HYAK HYBRID FERRY PROPULSION PROJECT

Green Fleet Ferry Program

TIGER III GRANT APPLICATION

October 28, 2011
# Application for TIGER III Grant Funding

**Hyak Hybrid Ferry Propulsion Project**  
Green Fleet Ferry Program  
*Cutting Fuel Use and Pollution in Puget Sound*

**Washington Department of Transportation – Ferries Division**  
October, 2011

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Executive Summary

Hyak Hybrid Ferry Propulsion Project – Green Fleet Ferry Program

The Washington State Department of Transportation (WSDOT) – Ferries Division (WSF) is requesting $10,000,000 in TIGER III grant funds to convert the propulsion system of a ferry vessel – Motor Vessel (MV) Hyak – from an antiquated system that emits large volumes of pollutants and greenhouse gas (GHG) emissions, to a modern, hybrid propulsion system which will reduce fuel consumption and pollution, while reducing operating costs and oil dependence. Over the Hyak’s remaining service life, this project will cut 44,933 metric tons of CO₂ equivalent, and save over 4.5 million gallons of diesel fuel. Annually, that is 2,365 metric tons of CO₂ savings, and 234,677 gallons of diesel.

The Hyak’s new hybrid propulsion system technology will achieve these environmental impacts in three ways:

- **Variable-speed generators** – the generators powering the Hyak’s current, outdated propulsion system run at a constant rate of 900rpm, and produce a fixed amount of power. This is like keeping a car engine running at full speed while waiting at a stop light. It wastes fuel, emits GHGs, and fills the Puget Sound Region and its port areas with diesel pollution. The hybrid Hyak will use variable-speed generators, capable of supplying power when needed, or slowing down when demand is low.

- **Power management, and auto-start/auto-shutdown technology** – This innovation resembles the technology used in “smart grid” systems, where a computer senses load, and responds with the appropriate amount of power. This will enable effective use of variable-speed generators, and save substantial amounts of fuel.

- **Batteries as backup power** – When a small number of the Hyak’s diesel generators are running and more power is needed, the bank of batteries can provide additional power, eliminating the need to switch on additional generators. Similarly, at times when many generators are running, but not all the power is being used, the batteries will store this additional power, rather than letting it go to waste.

This project’s long-term benefits outweigh its total costs by a sizable margin, making it a sound public investment. The estimated benefits at a conservative 7% discount rate are $18.8m over the course of the Hyak’s useful life, compared to $12m in total costs. At a 3% discount rate, the project yields $26.2m in benefits, compared to $12.7m in costs. Benefits include the following:

<table>
<thead>
<tr>
<th>Benefits and Costs (in millions [m])</th>
<th>7% Discount</th>
<th>5% Discount</th>
<th>3% Discount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel savings, and reduced fare increases</td>
<td>$10.4m</td>
<td>$12.1m</td>
<td>$14.5m</td>
</tr>
<tr>
<td>GHG and pollution reduction</td>
<td>$8.4m</td>
<td>$9.9m</td>
<td>$11.7m</td>
</tr>
<tr>
<td><strong>Total Benefits</strong></td>
<td><strong>$18.8m</strong></td>
<td><strong>$22.0m</strong></td>
<td><strong>$26.2m</strong></td>
</tr>
<tr>
<td><strong>Total Costs</strong></td>
<td><strong>$12.1m</strong></td>
<td><strong>$12.4m</strong></td>
<td><strong>$12.7m</strong></td>
</tr>
<tr>
<td>Benefit/Cost Ratio</td>
<td>1.56</td>
<td>1.78</td>
<td>2.06</td>
</tr>
</tbody>
</table>

These benefit estimates are derived primarily from direct, easy-to-verify improvements in engine performance leading to improved fuel efficiency and emissions cuts. This project lends itself to solid, output-based evaluation of tangible results, rather than relying on assumptions about user behavior, or indirect means to measure GHG reductions.
In addition to its long-term benefits, this project will have a solid, near-term impact in terms of job creation. Retrofitting the Hyak will create 158.32 job-years of work in the course of implementation. This includes 37.02 years of skilled shipyard labor, 15% of which will directly support maritime industry apprentice programs.

Washington State Ferries is currently among the region’s biggest emitters of GHGs and diesel pollution. In 2009 WSF released an estimated 174,000 metric tons of CO₂ equivalent, accounting for 63% of the State fleet’s total emissions and 16% of total emissions by State agencies. WSDOT recognizes that this is not sustainable, and is working aggressively to reduce fuel consumption and pollution. However, at a time of state budget cuts and limited funding opportunities, federal support is critical to sustaining these efforts. This TIGER III grant will enable WSDOT, local partners, and the USDOT to work together using innovative technology to reduce GHG emissions, oil dependence, and the threats to human health created by particulate diesel emissions.

I. Project Description

The Washington State Department of Transportation - Ferries Division (WSF) is applying for TIGER III funding from the US Department of Transportation to retrofit the diesel propulsion system of the Motor Vessel (MV) Hyak with a hybrid propulsion system. Hybrid ferries charge a bank of batteries with their diesel engines when the ferry is moving, and are capable of doing so with electric shore power if dockside facilities are available. Like a hybrid car, they can operate as an electric vessel for short trips. This project will create the first hybrid ferry vessel of its size and power, run on electric motors powered by a combination of battery and generator power, with electricity from a smaller number of diesel generators, supplemented by batteries. This new system will be energy-efficient and bring substantial environmental benefits to the Pacific Northwest region, while creating jobs and helping to reduce dependence on fossil fuels.

This project will annually reduce fuel consumption on MV Hyak by an estimated 15.71%, or 234,667 gallons, with commensurate reductions in GHG and particulate emissions. Over the vessel’s remaining 19 year useful life, this translates to a fuel savings of 4,458,866 gallons and 44,933 metric tons of CO₂ equivalent.

In addition to its environmental benefits, this project will boost the development of the nascent hybrid marine engine industry, creating jobs and improving the knowledge base and technical capacity of
US firms working in this sector. At the same time, the project will provide a working example of how this technology can produce dramatic reductions in fuel consumption, particulate pollutants, and greenhouse gas emissions, on a large ferry vessel, as it has on other types of boats.

This is a rural project, as the area in which it will be implemented is not on the US Census Bureau 2010 list of Urbanized Areas. Grant funds requested do not exceed $10,000,000.

The Vessel

MV Hyak is one of four Super Class vessels operated by WSF. Its length, from bow to stern, is 382’2”, and it holds up to 144 vehicles, and 2,000 passengers. It is powered by a direct-current diesel-electric propulsion system.

The Hyak’s propulsion system is outdated and inefficient, needlessly creating pollution and wasting fuel. Generators powering the motors have two speeds: On and Off; they run at a constant 900rpm, and cannot be turned down. WSDOT’s ferries spend substantial amounts of time at terminals, loading and unloading passengers. Because of the Hyak’s antiquated design, its generators run at full speed, even during times when it is not necessary. This design made sense in 1967, when fuel was plentiful and the Greenhouse Effect was unknown. But by today’s standards it is wasteful and unnecessarily destructive of the environment and human health.

MV Hyak’s Route

The majority of the year, MV Hyak operates on the route connecting Anacortes and the islands of Lopez, Shaw, Orcas, and San Juan. WSF’s 2010 ridership on this route was 1,725,450, consisting of 889,536 passengers and 835,894 vehicles. The route yielded $20,499,000 in revenue, and 25,844,058 passenger-miles. Of the passengers on this route, 32% were walk-on – completing their trip either by being picked up, walking, or transferring to transit upon arrival at their destination. The remaining 68% were vehicle passengers.

This route plays a vital role in the San Juan Island area. There is no road access, so the San Juan Islands can only be reached by boat or aircraft. This limited access means the ferry system plays a critical economic role in this area, and is essential in alleviating the problems associated with rural isolation. Ferries provide access to goods and services, as well as medical facilities – reducing the need for costly medical evacuations.
II. Project Parties

Washington State Department of Transportation – Ferries Division

The primary party for this project is Washington State Department of Transportation’s Ferries Division, also referred to as Washington State Ferries (WSF), which transports passengers and vehicles throughout the greater Puget Sound area.

WSF serves eight different counties, 20 communities, nine islands and Sidney, British Columbia, Canada. WSF operates nine distinct routes, providing a waterway link between western Washington mainland, the Olympic Peninsula and island communities, over a geographical area that extends from the City of Tacoma to the south and Orcas Island (US) / Sidney (BC) to the north. WSF routes bypass hundreds of highway miles and provide critical access to areas that are not well-served by other modes of surface transportation.

WSF is the largest ferry system in the nation, carrying nearly 23 million passengers and more than 10 million vehicles a year, with over 175 million passenger miles. WSF has a total fleet of 22 passenger-vehicle vessels ranging in size from the smallest ferry, carrying a maximum of 34 autos and 200 passengers, to large passenger-vehicle ferries carrying up to 202 cars and 2,500 passengers on a single voyage.

The State Ferries function as part of both the transit network and the highway system. As mass transit, WSF moves thousands of commuters to and from work on a daily basis. Ferry users and local communities depend on WSF to maintain its vehicle carrying capacity to reduce traffic congestion. Commuters rely on WSF as a critical component of the interdependent regional multi-modal mass transit system serving all of Puget Sound and the Pacific Northwest.

As part of the highway system, WSF transports 10.1 million vehicles per year, and provides access to areas that would otherwise be completely cut off from the road network. This enables commerce among areas linked by ferry.

WSF’s infrastructure includes a maintenance facility and 20 terminals, which range in size and complexity from a simple tollbooth with a single auto/passenger ramp on a remote, isolated island, to the major ferry terminal and transportation hub in the heart of downtown Seattle with multiple ferry slips, overhead passenger loading, and vendor services within the terminal. WSF promotes sustainable
communities by supporting intermodal connections to rail, bus, and encouraging bicycle, pedestrian, and van pool trips.

**Washington State Governor’s Office, Washington Department of Ecology, and WSDOT**

The government of Washington State and the Washington State Department of Transportation (WSDOT) are leaders and innovators in greenhouse gas emissions reduction efforts. Washington State law sets greenhouse gas emission reduction goals for the state and for state agencies, and establishes clear, aggressive targets for emissions reduction. As a state, Washington is working toward achieving 1990 GHG emissions levels by 2020. These targets are mandated by laws enacted by the Governor and approved by the State Legislature. These laws require all agencies to work towards these GHG reduction targets, and address during the planning processes for any projects involving new infrastructure. Washington state agencies are also required by law to supply 40% of their fuel from electricity or bio-fuel by June 1, 2013 for publicly-owned vessels, vehicles, and construction equipment.

![Washington State Fleet GHG Emissions, by Agency](chart)

Washington State, working through its Department of Ecology and local clean air agencies, works with public and private fleets to reduce harmful diesel emissions by retrofitting vehicles and equipment with emission control technologies. These technologies effectively reduce toxic emissions by 50% to 95%. Statewide more than 8,000 diesel vehicles are retrofitted with a variety of exhaust technologies. Most public fleets, including school districts, transit authorities, cities, counties, and public utility districts have retrofitted their fleets. Many private fleets, including refuse and recycle vehicles and port cargo handling equipment, are retrofitting their vehicles and equipment. With State support, some are installing idle reduction technologies, to rebuild or repower vehicles and equipment with new lower emission engines or to replace vehicles and equipment that are not suitable for exhaust retrofits.

WSDOT actively works to conserve energy, fuels and funding while reducing greenhouse gas emissions, using strategic business practices, and good environmental and economic sense. To reach the agency’s goal to reduce emissions 15% below 2005 levels by 2020, WSDOT has developed a greenhouse gas emissions reduction strategy for the agency.

WSDOT’s Sustainable Transportation approach addresses greenhouse gas emissions through a broad array of strategies. Four primary GHG reduction strategies are:

- Improve fuel - Support efforts to lower the carbon content of fuels and find alternative fuels.

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1 [http://www.wsdot.wa.gov/sustainabletransportation](http://www.wsdot.wa.gov/sustainabletransportation)
2 [http://www.ecy.wa.gov/climatechange/fuelstandards.htm](http://www.ecy.wa.gov/climatechange/fuelstandards.htm)
• Advance vehicle and vessel technology\(^3\) - Through improved vehicle and vessel technology leading to vehicles and vessels that run on energy sources other than petroleum and with better efficiency from each gallon.

• Support system efficiency - Operate the transportation system to maximize efficiency\(^4\) and improve traffic flow.

• Manage demand for transportation - Actively support efficient transportation options\(^5\) like carpooling, vanpooling, working from home, taking transit, riding your bike, walking or shopping closer to home.

**Current and ongoing efforts to reduce fuel use and GHGs at Washington State Ferries**

WSDOT’s Ferry System (WSF) produces roughly 63\% of WSDOT’s emissions and therefore has a critical role to play in reducing the agency’s carbon footprint. WSF must reduce annual emissions by roughly 36,872 metric tons of CO\(_2\) equivalent to meet the State’s GHG emissions reduction goals by 2020. This project will reduce fuel consumption by 234,677 gallons of diesel per year, lowering emissions by 2,365 metric tons, 15.71\% of the MV Hyak’s emissions. This will meet approximately 6.7\% of the agency’s GHG emission reduction goals. Over the retrofitted vessel’s expected 19-year useful life, a total fuel reduction of 4,458,866 gallons and 44,933 metric tons of CO\(_2\) equivalents.

WSF is at the vanguard of efforts to improve fuel efficiency and environmental sustainability in operations. WSF formed a fuel conservation group in 2006 to explore ways to reduce fuel consumption. Recent initiatives stemming from the group are at various stages of development and include seeking additional opportunities to reduce vessel speeds, passive restraint to reduce the fuel burn associated with docking, using biofuels, reducing the number of engines during transit operations, and retrofitting engines with efficient power assemblies. Many of these strategies are defined in our agency’s GHG emission reduction plan. Some of these initiatives are outlined below:

**Slowing down saves fuel**

Slowing a vessel reduces hull drag, which reduces fuel consumption. By reducing the vessel speeds on one route, WSF saves approximately 15,000 gallons of fuel per month, or about a 5\% reduction of total fuel consumption. A second route will begin selected slowdowns soon.

For safety reasons, ferries push against the docks while loading and unloading vehicles; ferries use 20 to 25\% of the total fuel consumed while docked. Tests are planned to determine options to safely reduce engine RPMs while docked. Reducing RPMs could significantly reduce fuel consumption and air pollution.

Ferry engines are more fuel efficient when operating at higher peak loads. Vessels have redundant engines to ensure safe and continuous operation in case of engine incapacitation. Recently, WSF reduced the number of engines used for transit one vessel class from three to two, improving efficiency.

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\(^3\) [http://www.westcoastgreenhighway.com/](http://www.westcoastgreenhighway.com/)

\(^4\) [http://www.wsdot.wa.gov/smarterhighways/](http://www.wsdot.wa.gov/smarterhighways/)

\(^5\) [http://www.wsdot.wa.gov/transit](http://www.wsdot.wa.gov/transit)
**WSF is using and investigating the use of alternative fuels and hybrid propulsion systems**

Biodiesel is carbon-neutral and reduces GHG emissions compared to 100% petroleum diesel. WSF currently uses biodiesel to the extent possible given budget constraints. Seventeen ferries currently use biodiesel, and five more will begin receiving it in early 2012.

Liquefied natural gas (LNG) has the potential to eliminate particulates and CO emissions, and reduce carbon dioxide by 15-20%, compared to petroleum diesel. LNG is used in ferries in Norway and the Joint Transportation Committee is currently studying the use of LNG for ferry vessels. WSF is exploring LNG fueling options for some vessels, and has a pending application for funding for an LNG retrofit of an Issaquah Class Vessel.

**Retrofits save oil and reduce air emissions**

During major engine overhauls of Electro Motive Division (EMD) engines, 1042 power assembly kits are installed to reduce the use of engine lube oil and particulate emissions. EMD engines are installed in most vessels in the WSF fleet. Retrofits recently made to two WSF vessels halved the consumption of lube oil. These kits reduce particulate emissions by a minimum of 25%. Two additional vessels are scheduled for retrofits.

**You can manage what you can measure**

In 2011 a fuel monitoring system was installed on MV Walla Walla. The project improves understanding how different vessel operations affect fuel consumption. WSF vessel operators will use this fuel information to adjust operations and maximize fuel efficiency. WSF estimates the close monitoring of fuel consumption could save 2% of the annual total fuel use for vessels with meters.

**III. Grant Funds – Sources and Uses of Project Funds**

The MV Hyak operates in a rural area. TIGER III criteria do not require matching funds for rural projects. However, if awarded TIGER III funds, WSDOT and partners will cover 20% of total project cost to demonstrate support for the project, and commitment to its’ implementation. WSDOT has also applied for $500,000 from the Washington State Department of Ecology’s (DOW) Clean Diesel Grant program. The Washington DOE will not announce award decisions before late November 2011, but WSDOT is optimistic about this additional local funding source.

TIGER III and matching funds for this project will cover the cost of equipment, installation, and project management. Equipment procurement includes a bank of batteries, A/C drive motors to propel the vessel,

<table>
<thead>
<tr>
<th>Category</th>
<th>Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery Bank</td>
<td>1,100,000</td>
</tr>
<tr>
<td>AC Drive Motors</td>
<td>1,000,000</td>
</tr>
<tr>
<td>Purchase Switch Boards, , variable frequency drives, Motor Field Transformer, Control Console, Pilot house Console</td>
<td>2,400,000</td>
</tr>
<tr>
<td>Two Thrust Bearings</td>
<td>200,000</td>
</tr>
<tr>
<td>Engines and Generators</td>
<td>4,800,000</td>
</tr>
<tr>
<td>Integrator and install at a Shipyard</td>
<td>3,000,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$12,500,000</strong></td>
</tr>
<tr>
<td>20% Match</td>
<td>$2,500,000.0</td>
</tr>
<tr>
<td>Less Match</td>
<td>$10,000,000.0</td>
</tr>
</tbody>
</table>
control equipment, engines and generators, to produce power to drive the motors, and two thrust bearings, designed to withstand over 200,000 pounds of torque, to support the vessel against the massive counterforce exerted against the propeller shaft when en route.

The project budget includes the cost of an Integrator, who oversees the process of procuring and sizing all of the equipment, and installing it in the vessel. Hiring a competitively-selected integrator for this type of work minimizes the risk for WSDOT, as the integrator assumes responsibility for integrating all parts and equipment, as opposed to using an Owner Furnished Equipment (OFE) model, for which WSDOT bears the risk involved with the procurement and integration process. An integrator must ensure that both the timeline and specifications are followed, and components fit the vessel and work together. For projects with some novel design elements, such as this one, capitalizing on the expertise of an integrator enables WSDOT to minimize risk.

IV. Selection Criteria

A) Long-Term Outcomes

(i.) State of good repair

The hybrid retrofit of MV Hyak will play a significant role in maintaining key assets needed for critical transportation services, and will greatly reduce life-cycle and operating costs over the vessel’s remaining useful life.

Built in 1967, MV Hyak’s vital on-board systems are due to be replaced or rebuilt. WSF’s Long-Range Plan shows the vessel retiring in 19 years. Propulsion systems due for replacement or reconstruction include the diesel generators, as well as Motors One and Two, switch boards, and propulsion controls, each of which were installed in 1967 and have a 30-year expected useful life. WSF will use TIGER III funds to replace the existing propulsion system with a hybrid system to reduce fuel costs by 15.71% for the remaining life of the vessel, as well as life-cycle cost savings through engine modernization.

Vital propulsion systems must either be replaced with new, like-kind diesel generators or proposed hybrid system. A hybrid system will yield significant reductions in fuel use and cut harmful GHG and particulate emissions compared to the existing diesel generators.

Modern replacement alternating-current (A/C) generators have lower life cycle costs than the generators due for replacement (and the alternative of a rebuilt version of the current, antiquated generators powering MV Hyak). Maintenance and spare parts costs will be lower for the new generators than for the existing ones, as the motors will run partially from stored power from the batteries, the diesel generators will likely have less wear-and-tear than traditional vessels, and should be easier to maintain. However, because these savings are difficult to precisely quantify, they are not included in the analysis.

This project rehabilitates assets which, if left unrepaired, will threaten future network efficiency, movement of goods, and economic competitiveness. The project has been deferred already and increasingly risks generator and/or control system failure, which would curtail operations and leave a major gap in the transportation network of an economically vital region. WSF lacks the spare vessels to continue current service levels in the San Juan Islands without the Hyak. A breakdown would reduce the number of sailings, efficiency and movement of goods on the route would suffer greatly.

WSF is well-prepared to implement this project, which is appropriately capitalized up-front, with revenue available for long-term operations and maintenance. The vessel is part of WSF’s long-term finance plan. WSF uses asset management to optimize long-term cost structure, budgeting capital improvements and preservation based on a life cycle cost model for assets’ useful life and operating condition. The preservation of MV Hyak in operating condition through replacement and rebuilding of propulsion systems is part of the WSF 16-year project plan.

The State of Washington places great emphasis on the protection of Ferry System infrastructure. State law requires WSDOT to inspect Ferry System assets at least once every three years to determine the condition of its terminals and vessels, providing data to update the WSF Life Cycle Cost Model (LCCM). The law requires WSF to determine its needs and make budget requests based on the LCCM, and to spend appropriated funds only if conditions warrant preservation.

The LCCM is a key tool for managing the preservation of Ferry System infrastructure. It provides needs assessment data the Legislature uses in the long-range planning process to identify revenue requirements, prioritize preservation work, and develop preservation projects for the budget process.

WSDOT also uses the LCCM for performance-based budgeting, and as a key tool in assessing the preservation program’s level of performance compared to projections. The Legislature has established preservation performance measures and objectives. The project list associated with a budget proposal can be evaluated in terms of performance measures and compared to alternative investment proposals. Finally, the Legislature is able to determine how effective a proposed level of funding will be in terms of reaching their preservation performance objectives.

(ii.) Economic competitiveness

This project will measurably contribute to the long-term growth and productivity of the US economy by boosting the long-term sustainability of the Washington State Ferry system, supporting technological development and private-sector efforts directed towards improving fuel-efficiency in maritime engines, and enabling continued ferry service, which provides economic benefits to an important area. Washington State Ferries play a vital role in the transportation network and economy of the United States.

WSF’s long-term financial sustainability depends in part on reducing fuel consumption to minimize fuel price volatility impacts on operating costs. WSF is currently dealing with record-high fuel prices, driving up the cost of operations at a time when stagnant wages and high unemployment would exacerbate the economic burden of prospective fare increases.
WSF is identifying ways to reduce fuel needs and diversify its sources of energy as a hedging strategy against price spikes. The hybrid retrofit for MV Hyak is a key part of this strategy, with the potential to save 15.71% per year on fuel, cutting costs by $1,104,900 annually, based on current fuel forecast of $3.81/gal for useful life of this project.

**Support to fuel-efficient marine engine industry**

This project will provide critical support to the development of US private-sector capacity to convert marine engine systems to improve fuel efficiency. This project will produce an additional high-profile example of both the financial and technological feasibility of this type of engine system.

Other transportation sectors, such as aerospace, are quickly developing new technologies to cut fuel use and improve efficiency, giving rise to new entrepreneurial firms working to develop profitable technological solutions. The marine transportation sector has lagged in this type of innovation. Efforts to improve fuel efficiency in marine vessels have begun to appear, however, and projects such as this hybrid retrofit will foster the development of a market for efficiency enhancements in marine propulsion systems.

**Economic benefits to an important area**

In the Pacific Northwest, ferry service on the Anacortes – San Juan Islands route contributes substantial economic benefits to an important area. A central component of the transportation system, this ferry route is a critical component in the freight network for agricultural products and merchandise for small businesses and communities. The San Juan Islands are only accessible by boat or plane, building bridges is impractical. This limited access means the ferry system plays an important economic role in this area.

Building and maintaining vessels for the WSF fleet sustains hundreds of jobs at major shipyards, and creates business for dozens of subcontractors. Washington has several shipyards as well as design companies, naval architects and engineers, and many other businesses that make up a diverse marine vessel industry. “This provides multiple benefits for the state and its communities as a source of manufacturing and service employment that provides family-wage jobs and economic diversity.”

**Tourism benefits**

Around 25 percent of ferry riders – roughly six million per year – are tourists or recreational users of the ferry system. This type of use brings substantial economic benefits to the region, particularly in San Juan County. Tourism is the state’s fourth largest industry, according to a

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Washington State Department of Commerce study, which also found that travelers spent approximately $15.2 billion in the state in 2010, generating 143,000 direct jobs, with the greatest benefit going to non-urban areas, such as San Juan County.\(^{10}\)

### (iii.) Livability

MV Hyak serves a vital corridor between San Juan and Skagit Counties, linking the Cities of Anacortes and Friday Harbor with nearby rural areas and communities, including locations with no other highway access, such as Orcas and San Juan Island. WSF service is a critical part of mobility and quality of life in this area. The route’s annual ridership is 1,725,430, based on 2010 figures.

Washington State Ferries, and in particular the Anacortes-San Juan Islands route, is part of a diverse transportation system which offers a range of modes and choices to users. As described in the 2010 study by the Passenger Vessel Association, “vehicles (cars, trucks and trailers, buses, carpools, vans, motorcycles, and bicycles), vehicle passengers, and walk on passengers are all significant segments of the system's ridership.”\(^{11}\) This route serves vital commercial needs as well, with roughly double the commercial vehicle traffic seen system-wide: 6.5% oversize vehicles (used here as a proxy for commercial vehicles) compared to the 2.75% system average.

WSF service on this route improves accessibility and transport services to economically disadvantaged populations, linking urban and rural areas, and providing transportation options in locations otherwise cut off from the larger transportation network. Areas served by this route are only accessible by boat or air, making this a vital part of the transportation network to these populations, and reducing public costs associated with rural isolation, such as emergency medical service and evacuations.

#### Reduced fare increases

Reducing fuel costs on routes served by MV Hyak lessens the magnitude of future fare increases and limits the need for a fuel surcharge. This is especially important in current economic conditions. WSF is facing record-high cost increases due to fuel prices. The percentage of WSF’s operating costs consisting of fuel has risen more than 8%, from an average of 20.5% in the period of FY 2007-2010, to 28.6% in FY 2012, to-date.

The 15.71% fuel reductions for MV Hyak over 19 years could eliminate the need for one fuel related portion of a future fare increase. These savings to riders are quantified in the Benefit-Cost Analysis section as a reduction in currently projected fare increases in year two from 2.5% to 2%, resulting in savings to approximately 1.7M

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\(^{10}\) Ibid.

riders on this route of $1.3M-$2.1M. If circumstances in year two, and other variables contributing to fare increases, prevent a reduced fare increase from the projected fuel savings, riders will realize additional non-fuel related service as a result of fares paid.

By cutting diesel emissions, this project will directly impact human health in a region where air pollution has been identified as a serious health concern. According to the Clean Air Task force, residents of Skagit County where the primary terminal for MV Hyak, Anacortes, is located the average lifetime diesel soot cancer risk is 1 in 22,296, which is 45 times greater than EPA’s acceptable cancer level of 1 in a million.\(^\text{12}\)

Diesel emissions contain a hazardous mixture of pollutants that have serious health effects. Diesel exhaust has been linked to the onset or worsening of most major, chronic and, terminal ailments, including cancer, emphysema, auto-immune disorders, asthma, heart disease, stroke, and the underdevelopment of children’s lungs. Fine particles in diesel exhaust penetrate the lungs and remain there indefinitely to aggravate or create lung and heart conditions when inhaled. Research indicates diesel emissions cause premature deaths within populations and occupations where people are regularly exposed to these toxins. Diesel exhaust is one of the most toxic forms of air pollution for this reason.

*Environmental Sustainability*

This project will promote environmental sustainability by achieving substantial, large-scale energy efficiency improvements, reducing fuel consumption, GHG emissions, and lowering oil dependence.

This project will reduce the Hyak’s fuel consumption by an estimated 15.71%, or 234,677 gallons per year, cutting similar levels of GHG emissions and particulates. This translates to a fuel savings of 4,458,866 gallons and 44,933 metric tons of CO\(_2\) equivalent, with a commensurate reduction in particulate pollutants during expected 19 year useful life of the retrofitted vessel. These reductions in emissions could lead to social benefits such as:

- Estimated annual health costs attributable to vehicles burning gas and diesel: \$.32 / gallon\(^\text{13}\)
- Estimated annual cost of crop damage: \$.01/gallon\(^\text{14}\)
- Estimated annual cost of climate change: \$.06/gallon\(^\text{15}\)
- Estimated annual environmental cost of oil spills: \$.01/gallon\(^\text{16}\)

*Safety*

One of the benefits of this project is that the hybrid retrofitted vessel will need less frequent refueling, reducing the risk of

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\(^{12}\) Source: Clean Air Task Force, *Diesel Soot Health Impacts*  
\(^{13}\) Source: http://www.epa.gov/oms/climate/regulations/scc-tds.pdf  
\(^{14}\) Ibid.  
\(^{15}\) Ibid.  
hazardous materials spilled during fuel deliveries and refueling. Because of the difficulty of accurately quantifying the reduction of spillage frequency, this benefit has been left out of WSF’s Benefit-Cost Analysis. However, in implementation of this project WSF may be able to collect data to allow quantifying this benefit in future projects.

WSDOT takes pride in a pristine safety record of zero accident-based fatalities at WSF in 60 years operating, and employees work hard to maintain it. WSF often provides assistance when needed at the scene of marine accidents in the Puget Sound. In many cases, the vessels are closest to the scene, and WSF crews are therefore the best-placed to provide emergency assistance. Over the years, through effective coordination with the US Coast Guard, WSF vessels and crews have saved a number of lives by intervening when help is needed.

**B) Job Creation & Near-Term Economic Activity**

In addition to long-term economic benefits, the hybrid retrofit of the Hyak will produce a rapid economic impact, boosting near-term employment in the region, and sustaining jobs during and after implementation.

**Economic Impact Analysis Methods**

WSF’s economic impact analysis follows the job creation estimate guidelines provided in the May, 2009 Executive Office of the President, Council of Economic Advisors’ (CEA) document, “ Estimates of Job Creation from the American Recovery and Reinvestment Act of 2009.” For the shipyard-based portion of the work, WSF has supplemented the information in the CEA document with actual data from a similar project recently implemented by WSF, as described below.

**Unit of Measurement** – This analysis uses job-years. A job-year is the equivalent of full time employment for a person at one job for one year.

**Standard multiplier for job creation** – For Government Spending, $92,136 = 1 job-year.\(^{17}\)

**Direct, Indirect, and Induced job creation** – The White House paper divides job-year estimates into three categories: Direct, Indirect, and Induced jobs created, with 64% of job-year creation in the form of Direct and Indirect jobs, and the remaining 36% in Induced jobs.

- Direct jobs: job-years created in the actual government-sponsored project.
- Indirect jobs: job-years created at suppliers who make the materials used in the project.
- Induced jobs: job-years created elsewhere in the economy as increases in income from the direct government spending lead to additional increases in spending by workers and firms.

**Timing of job creation impacts** – To estimate job creation impacts for project spending, per the timeline in the Project Schedule, WSDOT assumes that “one-half of the employment effect occurs in the contemporaneous quarter, one-third occurs in the subsequent quarter, and one-sixth

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in the quarter two quarters ahead.”  

As requested in the NOFA, a table showing projected job-creation by quarter is provided later in this document with the Project Schedule.

**Incorporation of shipyard labor-hours data in analysis** – This application provides additional data on labor hours for the shipyard installation portion of the project. WSF has performed very similar propulsion system replacements on vessels of the exact same model as the Hyak (Super Class Vessels). Because WSF has carefully-tracked shipyard labor-hour records for replacing a Super Class vessel’s propulsion system, this data is included in WSDOT’s labor hour estimate for installation.

This project’s actual labor hour requirements will likely be slightly higher than for a standard propulsion system installation because elements of this job will be new and/or unfamiliar to many of the workers. However, because it is difficult to determine precisely the number of additional hours that will be required due to the newness of this type of installation, this analysis assumes this retrofit will require the same number of shipyard labor hours as previous jobs. To the extent that the estimate may be inaccurate, it will therefore err on the side of underestimating the number of job hours, rather than inflating them.

To translate shipyard labor-hour data into job-years, WSDOT divided the total number of labor hours by the number of labor hours in a standard year for full-time, eight-hour-a-day work. By this method, a single job-year consists of 2,080.32 labor hours. That is based on the number of work days in a person-month (21.67), times the number of hours in a standard work-day (8).

Here are the calculations:

<table>
<thead>
<tr>
<th>Labor hours in a job-year</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit of Work</strong></td>
</tr>
<tr>
<td>Day</td>
</tr>
<tr>
<td>Month (Day x 21.67)</td>
</tr>
<tr>
<td>Year (Month x 12)</td>
</tr>
</tbody>
</table>

The shipyard portion of this project will require 77,000 labor hours. Total Shipyard labor hours divided by the labor hours in a job year (77,000/2,080.32) = 37.02 Direct Job Years created by the shipyard portion of the project.

Using shipyard labor-hours data from the bonding determination of a comparable project – the replacement of the propulsion system on MV Spokane, which took 77,000 shipyard labor hours – WSDOT estimates that this retrofit will create **45.22 shipyard job-years**, including direct, indirect, and induced job creation. These were union shipyard jobs, with approved apprenticeship programs employing steel workers, electricians, ship-fitters, painters, welders, riggers, machinists, pipefitters, and various others.

Furthermore, MV Hyak Hybrid Propulsion System

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Retrofit project will create job opportunities for low-income workers through union-supported best-practice hiring programs and apprenticeship programs. Work done on this project will provide direct support to training and apprenticeship programs to improve the professional capacity of the area’s maritime industry professionals. Washington State law (2SSB 6480) creates an apprenticeship utilization requirement of 15% of labor hours on construction contracts two million dollars or greater. The State Secretary of Transportation’s Apprenticeship Utilization Advisory Committee ensures effective implementation of this requirement.

WSDOT emphasizes equal opportunity for all businesses competing to complete work on projects. This includes disadvantaged business enterprises (DBEs) such as small businesses and minority and women owned businesses. The project will not require a set percentage for DBE firm participation, and options for DBE participation are limited by the relatively few local firms operating in the maritime industry available for this type of work. However, the project will require a number of steps during the procurement process to ensure equitable opportunity for disadvantaged firms to participate.

C) Innovation

This project employs new, innovative technologies which have been tested and shown to produce substantial fuel efficiency improvements and emission reductions in a variety of contexts.

Hybrid engine technology has proven effective in cutting fuel use and emissions in various applications. The most well-known examples are hybrid cars but it has also been successful in other types of vehicles, such as locomotives, mine haul trucks, ships, and buses. In the Puget Sound region, King County Metro has 236 hybrid buses which have successfully reduced emissions in populated areas since 2002.

Three key elements will achieve major fuel savings in the hybrid vessel:

- Variable speed diesel generators
- Power management system
- Batteries as backup power

**Variable speed diesel generators** – will provide power on demand. A/C variable speed generators are more fuel-efficient, only providing peak power during peak demand. WSF’s Jumbo Mark II vessels: the MV Elwha, and the three E-state vessels, use electric motors and generators. But, their A/C generators create fixed 60HZ frequency (as is common in all US electric distribution, i.e. any wall socket) and therefore have to spin the diesels at a constant 900rpm. The Hybrid Hyak will use A/C generators but at variable speeds. This is akin to not racing the engine while waiting at a stop light. Other large ferries have used A/C generators in variable-speed operation for almost 40 years.

**Power management and auto-start/auto-shutdown of diesels** – This system will operate like “smart grid” power technology; a computer will sense load and respond with the appropriate amount of power needed, either from the batteries or diesel generator activation/deactivation.

**Batteries as backup power** – The system will store any additional power in batteries increasing overall energy efficiency of the vessel. The batteries planned for MV Hyak will provide at least...
one full diesel engine’s worth of power. This large reserve power will allow optimized energy efficiency.

**Additional possibilities with batteries** – This project creates additional future opportunities involving use of batteries to store cheaper electricity from shore-based sources, and adding additional batteries to capitalize on falling costs and rising efficiencies. Charging batteries during overnight tie-up would allow use of more economical shore-supplied energy. At current cost this would save $0.17/kWh, compared to diesel-generated energy. More importantly, as batteries improve and costs decrease, so will their potential cost savings in hybrid engines. The ability to add additional batteries at a later date to achieve greater fuel savings levels is one of the more exciting elements of the Hyak’s design. These options are not included in current plans for the Hyak hybrid retrofit, but WSF will explore these, and other follow-on projects, as possibilities post-award.

**WSF’s innovative funding approach**

Washington State Ferries provides excellent service reliably and affordably. Funding for this project will provide a good value to the FTA. According to a 2010 comparison of ferry systems worldwide, Washington State Ferries operates at less than half the average cost per customer than other systems, and with substantially lower per-passenger taxpayer subsidies than its peers in British Colombia, Alaska, North Carolina and Sydney, Australia.19

Part of the reason WSF is able to provide affordable service is an innovative approach to funding and finance, including private sector partnerships. WSF Operations Department manages vendor agreements, and coordinates use of ferry system facilities by companies and individuals for a variety of services such as special events, and filming for TV and movie production. Revenue generated by these contracts support ferry service by reducing the amount of state funding needed to operate and maintain the system. The majority of current vendor agreements were initiated in the last 6 years, developed through outreach efforts. A team reviews monthly revenue reports as well as new products, promotions, price fluctuations, and customer input. These activities contributed $2,957,000 in non-firebox revenues to fund WSF service and maintenance in FY 2010, helping to minimize fare increases and taxpayer subsidies needed to provide this vital service.

**Need for TIGER III funding**

Without TIGER III grant assistance, full funding for the hybrid project is not available. The alternative project, currently in WSF’s work-plan, does not include variable speed control or hybrid technology. It is an inefficient, but

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cheaper-to-install, in-kind replacement of the current D/C system, which would result in no fuel savings or emission reductions.

Washington State agencies have faced severe budget cuts due to the economic downturn, forcing repeated belt-tightening at all levels of state government, including WSDOT. Similar cuts have occurred at the federal level. In the current fiscal year, $5,000,000 in federal FHWA Ferryboat Discretionary funds originally slated for WSDOT vessel preservation activities was unexpectedly cut. WSDOT has responded effectively to the challenge, and shifted funding among projects, but falling revenues have made supporting innovative projects more difficult. Even when a project brings substantial savings in future operating costs, such as the Hyak Hybrid Retrofit, higher up-front capital requirements make winning support for such projects extremely difficult in the current fiscal climate.

Additionally, funding for sustainable maritime projects and related research has been scarce in recent decades. A recent Transportation Research Record study found useful metrics, data, and analytical methods for assessing emissions and fuel efficiency in marine vessels deficient compared to similar work in other transportation sectors. The study identified scarcity of government funding for these projects as a major culprit, saying that “maritime focused research does not have the same level of support as other modes of transportation.”

**d) Partnership**

WSF’s partnership strategy is based on collaboration among stakeholders and jurisdictions, and disciplinary integration, to ensure a balanced approach. WSDOT works closely with Washington State’s Departments of Commerce and Ecology through a collaborative, coordinated approach to work toward implementation of state GHG emissions limits, as called for by Washington State Governor’s Executive Order 09-05.

Letters of support signed by local partners are listed below. WSF’s partners in this project include a multidisciplinary mix of entities, with non-transportation organizations, and groups with energy and/or environmental missions.

- City of Anacortes
- Puget Sound Regional Council (PSRC)
- Puget Sound Clean Air Agency (PSCAA)
- Northwest Clean Air Agency
- Western Washington University (WWU) Shannon Point Marine Center
- Orca Network
- People for Puget Sound
- Washington State Department of Ecology

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- Western Washington Clean Cities Program

WSDOT has support letters from the clean air agencies covering both jurisdictions where the Hyak operates – Puget Sound Clean Air Agency, and the Northwest Clean Air Agency.

WSDOT works closely with State Department of Ecology in implementing GHG reduction projects establishing metrics, targets, and reporting standards, ensuring effective monitoring and evaluation of project impacts, and lessons learned.

**E) Results of Benefit-Cost Analysis**

<table>
<thead>
<tr>
<th>Category</th>
<th>(7% Discount Rate)</th>
<th>(5% Discount Rate)</th>
<th>(3% Discount Rate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPV Fuel Savings of 15.7% year for 19 years</td>
<td>$9,232,425</td>
<td>$10,795,394</td>
<td>$12,794,948</td>
</tr>
<tr>
<td>Social Costs of Carbon benefit of reducing Fuel</td>
<td>$638,002</td>
<td>$754,767</td>
<td>$905,563</td>
</tr>
<tr>
<td>Social Costs of Particulate Matter benefit of reducing Fuel</td>
<td>$5,573,780</td>
<td>$6,517,372</td>
<td>$7,724,538</td>
</tr>
<tr>
<td>Social Costs of NOx benefit of reducing Fuel</td>
<td>$2,227,081</td>
<td>$2,604,106</td>
<td>$3,086,446</td>
</tr>
<tr>
<td>Livability (potential reduced future fare increase related to fuel cost savings)</td>
<td>$1,146,397</td>
<td>$1,374,134</td>
<td>$1,669,074</td>
</tr>
<tr>
<td>Total Benefits</td>
<td>$18,817,685</td>
<td>$22,045,773</td>
<td>$26,180,570</td>
</tr>
<tr>
<td>Battery Bank</td>
<td>$1,435,444</td>
<td>$1,521,407</td>
<td>$1,620,548</td>
</tr>
<tr>
<td>AC Drive Motors</td>
<td>$934,579</td>
<td>$952,381</td>
<td>$970,874</td>
</tr>
<tr>
<td>Purchase Switch Boards, variable frequency drives, Motor Field Transformer, Control Console, Pilot</td>
<td>$2,242,991</td>
<td>$2,285,714</td>
<td>$2,330,097</td>
</tr>
<tr>
<td>Two Thrust Bearings</td>
<td>$186,916</td>
<td>$190,476</td>
<td>$194,175</td>
</tr>
<tr>
<td>Engines and Generators</td>
<td>$4,485,981</td>
<td>$4,571,429</td>
<td>$4,660,194</td>
</tr>
<tr>
<td>Integrator and install at a Shipyard</td>
<td>$2,803,738</td>
<td>$2,857,143</td>
<td>$2,912,621</td>
</tr>
<tr>
<td>Total Costs</td>
<td>$12,089,649</td>
<td>$12,378,549</td>
<td>$12,688,509</td>
</tr>
<tr>
<td>Benefit Cost Ratio</td>
<td>1.56</td>
<td>1.78</td>
<td>2.06</td>
</tr>
<tr>
<td>NPV</td>
<td>$6,728,036</td>
<td>$9,667,224</td>
<td>$13,492,061</td>
</tr>
</tbody>
</table>

At a 7% discount rate, a $12.1 million lifecycle cost results in a benefit to cost ratio of 1.56. If the discount rate is reduced to 5%, a $12.4 million cost results in a benefit-cost ratio of 1.78. If the discount rate is reduced to 3%, a $12.7 million costs result in a benefit-cost ratio of 2.06.
(i) Baseline and Alternatives

The baseline for this analysis is the Hyak’s current operating parameters, in terms of fuel use and estimated GHG emission levels. Alternatives considered include: a) a “do nothing” alternative (i.e. using the money elsewhere) which runs the risk of the generators failing as they are past their recommended lifecycle, b) replacing the current D/C propulsion system with a similar one which results in no fuel savings, and c) using a variable speed A/C power plant, and the hybrid option WSF is proposing in this grant application due to the potential fuel savings and emission reductions.

(ii) Affected Population

The population which benefits from this project includes all who live and work in the Georgia Basin/Puget Sound Air-shed, an area spanning approximately 140 miles south to north and 160 miles west to east, at its extremities, encompassing the greater Puget Sound Region, and parts of British Colombia, Canada. Circulation of air currents in this region create shared air space in which aggregate pollution impacts are similar.

(iii) Discounting

WSF uses discount rates of 7% and 3% in calculating the net present value of the benefits accrued from this project. The 3% rate is provided because the alternative use of funds currently dedicated to this project would be other public expenditures, rather than private investment.

(iv) Cost Assumptions

The benefit-cost analysis shown above includes the following cost assumptions:

Livability

- Livability benefits are based on a potential reduced fare increase in year two from 2.5% to 2.0%.

Fuel projections and savings

- Diesel is priced at $3.79 per gallon for the current year with projected increases built into an Average Over-Time cost of $3.81 to factor in future price increases.

Social costs of emissions

- Social costs of carbon are calculated based on a multiplier increasing 3% per year, times 2,944 tons of CO2 emissions reduction per year.
- Social costs of NOx are based on a multiplier of $4,000 per metric ton, provided in the NOFA.
- The social cost of particulate emissions is based on 3.21 metric tons per year reduction times the $168,000 multiplier provided in the NOFA.
Batteries

- Batteries will need replacement after 10 years, and costs of new batteries will be 30% lower than current prices, due to improvements in battery technologies. Analysts predict a 30% price reduction in battery costs as early as next year, so estimating prices will be 30% lower in 10 years is a conservative estimate.21

Some project benefits mentioned in the application narrative are not included in the Benefit-Cost Analysis because of the lack of a reliable basis to estimate their monetary value. These include:

- **Sulfur dioxide emissions** – the WSF uses ultra-low sulfur fuel, which reduces these emissions to an almost negligible amount.
- **Reduced hazmat spills from less frequent fueling** – WSDOT does not have sufficient data on refueling-related spill frequencies to produce a monetized benefit estimate.
- **Lower maintenance** – WSDOT experience has shown that the modern engine type proposed is less expensive to maintain than the antiquated system the Hyak currently uses. However, until WSF staff have more data on actual hybrid propulsion system maintenance costs, WSDOT opts to omit this from the Benefit Cost Analysis, rather than produce a speculative figure that may be inaccurate.

V. **Project Readiness and NEPA**

A) **Project Schedule**

<table>
<thead>
<tr>
<th>Deliverable/Milestone</th>
<th>Phase</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Right of Way</td>
<td>PE</td>
<td>Not applicable</td>
</tr>
<tr>
<td>3. Environmental permits (NEPA)</td>
<td>PE</td>
<td>Not applicable</td>
</tr>
<tr>
<td>4. Inclusion in TIP/STIP</td>
<td>PE</td>
<td>Completed August, 2011</td>
</tr>
<tr>
<td>5. Equipment RFP issued</td>
<td>CN</td>
<td>May, 2012</td>
</tr>
<tr>
<td>6. All segments ready for construction</td>
<td>CN</td>
<td>May, 2012</td>
</tr>
<tr>
<td>7. Equipment Contract Award</td>
<td>CN</td>
<td>August, 2012</td>
</tr>
<tr>
<td>8. Installation Contract Advertise</td>
<td>CN</td>
<td>October, 2013</td>
</tr>
<tr>
<td>10. Installation Contract Completion</td>
<td>CN</td>
<td>November, 2014</td>
</tr>
</tbody>
</table>

**Job Creation Figures by Quarter**

As requested in the NOFA, the table to the right shows estimated economic impact in job-years, quarter by quarter. This includes direct, indirect and induced job creation including the labor in the shipyard portion of the project, and the other work performed on the project. The table below provides additional detail in regards to spending on a quarter by quarter basis. Quarters which occur after the project’s end date, but in which job-creation impacts are still occurring, are shown in grey text.

<table>
<thead>
<tr>
<th>Calendar Quarter</th>
<th>Job-Years Created</th>
<th>Running total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q3 2012 Jul-Sept</td>
<td>7.07</td>
<td>7.07</td>
</tr>
<tr>
<td>Q4 2012 Oct-Dec</td>
<td>18.85</td>
<td>25.92</td>
</tr>
<tr>
<td>Q1 2013 Jan-Mar</td>
<td>25.92</td>
<td>51.84</td>
</tr>
<tr>
<td>Q2 2013 Apr-Jun</td>
<td>21.21</td>
<td>73.05</td>
</tr>
<tr>
<td>Q3 2013 Jul-Sept</td>
<td>16.5</td>
<td>89.55</td>
</tr>
<tr>
<td>Q4 2013 Oct-Dec</td>
<td>10.6</td>
<td>100.15</td>
</tr>
<tr>
<td>Q1 2014 Jan-Mar</td>
<td>8.25</td>
<td>108.4</td>
</tr>
<tr>
<td>Q2 2014 Apr-Jun</td>
<td>10.39</td>
<td>118.79</td>
</tr>
<tr>
<td>Q3 2014 Jul-Sept</td>
<td>22.19</td>
<td>140.98</td>
</tr>
<tr>
<td>Q4 2014 Oct-Dec</td>
<td>15.30</td>
<td>156.28</td>
</tr>
<tr>
<td>Q1 2015 Jan-Mar</td>
<td>1.59</td>
<td>157.87</td>
</tr>
<tr>
<td>Q2 2015 Apr-Jun</td>
<td>0.45</td>
<td>158.32</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>158.32</strong></td>
<td></td>
</tr>
</tbody>
</table>

In the detailed table, below, direct and indirect job-years for the shipyard portion are shown in red, and induced labor from the shipyard installation is shown in blue.

### Job Creation by Quarter - detail

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Shipyard</td>
<td>$1,300,772</td>
<td>$1,200,544</td>
<td>$3,605,544</td>
<td>$1,300,772</td>
<td>$1,300,772</td>
<td>$650,386</td>
<td>$650,386</td>
<td>$650,386</td>
<td>$650,386</td>
<td>$650,386</td>
<td>$650,386</td>
<td>$650,386</td>
<td>$348,970</td>
</tr>
<tr>
<td>Time-Adjusted</td>
<td>7.07</td>
<td>18.85</td>
<td>25.92</td>
<td>21.21</td>
<td>16.5</td>
<td>10.6</td>
<td>8.25</td>
<td>10.39</td>
<td>22.19</td>
<td>15.30</td>
<td>15.9</td>
<td>0.45</td>
<td>158.32</td>
</tr>
</tbody>
</table>

### B) Environmental approvals

WSDOT has a Categorical Exclusion (CE) for this work, per the guidelines in 23 CFR 771.117(c), which lists among the types of work ordinarily excluded from a full NEPA process “bus, ferry, and rail car rehabilitation (including conversion to alternative fuels).”

WSDOT received concurrence from FHWA on August 28, 2002 for a Programmatic No Effect Determination which covers vessel preservation activities. The work covered in this agreement includes propulsion system preservation and replacement, major mechanical and electrical system preservation, auxiliary generator replacement, and other types of work required to maintain the safety and efficiency of ferry vessels. The work to be performed on this project falls within the types of work covered by the programmatic no effect determination, and meets the criteria of 23 CFR Part 771.117 for a Categorical Exclusion (CE). On January 18, 2011, WSDOT renewed its Programmatic No Effect Determination with the United States Department of Transportation.

Additional State and local-level environmental approvals are not required for the implementation of this project.

### C) Legislative approvals

Washington State Ferries is authorized to charge user fees in RCW 47.60 by Washington State.

We have received letters of support from members of the US House of Representatives from Washington State: The Honorable Jay Inslee, and the Honorable Norm Dicks. Letters from both US Senators are expected shortly as well. The following local entities involved with planning and decision making in the region have provided letters of support for this project:

- City of Anacortes
- Puget Sound Regional Council (PSRC)
- Puget Sound Clean Air Agency (PSCAA)
- Northwest Clean Air Agency
- Western Washington University (WWU) Shannon Point Marine Center
- Orca Network
- People for Puget Sound
Advantages of Hybrid Engines for WSF

- Washington State Department of Ecology
- Western Washington Clean Cities Program
- Washington State Legislature Transportation Committee members
- Labor Councils and Organizations

D) State and local planning

The project is included in the current Transportation Improvement Plan and State Transportation Improvement Plan, with funding, as seen in the links below.

Current Transportation Improvement Plan (TIP)

The current Transportation Improvement Plan project is available online at the Puget Sound Regional Council (PSRC) TIP website: [http://www.psrc.org/transportation/tip/current](http://www.psrc.org/transportation/tip/current), click on the link labeled “Appendix A” for a current list of projects included in the TIP. The entry in which this project is included is WSF-73, Vessel Preservation.

State Transportation Improvement Plan (STIP)

The corresponding State Transportation Improvement Plan (STIP) entry can be found here: [http://www.wsdot.wa.gov/LocalPrograms/ProgramMgmt/STIP.htm](http://www.wsdot.wa.gov/LocalPrograms/ProgramMgmt/STIP.htm). See entry #WSF-73, Vessel Preservation, found on page 451 of the document.

To ensure full compliance, and accurate reporting, upon award of a TIGER III grant for this project WSF will update the TIP and STIP to show the change to the planned project from a standard propulsion system replacement to a hybrid retrofit.

E) Technical feasibility

This project will employ proven technologies to achieve projected reductions in fuel use and GHGs, demonstrated by previously-performed studies and pilot projects. As described below, in the project’s Design Criteria, and Staffing and Management Plan, WSF has the resources and capacity to implement this project quickly and effectively, as well as demonstrated experience in successfully implementing similar work.

Hybrid engine technology has proven effective in multiple vehicle types.

Hybrid technology has proven effective in cutting fuel use and emissions in multiple applications. The most well-known examples are hybrid cars, it has also been successful in other types of vehicles, such as locomotives, mine haul trucks, ships, and buses. In the Puget Sound region, King County Metro has used 236 hybrid buses, successfully cutting emissions in service areas since 2002.

The type of hybrid marine engine proposed for this project is used successfully in other vessels, and is being deployed in others.

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Three smaller passenger-only hybrid ferries are, or will soon be, operating in the US – in San Francisco, New York, and Pittsburgh. Outside the US, Scotland and Norway are moving ahead with hybrid or battery powered vessels. The success of the first hybrid tug boat in California, the Carolyn Dorothy, run by Foss Maritime Company, has led to the creation of a second hybrid tug vessel in Los Angeles.

WSF is uniquely well-situated to take advantage of the characteristics of this type of engine technology. It is rare for an agency to operate vessels as large as WSF’s, for such short trips and to have them idling at dock for such a large percentage of the day. These operating characteristics create poor efficiencies with diesel technology, but work quite well with hybrid engines.

(i) Staffing and Management Plan

Washington State Ferries’ (WSF) engineering and project management staff are responsible for conducting and overseeing facility and system design, improvements, maintenance, and preservation of the vessel fleet and terminals throughout the system, as part of their daily work. To accomplish this work WSF utilizes the skilled workforce of the WSF Eagle Harbor Maintenance Facility, maritime consultants, and commercial shipyards in the Puget Sound region. The proposed project is well within the scope of work regularly conducted by the agency in regular maintenance and retro-fittings for a fleet of 22 ships.

In addition to an experienced project management team leader and regular workforce, this project has an experienced technical team with expertise in air quality, green house gas emissions, environmental effects and performance measurement.

WSF’s Vessel Engineering team is an industry leader in finding innovative ways to reduce fuel consumption and GHG emissions. WSF is currently seeking to adapt liquid natural gas technology to Issaquah-class ferry system vessels, which are well-suited for that type of retrofit and for potential use in future ferry construction projects.

Monitoring and Evaluation

WSDOT is also ready to work with the USDOT to develop and implement a data collection/performance measurement plan, and report on performance with regard to long-term outcomes.

WSDOT has already taken steps to improve monitoring and evaluation capacity for fuel use, in order to use this data for reporting and finding ways to improve fuel efficiency in the operation of vessels. In 2011 WSDOT installed a fuel monitoring system on the MV Walla Walla. The project goal is to improve understanding how different vessel operations affect fuel use. WSF expects that vessel operators to use this fuel information to adjust operations and maximize fuel efficiency. WSF estimates that the meters could save 2% of the total fuel annual use for ferries with the meters installed.

WSF is actively involved with efforts to determine fleet emissions levels. The Puget Sound Air Emissions Inventory (PSAEI) is a collaborative effort between Puget Sound Ports, vessel owners and operators, railways, and nongovernmental organizations to develop a snapshot of the maritime and port related air emissions. The first PSAEI was collected in 2005. The second PSAEI for 2011 data collection effort is over half complete and the final report is due in summer 2012. The 2005 study found WSF was accountable for 1/3 of the Puget Sound region harbor emissions.
craft emissions. WSF expects to show a significant reduction in emissions since the 2005 PSAEI due to efforts and improved accuracy in ferry emissions load factors used in calculations.

This project will enhance measurement of fuel and GHG reduction outcomes, through the design of variable-speed diesel operation, power management, and auto-start/auto-shutdown equipment. The data thus collected will pave the way for additional marine emissions reduction projects in the future.

**F) Financial Feasibility**

**Spending Plan**

WSF has a spending plan in place, tied to an overall project management plan, and has the funds and resources available to execute this project on schedule. WSF has federal funds currently available for the preservation and refurbishment of the MV Hyak, but at the existing level does not fully fund the project considered in this application. Current funding levels provide only enough for an in-kind replacement of the existing, antiquated system which would provide no fuel savings, and bring higher life-cycle costs, as routine repairs and maintenance on obsolete propulsion systems are more costly than for the proposed project which in addition to the batteries would bring the rest of the propulsion plant up to industry standards.

**Institutional Capacity**

WSDOT Ferries Division (WSF) is a public agency that is in good standing with FTA. WSF is a publically-owned provider of mass transportation, administered by the Washington State Department of Transportation. The authority to take all necessary action and responsibility on behalf of the grantee is properly delegated and executed.

Annually, WSDOT provides all certifications and assurances expected to apply to any active grant of the applicant in the fiscal year, and will record these in FTA’s Transportation Electronic Award Management web-based system (TEAM-Web) with the appropriate electronic signatures.

WSF assures compliance with all applicable Federal statutes, regulations, executive orders, FTA circulars, and other Federal requirements in carrying out any project supported by an FTA grant or cooperative agreement. WSF agrees that it is under a continuing obligation to comply with the terms and conditions of the grant agreement or cooperative agreement issued for its project with FTA. WSDOT and WSF recognize that Federal laws, regulations, policies, and administrative practices may be modified from time to time and those modifications may affect project implementation. WSF agrees that the most recent Federal requirements will apply to the project, unless FTA issues a written determination otherwise.

WSF also takes steps to ensure compliance with Buy America regulations in procurement, and actively seeks domestic-origin end products prior to considering a waiver request.

**VI. Federal Wage Rate Certification**

See attached.
VII. Material Changes to Pre-Application Information

Change to Project Title
The original title was “MV Hyak Hybrid Propulsion System Retrofit”
The revised title is “Hyak Hybrid Ferry Propulsion Project – Green Fleet Ferry Program”

Construction Phase Start Date
In our Final Application, the start of the construction phase is May, 2012. The Pre-Application stated that construction would start in August 2012.

Changes to Cost Information
Based on recent responses to Requests for Information WSF has received, the cost information totals are different than those in the pre-application.

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<thead>
<tr>
<th>MV Hyak Hybrid Propulsion</th>
<th>Pre-Application</th>
<th>Final Application</th>
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