

# Washington State Ferries Decarbonization Plan

JULY 1, 2021



Washington State Ferries

# CONTENTS

<b>Executive Summary</b> . . . . .	<b>.2</b>
<b>Agency Approach to GHG Reduction</b> . . . . .	<b>.4</b>
<b>Energy Efficiency Initiatives</b> . . . . .	<b>.5</b>
<b>Fuel Transition Initiatives</b> . . . . .	<b>.8</b>
<b>Reduction Plan</b> . . . . .	<b>.10</b>
<b>Conclusion</b> . . . . .	<b>.12</b>

# Executive Summary

The Washington State Ferry (WSF) system is the largest ferry system in the United States and provides critical links in Washington State’s transportation network as part of the state highway system. WSF is a division of the Washington State Department of Transportation (WSDOT), which is a cabinet-level government agency in the State of Washington. In 2019, the fleet of ferry vessels produced about 180,000 metric tons (MT) of greenhouse gases (GHGs), which equated to approximately 73% of the GHG emissions for WSDOT as an agency. In addition to the vessels, operating the Eagle Harbor maintenance facility, terminals, and administration contribute about 700 MT of GHG per year. This is less than 1% of the emissions from the vessels.

In 2009, Washington State established state agency GHG limits and reporting requirements in state law (RCW 70A.50).<sup>1</sup> In 2020, the Washington State Legislature updated these limits to make them more stringent in alignment with more recent scientific and international efforts calling for larger GHG reductions to avoid the most severe impacts of climate change. Figure 1 illustrates the original requirements in comparison to the stricter 2020 updates for all state agencies in Washington, including WSDOT.

Year	2009 GHG Reduction Requirement	2020 Revised GHG Reduction Requirement
2020	15% below 2005 levels	15% below 2005 levels
2030	No requirement	45% below 2005 levels
2035	36% below 2005 levels	No requirement
2040	No requirement	70% below 2005 levels
2050	57.5% below 2005 levels	95% below 2005 levels and net zero

**Figure 1. State-Mandated GHG Limits for State Agencies (2009 and 2020)**

In 2018, Washington State Governor Jay Inslee issued Executive Order 18-01.<sup>2</sup> This executive order requires WSF to “ensure that the Washington State Ferry system begins the transition to a zero-carbon-emission ferry fleet, including the accelerated adoption of both ferry electrification and operational improvements that will conserve energy and cut fuel use.” In 2020, the order was superseded by Governor Inslee’s issuance of Executive Order 20-01,<sup>3</sup> which clarified some parts of the order.

To address the challenges set forth by Governor Inslee and the Washington State Legislature, WSF formed an Operational Efficiency Work Group as part of its development of an interdepartmental sustainability effort. Furthering these efforts, in 2019, WSF completed its 2040 Long Range Plan,<sup>4</sup> which established “Sustainability and Resilience” as one of its four primary themes to guide WSF over the next 20 years. As this plan has moved into implementation, WSF completed its first Sustainability Action Plan<sup>5</sup> for the 2019-2021 biennium, which outlines goals and actions for GHG and other emissions reduction. Refining this effort, in 2020, WSF completed a System

<sup>1</sup> Limiting Greenhouse Gas Emissions, RCW 70A.45, <https://app.leg.wa.gov/RCW/default.aspx?cite=70A.45>

<sup>2</sup> Executive Order 18-01 “State Efficiency and Environmental Performance,” Washington State Governor Jay Inslee [https://www.governor.wa.gov/sites/default/files/exe\\_order/18-01%20SEEP%20Executive%20Order%20%28tmp%29.pdf](https://www.governor.wa.gov/sites/default/files/exe_order/18-01%20SEEP%20Executive%20Order%20%28tmp%29.pdf)

<sup>3</sup> Executive Order 20-01 “State Efficiency and Environmental Performance,” Washington State Governor Jay Inslee, [https://www.governor.wa.gov/sites/default/files/exe\\_order/20-01%20SEEP%20Executive%20Order%20%28tmp%29.pdf](https://www.governor.wa.gov/sites/default/files/exe_order/20-01%20SEEP%20Executive%20Order%20%28tmp%29.pdf)

<sup>4</sup> 2040 Long Range Plan, Washington State Ferries, <https://wsdot.wa.gov/sites/default/files/2020/09/16/WSF-LongRangePlan-2040Plan.pdf>

<sup>5</sup> Sustainability Action Plan 2019-2021, Washington State Ferries, <https://wsdot.wa.gov/sites/default/files/2019/04/22/washington-state-ferries-sustainability-action-plan.pdf>

Electrification Plan,<sup>6</sup> and former WSF Assistant Secretary Amy Scarton initiated an internal, agency-wide Near-Term Electrification Action Plan to help coordinate and move forward electrification and energy efficiency efforts throughout WSDOT. This Decarbonization Plan draws upon all of these documents to highlight the efforts WSF is taking to address energy use with a primary focus on GHG reduction.

---

<sup>6</sup> System Electrification Plan, Washington State Ferries, <https://wsdot.wa.gov/sites/default/files/2021/01/13/WSF-SystemElectrificationPlan-December2020.pdf>

# Agency Approach to GHG Reduction

As developed in the WSDOT Near-Term Electrification Action Plan, WSDOT focuses on two pathways for GHG reduction: Reducing Fuel Use through Energy Efficiency; and, Reducing Carbon Intensity through Fuel Transition. Given the challenge faced by WSF to meet its reduction mandates, both pathways will be necessary components of an overall strategy to address energy performance.

## REDUCING FUEL USE THROUGH ENERGY EFFICIENCY

Reducing fuel use reduces emissions. Using less fuel also saves financial resources due to reduced fuel purchases. A number of the emission reduction efforts implemented to date rely on this approach. Purchasing more efficient equipment uses less fuel, as does operating the equipment – be it a tool, vehicle, or vessel – in an optimal manner.

## REDUCING CARBON INTENSITY THROUGH FUEL TRANSITION

The carbon intensity of a fuel is the amount of GHGs emitted per unit of energy. This value varies from fuel to fuel based on both the chemical nature of the fuel and the accounting procedures used to determine an emissions inventory. For example, propane is a bit more carbon efficient than gasoline because of the nature of the fuel. On the other hand, biodiesel is more carbon efficient than ultra-low sulfur diesel (ULSD), the standard petroleum-derived diesel, because the inventory protocol assumes that biodiesel is derived from material that recently removed carbon from the atmosphere. Thus, when burned, it is not adding “new” carbon. So, our GHG accounting protocol does not count these emissions.

### Liquid Biofuels

For over a decade, WSF has relied on ULSD as the primary fuel source for its vessels. The transition to ULSD from standard diesel provided a tremendous reduction in sulfur oxides (SOx). In more recent years, the transition to a blend of 5% biodiesel (B5) and then to 10% (B10) has resulted in additional reduction of GHGs. Biodiesel, while similar to diesel, is chemically different and can only substitute for a portion of the fuel. Renewable diesel, on the other hand, is chemically the same as ULSD and is a direct “drop in” substitute fuel. Unfortunately, at this time, global supplies of renewable diesel are limited and the fuel may come at a significant cost premium. In California, Oregon, and British Columbia, renewable diesel is available at nearly same price as ULSD as suppliers work to comply with state and provincial renewable fuel requirements. In the longer term, this fuel may provide a potential “bridging” fuel as WSF transitions its fleet to electricity.

### Electrification

Electrification is a major component of using lower carbon fuels and is the overarching strategy for WSF to meet its mandated reductions in 2030, 2040, and 2050. The Pacific Northwest is fortunate to have relatively low emissions associated with its grid electricity, making it an optimal energy source for GHG reductions. New requirements in the Clean Energy Transformation Act (CETA),<sup>7</sup> adopted by the Washington State Legislature in 2019, further direct utilities in the state to eliminate emissions associated with electricity over the next few decades. This means that, over time, emissions associated with using electricity will go down even if the amount of electricity used remains the same. WSF has several efforts completed and underway both for vessels and shoreside operations that transition to electricity. Although electrification is a key emissions reduction strategy, overall cost and applicability mean that it is best implemented in conjunction with efficiency efforts and the use of less carbon intensive biofuels.

<sup>7</sup> Washington Clean Energy Transformation Act, RCW 19.405, <https://app.leg.wa.gov/RCW/default.aspx?cite=19.405>

# Energy Efficiency Initiatives

Energy efficiency initiatives at WSF are generally classified in two categories: Operational Efficiency Initiatives; and, Capital and Maintenance Efficiency Initiatives. While Capital and Maintenance Efficiency Initiatives focus on changes to infrastructure and equipment, Operational Efficiency Initiatives emphasize how we can use infrastructure and equipment in a more efficient manner. Both categories of initiatives are essential for a holistic approach to energy efficiency at WSF.

## OPERATIONAL EFFICIENCY INITIATIVES

In 2017, WSF formed an Operational Efficiency Work Group with representatives from several departments, including Marine Operations, Vessel Engineering & Maintenance, Terminal Engineering, Finance & Administration, and Community Services & Planning. The work group is facilitated by the Chief Sustainability Officer. When the work group formed, meetings were held biweekly, but as the group and its efforts have matured, the frequency of meetings have shifted to monthly. Detailed meeting minutes, including action items, are recorded and tracked by the Chief Sustainability Officer.

The efforts of the Operational Efficiency Work Group are guided by Governor Inslee's EO 20-01, which mandates WSF to undertake "the accelerated adoption of both ferry electrification and operational improvements that will conserve energy and cut fuel use." The overarching approach of the work group is to make data-driven decisions on efficiency initiatives, implement the initiatives quickly, track the initiatives consistently, and either continue to track their success or, "fail fast" and adjust course as necessary. The work group solicits as many ideas from the frontline as possible to encourage a culture of sustainable problem solving, and to build trust between the frontline and management.

Generally, the implementation of the work group's initiatives has been accomplished through the identification of "champions" in the fleet, who encourage peers and provide feedback. Distribution of information happens in several ways, including direct communications between work group members and the frontline, particularly through existing system tools, such as the Fleet Advisory and Quick Notice. When the effectiveness of initiatives is validated through continued tracking, and where appropriate, the initiatives become policy and are incorporated into WSF's Safety Management System (SMS).

The work group's initiatives fall into two categories, each with several initiatives:

- Operating vessels more efficiently
  - Optimizing Fleet Speed
  - Reducing the Number of Engines Used
  - Revising Vessel Loading Procedures to Minimize Trim
  - Reducing Boiler Use through Closing Weather Deck Doors
- Managing the fleet for efficiency
  - Optimizing Vessel Assignments (Substituting Smaller Vessels on Underutilized Runs)
  - Optimizing Sailing Schedules (Reducing Need for Full Speed, Small Load Late Night Runs)
  - Carrying Less Fuel

## Operator Efficiency – Optimizing Fleet Speed

In May 2018, WSF issued a Fleet Advisory establishing standard crossing speeds for each vessel class and identifying conditions when these could be exceeded. This fleet advisory was subsequently reissued in 2019 and 2020. The measures have become so effective that they were incorporated as standard procedures into SMS manuals for both deck and engine crews.

Fuel savings are difficult to quantify because vessel operation is one among a variety of factors that affect fleet fuel use each year. However, during the first twelve months of the initiative, approximately 460,000 gallons less fuel was consumed than the previous year, equating to about 4,200 MT GHGs.

## Operator Efficiency – Reducing the Number of Engines Used

Shifting standard operation of the Jumbo Mark II vessels from three engines to two will not only reduce the number of engines operating, but will also allow the two engines that are operating to function at a more efficient load. Although not required, WSF will test this operational change with USCG prior to implementation. Due to competing demands for vessel availability (primarily service requirements, repairs, preservation, and maintenance), this trial is on hold. This change is expected to reduce fuel use between 10% and 20%, saving roughly 500,000 to 1,000,000 gallons of fuel per year, and GHG emissions by 4,500 to 9,000 MT combined for the three vessels in this class.

## Operator Efficiency – Revising Loading Procedures to Minimize Trim

How a vessel sits in the water affects the amount of energy needed to propel it forward. When a vessel is not carrying a full vehicle load, the position of vehicles on the deck can affect the vessel trim, the difference between the forward and aft draft of the vessel. Given lower ridership resulting in less full loads, vessels being “out of trim” primarily occurs during the winter for the WSF system. During 2019, WSF collected data to inform improved vessel loading practices. Although formal implementation is currently underway with “champions” in the fleet, information has been distributed to crews. A poorly trimmed vessel can burn as much as 15% more fuel than one that is properly trimmed.

## Operator Efficiency – Reducing Boiler Use through Closing Weather Deck Doors

The weather deck doors allow walk-on passengers to access overhead loading. Previously, these doors had been propped open the entire time the vessel was docked for loading and unloading. Now they are only held open during initial pulses of loading and unloading, and otherwise remain closed. Keeping these door closed retains heat in the passenger cabin, thus reducing the fuel use to heat the space. Reducing the heating load of the vessels is expected to reduce fuel use across the system by about 125,000 gallons of fuel per year, reducing emissions by 1,200 MT GHG per year.

## Management Efficiency – Optimizing Vessel Assignments (Substituting Smaller Vessels on Underutilized Runs)

In addition to operating each vessel more efficiently through efforts such as optimal speed and minimized trim, operational efficiencies can also be achieved through the careful assignment of the vessels. By analyzing ridership data and taking into account the availability of vessels, runs can be assigned the most appropriately-sized vessel given the projected ridership. In this way, larger vessels, which in general burn more fuel, are not used on runs where their additional capacity is not necessary. Given the current size of the fleet, there is not a great deal of flexibility in vessel assignments, but management will prioritize considerations of fuel savings as assignments are considered in the future.

## Management Efficiency – Optimizing Sailing Schedules (Reducing Need for Full Speed, Small Load Late Night Runs)

In addition to careful assignment of vessels based on availability and ridership statistics, operational efficiencies can also be achieved by considering optimized speeds as one factor in developing sailing schedules. In addition to optimized speeds, sailing schedules must take into account a multitude of factors that in some instances may compete with fuel efficiency. However, even minor adjustments in sailing schedules may have a positive benefit on energy performance. In addition, slight schedule changes that allow sufficient time for shoreside tasks, such as pumping waste, would mean crossings are not used to make up time, thus maintaining optimum speeds and still achieving on-time schedule performance.

## Management Efficiency – Carrying Less Fuel

Carrying more fuel than is necessary for operations between refueling takes more fuel to operate the vessels than it does for operating the vessels at a lower displacement (with less fuel onboard). This initiative reduces fuel consumption by operating the ferries with less fuel onboard. Implementing this initiative also enables a one-time cost savings for the fleet. This is accomplished by reducing the amount of fuel taken on by the boats during the initial refueling after revised refueling policy is implemented. Initial analysis has identified the Jumbo Mark II and Jumbo Mark I classes of vessels as candidates for this initiative. Further analysis is needed to determine whether this initiative will be viable for the Issaquah Class. The Jumbo Mark II vessels can safely be operated with 11,000 gallons less per vessel while the Jumbo Mark I vessels can operate with 40,000 gallons less per vessel. Ongoing fuel savings due to more efficient operation would be over 60,000 gallons per year for the Jumbo Mark II Class and almost 84,000 gallons per year for the Jumbo Mark I Class.

## CAPITAL AND MAINTENANCE EFFICIENCY INITIATIVES

Capital and maintenance efficiencies include ongoing investments in infrastructure and equipment that result in increased overall energy efficiency. These efforts are generally financed through biennial budgeting or grants. Due to financial constraints and scheduling of vessel layups, these efforts occur over a longer time span than operational efficiency initiatives.

## Fuel Consumption Instrumentation and Operator Feedback

Fuel consumption gauges allow crews to correlate vessel operation with fuel use and provide quantitative data to make better operational decisions, helping to implement other operational efficiency measures. The gauges are funded with a \$1.84 M Congestion Management and Air Quality (CMAQ) grant from the Federal Highway Administration (FHWA). Efforts are underway to contract for the installation, which will take place during the 2021-2023 biennium.

## Issaquah Class Propellers

The blades on the Issaquah Class propellers are over 40 years old. They are robust but lower efficiency blades. WSF prototyped an upgraded skewed blade design on the M/V Chelan and experienced gains in efficiency. The Issaquah and Olympic classes use the same central hub, but different blades. Funded by an approximately \$2.9 M CMAQ grant, this initiative upgrades the Issaquah Class to similar skewed blades as the Olympic Class.

## LED Replacement

As part of ongoing maintenance efforts to the WSF fleet, vessels have continually been retrofitted with LED lighting fixtures during scheduled shipyard preservation projects. Although lighting loads may represent a nominal amount of overall energy use for vessels, LED technology can provide upwards of 90% savings in electricity usage compared to conventional fixtures. While new build vessels will be equipped initially with LED fixtures, the transition of existing vessels in the fleet will be opportunistic but likely to be completed over the next several biennia as budget and layup time allow.

# Fuel Transition Initiatives

While energy efficiency measures represent a substantial savings in fuel use and reduction in emissions, the significant challenges set forth in RCW 70A.45.050 and Governor Inslee's EO 20-01 will only be met through a direct fuel transition. As outlined in the 2040 Long Range Plan, WSF's long-term strategy is a transition to an electric hybrid fleet through retrofitting, new builds, and retirements. As a bridging strategy to the future electric hybrid fleet, WSF has increased its use of liquid biofuels and continues to try to expand the use as technology and market forces allow.

## LIQUID BIOFUELS

### Transition to B10

WSF is required by the Washington State Legislature to use up to a 5% blend of biodiesel (B5) if the price of B5 does not exceed that of conventional diesel by more than 5%. In 2018, WSF tested the use of a 10% blend of biodiesel (B10) in the M/V Tacoma. The test concluded that there were no ill effects of running B10 on WSF vessels. For this reason, WSF negotiated a new fuel contract with its fuel provider to provide B10 at a price that was within 5% of that of conventional diesel to allow for the increased use of biofuels across the fleet. In 2019, WSF issued a Fleet Advisory for B10 to be the standard order of fuel for all vessels. By early 2020, WSF's fuel provider overcame supply issues and began almost exclusive delivery of B10 to the entire WSF fleet. In an average year where WSF may use upwards of 19,000,000 gallons of diesel, the use of B10 represents a reduction of 20,000 MT GHG over conventional diesel, and an additional 10,000 MT GHG over B5.

## ELECTRIFICATION

### Systemwide Shoreside – ESCO Project

Energy services companies (ESCO) provide comprehensive energy efficiency services from energy audits to energy efficiency improvements and follow up monitoring. The Washington State Department of Enterprise Services (DES) manages the Energy Savings Performance Contract Program, which is the vehicle WSDOT uses to perform these projects. ESCO projects are packaged so that the energy savings can be used to pay for the improvements over time.

In 2019, WSF initiated a ferry terminal ESCO project to improve efficiency through the transition to LED lighting fixtures, remote controls for heating and ventilation, and water saving fixtures. The project was carried out at all ferry terminals (except Seattle and Mukilteo, which are currently undergoing major construction and will be a minimum of LEED Silver when completed) and the Eagle Harbor Maintenance Facility, where propane-powered heating equipment was also replaced by electric heat pumps. This contract also included a solar array installation at the Bainbridge Island Terminal. Energy savings and solar generation from this project are expected to reduce emissions by at least 230 MT GHG per year.

### Olympic Class – Shore Power Capacity Increase

When tied up following a service day, ferries still require power to operate essential systems. Electrical power from shore is the preferred power source, otherwise a vessel needs to run a diesel-powered generator to provide this power. The existing four Olympic Class vessels require more shore power than currently available at their tie-up locations. To enable this class of vessels to use electric shore power, modifications must be made to the vessels and at the terminals. Currently, vessel modifications are planned and funded. The necessary terminal modifications are not funded but are currently being developed as projects to seek funding. Both vessel and terminal modifications must be operational to be able to use shore power. Emission savings from these modifications have not yet been estimated.

## Fleetwide Transition – Electric Hybridization

WSF’s 2040 Long Range Plan calls for the transition to an electric hybrid fleet, including retrofitting, new build, and retirement of vessels as well as the electrification of terminal infrastructure to support shoreside charging of vessels. This transition represents a significant investment and includes the retrofitting of six existing vessels, the construction of 16 new vessels, the retirement of 13 existing vessels, and infrastructure projects at 16 terminals within the system. WSF’s 2040 Long Range Plan and the System Electrification Plan break these investments into near- (0-5 years), medium- (5-10 years), and long-term (10-20 years) planning horizons, which will result in a fleet of all hybrid electric vessels with the exception of the four existing Olympic Class vessels by 2040.

In the near-term (0-5 years), WSF will retrofit three existing Jumbo Mark II Class vessels as hybrid electric, build two new Hybrid Electric Olympic (HEO) Class vessels, and retire two vessels, the M/V Hyak and M/V Elwha. In addition, shoreside charging infrastructure to support the hybrid electric vessels will be constructed at Seattle (at two slips to serve both Bremerton and Bainbridge), Bremerton, Bainbridge, Clinton (one-sided charging to serve the Clinton-Mukilteo route), and Kingston (one-side charging to serve the Kingston-Edmonds route).

In the medium-term (5-10 years), WSF will build three additional HEO Class vessels, build three new 124-car class, hybrid electric vessels, and retire five vessels, M/V Tillikum, M/V Kaleetan, M/V Yakima, M/V Issaquah, and M/V Kitsap. In addition, shoreside charging infrastructure to support the hybrid electric vessels will be constructed at Coupeville, Port Townsend, Fauntleroy, Vashon, Southworth, and Point Defiance (one-sided charging to serve the Point Defiance-Tahlequah route).

In the long-term (10-20 years), WSF will retrofit three existing Kwa-di Tabil (KDT) Class vessels as hybrid electric, build one additional new 124-car class, hybrid electric vessel, build seven new 144-class, hybrid electric vessels, and retire six vessels, M/V Kittitas, M/V Spokane, M/V Walla Walla, M/V Cathlamet, M/V Chelan, and M/V Sealth. In addition, shoreside charging infrastructure to support the hybrid electric vessels will be constructed at Anacortes, Lopez Island, Shaw Island, Orcas Island, and Friday Harbor.

Over the course of this planning period, the WSF fleet will transform from 21 diesel-powered vessels in 2020 to a fleet of 22 hybrid electric and four diesel-powered vessels by 2040 (Figure 2). As outlined in the subsequent section concerning emission reductions, this fleet transition will allow WSF to achieve its legislatively mandated GHG reduction goals in 2030 and 2040. The final goal for 2050 to be 95% below 2005 levels and net zero will have to be achieved by addressing either the fuel used in the four diesel-powered vessels that will remain in the fleet, or through the retrofit of those vessels as hybrid electric. However, the period from 2040 to 2050 is beyond WSF’s current long-range planning horizon.

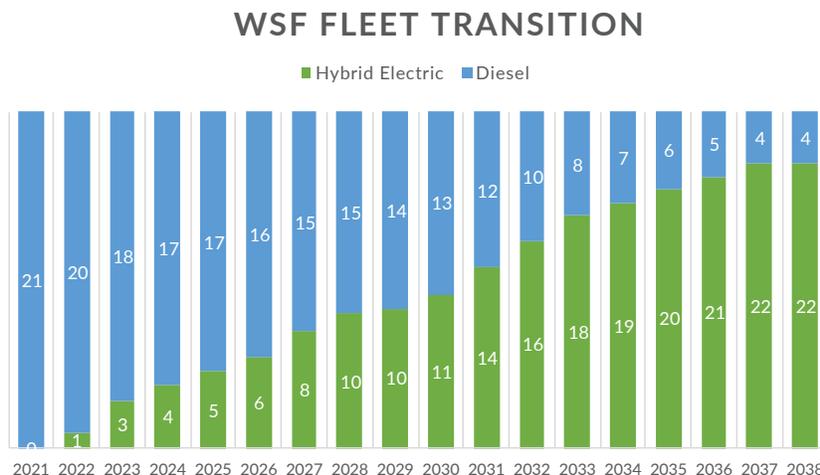


Figure 2. WSF’s Fleet Transition from 2020 to 2040

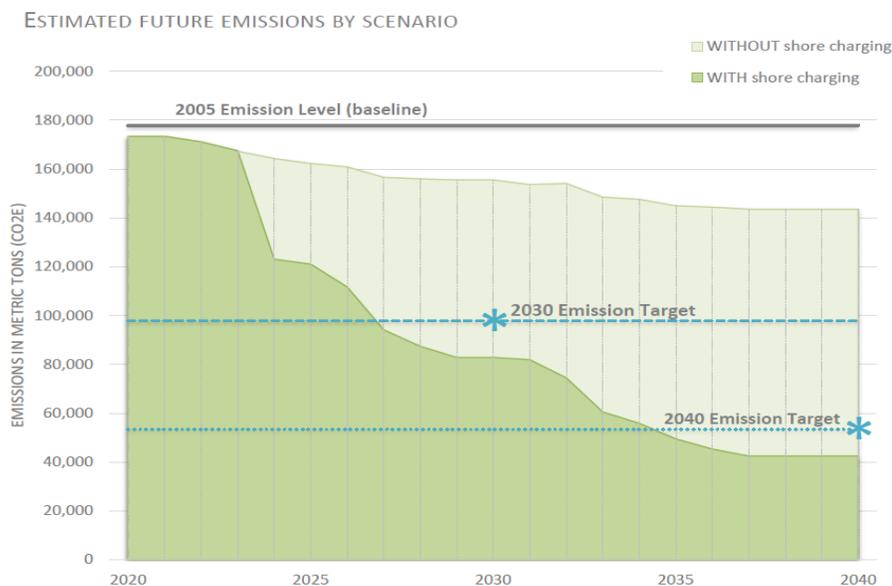
# Reduction Plan

Quantifiable GHG reduction targets for WSF are set by the Washington State Legislature in RCW 70A.45.050. In 2020, this code was updated to increase the total reductions required for state agencies between 2020 and 2050. In addition, Governor Inslee’s EO 20-01 directs WSDOT to ensure that the ferry system begins the transition to a zero-carbon emission fleet through the “accelerated adoption of both ferry electrification and operational improvements that will conserve energy and cut fuel use” as part of state government actions to meet or exceed state agency GHG limits. Figure 3 provides the current GHG reduction targets for state agencies specified in RCW 70A.45.050.

Year	2020 Revised GHG Reduction Requirement
2020	15% below 2005 levels
2030	45% below 2005 levels
2040	70% below 2005 levels
2050	95% below 2005 levels and net zero

**Figure 3. GHG Reduction Requirements for State Agencies**

In addition to achieving the targeted reduction of 15% below 2005 levels in 2020, the measures outlined in this plan for energy efficiency and fuel transition will allow WSF to exceed the targets for 2030 and 2040, and be in a good position to achieve its 2050 requirement. By 2030, GHG emissions will be reduced by 53% below 2005 levels and, by 2040, reduction below 2005 levels will reach 76%.<sup>8</sup> Figure 4 presents a multiyear projection to 2040 demonstrating GHG emission reduction over time as this plan is implemented. Within the next decade, WSF will have to plan for the 2050 goal of 95% reduction. As previously mentioned, this will likely be accomplished through fuel transition, either to a drop-in, liquid biofuel, such as renewable diesel, or the hybridization of the remaining diesel-powered fleet.



**Figure 4. Multiyear Projection of GHG Emission Reductions<sup>9</sup>**

<sup>8</sup> For these reduction calculations, the GHGs considered were carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), and nitrous oxide (N<sub>2</sub>O).  
<sup>9</sup> System Electrification Plan, WSF, p.7, <https://wsdot.wa.gov/sites/default/files/2021/01/13/WSF-SystemElectrificationPlan-December2020.pdf>

In addition to the reduction in GHG emissions, the energy efficiency and fuel transition outlined in this plan will also result in a reduction of toxic air emissions, specifically sulfur oxides (SO<sub>x</sub>), nitrogen oxides (NO<sub>x</sub>), and diesel particulate matter (PM). Figure 5 presents a projection for reduction of SO<sub>x</sub>, NO<sub>x</sub>, and PM from a 2018 baseline. The projection shows reductions for 2030 and 2040 based on the current schedule for fleet electrification both with and without shore charging. The current electrification plan includes shore charging. By 2030, WSF is on track to reduce SO<sub>x</sub> by 52%, NO<sub>x</sub> by 66%, and PM by 53%. By 2040 these reductions will increase to 75% for SO<sub>x</sub>, 94% for NO<sub>x</sub>, and 90% for PM. These reductions form WSF’s target toxic air emission reductions through 2040.

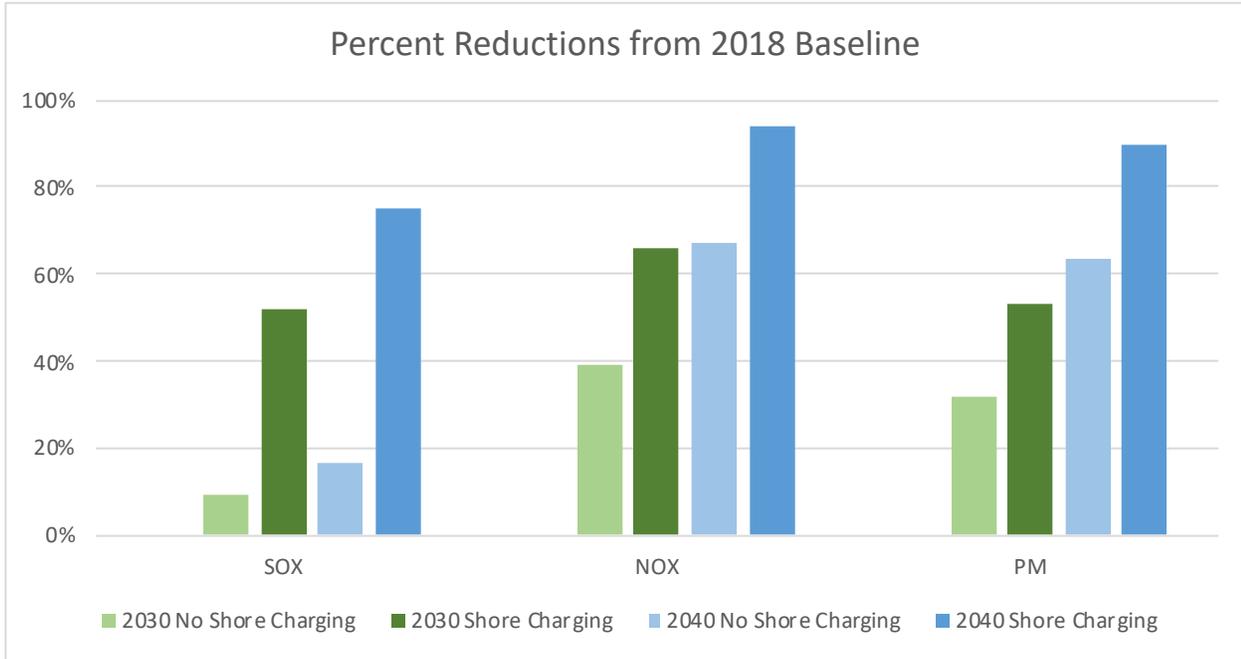


Figure 5. SO<sub>x</sub>, NO<sub>x</sub>, and PM Reduction Projections for 2030 and 2040

# Conclusion

As outlined in this plan, WSF has an aggressive strategy to meet legislatively mandated GHG reduction goals over the next twenty years. This direction has been set through long range planning that has been responsive to legislative mandates, executive orders, and community needs. WSF will continue to improve operational efficiencies over this period and remain up to date on the latest technologies related to fuel transition. WSF will particularly track the market availability and price point of renewable diesel to see if it may be used as a bridging fuel during the transition to an electric hybrid fleet.

The ultimate responsibility for the implementation of this plan is the Executive Team at WSF, which is made up of the directors of each department, the Chief of Staff, and the Assistant Secretary of WSF. The tracking and updating of the plan will be headed by Chief Sustainability Officer. For such a far-reaching plan to be successful, management within WSF must engage individuals across the organization. There is also a need for front line staff to continue to bring forward ideas to help WSF operate more efficiently and, in doing so, foster a culture of sustainability throughout the organization. We will know that our sustainability journey is reaching towards success when sustainability is considered throughout our decision making processes, and has thus become a lived cultural value of our organization.

**Americans with Disabilities Act (ADA) Information:** This material can be made available in an alternate format by emailing the Office of Equal Opportunity at [wsdotada@wsdot.wa.gov](mailto:wsdotada@wsdot.wa.gov) or by calling toll free, 855-362-4ADA(4232). Persons who are deaf or hard of hearing may make a request by calling the Washington State Relay at 711.

**Title VI Notice to Public:** It is the Washington State Department of Transportation's (WSDOT) policy to assure that no person shall, on the grounds of race, color, or national origin, as provided by Title VI of the Civil Rights Act of 1964, be excluded from participation in, be denied the benefits of, or be otherwise discriminated against under any of its programs and activities. Any person who believes his/her Title VI protection has been violated, may file a complaint with WSDOT's Office of Equal Opportunity (OEO). For additional information regarding Title VI complaint procedures and/or information regarding our non-discrimination obligations, please contact OEO's Title VI Coordinator at (360) 705-7090.