeline directly to the airport, or other airports in the state via truck.[48] SAF will require new transport, storage, and blending infrastructure at fuel terminals at the Critical Energy Infrastructure hub in Portland to support receiving and blending both conventional jet fuel and SAF to meet ASTM International fuel quality standards. The National Renewable Energy Lab evaluated fuel blending at airports or refineries as an alternative to fuel terminals and found it is possible but the need for additional infrastructure, insurance, certification testing, and capital investment make fuel blending at airports or refineries less feasible options. Terminals have existing tanks, equipment, staff, permitting, and expertise and have long offered blending as a service. SAF storage and blending may be able to utilize existing tanks to start but will likely need new infrastructure as supply grows and to improve the efficiency of the blending and distribution process.[49]

Health and Environmental Justice Considerations

Sustainable aviation fuel produces fewer air pollutant emissions than conventional jet fuel, contributing to improved air quality for airport workers and nearby communities.[50] [51] Although blend compositions can vary, sustainable aviation fuel generally results in lower particulate emissions and sulfur oxides from aircraft engines.[51] [52] These reductions are particularly important for ground crews working in close proximity to idling or taxiing aircraft. A national study by Third Way modeled the replacement of conventional jet fuel with sustainable aviation fuel at major U.S. airports between 2025 and 2050 and found that lower particulate emissions could reduce respiratory and cardiovascular risks, potentially avoiding 1,600 to 3,300 premature deaths and generating an estimated $20 to $35 billion in public health benefits.[53]

While the use of sustainable aviation fuel offers broad air-quality and health benefits, the environmental effects associated with production facilities warrant careful consideration. All fuel facilities and infrastructure come with environmental and community risks, which will be borne most strongly by nearby communities and the workers at these facilities. For example, fuel facilities generate air pollutants such as particulate matter, volatile organic compounds, nitrogen oxides, and odors from feedstock handling. Accidental spills may affect soil or water quality. Production processes often require substantial water use, and wastewater can contain contaminants that may enter rivers, groundwater, or wetlands. The Oregon Department of Environmental Quality permits and monitors these industrial facilities to maintain air and water quality standards.[54] [55] Most SAF production pathways use hydrogen that is typically derived from fossil natural gas. Renewable natural gas or renewable hydrogen could be used but they are in limited supply. Combustion of fossil natural gas can lead to significant site GHG emissions. These operational factors can affect environmental quality and contribute to health risks for nearby communities.

Energy Justice[56]

Energy justice is a goal of achieving equity in both social and economic participation in the energy system, while also remediating social, economic, and health burdens on those historically harmed by the energy system ("frontline communities"). Energy justice explicitly centers the concerns of marginalized communities and aims to make energy more accessible, affordable, clean, and democratically managed for all communities.

As Oregon considers opportunities to secure reliable access to low-carbon aviation fuels, the state will need to balance the benefits of in-state production with financial, infrastructure, and community-level considerations, including energy justice, associated with developing new fuel facilities. Industrial operations are often located near rural or lower-income frontline communities. Without safeguards, residents may face disproportionate exposure to pollutants, noise, light, traffic impacts, and other environmental harms. The state can encourage incorporation of community benefit agreements between developers and local jurisdictions to mitigate harm and ensure all benefit. Facilities are subject to local, state, and federal permitting and environmental review, but it will be important to assess both direct and indirect effects on natural resources and community well-being as part of any future planning and siting decisions.

Community Benefit Agreements[57]

Legally binding agreement between project developers and communities with explicit benefits they will receive for support of the project. Benefits are negotiated by communities and depend on their unique concerns and priorities. To learn more, please visit this article on community benefit agreements.

Low-carbon fuel economy

Strategic investments in sustainable aviation fuel can support and strengthen a low-carbon fuel economy in Oregon and the broader Pacific Northwest. SAF facilities that use the HEFA pathway typically co-produce renewable diesel, as both fuels rely on the same feedstocks and a similar chemical refining process.[58] [59] Oregon's consumption of renewable diesel has increased 479 percent in recent years, from 17.6 million gallons in 2020 to almost 102 million gallons in 2025, and demand is outpacing regional supply.[60] Increasing local and regional SAF production could improve access to renewable diesel as well. Hydrogen, a key input for HEFA production, has experienced reduced domestic growth due to federal energy policy changes. This trajectory may change with increased demand as SAF facilities scale, supporting development of a clean hydrogen economy in the Pacific Northwest.

The Oregon Energy Strategy found that the use of low-carbon fuels for hard-to-decarbonize sectors like aviation is necessary to meet state emissions-related goals.[56] Modeling conducted for the strategy indicates that achieving full replacement of petroleum jet fuel with sustainable aviation fuel by 2050 is an important pathway for meeting long-term emissions goals, as it represents the most commercially viable near-term option for reducing emissions from aviation. Demand for jet fuel in Oregon is increasing; Port of Portland is forecasting an annual increase in domestic and international aircraft

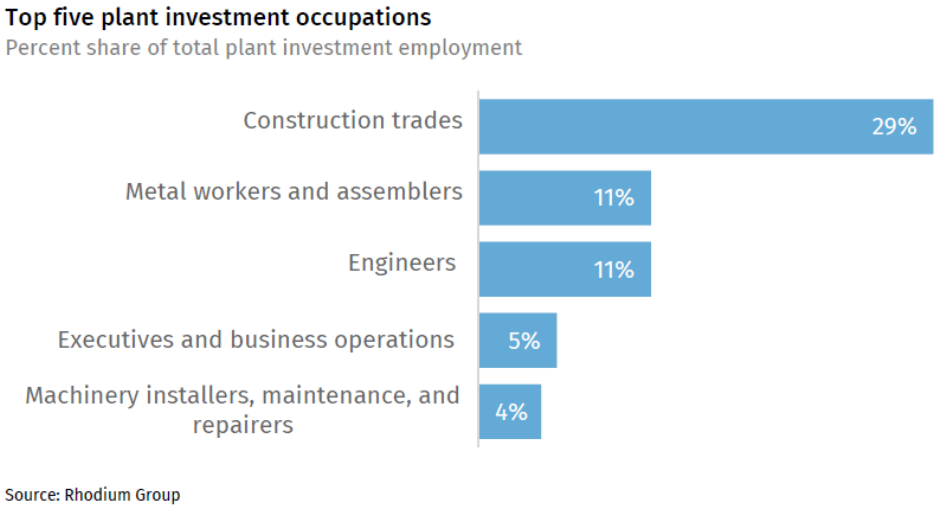
operations of 2.9 percent between now and 2045.[61] Electrification and the use of alternative low-carbon fuels may provide future opportunities for smaller aircraft, but sustainable aviation fuel remains the only option currently available for reducing emissions from larger commercial aircraft, which account for approximately 3 percent of Oregon's greenhouse gas emissions.[5]

Investment in emerging low-carbon fuels carries inherent risks, including uncertainty about future technologies and the relative availability of feedstocks. There is the potential for new fuels or technologies to emerge with attributes that are more beneficial for Oregon, and the state should continue to assess and evaluate these innovations to determine if new policies are warranted. There are also limitations in the volume of feedstocks that could be made available for use at these facilities. The feedstocks are renewable but only insofar as how quickly they can be replenished, where they came from, and what else they could be used for. These limitations underscore the need for coordinated planning to ensure adequate supply and continued reductions in transportation emissions.[3] [62]

Economic growth and jobs

The development of a Sustainable Aviation Fuel industry can not only support economic growth in Oregon but also retain more of the money Oregonians spend on fuels within state and local economies. Developing fuel and feedstock transport, storage, and production infrastructure creates short- and long-term employment opportunities, particularly near the siting of new infrastructure. Establishing new low-carbon fuel production facilities is likely to create the greatest economic benefits by expanding Oregon's industrial sector and generating new employment in urban and rural communities. The Oregon Department of Energy and the Institute for Policy Research and Engagement at the University of Oregon, are conducting the Oregon Energy Strategy Workforce Needs Assessment to evaluate what Oregon's workforce may need to meet the demands of new low-carbon fuel production, renewable energy generation, transmission, energy efficiency, and clean transportation. A Rhodium Group study estimated that a facility designed to produce approximately 100 million gallons of SAF annually can support an estimated 1,100 jobs during construction and 75-150 ongoing operations and management positions once in service. Jobs associated with these facilities include well-paying construction trade positions, metal workers and assemblers, engineers, executives and business operations managers, machinery installers, and maintenance and repairer crews. Construction and operation of these facilities indirectly support state and regional industries and businesses, including equipment manufacturing, fabrication, and feedstock supply industries, as well as local businesses like shops, restaurants, and entertainment venues. Nationwide, the buildout of SAF production capacity is projected to increase public revenues by an estimated $12-$18 billion by 2030.[63]

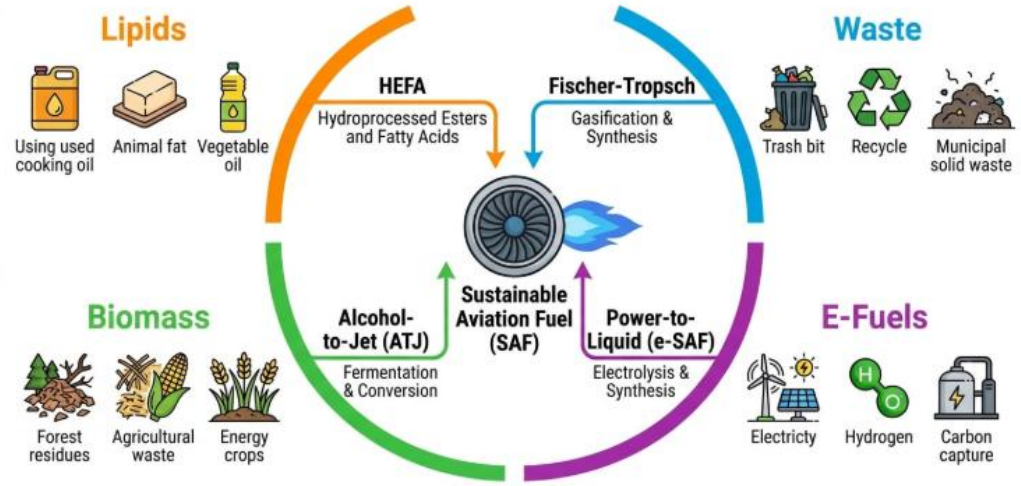
Figure 4: Top Five New SAF Plant Occupations[64]



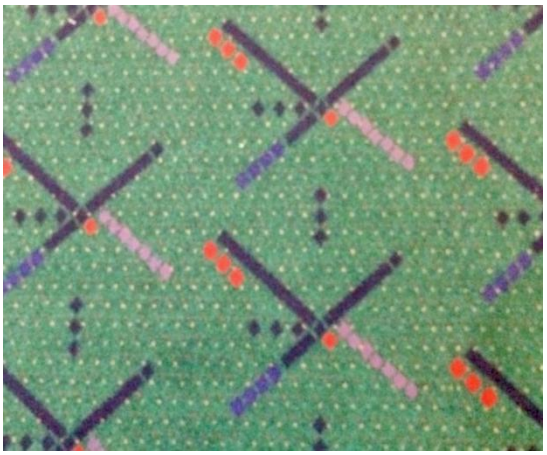
There is limited risk of job displacement in Oregon from the transition from conventional jet fuel to sustainable aviation fuel. Oregon imports all the jet fuel it uses, so jobs in this subsector are focused on the administration and distribution of fuels, which would not be affected by a change in the type of fuel. The Oregon Energy Strategy jobs analysis found that Oregon's fuel sector employs about 10,000 people, which would grow with the siting of low-carbon fuel production in the state.[56]

Collecting, transporting, and processing sustainable aviation fuel feedstocks could stimulate additional rural and regional economic activity. The feedstocks shown in Figure 5 could all be cultivated in Oregon and the greater Pacific Northwest. Using existing waste streams and supplementing them with additional resources cultivates an industrial symbiosis economy, where waste from industries or activities are used as a resource by another industry, improving economic efficiency and reducing waste – ultimately creating more local economic activities that are not as reliant on global trade costs and constraints. For example, the alcohol-to-jet process that uses biomass from agriculture waste or crops grown specifically for energy to create SAF would likely be sited near specific waste or energy crops. Economic opportunity would extend beyond plant operations to agricultural workers and managers in rural farming communities to consistently supply the plant with the needed biomass.[64]

Figure 5: SAF Feedstocks and Pathways[65]



Feedstock availability and costs are a key barrier to sustainable aviation fuel production. Waste fats, oils, greases, and woody biomass are available in Oregon, but are geographically dispersed, creating logistical challenges for economical collection, storage, and distribution. SAF will compete for many of these feedstocks with other low-carbon fuels such as renewable diesel.[66] [67] Each SAF pathway requires a distinct feedstock supply chain that is not yet fully developed. Resources like woody biomass from forest operations, agricultural residues from dairies or concentrated animal feeding operations, and fish byproducts from the seafood sector exist, but larger-scale facilities may need to source additional feedstocks from national or global markets to meet production requirements.[26]



Call Out Box: PDX Statistics[68] [69]

Opened in 1941

1 terminal, 4 concourses, 3 runways

400 flights per day on average (500 at peak times)

18.5 million travelers in 2025[70]

9,600 on-site jobs

$963 million annual contribution to the regional economy

Although developing low-carbon fuel refineries and feedstock supply chains in Oregon will involve significant upfront costs and long project timelines, continuing to rely solely on imported fuels carries long-term economic risk. In 2024, Oregonians spent $10.7 billion on imported petroleum fuels—most of which left the state economy.[2] This outflow increases transportation costs for households and businesses, making Oregon one of the highest-cost petroleum markets in the nation.[2] High fuel prices elevate logistical costs for exporting Oregon-made goods, reducing competitiveness in regional and national markets.[71] Transitioning from imported petroleum to in-state SAF and other low-carbon fuels would help retain economic value and reduce exposure to global price volatility. Airports near SAF production facilities with dedicated distribution infrastructure have fewer logistical and transportation expenses, which reduce SAF premium costs, but those scenarios are rare in this emerging industry. Just as important are the federal and state policies that reduce the price gap; producers send the fuel where there is demand and attractive pricing.[72] If Oregon depends solely on imported SAF, the state will compete with strong policy-driven demand in California and Washington, with no guarantee of securing needed volumes and a high likelihood of paying elevated prices.

Energy security

Expanding low-carbon fuel production and storage within Oregon could strengthen the state's energy security by reducing reliance on external supply chains and improving resilience to future supply interruptions, market volatility, or geopolitical disruptions.[73] Most of Oregon's jet fuel supply depends on a single pipeline, with smaller volumes transported to Portland by marine vessels. Increasing in-state SAF production would create additional supply pathways and provide more options during emergencies. The Oregon Department of Aviation's Strategic Plan identifies limited and inconsistent access to sustainable aviation fuel as an ongoing challenge for the aviation sector.[41]

Oregon Department of Aviation

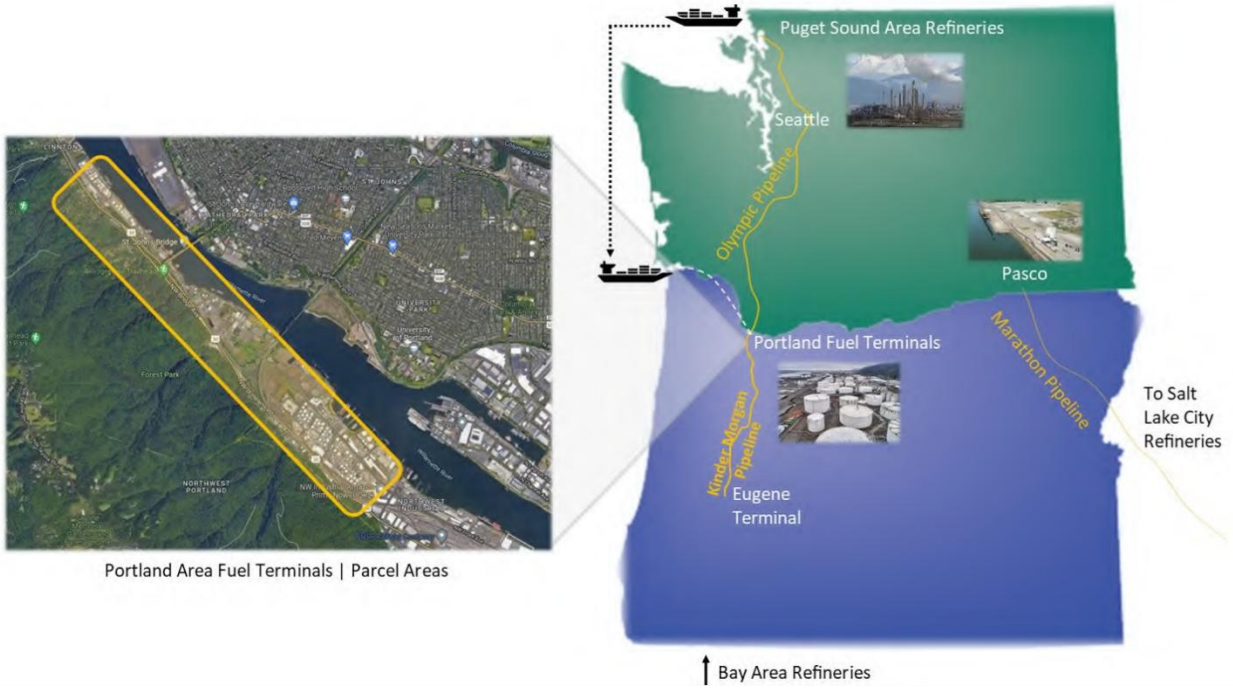
ODAV was founded in 1921 and is the United States' oldest state aviation agency[74]

Expanding fuel production and storage capacity outside high-risk areas can reduce vulnerability to major supply disruptions from natural hazards, including earthquakes. Oregon's Critical Energy Infrastructure Hub along the lower Willamette River remains a central storage and distribution point for liquid fuels, natural gas, pipelines, and high-voltage electric infrastructure, but it is also located in a zone of significant seismic risk. The Oregon Department of Environmental Quality's Fuel Tank Seismic Stability Program requires large-capacity fuel storage and distribution facilities to assess and mitigate seismic risks to their facilities. Each plan will identify specific measures that a facility will take to reduce risk and must be fully implemented within 10 years of DEQ's approval of the mitigation plan. As of October 2026, the City of Portland is considering zoning limitations on new storage tank and transloading capacity, as well as long-term drawdown measures to reduce fuel storage at the Hub over the next 10 years.

These local actions have important implications for the future of sustainable aviation fuel and other low-carbon fuels in Oregon. As currently proposed, Portland's CEI Hub policy would treat low-carbon fuels the same as conventional petroleum products, limiting opportunities to expand low-carbon fuel infrastructure and requiring a 20 percent reduction in total fuel storage capacity. Aviation fuels, including SAF, are exempt from the drawdown requirements, and there is a potential pathway for very modest future expansion of aviation fuel storage capacity — but the limitations to compatible fuels like renewable diesel may slow low-carbon fuel adoption in Oregon. As ODOE noted in formal comments to the City of Portland, "We are … concerned that including low-carbon fuels – such as renewable diesel and sustainable aviation fuel, in the same category as traditional petroleum-based fuels could hinder the development of the nascent low-carbon fuel economy in Oregon. These fuels are essential to meeting transportation-sector greenhouse gas emissions reduction goals as outlined in the Oregon Energy Strategy, as well as to improving local air quality."[75]

Developing low-carbon fuel production and storage outside the CEI Hub would reduce exposure to seismic and other natural-hazard risks and improve long-term resilience. However, Oregon remains heavily dependent on the CEI Hub's terminal network for fuel supply. Nearly all refined petroleum products and low-carbon fuels, including all jet fuel and SAF used at Oregon's commercial airports in Portland, Eugene, Redmond, and Medford, flow through this single hub. Strengthening alternative storage and distribution pathways will be essential to reducing this vulnerability and supporting a more resilient low-carbon fuel system statewide. The ODOE Energy Security Plan highlights opportunities to distribute fuel storage more broadly across the state to strengthen emergency preparedness and response.[73]

Figure 6: Map of Oregon and Washington Fuel Supply and Distribution System[73]



Policy Exploration

State and federal policies can play an important role in increasing sustainable aviation fuel use while minimizing harm to communities, the economy, and the aviation industry. Oregon currently provides financial incentives for SAF but lacks specific plans and goals that provide market certainty and encourage collaboration among state agencies, community and environmental organizations, airports, and industry partners. State plans and goals would need to include mechanisms to secure fuel from out of state or spur development of a SAF economy in Oregon, including fuel infrastructure and feedstock supply chains. This could include policies that support financing tools or direct monetary incentives. The following sections explore these policy needs and provide potential options, including examples of policies other states are implementing to advance SAF markets.

Setting Goals

Establishing clear goals for sustainable aviation fuel consumption and production would signal Oregon's long-term commitment to decarbonizing aviation and encourage collaboration among incumbent fuel suppliers, new market entrants, and public partners. Integrating SAF targets into Oregon's broader energy system planning would also ensure consistency across existing aviation, transportation, and low-carbon fuel policies.

Creating sustainable aviation fuel goals in Oregon would also align with emerging regional strategies. In 2024, California and Airlines 4 America set a goal to increase SAF availability to 200 million gallons by 2035, while establishing a working group to report on progress and evaluate potential barriers to meeting the goal.[76] The Port of Seattle set a goal to power all flights at Seattle-Tacoma International Airport with at least a 10 percent blend of SAF by 2028.[77] British Columbia has taken a different approach by requiring all aviation fuel sold in the province to include at least 1 percent SAF beginning in 2028, increasing over time, and pairing this requirement with a declining carbon-intensity standard

for qualifying SAF. This mandate is the first of its kind in North America, though limited regional supply and distribution constraints will need to be addressed for it to be successful.[78]

By setting sustainable aviation fuel consumption goals, Oregon can signal long-term demand certainty to fuel producers and investors. This could potentially de-risk private sector capital decisions and encourage development of local SAF production facilities, supply chains, and supporting infrastructure. An Oregon target could combine increasing consumption volumes through 2050 with declining carbon-intensity requirements to spur innovation and encourage use of local waste resources. Oregon could collaborate with airlines, fuel producers, and distributors to identify a target and develop procurement strategies to support achievement.

Infrastructure

Reliable access to sustainable aviation fuel will require in-state production or distribution from new regional facilities. No planned SAF production facilities in the Pacific Northwest are integrated with existing petroleum pipelines; Oregon will likely need additional storage and transport capacity, such as marine, barge, or rail shipments to Portland terminals, or new fuel terminals elsewhere in the state. To be successful, policy options encouraging infrastructure development must consider siting constraints, capital costs, and environmental and community impacts.

Other states are clarifying regulatory processes to reduce uncertainty for developers while ensuring the benefits of sustainable aviation fuel are realized. Minnesota created regulatory and environmental review roadmaps for SAF projects, outlining key steps and information requirements without reducing environmental safeguards.[79] The state of Washington established two-year environmental review timelines and is allowing SAF facilities to qualify as Clean Energy Projects of Statewide Significance. This designation allows for consolidated reviews but also requires developers to account for their ability to reduce emissions, achieve economic development goals, engage affected federally recognized Tribes, and document potential effects on environmental and public health.[80] [81] Colorado introduced a refundable tax credit to offset a portion of SAF production facility costs, which is available to producers, airports, and aviation businesses when new facilities come into service. The tax credit may be recaptured by the state of Colorado if SAF production reaches less than 60 percent of the facility's total annual production in any of the three taxable years following operation. This ensures SAF is produced in the state even when market forces are driving demand for other low-carbon fuels like renewable diesel.[82] These policies provide clarity to support development while maintaining environmental, community, and fiscal protections.

To strengthen long-term sustainable aviation fuel access, Oregon could conduct a statewide assessment of fuel infrastructure needs and use the results to guide investment. The Cascadia Sustainable Aviation Accelerator, of which ODOE is a member, is evaluating regional infrastructure and policy barriers. Oregon could build on this work by developing a SAF Infrastructure Strategic Plan, identifying priority locations for future facilities, and creating a regulatory roadmap for low-carbon fuel projects that incorporates community benefit frameworks. Applying the Oregon Energy Strategy's Equity and Justice framework will be important to ensure infrastructure decisions balance economic benefits, resilience, community impacts, and environmental protection. The state's developing environmental justice tool may help identify potential benefits and burdens to communities and natural resources. Oregon could also adopt maximum environmental-review timelines for

high-priority projects and consider designating low-carbon fuel facilities as critical energy infrastructure to support a resilient transition.

Feedstocks

A statewide sustainable aviation fuel feedstock strategy could help maximize GHG emission reductions and economic benefits. Waste feedstocks are dispersed and may be costly to collect, store, and transport, and many already serve other markets. An assessment of feedstock availability, developmental costs, and economic benefits could serve as the basis for such a strategy. ODOE conducted a statewide renewable natural gas feedstock inventory in 2018, which has been used to inform planning activities for uptake of this lower carbon fuel. A SAF feedstock inventory would help identify synergies between locally sourced industrial, municipal, agricultural, and forest waste that could reduce costs for feedstock collection and transport. Important considerations for the strategy should include:

- Whether energy crops, such as oil seeds and perennial grasses, should be encouraged,
- Whether and how other feedstock end uses could affect the economics of feedstock collection.
- How the commercial viability of different SAF production pathways affects the economic feasibility of feedstock collection. For example, woody biomass pathways are not yet commercially viable, and the uncertainty of the need for this feedstock should be taken into consideration.

Ensuring alignment with community priorities and environmental protection is key to making a strategy successful. Other states have adopted policies to encourage low-carbon feedstocks that consider their broader environmental and equity goals. Many limit use of energy crops, encouraging use of waste feedstocks and feedstock diversification, and/or require lower carbon feedstocks. California's Low Carbon Fuel Standard limits the use of energy crops in SAF and requires independent feedstock verification. Requiring fuel producers to track crop- and forestry-based feedstocks to their source can help ensure that SAF feedstocks are not directly or indirectly leading to land use changes that release more carbon than the fuel will save.[83] Illinois sets an annual 10 million gallon cap on the amount of SAF from soybean oil feedstock for their SAF purchase credit program to encourage the development of other feedstocks. Illinois also doesn't restrict the credit to in-state SAF production, which could encourage more regional feedstock economic development.[84] Minnesota requires at least a 50 percent lifecycle emissions reduction and integrates equity, water protection, biodiversity, and land-use safeguards. Successful policies in Oregon will need to take into consideration state priorities within the context of community interests and concerns.

Developing a sustainable aviation fuel feedstock strategy would inform a broader SAF policy framework, helping to foster a state SAF economy that supports increased SAF availability and use. ODOE is contributing to Cascadia Sustainable Aviation Accelerator's regional feedstock assessment, which will help characterize the volume and distribution of available feedstocks in Oregon relative to the rest of the region. Oregon could further advance this work through research grants and public funding to address barriers to using waste feedstocks, and explore opportunities related to woody biomass, captured carbon dioxide, renewable hydrogen, and other emerging pathways. Findings from this work should be considered against other Oregon priorities, such as how SAF feedstock

development intersects with state natural carbon sequestration goals, environmental justice goals, and economic development strategies.

Financing

Strategic investments and incentives that support new infrastructure, reduce costs, and encourage market participation can help expand sustainable aviation fuel production at a pace necessary to meet state climate goals. SAF currently costs two to four times more than conventional jet fuel, and while federal tax credits help offset costs through 2029, long-term federal support is uncertain. Oregon will compete for limited SAF with neighboring states, and near-term demand will be shaped by fuel pricing in an emerging market. Developing in-state production and distribution could strengthen access by reducing costs for delivery in Oregon. Clear state goals and stable incentives can reduce investment risk and signal long-term market viability but like supporting feedstock development, these policies should be constructed in a way that minimizes negative outcomes while maximizing benefits for communities and the environment.

States are testing various approaches to financing sustainable aviation fuel production and consumption. Illinois has a SAF purchase credit of $1.50 per gallon and it is applied toward the 6.25 percent state sales tax liability on the purchase of aviation fuel at point of sale.[84] Minnesota offers a per-gallon tax credit of up to $1.50 for SAF that meets strict sustainability requirements, including use of in-state waste biomass and a minimum 50 percent lifecycle emissions reduction, and requires the fuel to be used on flights departing from Minnesota airports. This approach ensures that economic benefits remain in state, but may limit flexibility for producers operating in a dynamic and evolving market where they may need to import or export fuel out of the state. Washington State enacted a per-gallon tax credit tied to lifecycle emissions performance. However, the credit will not take effect until in-state production reaches at least 20 million gallons per year. With commercial production in Washington still in the early stages, it will be years before these incentives become available.

Oregon could expand sustainable aviation fuel access through targeted financial incentives programs, or tax relief designed to reduce costs and spur infrastructure investment. Options include grants or low-interest financing for blending, storage, and airport distribution, or a per-gallon tax credit tied to emissions-reduction thresholds and Oregon-sourced feedstocks. Financial support to accelerate investment in sites to prepare them for development and updates to standards for industrial lands as recommended by the Oregon Prosperity Council could make Oregon an attractive location for a low-carbon fuel production facility.[85] Oregon could also explore expanding existing market transformation programs like the Climate Protection Program and the Clean Fuels Program to include aviation fuels. Transitioning from voluntary to mandatory participation for jet-fuel suppliers would enhance SAF credits, establish a transition timeline, and consistent demand. Collaboration with industry will be important to identify key financial barriers and the most effective policy approaches to reduce supply-chain risk for producers, increase blending capacity at fuel terminals, and bolster airline demand.

Strategic Planning and Regional Coordination

Strategic planning and regional coordination will be essential to support sustainable aviation fuel development and long-term decarbonization of Oregon's aviation sector. Aligning efforts across state agencies, local governments, airports, industry, and academic institutions can help create a

coordinated roadmap for feedstock supply, infrastructure needs, and regulatory pathways. Aspirational state goals aligned with regional partners could strengthen policy signals, and Oregon could lead by example through SAF procurement targets for state air travel.

Continued regional collaboration will help ensure reliable access to sustainable aviation fuel, support Oregon's economic opportunities, and manage risks associated with a transitioning fuel market. Additional SAF challenges —including fuel testing, engine manufacturer requirements, and safety evaluations — extend beyond state boundaries and require multi-state and private/public collaboration to overcome. Minnesota's SAF Hub demonstrates a model for coordinated infrastructure development, feedstock sourcing, research, and commercialization. Oregon and Washington are supporting the Cascadia Sustainable Aviation Accelerator, a regional partnership focused on scaling production, deployment, and use. Through the Accelerator, Oregon will evaluate policies, infrastructure needs, and feedstock availability to identify economic opportunities and support regional SAF production. This collaborative approach aligns with Governor Kotek's Executive Order 25-29, Business Oregon's forthcoming Economic Development Strategy, and the Oregon Department of Aviation's 2025 Strategic Plan, all of which emphasize coordinated regional planning and sustainable infrastructure development.

Conclusion

Sustainable aviation fuel offers Oregon a practical path to reduce emissions from commercial aviation and a broader opportunity to strengthen the state's clean energy economy and energy security. Leveraging Oregon's waste-based resources as feedstocks could bolster economic growth in rural communities, strengthen regional supply chains, and expand access to other high-demand, low-carbon fuels such as renewable diesel. Increasing the availability of SAF would enhance energy security by reducing reliance on imported petroleum fuels and retaining more transportation fuel investments in Oregon.

At the same time, policies driving economic investments must also be in place to attract sustainable aviation fuel producer investments. Establishing SAF consumption and production targets that are regionally aligned could foster more predictable market conditions for developers. These could be bolstered with policies that incentivize in-state SAF production and infrastructure development.

Achieving these outcomes will require coordinated planning, regional alignment, and clear regulatory frameworks to support market growth and new industrial development. Thoughtful planning and local engagement to address environmental, health, and equity considerations must be priorities when considering new fuel production and distribution infrastructure development. Identifying options to mitigate inequities associated with SAF-related infrastructure requires engaging with communities early and often and ensuring their input informs state and local siting and permitting decisions. Coordinated planning across state agencies, airports, industry partners, and regional initiatives can reduce timelines for developers while still enabling public input on infrastructure development and ongoing operations and eventual decommissioning.

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Flexible by Design: How Medium- and Heavy-Duty Vehicle Charging Can Support Grid Integration in an Era of Rapid Load Growth



Electricity demand in the Pacific Northwest is entering a period of renewed growth, with data centers emerging as the dominant near-term driver of load[i] growth.[1–3] Building electrification and electric vehicles are expected to contribute an increasing share of demand over time. Recent projections from the Northwest Power and Conservation Council indicate regional electricity demand could increase by roughly 1.8 to 3.1 percent annually over the next two decades, potentially doubling by 2046.[4] This marks a significant departure from historical trends, as electricity demand in the U.S. grew slowly over the past two decades and was largely offset by improvements in energy efficiency.[5]

Unlike many historical sources of load growth, emerging tech loads are often large, concentrated, and relatively inflexible. Oregon already hosts one of the fastest-growing data center markets in the country, and these facilities tend to operate with high-capacity, continuous electricity demand.[6] This shift creates new challenges for system capacity, reliability, interconnection timelines, and utility planning. Utilities must increasingly prepare for and accommodate large, concentrated loads – particularly data centers – that operate around the clock and have limited ability to adjust consumption in response to grid conditions.

At the same time, medium- and heavy-duty vehicle electrification is introducing another major source of high-powered load. While not the primary driver of demand growth in the near term, electric vehicles are projected to play a much larger role by 2030, and become one of the largest contributors to load growth over time, according to numerous studies.[1–3] Importantly, the effect of medium- and heavy duty electric vehicles on the power system depends not just on how much electricity these vehicles consume, but on the *shape* of charging demand: when, where, and how vehicles charge.[7]

Unlike many emerging tech loads, medium- and heavy-duty vehicle charging applications often have inherent flexibility that can be leveraged in different ways. Charging can be scheduled around predictable fleet operations and long dwell times,[ii] creating opportunities to actively manage electricity demand in ways that support grid reliability. Managed charging can provide value at both the bulk power and distribution system levels[iii] by reducing overall peak demand, improving the utilization of existing infrastructure, and helping keep EV charging loads within local feeder and equipment limits.[8] By reducing system costs and making more efficient use of existing grid assets, these benefits can help moderate future cost increases. In addition, when paired with battery energy storage, microgrids, or bidirectional charging technologies such as vehicle-to-grid or vehicle-to-building, electric vehicles and charging infrastructure may also provide resilience benefits by

[i] Load refers to the amount of electricity being used or required at a given time. Load growth refers to an increase in that electricity demand over time.

[ii] Dwell time refers to the period when a vehicle is parked and available for charging. For many medium- and heavy-duty fleets, overnight depot parking creates long dwell times that provide flexibility over when charging occurs.

[iii] The electric grid is often divided into two levels: the bulk power system, which includes generation and high-voltage transmission infrastructure that moves electricity across the region, and the distribution system, which delivers electricity from local substations to homes and businesses.

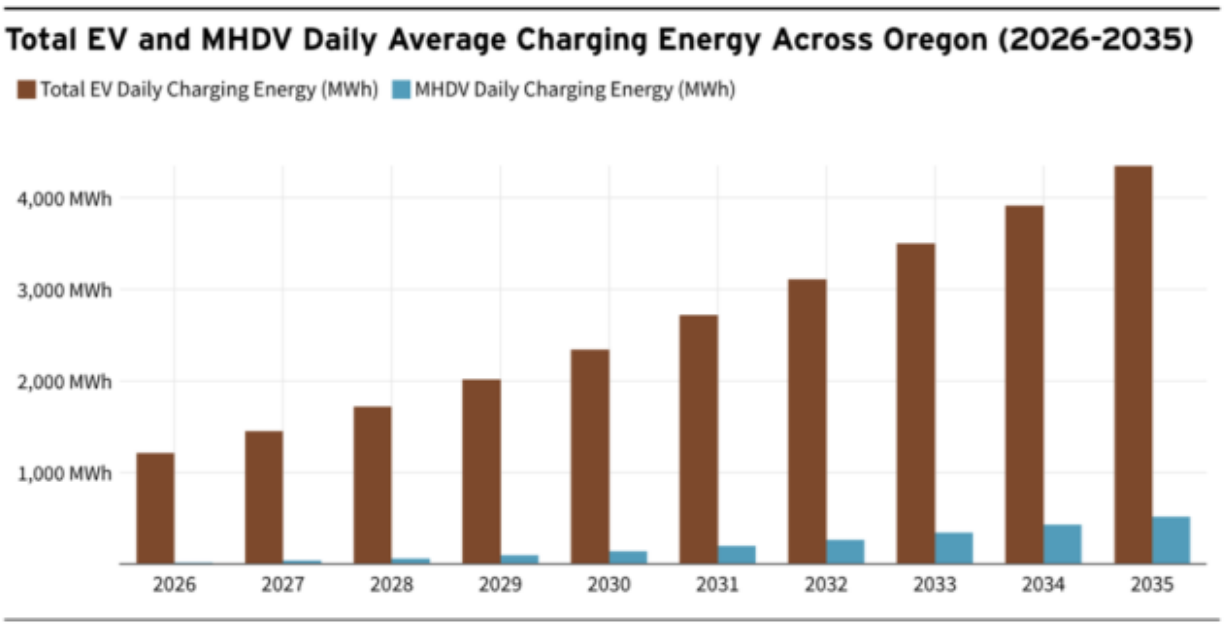
supplying backup power to home, businesses, or the grid, and maintaining essential fleet operations. With the right policies, infrastructure, and incentives, medium- and heavy-duty vehicle charging has the potential to function not only as new electric load, but a valuable source of grid flexibility, reliability, and resilience.

What Makes MHD Charging Distinct and Valuable

Oregon's medium- and heavy-duty vehicle sector represents a significant and growing opportunity for transportation electrification, as well as a potentially valuable source of load flexibility. Oregon has roughly 380,000 registered medium-and heavy-duty vehicles.[9] Though just over 1,050 of those vehicles were electric as of June 2026, state policies, manufacturer commitments, and broader market trends are expected to accelerate adoption over the coming decades. Much of Oregon's existing MHD fleet appears well suited for near-term electrification: class 2b and 3 vehicles, including commercial pickups and delivery vans, account for roughly 84 percent of Oregon's registered medium- and heavy-duty vehicles and are among the most commercially mature applications for battery-electric technology today.[10]

Transportation electrification is expected to create substantial new electricity demand in Oregon. A recent RMI report prepared for the Oregon Department of Environmental Quality estimates statewide EV charging demand could reach approximately 4.3 GWh per day by 2035, with MHD vehicles accounting for roughly 10 percent of total transportation electricity demand (Figure 1).[11] Unlike residential light-duty charging, which is typically small and dispersed, MHD charging often involves large amounts of electricity concentrated at fleet depots, warehouses, transit yards, ports, or industrial facilities. Heavy-duty truck chargers can require hundreds of kilowatts of power, and fleets may charge many vehicles simultaneously, creating substantial aggregate demand. These high-powered, clustered charging patterns can create localized challenges for distribution infrastructure and utility planning, particularly in areas where freight and industrial activity are already concentrated.[13]

Figure 1: RMI Analysis on Statewide EV Charging Demand – Total EV vs. MHDV



These impacts can be especially significant if charging is unmanaged.[7] Simultaneous charging at large fleet depots or freight hubs can produce sharp peaks in electricity demand, potentially requiring costly upgrades to substations, feeders, transformers, and other grid infrastructure. Studies in California and New York estimate that unmanaged charging could drive tens of billions of dollars in distribution system upgrades, while managed charging could reduce those costs by half.[14,15] High-powered charging that coincides with periods of high system demand or limited resource availability can also increase bulk power system costs and contribute to reliability challenges.[11] Because fleet charging infrastructure can often be deployed faster than traditional utility planning and infrastructure upgrades, unmanaged charging has become a growing concern for utilities and regulators nationwide.[16] Absent interventions such as capacity upgrades or managed charging, many locations on Oregon's electric grid are likely to face capacity constraints in the near future: RMI's study estimated that by 2035, approximately 33 percent of Portland General Electric feeders and 60 percent of Eugene Water & Electric Board substations could be capacity-constrained (see Figure 2).[11]

Figure 2: Utility Infrastructure Capacity Constraints Due to EV Load Growth in RMI's High Adoption, Unmanaged Charging Scenario

Utility	Asset Type	Total Assets	Assets Over Capacity (2030)	Assets Over Capacity (2035)
PGE	Feeder	556	155	179
Pacific Power	Transformer	249	5	11
EWEB	Substation	29	17	17
Idaho Power	Feeder	52	0	1

Not accounting for capacity expansions beyond 2025.

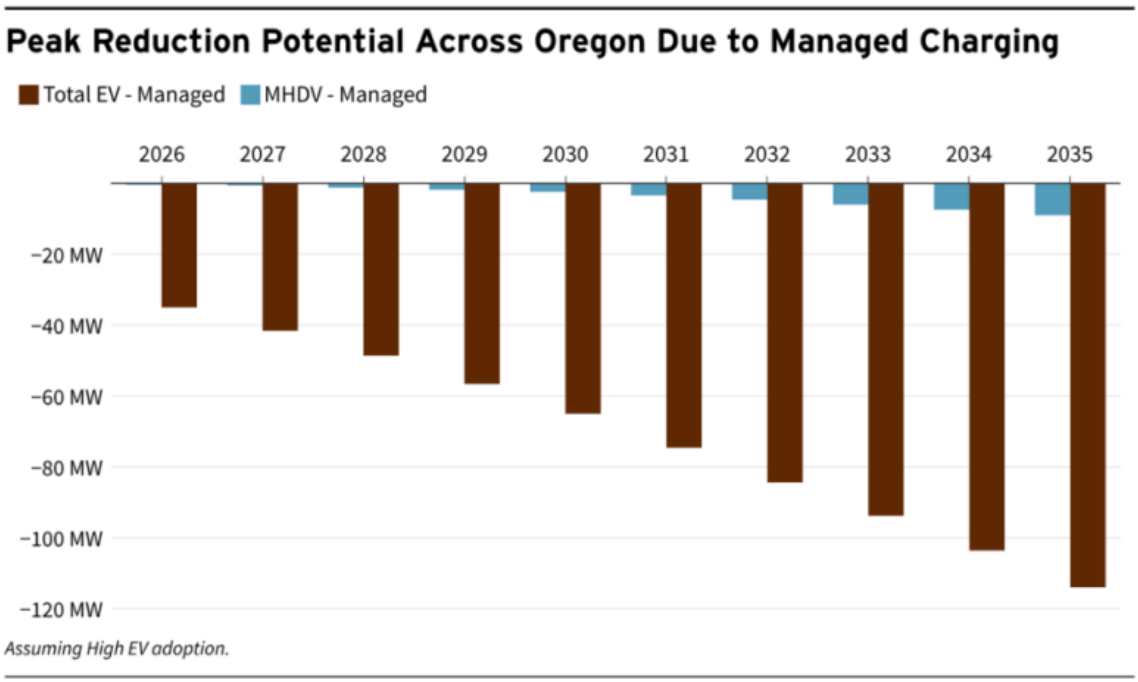
At the same time, the operational characteristics that make many medium- and heavy-duty vehicles strong candidates for electrification can also make them well suited for managed charging. Commercial fleets often operate on highly structured schedules, with predictable routes, centralized parking locations, and defined dwell periods. This is especially true for medium-duty and vocational applications such as delivery vans, local freight trucks, school buses, transit buses, refuse trucks, and drayage[iv] vehicles. In Oregon, DEQ fleet reporting data show that most MHD vehicles travel less than 100 miles per day, the majority return to a home base each night, and most remain parked for more than eight hours.[17] These characteristics can create opportunities for flexibility in both the timing and rate of charging, allowing fleets to shift charging within available dwell periods or charge at lower power over longer periods without disrupting vehicle operations.

As medium- and heavy-duty vehicle adoption scales, this flexibility could become increasingly valuable for managing the impacts of new electricity demand. Rather than behaving as purely inflexible load, many fleet charging applications can be actively managed in response to grid conditions and infrastructure constraints. RMI estimates that by 2035, relatively simple managed charging strategies could reduce Oregon's statewide EV peak load by more than 100 MW, or 35

[iv] A drayage vehicle is a truck used to transport shipping containers over short distances, typically between ports, rail yards, warehouses, and distribution centers. Drayage is the "first mile" or "last mile" of freight movement, connecting marine, rail, and trucking networks.

percent, while managing medium- and heavy-duty vehicle charging alone could reduce EV peak demand by nearly 10 MW (Figure 3).[11] More advanced or targeted charging management strategies could further reduce the grid impacts and costs associated with EV charging.

Figure 3: Peak Reduction Potential in RMI's High Adoption, Managed Charging Scenario



Load Flexibility as a Grid Resource

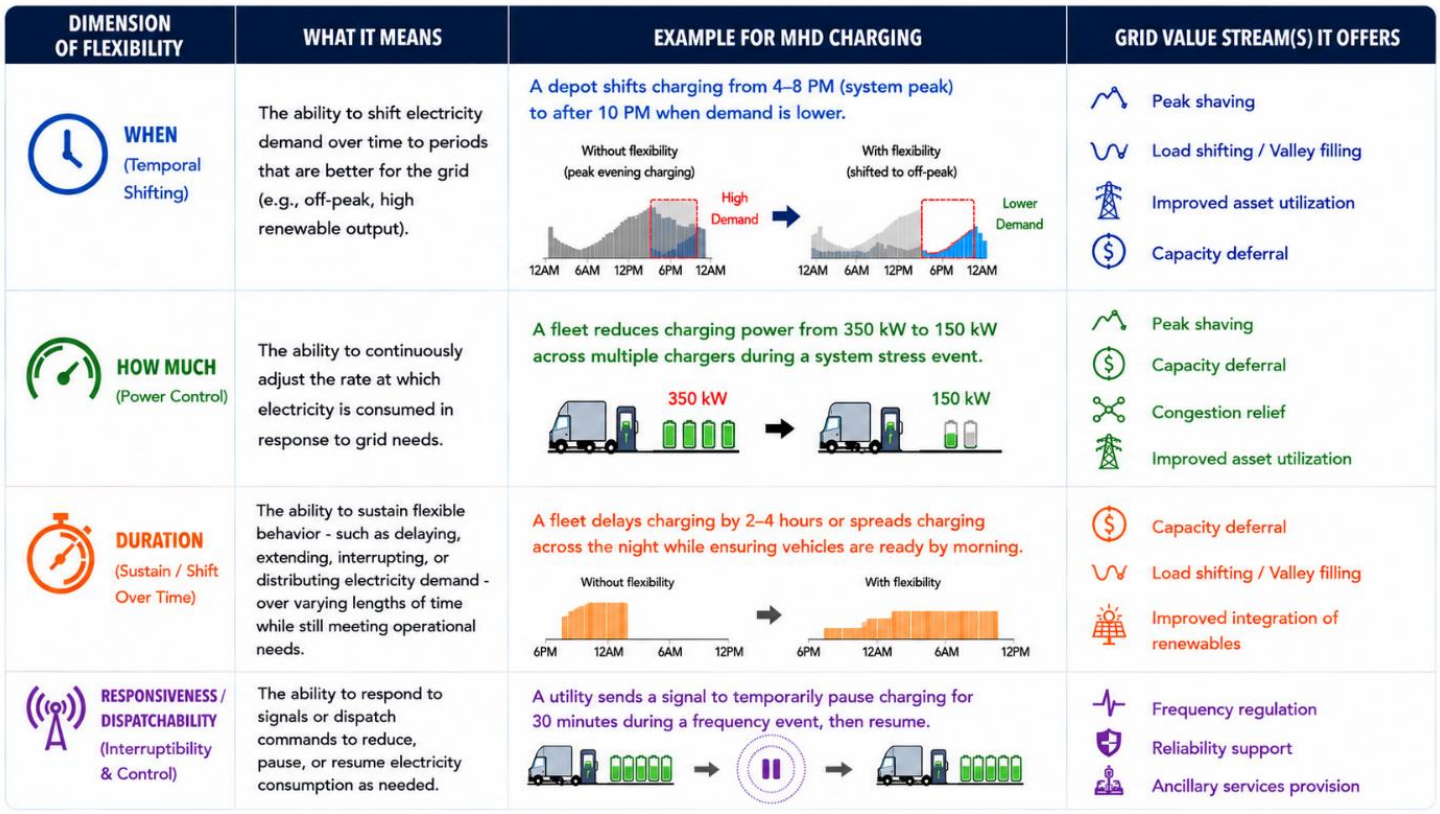
Electricity systems must continuously balance supply and demand. Historically, system flexibility came primarily from generators (supply) while electricity demand was treated as largely fixed. As demand grows and the grid becomes increasingly variable and constrained, the ability to shift or adjust electricity consumption is becoming increasingly important for managing grid conditions and infrastructure needs. Flexible loads can shift when and how they consume power in response to grid conditions, reducing peak demand, improving utilization of existing infrastructure, lowering system costs, and supporting renewable energy integration. Medium- and heavy-duty vehicle charging represents a particularly important emerging source of flexible load due to the operational characteristics discussed above, which creates opportunities to actively manage charging without disrupting operations.

Dimensions of Flexibility

Load flexibility is not one-size-fits-all. The value of medium- and heavy-duty charging depends on how it can be managed across multiple dimensions.[13] Flexible charging may involve shifting charging over time (temporal flexibility), adjusting charging power levels (power control), temporarily interrupting charging (interruptibility), responding dynamically to external signals (dispatchability), or changing where charging occurs within the system (spatial flexibility). These dimensions of flexibility can provide a range of grid benefits, including peak reduction, load shifting, renewable energy

integration, congestion management, improved asset utilization, ancillary services[v], and deferred infrastructure investments. Figure 4 illustrates the major dimensions of medium- and heavy-duty charging flexibility, real-world examples, and the value streams they can provide to the electric system.

Figure 4: Dimensions of MHD Charging Flexibility and Grid Value Provided[13]



Enabling Load Flexibility in Practice

Realizing the grid value of flexible medium- and heavy-duty charging depends not only on the operational characteristics of fleets, but also on the strategies, technologies, and charging infrastructure attributes used to shape charging demand. Capturing MHD charging flexibility in practice requires intentional planning across both charging operations and site design. A range of approaches can be used to influence when and how charging occurs, manage power demand, integrate distributed energy resources,[vi] and align electricity consumption with available grid capacity.

[v] Ancillary services are services that help grid operators maintain the reliability and stability of the electric system and include services such as frequency regulation and operating reserves. Flexible loads can provide some ancillary services by rapidly increasing or decreasing electricity consumption in response to grid conditions.

[vi] [vi] Distributed energy resources, commonly referred to as "DERs", are small-scale energy technologies located on the customer side of the electric meter or connected directly to the distribution system that can generate, store, manage, or reduce electricity consumption. Examples include rooftop solar, battery storage, and smart thermostats.

Managed Charging – Scheduling and Power Control Strategies

Managed charging is the primary strategy for enabling the load flexibility of medium- and heavy-duty electric vehicles. It includes a portfolio of strategies, from passive, behavior-based programs to active and dynamic coordination between electric vehicles, charging infrastructure, and utilities.

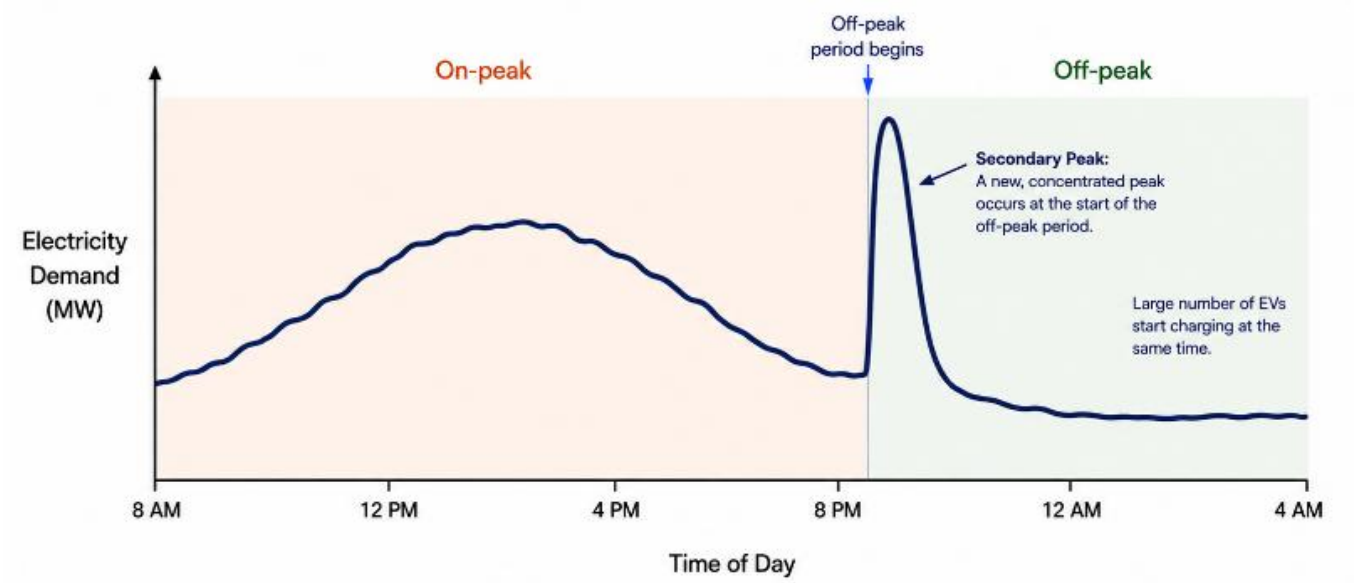
Passive Managed Charging

Passive managed charging relies on customer behavior in response to price signals and static charging schedules rather than real-time utility coordination. Customers typically program charging schedules through the vehicle or charging equipment to align with preferred charging periods. This approach places more responsibility on customer participation and behavior, while requiring less direct utility control or real-time oversight. The following are examples of passive managed charging strategies:

- **Simple Off-Peak**: Simple off-peak programs use rebates, bill credits, or seasonal pricing structures to incentivize EVs to charge during periods of lower electricity demand, typically overnight or during other non-peak hours.[8] These programs are typically structured around a simple distinction between on- and off-peak periods, rather than multiple pricing tiers.
- **Time-of-Use Rates:** Time-of-use rates vary electricity pricing by time of day to encourage charging during lower-demand periods. EV-specific TOU programs often include tiered rates that apply specifically to vehicle charging, while "whole home" approaches apply time-varying prices to all electricity consumption.[8] EV-specific rates require a way to separately measure vehicle charging, which can be accomplished through a dedicated EV meter or, where supported, charging data from the vehicle or charging equipment.
- **Demand Charges:** Demand charges are a component of many commercial and industrial electricity rates based on a customer's highest short-duration (typically 15- or 30-minute) power demand during a billing period. They are designed to help utilities cover the cost of maintaining sufficient generation, transmission, and distribution capacity to serve customers' peak demands. Because high-powered EV charging can produce large demand spikes, demand charges can significantly increase electricity costs. This creates a strong financial incentive for fleets to manage charging to limit their facility's peak demand, for example by staggering charging sessions, reducing charging speeds, or shifting charging to when other facility loads are lower.

Managed charging can create new "secondary peaks" if many vehicles begin charging simultaneously after charging has been delayed or reduced. This risk can be particularly pronounced with passive approaches, where many vehicles may respond to the same price signal or charging schedule.[8] In one simulation, off-peak demand increased by as much as 20 percent when charging began immediately after the on-peak period ended, demonstrating how passive approaches can shift rather than eliminate grid stress (See Figure 5).[18] More advanced active managed charging strategies can help address this challenge.

Figure 5: Illustration of Secondary Peak Risk from Passive Managed Charging



Active Managed Charging

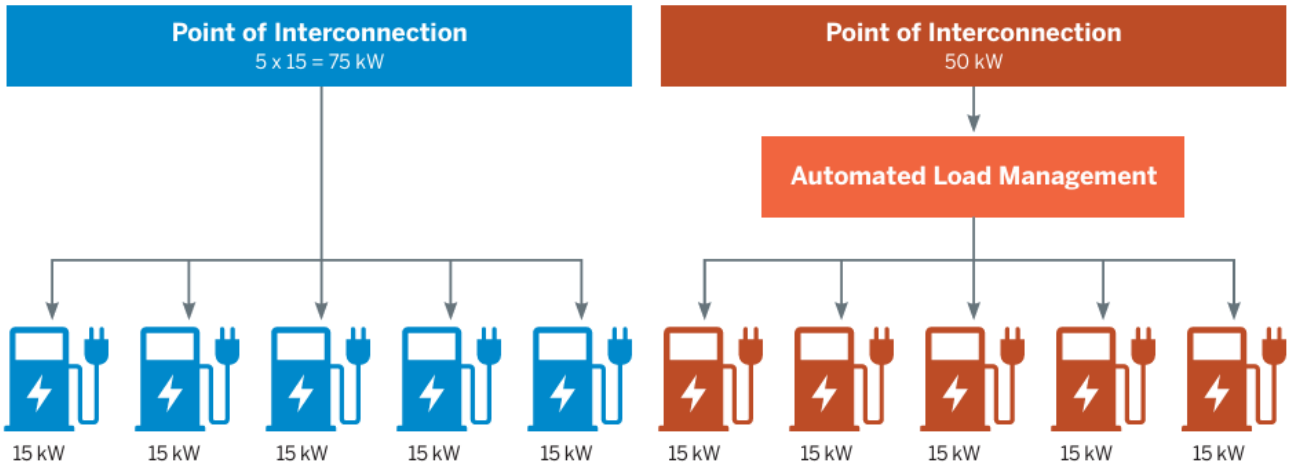
Unlike passive managed charging, which relies on customer behavior and static price signals, active managed charging uses two-way communication, software, and automated or remotely initiated controls to dynamically adjust charging in response to grid conditions, utility signals, or operational needs. These approaches can determine when charging occurs, how fast vehicles charge, and whether charging is temporarily paused. While some customers worry that active managed charging could leave a vehicle without enough charge when it is needed, these systems are designed to incorporate scheduled departure times, required state of charge, operating schedules, and other customer-defined requirements as constraints, allowing charging to be optimized within the flexibility available while ensuring vehicles are ready for their next trip. Many programs also allow customers to override or opt out of charging adjustments when necessary. When charging can be coordinated across many participating vehicles, relatively small adjustments across a portfolio can aggregate into meaningful flexible load while limiting impacts to individual customers or fleets. Common active managed charging strategies include:

- **Event-Based Demand Response**: During these events, utilities send signals to customers to reduce or pause charging during periods of grid stress or high demand. Because EV charging can often be delayed with minimal energy losses or operational impacts, it is particularly well-suited for demand response applications.[16] However, event-based demand response programs may not fully address the challenge of a secondary spike when all vehicles resume charging, and thus may not capture the full value of charging flexibility.[8]
- **Dynamic Pricing**: Under dynamic pricing, electricity rates change based on real-time or near-real-time grid conditions in the bulk or distribution systems. Price changes may reflect factors such as electricity demand, wholesale prices, renewable energy availability, or local grid constraints.[16] Unlike static time-of-use rates, dynamic pricing provides a more responsive, granular signal because prices may vary hourly or sub-hourly. Utilities are increasingly pairing

dynamic pricing with automated charging systems that optimize charging schedules based on customer needs and grid conditions.[16]

- **Automated Load Management**: Automated load management systems control charging demand at a site to keep total electricity use within specified limits.[16] These systems may cap total charging demand, share power across chargers, or stagger charging sessions to avoid infrastructure overloads, reduce peak demand, or lower electricity costs. In some cases, they allow the combined nameplate capacity of chargers to exceed the site's available electrical capacity. For example, Figure 6 shows five 15 kW chargers with a combined capacity of 75 kW served by a 50 kW interconnection. Automated load management keeps their combined demand below the 50 kW limit by adjusting charging power or staggering charging across vehicles, while still allowing all five chargers to be installed and available for use.

Figure 6: Using Automated Load Management to Allow the Same Charging Equipment to Operate at Sites with Lower Available Grid Capacity[16]

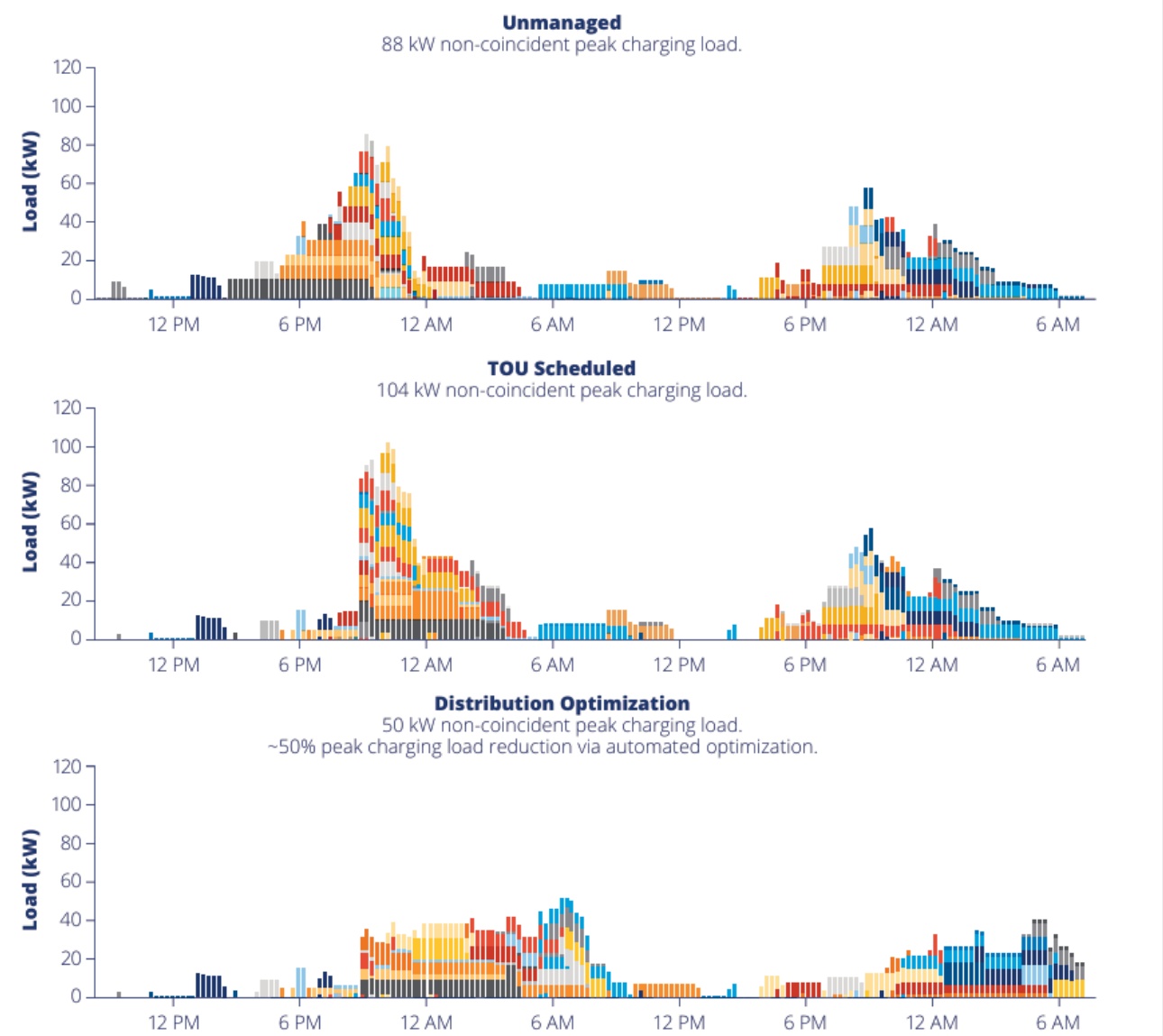


- **Dynamic Managed Charging**: Dynamic managed charging continuously adjusts EV charging in response to real-time or near-real-time grid conditions, utility signals, and customer charging needs.[16] Unlike automated load management, which primarily focuses on site-level demand limits, dynamic managed charging actively coordinates charging with external grid conditions. These systems can increase, decrease, delay, pause, or resume charging while still meeting vehicle operational requirements, helping avoid the secondary peaks associated with static charging schedules or demand response events.
- **Multi-layer Optimization**: Multi-layer optimization coordinates EV charging across multiple objectives and system constraints simultaneously.[8] As a more advanced control strategy than dynamic managed charging systems, multi-layer optimization is able to consider both bulk- and distribution-level constraints alongside fleet operational requirements and customer charging needs. While dynamic managed charging may optimize for a single objective, such as minimizing electricity costs, multi-layer optimization balances several objectives at once to coordinate charging across fleet and grid conditions.

Passive vs. Active Managed Charging

Not all charging strategies deliver the same grid benefits. Figure 7 provides an example of how different charging strategies can affect electricity demand over a 48-hour period. Using data from a subset of vehicles participating in Portland General Electric's managed charging program through WeaveGrid, the figure illustrates how unmanaged and time-of-use charging can concentrate demand into short periods, while more charging optimization can spread charging over time and substantially reduce peak load.

Figure 7: Example of Charging Load Profiles Under Different Management Strategies



Source: Portland General Electric and WeaveGrid

No single managed charging strategy is universally optimal. Each approach involves tradeoffs related to implementation cost, operational complexity, customer participation, grid value, and suitability for different parts of the electric system. Passive strategies that use prices, rates, or other incentives to encourage customers to change when or how they charge are generally simpler and less expensive to implement but offer less precision in managing grid impacts. Active strategies that use direct or

automated control to adjust timing or power can provide more targeted, responsive, and effective grid support, but require more advanced communications infrastructure, customer enrollment, software integration, and operational coordination.[8] Figure 8, adapted from the Energy Systems Integration Group, broadly categorizes common managed charging strategies by mechanism and timing and indicates their relative suitability for addressing grid challenges at different levels, as well as their implementation complexity and cost.

Figure 8: Suitability of Different Types of Managed Charging to Address Grid Challenges[16]

Managed Charging Strategy	Classification		Suitability to Address Challenges at Multiple Levels				Implementation Complexity	Cost
	Mechanism	Timing	Site	Distribution	Transmission	Generation		
Demand charge	Passive (pricing)	Preset						
Time-of-use rate	Passive (pricing)	Preset						
Dynamic price signal	Passive (pricing)	Dynamic						
Consumer response to event-based demand response	Active (control)	Dynamic						
Dynamic managed charging	Active (control)	Dynamic						
Automated load management	Active (control)	Preset						

Most to Least Suitable

Easier to Complex

Medium- and heavy-duty EV operators are not monolithic. Commercial fleets, transit agencies, school buses, and freight operators all have different operational requirements, risk tolerances, and charging behaviors. As a result, successful managed charging programs will likely require a portfolio of options that provide customers with flexibility and choice. Price-based strategies and active management can also complement one another rather than function as competing approaches. Electricity rates can provide a broad, ongoing shaping of charging demand while more active managed charging programs can serve as precise tools for responding to real-time grid constraints, reliability events, or localized distribution system needs. Designing effective programs therefore requires a strong understanding of grid conditions and customer behavior. In particular, there remains a significant need for additional research and real-world experience to better understand customer willingness to adopt smart charging technologies, participate in managed charging programs, and adjust charging behavior in ways that support grid needs while still meeting operational requirements.[16]

Infrastructure and Site Design Strategies

Realizing the full flexibility potential of medium- and heavy-duty charging requires more than managed charging programs alone. Infrastructure and site design decisions can determine how charging flexibility is enabled, used, and preserved in practice. Decisions such as how much electrical capacity to install, how chargers are shared across vehicles, whether charging is deployed in phases, and how charging is coordinated with onsite energy resources can affect both the magnitude and timing of grid impacts.

Right-Sizing Interconnection Capacity

One way that fleets can leverage charging flexibility is by "right-sizing" interconnection capacity – aligning electrical service with realistic charging needs rather than the theoretical maximum demand of all chargers operating simultaneously at full power. This can be achieved through appropriate charger power level sizing and managed charging strategies that limit coincident charging demand. Because many fleets do not require every vehicle to charge at maximum power or on the shortest possible timeline, right-sizing can reduce the amount of interconnection capacity required at a site.[19] One study by the National Laboratory of the Rockies found that charging power levels required by electric trucks were often lower than commonly assumed, creating financial benefits for utilities and fleet operators.[20]

Charger-to-Vehicle Ratio

Charger-to-vehicle ratio, or the number of chargers available relative to the number of vehicles served, can also influence how fleets use and preserve charging flexibility. Where vehicle schedules and dwell times allow, fleets may be able to leverage flexibility to support more vehicles with fewer chargers through charger sharing, coordinated charging schedules, and managed charging systems. This can increase charger utilization and potentially reduce the electrical capacity and infrastructure needed at a site. However, lower charger-to-vehicle ratios can also reduce the flexibility that remains available by requiring tighter charging schedules or, in some cases, higher charging power. Rather than assuming every vehicle requires a dedicated charger, lower charger-to-vehicle ratios encourage more active management of charging demand across the fleet.

Phased Infrastructure Deployment

Phased infrastructure deployment involves expanding charging infrastructure and electrical capacity incrementally as fleet electrification needs grow. Rather than building for a fully electrified future fleet upfront, phased deployment aligns investments with actual vehicle adoption and operational experience. This approach allows fleets and utilities to better understand real-world charging behavior, utilization patterns, and the amount of type of charging flexibility available before committing to major infrastructure upgrades. Early phases may leverage that flexibility through lower-power charging equipment, shared charging strategies, or managed charging systems to make more efficient use of limited electrical capacity. As vehicle adoption increases and charging needs become clearer, infrastructure can be expanded in a more targeted and informed manner.

Distributed Energy Resources Integration

Distributed energy resource technologies like battery energy storage, solar generation, and microgrids can enhance the flexibility of MHD charging by increasing the ability of fleets to delay, stagger, or modulate charging while still meeting operational needs. Although DERs are not necessary or cost-effective for every charging project, they may provide significant value at sites facing limited grid capacity, long interconnection timelines, high demand charges, reliability concerns, or concentrated fast-charging demand.

Onsite Battery Energy Storage Systems

Battery energy storage systems are among the most promising DERs for MHD charging because they can help manage the high-power demands associated with fleet charging. Batteries can store

electricity when demand is low and discharge it during periods of heavy charging, reducing short-duration demand spikes – and the associated demand charges – created by high-powered chargers.[21] This peak shaving capability can lower operating costs, reduce coincident peak demand, and decrease the amount of power required from the grid.[22] For large fleet depots, storage can also support phased infrastructure deployment by allowing charging operations to begin before full grid upgrades are completed.

Solar + Storage Integration

Solar generation can support flexible charging strategies, particularly when paired with battery storage. While solar production does not always align with fleet charging needs, especially for fleets that charge overnight, solar can help reduce facility electricity use, support daytime charging, and lower demand on the grid during periods of high electricity use.[23] When combined with battery storage and managed charging, these technologies can increase site flexibility and reduce the need for costly infrastructure upgrades.

Microgrids

Microgrids can further enhance charging flexibility by coordinating onsite generation, storage, and charging loads as a unified system. Acting as an energy management platform, a microgrid can optimize charging in response to grid conditions, electricity prices, onsite generation, and operational priorities. This coordination can improve the ability to shift, limit, or smooth charging demand while also providing resilience and backup charging capability during outages. Many of the flexibility benefits associated with DER integration can be achieved without a full microgrid; however, microgrids may provide additional coordination and resilience benefits in certain applications.

Emerging and Future Grid-Interactive Capabilities: Vehicle-to-X

Vehicle-to-X, or bidirectional charging, allows electric vehicles to discharge electricity from onboard batteries to support buildings, other loads, or the grid during periods of high demand or system stress. Unlike managed charging, which shifts when electricity is consumed, V2X allows EVs to function as distributed energy resources that can provide backup or supplementary power, demand response, and other grid services, creating new revenue and value streams for customers and utilities alike.[24] Some medium- and heavy-duty fleets may be particularly well suited for certain V2X applications due to their large battery capacities, predictable schedules, and long dwell times. As fleet electrification scales, the aggregate battery capacity connected to Oregon's electric grid could become a significant source of flexible load and distributed energy storage, with even limited participation in vehicle-to-grid programs offering substantial system value.[25]

However, V2X applications for MHD vehicles remain at an early stage of development and face ongoing technical, operational, and economic challenges, including higher charger costs, battery warranty considerations, interoperability standards, and uncertain compensation structures.[24] As a result, most near-term flexibility opportunities are likely to come from managed charging, power controls, and DER integration. Still, V2X technologies may play a growing role in future grid-interactive fleet operations as technology and market structures continue to evolve.

Operational Considerations for Flexible Fleet Charging

While the strategies above demonstrate the technical potential of flexible charging, the amount of flexibility available in practice depends on how well charging strategies align with real-world fleet operations. Fleet operators have indicated that business needs require vehicles to be available when needed, leaving little tolerance for disruptions to routes, schedules or service obligations. As a result, the operational characteristics of different fleets play a major role in determining what types of charging flexibility are practical and what grid services fleets may realistically be able to provide. Understanding these constraints is critical to designing programs that fleets are willing to adopt.

Aligning Charging Strategy with Duty Cycles

Charging strategies must reflect how vehicles are actually used, and flexibility will vary significantly across fleet types. Many commercial and municipal fleets – including delivery vehicles, transit buses, refuse trucks, and school buses – operate on repeatable daily schedules and remain parked overnight, making them strong candidates for managed charging. In contrast, long-haul trucking operations or other fleets with highly variable schedules, long operating hours, or limited dwell time may have fewer opportunities for flexible charging.

Fleet Availability and Reliability Constraints

Even when managed charging is technically feasible, fleets may require charging buffers or minimum battery levels to ensure vehicles can reliably complete routes under varying conditions. Successful flexible charging strategies will be those that operate largely in the background, automatically accounting for schedules, departure times, and charging needs without disrupting normal operations.[26] Charging approaches that introduce uncertainty, increase operational risk, or fail to account for operational constraints are unlikely to be adopted.

Range, Charging Speed, and Dwell Time Tradeoffs

The amount of charging flexibility is also influenced by vehicle range requirements, charging speed, and available dwell time. Longer dwell periods can provide fleets with greater flexibility in how charging needs are met – for example, by charging at lower power over a longer period of time or by shifting and staggering charging within the available window in response to grid conditions. Fleets with limited dwell time or high daily mileage may require higher-powered charging or faster charging schedules to maintain operations, reducing opportunities for managed charging.

Delivery Fleets Lead Early Electrification: Amazon's Experience with Depot Charging

Amazon's electric delivery fleet illustrates why last-mile delivery vehicles have emerged as some of the earliest and most successful candidates for electrification. Delivery vans typically operate on predictable routes, return to a central depot each night, and travel relatively modest distances. In addition to making them well suited for electrification, these duty cycles provide regular overnight dwell periods during which vehicles can often meet their charging needs using simpler, lower-cost Level 2 chargers.

Since announcing a commitment in 2019 to deploy 100,000 electric delivery vans by 2030, Amazon has grown its electric delivery fleet to more than 40,000 vehicles in thousands of

communities nationwide, including Portland.[28] To date, Amazon has largely relied on low-powered charging to support these vehicles.[29] At one Amazon delivery station in Seattle, approximately 100 electric vans are supported by roughly 70 charging ports, only three of which are fast chargers.[30] By taking advantage of long vehicle dwell periods to meet charging needs at lower power, this type of charging configuration can limit peak demand and site capacity requirements without relying as heavily on active charge management. Amazon has reported that most depots do not require charge management systems or battery storage.[30]

Even with these favorable operating characteristics, Amazon has found that charging infrastructure deployment – due to utility approvals, construction, and access to electrical capacity – can be more challenging than procuring and deploying vehicles.[30] In some cases, Amazon reportedly prioritized electrification at locations where sufficient electrical capacity was already available, rather than locations where vehicles were most needed operationally.[29] This experience highlights how grid readiness and charging infrastructure can influence the pace and location of fleet electrification.

As Amazon expands electrification beyond last-mile delivery into additional medium- and heavy-duty freight applications, these challenges are likely to become more pronounced. Amazon has already deployed electric drayage trucks at the Ports of Los Angeles and Long Beach and in 2026, the company announced a partnership with Swedish trucking company Einride to deploy 75 electric heavy-duty trucks across five U.S. freight locations.[31] Unlike delivery vans, larger vehicle classes often require significantly more energy, higher-powered charging, and tighter charging windows. While Amazon has been able to electrify much of its delivery fleet using relatively simple, low-powered depot charging approaches, scaling electrification to heavier-duty applications will increasingly require managed charging, greater coordination with utilities, and more sophisticated approaches to load flexibility and grid integration.



Amazon's Growing Lineup of Electric Vehicles[27]

Implications for Utility Planning and Grid Integration

Using Flexibility to Improve Utility Planning

The flexibility of medium- and heavy-duty charging loads has important implications for utility planning. Traditionally, utilities have planned for new demand as relatively inflexible, assuming that loads may be highest at times when the grid is already stressed. Infrastructure investments and interconnection decisions may therefore be based on these conservative, worst-case assumptions. This approach can trigger substantial infrastructure upgrades and long interconnection timelines. However, rather than planning exclusively around worst-case coincident charging assumptions, utilities may increasingly be able to incorporate flexible load behavior into distribution planning, load forecasting, hosting capacity analysis, and infrastructure investment decisions.

Supporting this transition will likely require improved planning tools, forecasting methods, and interconnection processes. Hosting capacity maps, a recommendation of the Oregon Energy Strategy, can help utilities and customers identify locations where existing grid infrastructure may be better able to accommodate new charging load with fewer upgrades or constraints. Improved forecasting methods that incorporate fleet electrification timelines, charging behavior, managed charging assumptions, and geographic clustering of freight activity can also help utilities anticipate where future charging demand is likely to occur. In addition, more standardized and transparent interconnection processes may help reduce uncertainty, improve coordination between utilities and fleet operators, and accelerate deployment timelines for charging infrastructure projects. In this way, medium- and heavy-duty charging flexibility can function not only as an operational tool for managing grid conditions in real time, but also as a planning input that shapes how utilities invest in future grid infrastructure.

Oregon Energy Strategy: Planning for Future Load Growth

The Oregon Energy Strategy provides a long-term framework for ensuring Oregon's energy system remains clean, affordable, reliable, and resilient as the state works toward its climate and energy goals. Recognizing that transportation electrification, building electrification, and other emerging loads will increase demands on the electric system, the strategy highlights the importance of collaborative and proactive planning to maintain reliability, manage costs, and maximize the value of existing grid infrastructure. The recommendations in this report build on that foundation by examining how medium- and heavy-duty charging can serve not only as a source of new electric load but also as a source of flexibility that supports grid operations, informs infrastructure planning, and improves the integration of new electric loads.

Using Flexibility to Improve Grid Integration

The ability to actively manage and shape medium- and heavy-duty charging load may also enable new approaches to grid integration. By treating charging load as controllable, utilities and fleets can

reduce infrastructure constraints and accelerate energization timelines through phased and flexible interconnection and other "bridge-to-wires" approaches,[vii] all while reducing upfront costs for fleets.

Phased Interconnection

Phased service connections provide customers with a temporary capacity limit while utilities build the infrastructure needed to serve a site's full long-term load request.[32] This approach can be particularly useful for fleets that plan to electrify gradually, allowing them to operate within existing grid capacity using managed charging and other operational controls until utility upgrades are completed. Phased interconnection is most effective when the additional EV charging load is incremental relative to the site's existing service rather than transformative, as smaller increases in demand can often be accommodated without major upstream infrastructure investments.[33]

Flexible Interconnection

Conventional utility planning approaches that evaluate new loads based on a site's maximum potential demand during the system's highest-demand hour can trigger costly infrastructure upgrades for large fleet charging depots. While intended to maintain system reliability, this approach can leave much of the grid's existing capacity underutilized most of the time and create a major barrier to transportation electrification. In response, some utilities are exploring flexible interconnection approaches that allow managed or time-varying loads to make use of existing grid capacity while limiting charging during constrained periods.[34] These approaches can help fleets begin operating and charging vehicles sooner, without waiting for full infrastructure upgrades.

Flexible service connections can be either static or dynamic. Under static approaches, available charging capacity is governed by predetermined schedules or fixed limits. Dynamic approaches communicate available capacity in real time based on actual grid conditions, allowing customers to operate at or near full capacity for more hours of the year. Dynamic approaches are more complex and expensive to implement, requiring more advanced communications, monitoring, and control systems.[32]

Flexible Interconnection in Practice – PG&E's Flex Connect Program

As transportation electrification accelerates, charging projects are increasingly encountering grid constraints that can delay energization for months or years while utility upgrades are completed. To address this challenge, Pacific Gas and Electric Company's Flex Connect program allows customers in California to connect and begin operating before full electrical capacity is available. In exchange, customers agree to temporarily limit electricity demand during periods when the local grid is constrained. Flex Connect relies on the ability for customers to actively manage and control their load through strategies such as managed charging, charging schedules, power limits, and onsite battery storage.

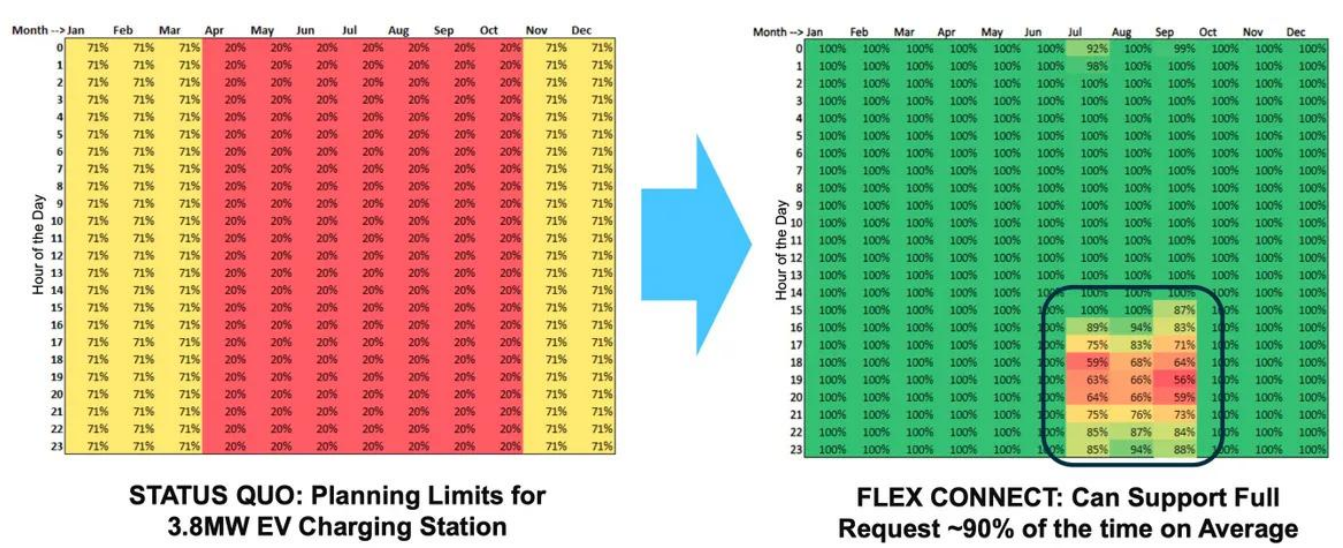
Figure 10 illustrates the concept behind PG&E's Flex Connect program and how flexible load assumptions can change interconnection outcomes for EV charging projects. In this example,

[vii] Bridge-to-wires solutions, sometimes called non-wires alternatives or bridging strategies, are measures that help serve new loads or relieve grid constraints without immediately building new distribution infrastructure.

although the grid can support the customer's full requested load most of the time, a small number of constrained hours limits the site to 3.8 MW of service. Under Flex Connect, the customer can interconnect at its full requested capacity while agreeing to temporarily reduce charging during those constrained periods. As shown, the site can receive its full requested load nearly 90 percent of the time on average, with temporary reductions required only during specific hours and seasons.

Flex Connect demonstrates how load flexibility can accelerate electrification by providing an alternative to traditional "build-first" interconnection approaches.

Figure 10: Flexible Interconnection Can Increase Available Charging Capacity by Leveraging Load Flexibility[35]



Key Considerations for Policymakers

The ability of medium- and heavy-duty vehicle charging to function as a flexible grid resource will depend not only on technology and fleet operations, but also on the policy, regulatory, and planning frameworks that govern how charging infrastructure is deployed and integrated into the grid. Managed charging, distributed energy resources, flexible interconnection, and other load management strategies can improve grid integration outcomes, but realizing these benefits at scale will require coordination among utilities, regulators, fleet operators, and public agencies.

Policymakers can help enable this transition by supporting planning approaches, utility programs, and regulatory frameworks that recognize flexible load as a valuable grid resource. At the same time, flexibility should be viewed as a complement to, not a replacement for, strategic grid investment. While flexible charging can reduce costs, improve asset utilization, and defer some infrastructure upgrades, continued investment in the electric system will still be necessary to support long-term transportation electrification. The following considerations highlight opportunities for Oregon policymakers and utilities to support more flexible, efficient, and scalable medium- and heavy-duty vehicle electrification.

1. Enable and Expand Managed Charging and Flexibility Programs for Fleets that Reflect Grid Conditions

Fleets should be able to select from a portfolio of options – including active managed charging programs, time-of-use rates, demand response programs, and other flexibility mechanisms – that reflect their operational needs, technology readiness, and business objectives.[36] Because fleet operations vary significantly, a one-size-fits-all approach is unlikely to be effective. Programs should be simple, transparent, and designed to integrate seamlessly into fleet operations, with clear expectations and compensation structures. Policymakers and regulators have a role in ensuring that compensation for flexible charging behavior is commensurate with the benefits flexible charging provides to the grid. Well-designed programs can help align utility, ratepayer, and fleet interests while encouraging broad participation.

To date, many of Oregon's consumer-owned utilities have had limited financial or operational incentive to develop EV charging flexibility programs. Unlike larger investor-owned utilities, many COUs have not yet experienced EV adoption levels or system constraints that create a strong business case for managed charging, and some report that existing rate structures provide limited opportunities to capture the value of load shifting. As transportation electrification and other sources of load growth accelerate, however, flexible charging is likely to become increasingly important for managing peak demand and making efficient use of existing infrastructure. Policymakers should consider technical assistance, planning support, and program development resources to help COUs evaluate and implement flexibility programs appropriate for their systems.

Continued support for pilot programs and demonstration projects will also be important for evaluating the grid and operational benefits of managed charging and emerging grid-interactive technologies such as vehicle-to-grid before broader deployment at scale. These efforts can help utilities, regulators, and fleet operators better understand key aspects of program performance, including customer participation, operational constraints, communications requirements, and the potential grid value streams associated with flexible fleet charging.

2. Encourage Early Coordination and Data Sharing between Fleets, Utilities, Charging Providers and Public Agencies

Oregon regulators and policymakers should encourage earlier coordination between utilities, fleet operators, charging providers, and site developers during fleet electrification planning and project development. Early engagement can help reduce uncertainty around infrastructure needs, interconnection timelines, and charging system design while improving utilities' ability to anticipate load growth, identify grid constraints, and evaluate opportunities for managed charging or phased energization. One way to support this is to encourage participation in the Electric Power Research Institute's (EPRI) GridFAST platform, which provides a standardized mechanism for notifying utilities of planned charging projects early in the development process.

Improved data collection and sharing around charging behavior will also become increasingly important as more Oregon fleets invest in medium- and heavy-duty electric vehicles. Utilities currently have limited visibility into how commercial fleets charge, including charging schedules, dwell times, load profiles, operational flexibility, and responsiveness to price or managed charging signals. Supporting the collection and sharing of anonymized charging data can help utilities improve

forecasting, better understand charging flexibility potential, and develop more effective rates, managed charging programs, and interconnection strategies over time. Policymakers should also support common communications standards and data-sharing practices that allow utilities, fleets, and charging providers to coordinate charging more effectively while maintaining appropriate customer privacy protections.

As recommended in the Oregon Energy Strategy, Oregon regulators should require utilities to maintain publicly accessible and regularly updated hosting capacity maps that provide customers and developers with better visibility into available grid capacity and potential distribution system constraints. Improving access to this information can help fleets make more informed siting and infrastructure decisions while supporting earlier coordination between utilities and charging developers.

3. Incorporate Load Flexibility into Utility Planning and Forecasting

As Oregon reduces transportation emissions with increasing numbers of electric vehicles, utilities will need planning approaches that reflect the increasingly flexible nature of electric vehicle charging. Utilities and regulators should incorporate flexible load assumptions and managed charging forecasts into transportation electrification, integrated resource, and distribution system planning processes. Utilities should use information gathered through customer engagement, charging data collection, and transportation electrification planning efforts to improve load forecasting and planning assumptions. Incorporating a range of charging scenarios, including managed charging participation, time-of-use rates, flexible interconnection arrangements, onsite energy resources, and other strategies that may alter charging behavior, can provide a more accurate picture of when and where new capacity will be needed. This approach allows flexible charging to be treated as a planning resource that can help defer, optimize, or right-size infrastructure investments while maintaining reliability and supporting transportation electrification goals. By explicitly accounting for flexible load behavior, utilities can improve forecasting accuracy, make more efficient infrastructure investments, and better align grid planning with the evolving capabilities of EV charging systems.

4. Support Investment in Charging Infrastructure and Flexibility-Enabling Technologies

Deploying MHD charging infrastructure at the scale needed to support transportation electrification will require sustained investment in both charging equipment and the technologies that enable charging flexibility. Consistent with recommendations in the Oregon Energy Strategy, Oregon policymakers should pursue dedicated, sustainable, long-term funding to support the deployment of public and private charging infrastructure, including MHD charging. As these investments are made, state and utility incentive programs should be designed to support charging flexibility as well as infrastructure deployment.

Many flexible charging strategies rely on smart charging technologies, such as networked chargers and energy management software, and may also incorporate onsite energy resources such as battery storage or solar. However, these technologies can increase upfront costs and create additional barriers for fleet operators. Oregon policymakers and utilities can help accelerate adoption by supporting incentives, grants, low-cost loans, or utility programs that reduce the cost of flexibility-enabling technologies and encourage their integration into fleet charging projects. In addition to supporting managed charging and other grid flexibility objectives, some of these technologies also

provide resilience benefits by helping maintain essential fleet operations during outages and providing backup power to homes, businesses, or the grid.

Charging incentive programs should recognize and support technologies that enable charging flexibility, rather than focusing solely on charging hardware installation. Utility make-ready programs, infrastructure incentives, and other funding opportunities should encourage the deployment of networked chargers, charging management systems, communications equipment, onsite energy storage, and other technologies that allow fleets to leverage flexibility. Many of these investments can provide multiple benefits, including enhanced operational reliability and increased resilience when paired with energy storage, microgrids, or other backup power capabilities. Program administrators should consider enhanced incentives for projects that demonstrate controllable load capabilities or provide measurable grid benefits through flexible charging behavior.

5. Support Flexible Interconnection and Phased Service Approaches that Leverage Controllable Load

Providing clear regulatory pathways for flexible interconnection and phased service approaches could help reduce the delays associated with traditional load interconnection processes while improving utilization of existing grid infrastructure and accelerating medium-and heavy-duty vehicle electrification in Oregon. Oregon regulators and utilities should develop formal frameworks for flexible interconnection and phased service connections for MHD charging projects. Regulators should also evaluate whether existing tariffs, interconnection rules, and cost allocation frameworks appropriately support flexible service connection models and other non-traditional approaches to integrating controllable load.

Other states and utilities have already begun piloting flexible service connection and bridge-to-wires approaches.[32] Oregon could build on these efforts by incorporating lessons learned, supporting utility pilot programs, and allowing utilities flexibility to test and refine new approaches with appropriate regulatory oversight. Oregon regulators should support utility investments in the operational capabilities, communications systems, analytical tools, and internal coordination processes needed to successfully implement flexible interconnection at scale. Utilities should also work to develop standardized customer agreements, operational procedures, and program structures compatible with managed charging technologies.

6. Support Proactive Infrastructure Planning and Investment Approaches

While managed charging and load flexibility can help reduce the impact of MHD charging, they are unlikely to eliminate the need for new grid investments altogether. Historically, utilities have taken a relatively conservative approach to investing ahead of anticipated load growth, particularly where the timing, location, or magnitude of new demand is uncertain. This approach reflects concerns that building infrastructure too far in advance of need could result in underutilized or stranded assets if projected demand fails to materialize.[37] As electricity demand grows more rapidly, however, there is increasing interest in more proactive infrastructure investment that plans, upgrades, and deploys grid infrastructure in anticipation of future load growth or system needs. Through enhanced forecasting, scenario analysis that accounts for the uncertainty in the pace and location of load growth, and long-term planning, utilities can identify “least-regrets” investments in areas where electrification and load growth are most likely to occur.[32] This approach, which has been recently authorized by utility

commissions in California, New York, and Massachusetts, can help reduce interconnection delays, avoid piecemeal upgrades, and better align grid infrastructure timelines with the pace of transportation electrification.[32] Studies have found that proactive grid investments can lower long-term system costs for both utilities and ratepayers compared to a purely reactive approach, while providing more timely and predictable service for fleets seeking to electrify.[37]

In Oregon, policymakers and utilities could support this approach by undertaking planning analyses to identify high-priority locations for early grid investment aligned with expected MHD charging demand, particularly along freight corridors, industrial areas, and major fleet hubs. Planning analyses should consider both projected charging demand and the expected impacts of managed charging when identifying infrastructure needs and prioritizing investments. The state could also develop guidance for high-confidence load forecasting methodologies to support strategic early investments and reduce uncertainty around future charging demand. In combination, Oregon could consider enabling utilities to make proactive and flexible infrastructure investments where forecast confidence and site prioritization criteria indicate a strong likelihood of near-term electrification and sustained load growth. Oregon should establish appropriate cost-recovery mechanisms and regulatory frameworks that allow utilities to make strategic early investments while maintaining safeguards for ratepayer protection.

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