"Depending on their location and operation, ferry size and energy needs can vary immensely."

July 2024

GREAT LAKES ST. LAWRENCE GOVERNORS & PREMIERS

FERRY ELECTRIFICATION IN THE GREAT LAKES ST. LAWRENCE MARITIME TRANSPORTATION SYSTEM

Investigating ferries in the Great Lakes St. Lawrence region with high electrification potential.

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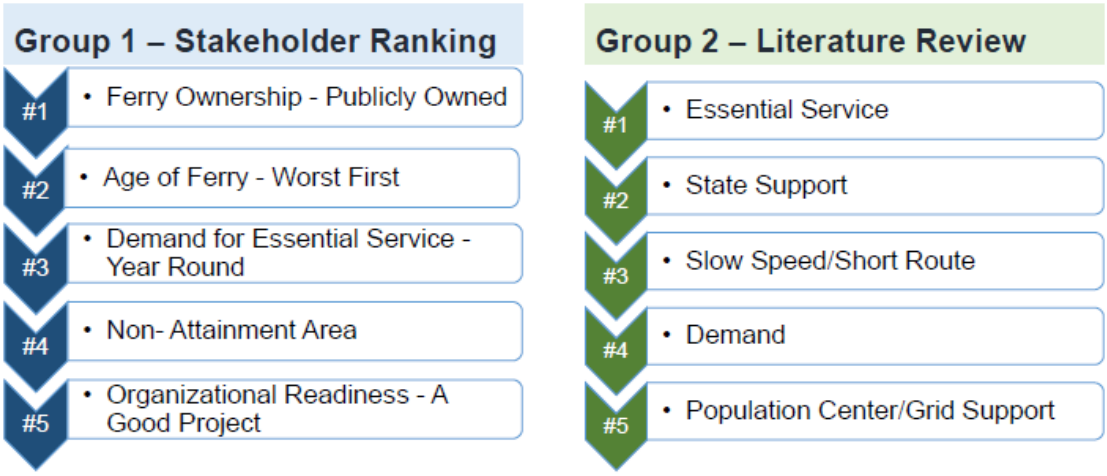
EXECUTIVE SUMMARY

This report examines the electrification potential of ferries operating in the Great Lakes St. Lawrence maritime transportation system, focusing on current initiatives and future prospects.

Several notable projects illustrate the feasibility and benefits of ferry electrification. For instance, the *Marilyn Bell I* in Toronto and the *Chippewa* in Michigan have been successfully converted to electric propulsion, supported by government grants and innovative funding models. Additionally, newly built electric ferries like the *James V. Glynn* and *Nikola Tesla* in Niagara Falls showcase technological advancements adapted from European models.

Guiding principles emphasize the systemic approach needed for ferry electrification, involving vessels, docks, mariners and electric grid infrastructure. This approach acknowledges the substantial costs involved, typically in the millions of dollars per vessel, often necessitating diverse funding sources and governmental support.

Stakeholders were asked to rank important criteria for ranking ferry prospects and a literature review was completed to identify criteria cited for completed projects.



These criteria were used to rank the 127 ferries identified in the study region. This desk reference analysis identified six ferries as strong potential candidates for early electrification:

1. MV *Nichevo II* - Bayfield and Madeline Island, Wisconsin
2. MV *Huron* - St. Ignace to Mackinac Island, Michigan
3. MV *Charlevoix* - Crossing South Arm of Lake Charlevoix to Ironton, Michigan
4. MV *Anna May* - St. Ignace to Mackinac Island, Michigan
5. MV *Glenora* - Glenora and Adolphustown, Ontario
6. MV *Howe Islander* - Mainland to Gillespie's Point East End of Howe Island, Ontario

Since this was a desk reference, only a limited number of ferry operators were contacted to confirm published information about the vessel registrations. Discussion with relevant parties should be the next step. The owner may, for a variety of reasons, be interested in electrification but may want to convert or replace a vessel different from the one proposed in this study. If the parties are interested in electrification, then a concept of operation and an engineering analysis for the vessel, dock, charging station and operations should follow. If public funds are being used, a benefit-cost analysis will also be needed to assess the long-term viability of the investment.

Recommendations for future work include:

1. Develop a concept of operations document for the top six prioritized ferries to identify duty cycles, loads, schedules, maintenance windows, power needs and design a plan comparing net-zero emissions to a hybrid model. The process developed by Quebec to assess which three ferries they are going to electrify needs to be explored and integrated into the concept of operations.
2. Host a workshop at Canadian or U.S. trade conferences to raise awareness, explore the operator's perspective and assess project readiness for ferry electrification and alternative fuels.
3. Prepare a Strategic Grant Funding Plan focusing on securing federal, state and private sector investments to repower the prioritized ferries.
4. Organize a trade mission to Europe with shipbuilders, vessel operators, academics and workforce development experts to gain insights into hybrid and net-zero ecosystems.
5. Develop a subgroup of GSGP members to promote multi-State/Provincial partnerships and leverage federal grants for ferry electrification sustainability challenges.
6. Collaborate with Mackinac Island Ferry Company and Michigan officials to electrify identified ferries, aligning with Michigan's Healthy Climate Plan and EGLE Fuel Transformation Program.
7. Advocate for FTA ferry grant amendments to remove the mileage requirement for eligible applicants, expanding funding for shorter ferry routes benefiting from electrification.
8. Advocate for NEVI funding amendments to include a 5-10% set aside for marine transportation projects, supporting essential ferry operators in electrification initiatives.

While challenges such as infrastructure readiness and financial viability remain, the electrification of ferries operating in the Great Lakes St. Lawrence maritime transportation system presents a promising avenue for reducing emissions and advancing sustainable marine transportation in the region.

WHAT IS A FERRY?

A ferry is a vessel used to transport passengers and/or vehicles across a body of water on a regular, frequent basis. Ferries can range from small boats carrying passengers across a harbor, lake or river, to large sea-going ships carrying passengers, cars, trucks and other heavy cargo across longer distances where overnight sleeping accommodations are required.

Generally, *<u>the following are not included</u>* in the definition of "Ferries":

- Vessels without a regular schedule.
- Vessels carrying only unaccompanied freight vehicles, e.g., RoRo freight vessels.
- Vessels on routes greater than 48 hours
- Vessels used primarily for purposes other than the transport of passengers/vehicles, e.g., cruise ships.

The map below shows Great Lakes and St. Lawrence ferry routes.

Figure 1: Great Lakes St. Lawrence Ferry Routes

What Roles Do Ferries Play in the Great Lakes St. Lawrence Region?

Ferry operations are unique and play a valuable role in connecting people to places that otherwise may not be accessible. Ferries may be part of a transit system or may play a role in the continuance of motor vehicle transportation along state/provincial highways where bridges do not exist. Ferries are useful to Tribal nations and for the National Park Services because they support access to remote areas where the construction of bridges or permanent structures may not be economically viable. The US National Park

System supports 33 water-based systems in 25 National Parks, 2 are based in the Great Lakes St. Lawrence system. Tribal nations also operate a ferry on the system. The short list below identifies some of the roles that a ferry system may support.

Connections: Ferries on the Great Lakes and St. Lawrence primarily connect various points between the United States and Canada, as well as islands within the lakes themselves.

Access: They provide essential access to islands such as Mackinac Island in Lake Huron, Beaver Island in Lake Michigan and the Toronto Islands in Lake Ontario.

Historical Significance: Some ferries on the Great Lakes and St. Lawrence have a significant historical background, dating back to the 19th century when they were crucial for transportation and trade.

Ferry Classification: Ferries on the Great Lakes and St. Lawrence range from small passenger-only vessels to larger ferries capable of carrying both passengers and vehicles.

Tourism: Many of these ferries are popular among tourists for providing scenic views of the Lakes, River and their surrounding landscapes.

Seasonal Operation: Due to the harsh winters and ice conditions on the Great Lakes and St. Lawrence, many ferries operate seasonally, typically from spring to fall.

Regulatory and Safety: Ferries on the Great Lakes and St. Lawrence are regulated by various maritime authorities to ensure safety standards are met, especially considering the sometimes-challenging weather conditions.

Economic Impact: They play a vital role in the local economies of the communities they serve, transporting goods, services and tourists.

Environmental Benefits: Efforts are made to minimize the environmental impact of ferries on the Great Lakes and St. Lawrence, including reducing emissions and protecting water quality.

Technological Advances: Modern ferries on the Great Lakes and St. Lawrence may incorporate advanced navigation systems, eco-friendly engines and amenities to enhance passenger comfort.

Table of Contents

I. Introduction and Overview

Michigan Technological University completed a report on August 22, 2023, entitled "*Great Lakes Vessels That Operate Like Ferries: A Potential Path to Electrification.*" The report recommended further research to determine which existing ferries within the region may have operational profiles suitable for electrification. The objective of this analysis was to prepare a comprehensive inventory of ferries operating within the Great Lakes St. Lawrence Maritime Transportation System and identify five or more ferries with operational attributes potentially suitable for future electrification.

Figure 2: Map of Study Region

The study was limited to ferries operating within the dark blue area shown in Figure 2. The study region includes the Great Lakes and St. Lawrence River upstream of Les Escoumins, Québec. No river ferry operations were included.

The Conference of Great Lakes St. Lawrence Governors & Premiers (GSGP) Regional Maritime Entity has identified ferry electrification as a key area for investigation. Figure 3 illustrates the 2019 Great Lakes St. Lawrence Ship Emission Inventory. Although ferry emissions constituted only 3.3% of the region's total emissions in 2019, electrification projects within this subset of marine transportation systems could yield substantial public benefits. These benefits include reduced emissions and noise, enhanced access and mobility.

Ferry electrification can entail significant initial costs, necessitating thorough consideration of various facets of project development, power sources and operating scenarios. Stakeholders are actively seeking sustainable and innovative solutions.

2019 ICCT Great Lakes St. Lawrence Seaway Ship Emissions Inventory

	Bulk carrier	Chemical tanker	Container	Ferry-ropax	Oil tanker	Service-tug	Others	Total
Berth	51,176	33,123	37,618	14,691	12,965	7,583	13,718	170,874
Anchor	18,283	56,686	28	13,036	33,754	2,160	14,514	138,461
Cruising	921,927	73,400	51,823	24,000	22,562	131,211	54,473	1,279,397
Maneuvering	18,727	3,079	1,732	3,216	1,046	5,070	3,957	36,827
Total	1,010,113	166,288	91,201	54,943	70,327	146,023	86,663	1,625,559

Source: Zhihang Meng and Bryan Comer, Great Lakes – St. Lawrence Seaway Ship Emissions Inventory 2019, The International Council on Clean Transportation, March 23, 2022.

Figure 3: Great Lakes - St. Lawrence Seaway Ship Emissions Inventory 2019

This report includes a methodology to evaluate the ferry inventory within the region as measured by publicly available data and through insights gained from public transportation leaders, trade association experts and ferry operators on the Great Lakes. This document represents a snapshot of an industry operating 127 ferries (including vessels in layup and on order). This analysis highlights important project attributes that align with public funding programs and will identify a short list of five or more ferry projects to consider for future electrification.

Before undertaking a ferry electrification project, assessing the power grid and conducting an engineering study is essential to ensure project feasibility. A ferry operator interested in transitioning to electrification must also conduct a benefit-cost analysis to ensure that public benefits outweigh costs, particularly given the number of uncertainties in projects of this nature. Power grid energy sources vary, and operational conditions may require more power than electrification can safely provide. Ultimately, whether publicly or privately owned, a ferry operator must be willing to undertake this transition. This report serves as a desk reference exercise. No engineering work was undertaken, no electric grid sourcing capacity was evaluated and only public data sources were used in the methodology. Sixteen interviews were completed to document stakeholder insights from public planning agencies, trade associations and public, non-governmental agencies to develop a data-driven prioritization process and an inventory of ferries operating on the Great Lakes.

II. Challenges and Benefits to Electrifying Great Lakes and St. Lawrence Ferries

Most challenges in electrifying ferries are common to all ferry owners. However, there are also challenges that are unique to private and public owners, as well as key differences between U.S. and Canadian registered ferries.

A. Financial Challenges

Repowering or replacing ferries for electrification is expensive. The electrification industry is rapidly evolving yet high initial costs remain a barrier. Repowering existing ferries is financially daunting for many private owners without public funding. Publicly owned ferries do not require profitability but generally must cover operational costs. Electrification promises fuel savings over time, offsetting initial costs and providing environmental and other societal benefits.

In competitive markets like Mackinac Island, raising fares to cover the costs of vessel electrification risks losing price-conscious customers to competing ferries. If fares do not fully cover the costs of chartering a replacement vessel during conversion, this expense adds to the overall conversion costs. Additionally, all batteries have a finite lifespan and will eventually require replacement.

B. Electrification by Repowering or New Build

Repowering:

Ferries operating in the Great Lakes and on the St. Lawrence River, with their freshwater environments, often have durable steel hulls that can last for decades. However, older hulls may limit the installation of new engines and may suffer from metal fatigue in structural members that are difficult to inspect. Repowering a ferry is a time-consuming process, during which the ferry may be out of operation for a year or more. This revenue loss can be significant and may deter operators from pursuing electrification unless a replacement vessel can operate on the route during the repowering process. For islands dependent on ferry service for essential services, the loss of a ferry during conversion could present insurmountable challenges. Even if a replacement ferry is available, if fares do not cover the charter costs, this expense further increases the conversion cost.

Historically, from the 1940s to the 1960s, many Great Lakes vessels transitioned from coal to oil. Repowering an older vessel benefits from already amortized capital costs. While new electric power charging outlets may be necessary, existing docks in good condition may not require modifications to accommodate the vessel. Repowering relatively newer ferries may not be cost-effective unless new energy costs are lower than current fuel and maintenance costs. In a rural ferry case study in North Carolina, it took eight years of operation to cover the initial cost of electrification. Converting existing ferries presents challenges; each powerplant and its installation is unique, requiring costly engineering studies for each vessel. The individuality of each conversion must consider that spare parts, especially for equipment not impacted by the conversion, may be difficult to find. New systems may require special maintenance and crew training to familiarize workers with new operating systems. During the life of the vessel, service use cases may have changed significantly. Increasing passenger and/or vehicle capacity may not be physically possible with the existing hull. Improvements to hotel services (air conditioning, heat, food services) may not be feasible within the existing space, especially for ferries approaching 50 years old.

New Build: One of Kind or Classes of Ferries

Constructing new vessels allows for leveraging advancements in shipbuilding technology, enhancing hotel services, passenger comfort, increasing capacity and improving safety systems. The total capital costs for new vessels are generally higher, sometimes significantly so, compared to repowering existing vessels. Replacing ferries over 50 years old or in poor condition with new builds extends the ferry's useful life for decades and capitalizes on advancements in the field. Electric propulsion systems in new builds offer benefits such as reduced emissions, elimination of oil spill risks and potentially lower operating costs. The high expense of new builds often stems from the common practice of building one-of-a-kind vessels, each unique in size, design, equipment and sometimes building techniques. Designing and building classes of vessels, as seen in Great Lakes and ocean freight operations in the twentieth century, spreads development costs across multiple vessels, which mitigates training needs, improves parts availability and lowers costs.

C. Technology Adaptation

Fleet operators must choose between permanently installed batteries or swapping fully charged batteries for depleted ones. This decision involves complex considerations of marine engineering, naval architecture, operational requirements and financial implications. Both systems require dockside evaluation and, potentially, reconstruction. The energy draw needed to supply electricity to repower ships may compete with other sectors using the same energy source, necessitating detailed analyses of energy supply, timing of energy demand and charging durations. The pros and cons of each system vary with vessel types and routes. Safety considerations are paramount in the selection process; for example, firefighting systems aboard vessels may need updates to address potential large battery fires.

Fixed Batteries

Charging permanently installed batteries requires high-speed charging capabilities and sufficient vessel downtime for adequate charging. Vessel schedules may need adjustment to accommodate charging needs. Dock systems must also be modified, and local power grids may need upgrades to meet increased electricity demands. Ideally, vessels would charge during off-peak hours when energy costs are lower, potentially reducing costs through peak shaving. Battery replacement can be challenging and costly, potentially hindering the adoption of new battery technologies.

Battery Swapping

An alternative to dockside charging involves swapping fully charged batteries for depleted ones. This system requires multiple sets of batteries, a vessel design that supports battery swapping (requiring shipboard or dockside cranes) and the ability to maintain limited electrical power while swapping occurs. Currently, this system is being implemented for the 295-foot inland cargo vessel Den Bosch Max Groen, which began operating in the Netherlands in 2024. Zero Emission Services (ZES) is establishing a network of 1 MW charging stations in the Netherlands, strategically located for battery recharging within three hours. Vessels exchange battery units rather than waiting for recharging to resume operations. Advantages over dockside charging

include minimal vessel downtime, potentially no or minimal electric grid modifications and the ability to utilize low-cost off-peak electricity. Implementing a logistical system is crucial for moving batteries between vessels and charging locations.

Hybrid System

Diesel-electric systems, which have been in use for almost a century, utilize diesel engines to power generators (gensets) that, in turn, power electric motors driving propeller shafts. The U.S. Coast Guard's 140-foot Bay Class icebreakers on the Great Lakes have utilized diesel-electric engines for decades. These systems eliminate gears, offering excellent power and control for navigating icy waters. Hybrid systems combine batteries as the primary power source with a small diesel genset for recharging as needed. Ferries operating during winter months may experience reduced battery life due to cold weather conditions. However, hybrid systems require readily available diesel and electric supplies.

Cable Systems

Denmark has pioneered a cable system for powering small ferries, potentially applicable to operations like the Howe Cable Ferry and other ferries within the study area. This system eliminates the need for batteries, maintaining a continuous connection to shore power.

Figure 4: Cable Ferry Application

Terminal Changes

Switching to electric or hybrid power requires modifications to dock facilities. Without significant structural changes, converted vessels can continue to operate from existing docks and ramps with minimal modifications to supporting structures. Extensive hull modifications in existing vessels or new builds may necessitate substantial changes to dock structures. Both fixed battery and battery swapping systems require designing and constructing dockside charging systems at one or more terminals based

on operational requirements. Remote terminals may require upgrades to electrical grids to meet power demands. Safety systems, including firefighting equipment, may require updates. A battery-swapping ferry necessitates a system for loading and unloading heavy batteries and a power source for operating the system. Additionally, a charging station located away from the terminal requires a logistical system to transport batteries promptly.

D. Funding Challenges

The cost of ferry electrification includes investments in shore power systems, vessel and fleet retrofits or new builds, and activating leadership or building political support to enact changes. These costs often exceed the means of ferry owners/operators, necessitating public funding. However, anticipated fuel cost reductions over time can justify these investments. Funding programs typically prioritize:

- ✓ Demonstration of Need
- ✓ Demonstration of Benefits
- ✓ Planning/Local Prioritization
- ✓ Local Financial Commitment
- ✓ Project Implementation Strategy
- ✓ Technical, Legal and Financial Capacity
- ✓ Positive benefits which exceed project costs

Potential funding sources include: public transit authority programs, highway funding for state or rural roads dependent on ferry services and U.S.EPA grants for vessel repowering or new purchases. State and Federal multimodal transportation programs may fund projects supporting National Park access, Tribal transportation, environmental goals and social justice considerations. Ontario plans to publish a summary of new grant programs by year-end.

U.S. States have established funding programs supporting ferries and marine improvements, detailed in State marine transportation plans. Special funding earmarks often finance one-time projects. The U.S. Department of Transportation's Maritime Administration (MARAD) offers a grant directory listing over 100 programs that may support marine transportation projects by funding infrastructure, ship financing, planning, economic development, technology, resilience, landside access, safety, sustainability, research and development. The Canadian federal government is studying marine transportation programs. Funding criteria often target specific locations like States, regions, corridors, or environmental conditions such as non-attainment zones. Population density criteria based on U.S. Census Bureau data may further define social and economic conditions in rural or urban areas. Location considerations may include land control by Tribal nations or National Parks.

By the Numbers				
Jurisdiction	Public Ferry	Private Ferry	Seasonal	Year Round
Québec	18	4	7	15
Ontario	23	6	7	19
Indiana	0	0	0	0
Illinois	0	8	8	0
Michigan	6	31	30	7
Minnesota	0	2	2	0
New York	0	1	1	0
Pennsylvania	0	0	0	0
Ohio	0	14	13	1
Wisconsin	5	8	10	11

Figure 5: Types of Ferry Operations in the Region

III. Inventory of Ferry Vessels

A. The Great Lakes and St. Lawrence Seaway Ferry System Summary

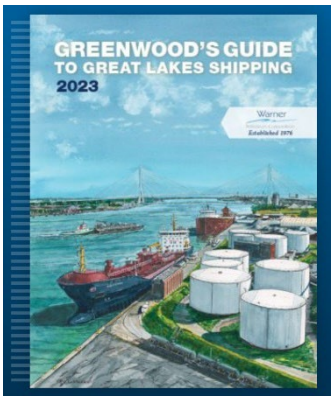
- There are 127 ferries in operation with five currently out of service or on order. Of these ferries, three are electrified.
- There are 51 Canadian ferries; 41 of which are public and 10 are private.
- There are 76 U.S. Ferries of which 62 are private and 14 are public.
- The average passenger capacity of ferries operating on the Great Lakes is 232.5 passengers.
- The average ferry vehicle capacity is 13.8 vehicles per ferry.
- 74 ferry operators can carry cars, 53 ferries do not carry cars.
- There are 79 seasonal ferries and 43 seasonal operations with five ferries either in lay-up/maintenance or in the delivery queue.

Figure 6 below identifies the number of Great Lakes ferries built within each decade since 1910. Ferry construction peaked in the 1980's. Twelve to fifteen ferries have been added each decade since. U.S. Shipbuilding capacity may slow the adoption of new vessels. Figure 6 also shows the inventory of ferries by passenger capacity. Ferries with passenger capacity of 101-200 are the most popular build.

Year Built	GSGP Ferry's		Passenger Capacity	GSGP Ferry's
1910-1920	3		1-50	21
1921-1930	1		51-100	14
1931-1940	3		101-200	40
1941-1950	3		201-300	15
1951-1960	14		301-400	22
1961-1970	17		401-500	5
1971-1980	14		501-600	7
1981-1990	25		800-1000	4
1991-2000	15			
2001-2010	15			
2011-2020	12			
2021-2024	7			

Figure 6: Distribution of Regional Ferries by Age and Capacity

B. Data Sources



Three sources were used to identify the ferry operation within the study area.

2023 Greenwood's Guide to Great Lakes Shipping which is the industry go-to. The ***National Census of Ferries*** compiled by Bureau of Transportation statistics, published in 2024. Finally, we contacted ferry associations and each GSGP member State and Province to validate the list of ferries within their jurisdiction. The Canadian Ferry Association was contacted and has ferry information, but it is not publicly available.

C. Inventory Characteristics

Vessel inventory characteristics are essential considerations when screening a ferry for electrification potential. Ferry characteristic profiles are grouped into two categories: 1) operational and 2) locational attributes. These attributes were considered when developing the ranking priorities for ferry electrification recommendations.

OPERATIONAL

Route: Impacts regulation and grant eligibility
International – between Canada and the U.S.
Interstate or inter-provincial – between States or Provinces
Intrastate or intra-provincial – within one State or Province

Cargo – Impacts ferry size, docks and waterfront road access, passenger only or passenger and vehicles (truck weight limit may be a factor).

Operating season – Impacts vessel structure, regulation and power if engaged in ice operations. Year-round or Seasonal (not during winter months).

Operating hours **-** Impacts ability to recharge an electric vessel.
Continuous – Less than two hours in a port
Limited – Two to four hours in a port

Operating speed –: Impacts electrical power needs.
High Speed – In excess of 20 mph/32 kmh
Low speed – 20 mph/32kmh or less

Ferry Class **–** Impacts cost of further studies
Class - Ferries that are identical in structure and power.
Unique – one of kind ferry

Age - Impacts onboard technology, condition of vessel and viability of repowering
1 – Built after 2000
2 – Built between 1980 and 2000
3 - Built between 1960 and 1980
4 - Built prior to 1960

LOCATIONAL

Ownership - Impacts financing and grant eligibility
Private or public (vessels publicly owned but privately operated are classed as public)

Terminal Location - Impacts road and power access
Connection major urban areas (over a population of 100,000)
Connecting a major urban area to an urban location
Connecting rural areas (less than 10,000 people in each port)

Operational Area **–** Impacts ferry size, design, regulations and personnel, and can be divided into Open Lake or Sheltered area (minimally impacted by lake swells or waves) and River.

Ice Class – Ability to operate in ice season and conditions.

Non-Attainment Area – In the U.S., determined by U.S. EPA based upon greenhouse gas emissions.

Population – Number of residents, demographics and public access.

Access to Power Grid – While a critical attribute, many variables exist and public data for each location was not available.

Organizational Readiness - Can be determined if the project is named in current public plans and is known to the public agencies in the operating area and/or has been funded by other planning or development programs.

IV. Inventory of Ferries

An inventory of 127 ferries which operate on the Great Lakes St. Lawrence Maritime Transportation System can be found in the appendix. This inventory was validated through the stakeholder interview process. The data for each vessel was used to rank the criteria the stakeholders identified as most important to the ferry electrification evaluation.

V. Stakeholder Interviews

A. Stakeholder Interviews

SIXTEEN STAKEHOLDER INTERVIEWS WERE COMPLETED

The figure below lists the public transportation agencies responsible for marine transportation planning: Bi-State Government, Trade Associations, Ferry Operators and Owners. These organizations identified key considerations for electrification.

Illinois DOT	Ontario	Interlake Steamship Company
Indiana DOT	Québec	Washington Island Ferry
Michigan DOT	Great Lakes Port Association	La Pointe Ferry (Madeline Island Ferry)
Minnesota DOT	Canadian Ferry Association	Christian Island and Cedar Point Ontario Ferry
Ohio DOT	St. Lawrence Seaway Corp.	
Pennsylvania DOT	Great Lakes Commission	

Figure 7: Stakeholders Interviewed

Surveys were conducted in May and June of 2024. Consultations were completed by phone and email. The survey comprised 30 questions divided into four categories including comments and a single ferry recommendation:

- Ferry Inventory Validation
- Organizational Capabilities
- Funding Resources
- Input for Selection Criteria
- Comments
- Individual Ferry recommendation

B. Ferry Inventory Validation

Sixteen stakeholders were asked to review and validate the ferry inventory and identify ferry operations with high electrification potential. Each stakeholder was asked questions related to their individual ferry program, or programs within their membership base or jurisdiction. In cases where government units own ferry operations on both the lakes and inland waterways, all comments were directed toward lake operations. In cases where ferries serve two U.S. States, the ferry operation was only counted in the State in which the ferry vessel was registered.

C. Organizational Capabilities

There is a stark difference in State and Provisional capability when it comes to ferry programs. Ontario, Michigan and Wisconsin stand out as units of government that have developed significant expertise in ferry ownership, management and program funding.

Stakeholders were asked about the current level of transportation, environmental and transit planning activities they are engaged in. Four States and one Province have a Marine Transportation System plan or are in the process of updating one. These plans are primarily focused on landside marine infrastructure supporting the transportation of cargo and passengers.

Stakeholders were asked about their current activity supporting vehicle electrification. The U.S. BIL legislation created the NEVI (National Electric Vehicle Infrastructure) program allocating U.S.$5.4 billion to building EV (electric vehicle) charging infrastructure across the U.S. The funds will be allocated at the State level. Most States are allocating NEVI funds through an RFP process for public and privately owned installations. Most of the requirements for NEVI funding include specific location criteria and specifications on the type of EV chargers that can be installed. Installations must be located within one mile/1.6 kilometers of designated corridors called Alternative Fuel Corridors, typically along main highways. Approved installations cannot be more than 50 miles/80.5 kilometers away from each other. Charging stations must be capable of charging four vehicles at 150kW simultaneously. Any organization interested in using NEVI funds must match 20%. While this program is eligible to support transit and publicly owned vehicles, this program has not been used for ferries. Wisconsin reported that two ferries that operate between Wisconsin and Michigan have expressed interest in ferry electrification.

States have sustainability responsibilities within their organizations, but this effort is typically outside of the transportation organization of the State Government.

D. Funding Resources

All States have access to U.S. Federal Transit, Federal Highway and National Park transportation funding for which passenger ferries are eligible if they are publicly owned and meet program requirements. Michigan, Minnesota, Ohio and Wisconsin have marine transportation development grants which can be used by ports, private businesses and economic development interests to improve shoreside infrastructure. Many States have leveraged the Congestion

Mitigation and Air Quality (CMAQ) grant, the American Rescue Plan Act of 2021 (ARPA) grant funds and Diesel Emissions Reduction Act (DERA) funds, including the Volkswagen Settlement monies and other programs for which public ferries can apply. Minnesota, Michigan, Illinois and Ohio have programs in place to leverage federal funding. Private ferries must use "pass-through agreements" with public agencies to access State and federal funds in many programs. Other programs within State Departments of Transportation include Carbon Reduction Programs. Some mentioned the development of resilience improvement programs and federal funding matching programs used to leverage federal grant programs. Michigan is creating a Maritime and Port Facility department within its Department of Transportation, but this program is primarily focused on freight. One State mentioned a program that is available for shipbuilding facilities, but it is not in use.

Some States have alternative funding and grant programs available to help with additional costs. However, these programs typically focus on landside infrastructure. Each State in the Great Lakes region has this program in place. Wisconsin has provided shore power for a large boat builder that has recently expanded and has provided funding for the S.S. Badger to complete a planning study for electrification. One State owns and operates a ferry. Both Provinces acknowledge public ownership of ferries.

U.S. States were asked about tax credits for ferry operations, and they are non-existent at the State level. There are tax credits for electric vehicle ownership and many States provide short-line railroads with tax credits for tie replacement programs. Similar tax-credit programs for vessels could be developed at the State or Federal level.

Ongoing funding for publicly owned ferries is provided by Ontario and Québec. LaPointe, Wisconsin, recently purchased a ferry operation to provide service to Madaline Island. The Harbor Commission felt that it was essential to provide a sense of stability for year-round island residents. Michigan, through the Department of Environment, Great Lakes and Energy, is providing ongoing funding for publicly owned ferries serving Mackinac Island. In general, the States noted that many of these support programs have been reactive in nature making it hard to plan. The Canadian Ferry Association has contracted for a complete listing of all ferry funding programs which is available for purchase. Ontario has commissioned a planning study to identify funding programs for ferry development.

E. Input for Selection Criteria

The opinion research collected is not statistically valid but is representative in understanding how public funding for ferry electrification is currently viewed. The input received was valuable in the identification and validation of how to begin to reduce the group of 127 ferries operating within the Great Lakes St. Lawrence Maritime Transportation System down to five or more candidates for potential electrification. Before any projects move forward, the ferry operator should be contacted about their level of interest and a full engineering study should be performed to understand. Essential secondary screening should include:

1. Are the sources of energy for electrification truly better than hybrid fuel sources?
2. Are the costs to bring electrification to the dock cost effective?
3. Is there physical space on the dock and in the vessel to support electrification?
4. Is the energy grid capable of supporting the draw for ferry electrification?
5. Is the public benefit greater than the public and private cost to support electrification?

F. State Comments

States should be viewed as implementers of programs and projects. They expect that the ferry operators or regional authorities will identify the need and timing for ferry electrification. Many States feel that a Benefit-Cost Analysis should be completed to support ferry electrification project prioritization. One State mentioned that to pursue this change in power source the benefits of electrification must either reduce operating costs or transit time to justify the expenditure. Organizationally, passenger and freight programs are often viewed via different lenses and while the same infrastructure may support both uses, planning and management can be located in different departments. This finding also applies to sustainability and resiliency.

Many projects underestimate the cost of bringing power from the utility substation to the dock. It was identified that an intermediary/consultant may be helpful in negotiating with the utility companies. States are in the early learning stages of vehicle electrification, there are still many unknowns in the process. Provinces mentioned that due to the cost and implementation uncertainties, a public agency was essential to help guide the process and government should be in a leadership role. Private stakeholders seem to favor hybrid service models, especially in rough operating environments. Operators indicated that they were ready to be responsible for the vessel from a plug-and-play perspective, but they were not in a position to coordinate power from the substation to the dock. They felt they could support a “plug and play” model if power was available on-dock.

In most States, cargo infrastructure is funded before passenger or cruise infrastructure. Most States are in a position to support terminals but not vessels. Funding typically goes to public projects before private projects and prioritizes a “worst first” strategy, typically found in public asset management. State funding in one State is available to ferries operating less than 20 miles/32.2 kilometers and funding for ferries connecting to public roads can also be prioritized under U.S. FHWA funding. One State identified that mail and UPS packages move on ferries within its jurisdiction and should be considered a criterion for prioritization.

States can play a key role as implementors, but one must start with a good project. States are looking for an applicant who has grant experience or a history in project management. States also want to know what type of support will be necessary to complete the project and if reserve resources are available in the event of unforeseen issues. To support a project, the State is interested in understanding the net benefit of the completed project. State funds have been earmarked or used to help projects of key interest.

There was no consensus about the best course of action. Some prefer hybrid power, and others with limited experience preferred new build technology and long-term reliability. New technologies require new staff, training and a new workforce. It will take 5-10 years to establish a new fleet due to shipyard capacity. States are strongly in support of addressing U.S. EPA non-attainment areas as early priorities. The Great Lakes Region is home to many shipbuilders and auto companies and suppliers pioneering E.V. systems and supplies. The region also is a primary supplier of steel. Building new vessels would represent a tremendous economic benefit to the region.

States are keenly interested in the issue of essential transportation services and non-attainment areas and suggested that these two criteria were of fundamental importance.

G. Provincial Comments

Ferry electrification is expensive and there are many risks in the implementation process. Government leadership has the financial capabilities necessary to address unexpected costs and project delays. Funding is available through a variety of sources in Canada and many programs vary by Province. Ontario is in the process of documenting all the sources of programmatic funds. Due to the large number of public ferries in Canada, there is a contractor dedicated to providing terminal services for multiple ferry operators. The U.S. does not have the scale of services yet to support this service. Ferries are funded primarily by public agencies in Canada and there are few programs for privately owned ferries in Canada. In Canada, ferry investment is primarily driven by population area, yet there are distinctions between rural and remote areas with no other viable transportation access. The public agencies in Canada feel that it will take five to ten years to determine the benefits of electrification due to the multitude of unknowns.

H. Trade Association, Operators and NGO Perspectives

Age is not a factor when considering electrification, according to operators and trade associations; it is the cost of electrification that is the biggest barrier. Many feel that electrification is the responsibility of the government since it is a public initiative. Private operators do not have the funding to go fully electric without help from the government. Demand for service and a population base should be a determinant of investment. Priority for electrification should be given to year-round operations. Some regional operators note that there are many electric grids still supported by fossil fuels (coal, gas, etc.) and that the ferry powering decision of hybrid vs. fully electric power should be determined on a case-by-case basis. Some ferry operators question the value of a full electric solution if they must rely on generators running fossil fuels as an auxiliary power source. Some rural ferries serving communities without highway alternatives do not feel that they are suited for the first round of electrification.

Operators report that the cost of electric ferries is beyond their reach and that the decision to electrify should be a place-based decision that recognizes the operating conditions as well as the availability of a reliable and cost-effective power supply. Each application needs to consider

the use case before they can decide to electrify. Not every operator will be able to easily adapt to electrification. It will take time to rebuild a boat if that is the best choice and many operators do not have a spare boat to put in service while a ferry is being retrofitted. Areas that are prone to heavy ice in the winter may not be good candidates for electrification.

Recommendations suggest starting with where shore power is available and doing the easy projects first, with small operations and small communities. Government will have to step in if small private operators do not have the funding. The biggest issue will be the cost to electrify and the capability of the operator to fund the project. An operation that has multiple vessels is preferred so that service can continue during the electrification retrofit.

I. Stakeholders' Individual Ferry Recommendations:

The following list of quantitative and qualitative recommendations was received. Some ferries were mentioned by the stakeholders and are listed in no particular order. Other attributes were often mentioned by Multistate and Trade Associations. This list reflects strong regional preference without any formal capability analysis. Not every stakeholder responded.

Quantitative Responses	Qualitative Responses
3 Votes Kelley Island (OH) (Private)	Do the easy ones first
2 Votes S.S. Badger (MI-WI) (Private)	Worst air attainment areas first
Ironton Cable Ferry (MI) (inland)	Prioritize year round first
Howe Island (ON) (Recommended)	Focus on organizational readiness
Madeline Island (WI) (Recommended)	Upgrade ferries that carry mail (U.S. FHWA Eligible)

Figure 8: Stakeholder Quantitative and Qualitative Responses

VI. Prioritization Criteria

Since ferry electrification is beyond the financial reach of nearly every private ferry operator and many public operators, public funding via grants, loans, public program fees or public-private partnerships is often necessary. As we approach ferry electrification, we must understand the complexity of the networks needed to support the service, which includes electrification energy sources, landside terminal modifications to support the vessel, vessel modifications and systems to support electrification and operational systems and backups to support navigation.

Figure 9: Ferry Prioritization Process

A. Criteria Development

The selection criteria for ranking the 127 ferry operations within the Great Lakes St. Lawrence Maritime Transportation System was driven by the States and Provinces primarily because it has been identified that the electrification process cost is beyond the reach of most private ferry operators and because most of the funding programs are only available for public agencies/public projects.

Each of the GSGP member States and Provinces was contacted to provide input about marine and energy programs available to support the electrification of passenger vehicles and marine ferry operations within their region. Additionally, vessel operators, trade associations and NGOs were asked for their input about essential criteria to evaluate a ferry for prioritization of funding for electrification.

Stakeholders were asked to consider the Canadian and U.S. State and Provincial funding programs available and the applicant types and project eligibility in their region. These public and private participants were asked to consider the goals and merit criteria for popular funding programs and were asked to identify the ***top five essential criteria*** out of a listing of 12 attributes. Each of the top five attributes was ranked and then weighted. Public data from the ferry inventory was then used to score the ferries against the short list of weighted attributes.

B. Ranked and Weighted Stakeholder Criteria for Ferry Selection

The figure below depicts the results of the Stakeholder Criteria Recommendation which is ranked from #1 (most important) to #5 (least important). The results of this exercise are shown below.

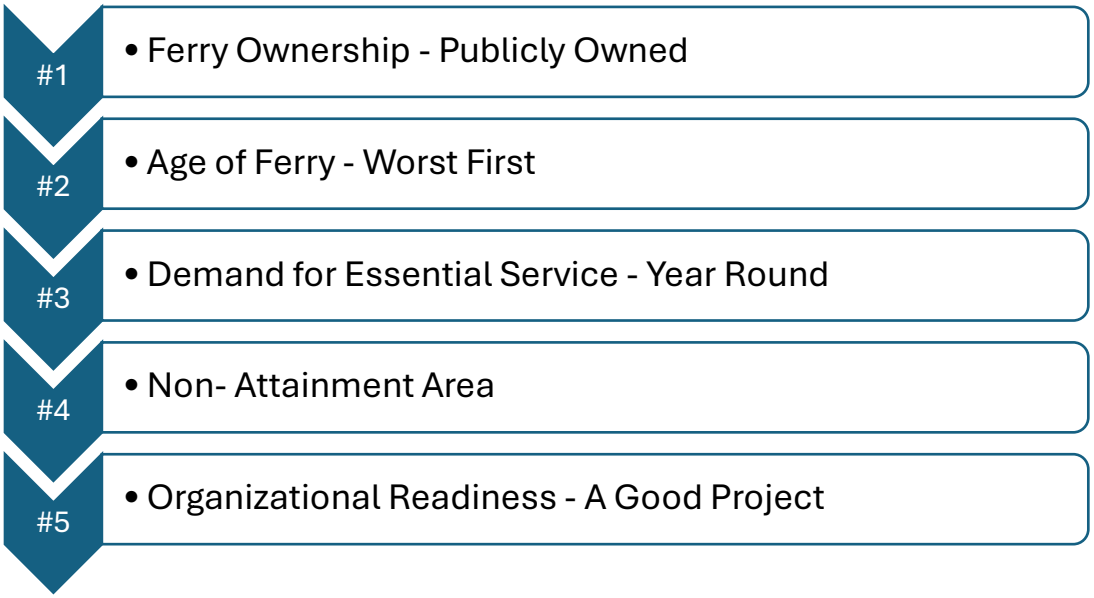


Figure 10: Stakeholder Prioritized Criteria

C. Prioritization Process Applied to Ferry Inventory

The following steps were undertaken to rank and prioritize the inventory of 127 ferries based on the Stakeholder ranked and weighted criteria.

Step 1 – Reduced 72 private vessels from the ferry inventory of 127 total units.

Step 2 – Eliminated all public ferry vessels less than 50 years of age.

Step 3 – Deleted any ferry operation that was seasonal in nature.

Step 4 – Prioritized ferries which operated in non-attainment areas.

Step 5 – Prioritized Organizational Capacity – Operators who have previously been awarded grants or States or Provinces with funding programs to support Marine Transportation Systems and operate their own ferry operations were ranked the highest.

Figure 11 below shows the highest-ranked ferries based on this methodology in "*Criteria Based Priorities*" or Group 1. Group 1 represents the composite ranking formula informed by the sixteen stakeholders who represented Public Agencies, Operators and Trade Associations. This group favored a Benefit-Cost approach which tended to favor non-attainment zones and population centers in the criteria put forward.

Group 2 was informed by a literature review that focused on desk reference work, which looked for news stories, journal articles or other current events sources that have captured ferry electrification activities around the world. A second set of evaluation criteria was developed from these articles and was used to rank the ferry database by a set of common and unique attributes to populate. A set of high-ranking ferries populates Group 2, labeled as the "*Literature Priority Group*". Group Two results are more focused on cost considerations and an operational focus.

The Group 3 block labeled "*Survey Priorities*" was populated by answers to the last question on the stakeholder survey which asked each stakeholder to identify an individual ferry that they would like considered for reasons not otherwise captured in the survey. This ranking is shown in figure 11 as "*Survey Priorities*" or Group 3. This group had multiple votes for the same ferry.

Twelve ferry boats ranked in one or more of the three highly rated ferries for electrification consideration shown in Figure 11. The Howe Island Ferry was named by all three groups. The Glenora and Charlevoix ferries were both named by two groups. The S.S. Badger and Kelley's Island ferries were named multiple times by individuals within the same group. The orange blocks in the age column note that is the oldest ferry in the State. No National Park ferries were mentioned. A ferry serving a Tribal region was highly ranked but was removed from the listing due to a recent grant award to replace their older ferry. Three ferries in total were withdrawn from the scored inventory ranking due to a recent funding commitment to repower or replace a candidate ferry.

D. Ferries Ranked by Stakeholder Priorities

Stakeholder Priorities	Registry	Vessel Name	Ownership	Capacity Pass	Capacity Auto	Operational Area	Operating Season	Age	Terminal Locations
Criteria Based Priority	**CAN - Ontario**	*Howe Island Foot Ferry*	Public MTO owned Op Township of Frontenac	12	3	Sheltered	Year-round	78	Howe Island, Ontario East End - Cable Ferry
	CAN - Ontario	*Glenora*	Public Government of Ontario	117	21	Sheltered	Year-round	72	Glenora — Adolphustown, Ontario
	CAN - Ontario	*Quinte Loyalist*	Public Amherst Island Ferry Service	117	21	River St. Lawrence	Year-round	70	Amherst Island and Millhaven, Ontario
	US - Wisconsin	*Island Queen*	Public Town of La Pointe, WI	150	15	Sheltered	Year round ice permitting	58	Bayfield to Madeline Ils / Apostle Islands
	CAN - Quebec	*Lomer-Gouin*	Public-Société des traversiers du Québec	590	54	River St. Lawrence	Year round	53	Québec-Lévis - Urban
Literature Review Priority	**US - Wisconsin**	*Nichevo II*	Public Town of La Point, WI	150	10	Sheltered	seasonal	62	Bayfield to Madeline Ils / Apostle Islands WI
	US - Michigan	*Huron*	Private Star Line St. Ignace, MI	330	0	Open lake	**Year-round**	71	Mackinac Island, St. Ignace, Mackinaw City
	US - Michigan	*Charlevoix (Cable Ferry)*	Public Charlevoix Transportation Authority	28	4	Sheltered	seasonal	98	Charlevoix Lake Ironton Michigan
	US - Michigan	*Anna May*	Private D/B/A Star Line St. Ignace, MI	150	0	Sheltered	**Year-round**	77	Mackinac Island, St. Ignace, Mackinaw City
	CAN - Ontario	*Glenora*	Public Government of Ontario	117	21	Sheltered	Year-round	72	Glenora — Adolphustown, Ontario
	CAN - Ontario	*Howe Island Foot Ferry*	Public MTO owned Op Township of Frontenac	12	3	Sheltered	Year-round	78	Howe Island, Ontario East End - Cable Ferry
Survey Priorities	**US - Michigan**	*Badger**	Private - Interlake	600	180	Open Lake	seasonal	71	Ludington MI - Manitowoc WI
	US - Michigan	*Charlevoix (Cable Ferry)*	Public Charlevoix Transportation Authority	28	4	Sheltered	seasonal	98	Charlevoix Lake Ironton Michigan
	CAN - Ontario	*Howe Island Foot Ferry*	Public MTO owned Op Township of Frontenac	12	3	Sheltered	Year-round	78	Howe Island, Ontario East End - Cable Ferry
	US - Ohio	*Juliet Alicia*	Private Kelleys Island Fe	149	0	Open Lake	seasonal	55	Marblehead to Kelly's Island OH
	US - Wisconsin	*Bayfield*	Public Town of La Point, WI	150	25	Sheltered	seasonal	72	Bayfield to Madeline Ils / Apostle Islands
		*Multiple Votes							

Figure 11: Ferries Ranked by Stakeholder Priorities (Shaded Vessel Names were mentioned multiple times. The Orange/Gold color represents the oldest vessel in the state ferry inventory)

E. Literature Reviews Showcasing Ferry Electrification Criteria

A literature review of ferry projects was completed based on a desk reference analysis and showcases projects that have completed preliminary planning work. The insights from this analysis, in some cases, agree with the stakeholder interview findings and, in other cases, identify alternative choices. Both perspectives are valid, and this highlights the complex process of coordinating stakeholder collaboration.

I. Sources of Public Funding

The *Marilyn Bell I* based in Toronto, Ontario, is owned by the Canadian federal government and has been converted to electric propulsion with support from PortsToronto. This ferry operates on a short route delivering passengers, vehicles and supplies to Billy Bishop Toronto City Airport. The *Marilyn Bell I* was built in 2009 and converted in 2021 to be the first completely electric lithium-ion ferry in Canada, powered by 100 percent renewable wind and solar energy through a partnership with Bullfrog Power. The C$3.8 million conversion cost was covered by proceeds from an airport improvement fee added to departing airline passengers' ticket prices.

The Michigan Department of Environment, Great Lakes and Energy (EGLE) Fuel Transformation Program (FTP) Part 2 has provided a U.S.$3.6 million grant to electrify the U.S. flagged ferry *Chippewa* built in 1962 and owned by Mackinac Island Ferry Company (MIFC), formerly Star Line. The conversion meets the policy goals of the Michigan Healthy Climate Plan. According to a 2024 study, Michigan's climate plan is the only one of the Great Lakes States' plans to address reducing the carbon footprint of ferries.

The EGLE grant covers half the cost of the project, which includes installing 1.5 megawatts in shore power infrastructure at the Mackinaw City ferry dock. Future electric power upgrades are also planned for the ports of St. Ignace and Mackinac Island. The ferry will operate seasonally between Mackinaw City and Mackinac Island. After converting the MV *Chippewa* to electric power, MIFC intends to convert its other seven steel vessels that operate passenger or freight service to electric or electric hybrid. The company will evaluate the possible conversion of their high-speed ferries after the low-speed ferry conversion is completed.

II. New Build Great Lakes Electric Ferries

In 2019 and 2020, the *James V. Glynn* and *Nikola Tesla* were built by Burger Marine in Manitowoc, Wisconsin, as all-electric vessels to operate tours for Maid of the Mist in Niagara Falls, New York. These were the first large commercial electric propulsion vessels in the Great Lakes region. The vessels utilized technology developed for European ferries and tour boats and were built in a U.S. shipyard. The vessels can carry 600 passengers on tours of the Falls.

Since 2017, the Canadian Federal Government's National and Regional Projects of the New Building Canada Fund has been working in partnership with the Ontario Ministry of Transportation on an electric ferry project. Two new hybrid electric ferries ordered by the Government of Ontario in 2018 to be built by Damen Shipyards Galati in Romania were delivered in late 2021. The two ferries were constructed to provide year-round service. *Amherst Islander II* will replace the *Frontenac II* on the Millhaven Ferry Dock-Amherst Island route and the *Wolfe Islander IV* will take over from the *Wolfe Islander III* on the Kingston-Wolfe Island service. The new ferries carry significantly more people and autos than the older ferries. The new ice classed vessels are designed to be capable of fully electric operation but are also equipped with twin diesel generators to allow hybrid or full diesel propulsion.

An innovative, fully automatic integrated shore charging and mooring system developed by Wabtec Stemmann comes equipped with motion compensation to ensure a stable connection between the ferry and the shore even as charging of the batteries is carried out in rough waters. The system delivers six MW of power to allow charging to be completed in as little as ten minutes. Charging occurs while loading/unloading passengers and lasts several trips, with a constant battery life of 80% during the approximately 20-minute ferry trips.

The new ferries cost about C$94 million. New dock upgrades, training and shore connection installations are additional costs. Both vessels have had significant delays caused by dock construction issues, a lack of mariners and grid delivery of electrical power and mooring

systems. The *Wolfe Islander IV* started service in the summer of 2023, but as of March 2024, the *Amherst Islander II* had not yet carried a single passenger.

III. Ferry Electrification Guiding Principles

- Ferry electrification requires a system approach (vessel, dock, mariners and electric grid).
- Multiple parties with relevant expertise are involved in the process.
- Public and private ferries are options for electrification.
- Ferry electrification will cost millions per vessel with funding generally needed from multiple sources.
- Government is driving electrification policies and electrification.
- Government provides significant financial and organizational support.
- Ferry electrification can take years to complete.
- Charging stations identified in the literature reviews deliver from 750 Kilowatts to 6 Megawatts.
- Shorter sheltered ferry routes are well suited to electrification.
- Slow-speed ferries are suited to early adoption of electrification.
- Year-round service ferries may need hybrid electric systems.
- Options are new builds or conversions, and each has pros and cons.

In January 2023, Geneviève Guilbault, Deputy Premier and Minister of Transport and Sustainable Mobility and the Société des Traversiers du Québec (STQ) announced a project to acquire three rechargeable electric ferries for the L'Isle-aux-Coudres and Sorel-Tracy ferries. These ferries would cost an estimated C$191.5 million with the first being delivered in 2029. These crossings are currently served by the vessels MV *Joseph-Savard*, MV *Félix-Antoine-Savard*, MV *Catherine-Legardeur*, MV *Didace-Guèvremont* and MV *Alexandrina-Chalifoux.* These existing vessels will serve as backups at other STQ crossings.

IV. Potential Ferry Electrification Location Selection Process

The Michigan Technological University's (MTU) study "Great Lakes Commercial Vessels That Operate Like Ferries: A Potential Path to Electrification", The International Council on Clean Transportation's (ICCT), "Feasibility Study Of Future Energy Options For Great Lakes Shipping", numerous articles listed in the bibliography, case study analysis and findings from interviews were all used to inform the short list of five or more ferries recommended for further examination for electrification. It should be noted that neither the MTU nor ICCT studies were focused on Great Lakes ferries. The ICCT study stated: "The lower energy density of alternative marine fuels should not be a major barrier to adoption in the GL-SLS. The one exception is battery-electric ships, which would not be widely applicable today due to battery energy density and charging constraints." The CPCS study "Estimating Emissions Reductions from Technology Implementation" has a more positive projection for the use of electric propulsion in ferries. However, the study also provides a very rosy but unrealistic projection for ferry electrification.

"Therefore, this project assumes that all the GLSLS's ferries and tugs could be electrified by 2030." Based on the Great Lakes electric ferry case studies analysis, this date would be unachievable even with unlimited funding due to construction time, grid availability and limited shipbuilding facilities.

The MTU study did suggest that the MV *Ranger III, Isle Royale Queen* IV and MV *Huron* package freight vessels that also double as ferries could be considered for electrification based on their Automated Identification System (AIS) tracked routes.

Several factors work against MV *Ranger III* and the *Isle Royale Queen IV's* early adoption. Isle Royale is one of the least visited of the national parks, so ferry service demand is low, and the Island has no permanent residents, so service is only seasonal. The probability of being able to build charging stations on Isle Royale is problematic as no high-amperage power lines go to the National Park. The MV *Ranger III*'s route is 72 miles one-way on the open lake so significant power will be needed. MV *Ranger III* is owned and operated by the National Park Service so funding would be solely federal in an agency with a constantly constrained budget. The MV *Isle Royale Queen* IV operates between Copper Harbor, Michigan and Isle Royale on a 52-mile one-way open lake route, requiring significant power. This vessel's home port is at the tip of the Keweenaw Peninsula in a very small community that may not have sufficient electric power coming to the harbor. While the private ownership of this vessel is not in itself a barrier, the low demand for service means a return on investment will be difficult and likely take a long time unless significant grants are available. One of the MTU-suggested ferries, the MV *Huron,* was further evaluated and is recommended as a possible early adopter of electrification.

These studies, numerous reports and articles listed in the bibliography, case study analysis and findings from interviews were all used to develop selection criteria that were applied to the ferry inventory to select five ferries recommended for further examination for electrification.

Literature Review Informed Ferry Selection Criteria		
	Selection Criteria	**Rationale**
1	Provides essential year-round service	The ferry is a key transportation corridor.
2	State/Provincial and local support for conversion	Both leadership and funding opportunities.
3	Slow running speed	High-speed ferries require significant energy and numerous batteries.
4	Short route preferably in sheltered waters	Smaller waves and swells require less power for safe operations. The vessel is never far from a safe harbor.

5	Strong demand for service	Provides a strong base for revenue generation. May have seasonal variations.
6	A community of sufficient size nearby to warrant a significant electric service on the grid	Remote ports and or island only based charging stations may have difficulty in obtaining sufficient amperage for a reasonable charge time.

V. Potential ferry electrification locations/operations for early adoption

1. Bayfield and Madeline Island, Wisconsin: MV *Nichevo II*

Built in 1962, LOA 19.8m-65' beam 9.7m-32', Draft 2.28m -7'5", 150 passengers, 10 autos, ice-capable, USCG Number: 288696 https://madferry.com/about-madeline-island-ferry-line/fleet

MV *Nichevo II* Pros	**MV *Nichevo II* Cons**
Public owned by Town of La Point, Wisconsin	La Point's recent purchase of the ferries may limit their funding ability.
Short route, 2.2 miles/3.5 km in sheltered waters	*Nichevo II* is 62 years old so condition may be an issue
Dock is in Bayfield City Center	Auto capacity on the *Nichevo II* is less than more modern ferries in the fleet
Year- round service is needed for Madeline Island residents. This includes emergency services and necessities. This could be considered a transit service making federal funds available. High School students use the ferry to get to school.	
Wisconsin has a Harbor Grant program that could provide funding for dock improvements and a charging station.	
Wisconsin has an electrification plan/fund that does not exclude ferries from funding.	
Nichevo II is iced classed.	
There are multiple ferries to cover the service while the *Nichevo II* is being converted.	
Other Bayfield ferries could be converted to use the charging station(s).	
This location and ferry service are popular tourist destinations. This can generate additional revenue through tiered (residential and non-residential) pricing to help cover conversion costs.	
This location would showcase ferry electrification in Wisconsin.	

With the Apostle National Lakeshore adjacent to the ferry, improved air quality is beneficial.	
The local utility service is supportive of this electrification project.	
Other National Park Tour boats operate in the area.	

The Public Town of La Pointe, Wisconsin, owns five ferries that operate between the city of Bayfield and Madeline Island that has 430 year-round residents but as many as 2,500-3,000 summer residents. The region is a popular tourist destination in every season, drawing tens of thousands of visitors. The influx of tourists requires an expanded ferry service for nine months of the year. The *Nichevo II* is the same age as the *Chippewa* that is being converted to electric. Based on the pros and cons, this route and this ferry would be an option for electrification. Discussion with relevant officials from the Town of La Pointe and the State of Wisconsin should be the next step. If the parties are interested in electrification, then an engineering and a cost-benefit analysis for the vessel, dock and operations should follow.

2. St. Ignace to Mackinac Island, Michigan – MV *Huron*

Built in 1955, Length Overall, (LOA) 27.9m - 91'6" beam 7.62m - 25', Draft 2.59m - 8'5", 330 passenger capacity and about 70 tons freight, USCG Number 269888.

MV *Huron* Pros	**MV *Huron* Cons**
Privately owned by the Mackinac Island Ferry Company which has a history of supporting ferry electrification.	The *Huron* was built in 1955. It was updated in 1972. A new build rather than repowering may be a viable option for a 69-year-old vessel.
Short route, 6 miles/9.7 km from St. Ignace or 7 miles/11.3 km from Mackinaw City in sheltered waters.	Tiered pricing may not generate significant additional revenue if *Huron's* service is primarily for residents during winter months.
Year-round service is needed for Mackinac Island residents. This includes emergency services and necessities. This could be considered a transit service making federal funds available.	
Michigan has the Michigan Healthy Climate Plan and the Michigan Department of Environment, Great Lakes and Energy (EGLE) Fuel Transformation Program (FTP) Part 2 that may provide funding.	
The *Huron* is ice-strengthened.	
There are multiple ferries to cover the service while the *Huron* is being converted.	
A charging station is being built in Mackinaw City for the *Chippewa* with plans for stations in St. Ignace.	

This location and ferry service are popular tourist destinations. This can generate additional revenue through tiered (residential and non-residential) pricing to help cover conversion costs.	

3. Crossing South Arm of Lake Charlevoix to Ironton, Michigan - MV *Charlevoix*

Built in 1926, LOA 18.35m 50', beam 9.14m - 30', Draft 5'6", 28 passenger capacity and 4 autos, USCG Number: 225736

MV *Charlevoix* Pros	**MV *Charlevoix* Cons**
Public Charlevoix Transportation Authority.	The vessel is 98 years old. A new build rather than repowering is the most viable option.
Short route, .12 miles (186 meters) in sheltered waters.	Seasonal, it is only open from mid-April through mid-November
This could be considered a transit service making federal funds available.	
Michigan has the Michigan Healthy Climate Plan and The Michigan Department of Environment, Great Lakes and Energy (EGLE) Fuel Transformation Program (FTP) Part 2 that may provide funding.	
This is a cable ferry, and a new build may be able to utilize an electric cord and not need batteries. Denmark's Randers Fjord Ferry uses 350 meters (just under 1,150 feet) of hardened, waterproof electrical cable that's rolled up on a drum to power itself.	

4. St. Ignace to Mackinac Island, Michigan – M/V *Anna May*

Built in 1947, (refurbished 2012), LOA 18.35m - 60'2", beam 9.14m - 30', Draft 7'3", 150 passenger capacity and 7 tons freight, USCG Number: 252256

MV *Anna May* Pros	**MV *Anna May* Cons**
Privately owned by the Mackinac Island Ferry Company currently supporting ferry electrification.	The *Anna May* was built in 1947. It was refurbished in 2012. A new build rather than repowering may be a viable option.
Short route, 6 miles/9.7 km from St. Ignace or 7 miles/11.3 km from Mackinaw City in sheltered waters..	The vessel is not listed as ice-strengthened or ice-classed, and that

	may limit winter operation, making it a seasonal vessel like the *Chippewa*.
Year-round service is needed for Mackinac Island residents. This includes emergency services and necessities. This could be considered a transit service making federal funds available.	
Michigan has the Michigan Healthy Climate Plan and The Michigan Department of Environment, Great Lakes and Energy (EGLE) Fuel Transformation Program (FTP) Part 2 that may provide funding.	
There are multiple ferries to cover the service while the *Anna May* is being converted.	
A charging station is being built in Mackinaw City for the *Chippewa* with plans for stations in St. Ignace.	
This location and ferry service are popular tourist destinations. This can generate additional revenue through tiered (residential and non-residential) pricing to help cover conversion costs.	

These ferries are owned and operated by the Mackinac Island Ferry Company and can operate year-round with the occasional support of the USCG ice breaker stationed at St. Ignace. These vessels can ferry people and bring supplies to Mackinac Island residents. The company is already converting the *Chippewa* to electric and has expressed an interest in converting more of its fleet. Discussion with the Mackinac Island Ferry Company and relevant Michigan State officials should be the next step. If the parties are interested in electrification, then an engineering and a cost-benefit analysis for the vessel, dock and operations should follow. The success of the *Chippewa* conversion and finance will be key factors in the company's decision to convert either or both ferries.

5. Glenora and Adolphustown, Ontario – Ferry MV *Glenora*

Built in 1952, LOA 38.7m- 126.9', Beam 10 m- 32.8', Draft 3m, 9.84', 117 passengers 21 autos, Canada Official Number, 194753

MV *Glenora* Pros	**MV *Glenora* Cons**
A public ferry owned the Canadian Ministry of Transport.	The Glenora was built in 1952. A new build rather than repowering may be viable option.
Short route, .55 miles/.89 km between Glenora and Adolphustown in sheltered waters	A ferry would have to be chartered if repowering was the most viable option
Year-round service. This includes emergency services and necessities.	A charging station would need to be built at either port. Both are on the mainland but not close to an urban

	area so sufficient power may be an issue
Ontario has taken a leadership role in electrifying ferries.	
There is constant demand for this operation to avoid significant driving.	

6. Mainland to Gillespie's Point East End of Howe Island, Ontario - MV *Howe Islander*

Built in 1949, LOA 15.2m – 49.9', Beam, 4.3 m – 14.1', Draft 1.1 m – 3.6', 12 passengers, 3 autos, Canada Official Number 192692, **Note:** This is a cable ferry.

MV *Howe Islander* Pros	**MV *Howe Islander Cons***
Public operation owned by the Corporation of The Township of Frontenac Islands.	This is a small vessel that may not have sufficient room for batteries if converted. A new replacement ferry may need to be larger
Short route, .2 mile (330 meters) in sheltered waters. Operated on demand and the trip takes 3 minutes. This is a cable ferry, and a new build may be able to utilize an electric cord and not need batteries. Denmark's Randers Fjord Ferry uses 350 meters (just under 1,150 feet) of hardened, waterproof electrical cable that's rolled up on a drum to power itself.	The vessel is not listed as ice-strengthened or ice-classed, and that may limit winter operation.
This is the only vessel that transports vehicles to the island on the east end. Howe Island has over 5000 year-round residents. The west end ferry can provide service if repowering is an option.	A charging station would need to be built on the mainland and the dock is at the end of a long peninsula.
Ontario has taken a leadership role in financing the building of electric ferries.	A larger vessel will require dock modifications on both sides
The current ferry could cover the service if a new build is selected. A new build could be ice classed.	

The Province of Ontario has provided leadership and funding for electrification of ferries. The Future of the Great Lakes Economy: Ontario's Marine Transportation Strategy 2023 specifically addresses strengthening Provincial ferry service and greening marine transportation. The *Howe Islander* and the *Charlevoix* are similar in size and service. There would be an opportunity to design a class of electric cable ferries that could also serve cable river crossings in Canada and the U.S. The Danish model of an extension cord on a wheel should be explored for these ferries. See photo in figure 4.

F. Conclusion

The following ferries were selected for further consideration because they best met the criteria established through literature analysis and the stakeholder interview process. The scope of this study was limited to publicly available transportation data. This analysis did not have access to electric capacity levels at the substation level or the cost to bring power to the dock/terminal. This limited study did not include discussions with all vessel owners and operators to understand their interest in electrification and did not inspect the vessels and their shore facilities. No engineering work has been completed to make cost estimates or definitive recommendations.

Changing a marine power system is a complex and expensive undertaking that will take years and millions of dollars per vessel. Over 85 years after conversion from coal to oil on Great Lakes vessels, the SS *Badger* still uses coal. Electric vessel operations are in their infancy, and it is a field that is constantly changing and improving. Early adoption of new technology can be difficult and risky for vessel owners, and frequently, the conversion does not warrant change when only assessed financially. Environmental improvements that benefit society from using renewable electric power will not initially be reflected in a marketplace that is focused on short-term financial return on investment.

Many parties will be involved in the final selection and many more in converting ship and shore to electrical power. Discussion with relevant parties should be the next step. The owner may, for a variety of reasons, be interested in electrification but wants to convert or replace a vessel different from the one proposed in this study. If the parties are interested in electrification, then an engineering and a benefit-cost analysis for the project (vessel, dock, charging station and operations) should follow. These studies may not result in a ferry route's conversion to electric if the proposed vessel is unsuitable or the operation is not cost-effective.

Owners will need to be willing risk-takers and investors to change their operations with evolving technology. Governments will need to take a leadership role in assisting with conversions both financially and, when needed, coordination with diverse players such as power companies. Governments will need to assist in funding not only the actual conversion but also the preliminary studies that may not result in a conversion. There are successful Great Lakes/St. Lawrence electric ferry operations which indicate a promising future, but change will take time and will not always go as planned.

G. Recommendations

1. Develop a concept of operations document for the top five prioritized ferries to identify duty cycles, loads, schedules, maintenance windows and power needs, and design a plan comparing net-zero emissions to a hybrid model. These resources will aid in future pilot projects.
2. Host a workshop in conjunction with other Canadian or U.S. trade conferences, such as the Canadian Ferry Association in September, the American Association of Port Authorities, or the American Great Lakes Ports Association, to raise awareness through education and communication. The sessions should explore the operator's perspective, planning for electrification and alternative fuel and assess project readiness.
3. Prepare a Strategic Grant Funding Plan to repower up to five prioritized ferries, focusing on securing federal and state grants as well as private sector investments.
4. Assemble a group of shipbuilders, vessel operators, academics and workforce development experts to participate in a trade mission to Europe. This mission would aim to gain insights on the development and support of a hybrid and full net-zero ecosystem of boat builders, suppliers, maintenance providers, education and public partners in project development.
5. Develop a subgroup of GSGP members to promote multi-State/Provincial partnerships, leveraging federal grant funds and special projects to further address sustainability challenges in ferry electrification.
6. Work with the Mackinac Island Ferry Company and relevant State of Michigan officials to electrify one or more of the identified ferries, building on their experience with the MV Chippewa conversion and aligning with Michigan's Healthy Climate Plan and EGLE Fuel Transformation Program.
7. Advocate for amendments to FTA ferry grants to remove the minimum mileage requirement, expanding funding opportunities for shorter ferry routes that could benefit from electrification.
8. Advocate for amendments to NEVI funding to include a 5-10% set aside for marine transportation projects supporting essential ferry operators, encouraging broader participation in electrification initiatives.

VII. Ferry Inventory of the Great Lakes St. Lawrence Region

The Ferry Inventory database is broken into segments by jurisdiction.

Definitions	Source	Key			Key	Information Sources				
Ferry operating on Great Lakes transporting passengers between two or more terminal on scheduled service. Does not include ferries on inland rivers or lakes	Compiled by Richard D. Stewart for GPGS Study	Pink highlight electric or being converted to electric			Blue highlight long term lay-up	Data from USCG, Transport Canada, BTS, Greenwoods, Interviews, Searches			Orange highlight oldest operating ferry	A ferry, such as the SS *Badger* , that serves multiple states or international routes is listed only once in the homeport location.
Registry	**Vessel Name**	**Ownership**	**Capacity Pass**	**Capacity Auto**	**Operational area**	**Operating season**	**Year Built**	**Upgrade**	**Age**	**Terminal Locations -**
CAN - Quebec	*Alphone-Desjardins*	Public-Société des traversiers du Québec	590	54	River St. Lawrence	Year round	1971	2002	50	Québec – Lévis Urban-Urban
CAN - Quebec	*Armand-Imbeau II*	Public-Société des traversiers du Québec	430	110	River St. Lawrence	Year round	2018		6	Tadoussac–Baie-Sainte-Catherine - Rural
CAN - Quebec	*Catherine-Legardeur*	Public-Société des traversiers du Québec	367	53	River St. Lawrence	Year round	1983	2006	41	Sorel-Tracy-–Saint-Ignace-de-Loyola
CAN - Quebec	*Didace-Guevremont* formerly *Armand Imbeau*	Public- Societe (Formerly Armand-Imbeau)	367	75	River St. Lawrence	Year round	1980	1996	44	Tadoussac – Baie-Sainte-Catherine
CAN - Quebec	*F.A. Gauthier*	Public-Société des traversiers du Québec	800	180	River St. Lawrence	Year round	2014		10	Traverse Matane–Baie-Comeau–Godbout
CAN - Quebec	*Felix-Antoine-Savard*	Public-Société des traversiers du Québec	376	70	River St. Lawrence	Year round	1996		26	L'Isle-aux-Coudres–Saint-Joseph-de-la-Rive
CAN - Quebec	*Grue-des-Iles*	Public-Société des traversiers du Québec	293	29	River St. Lawrence	Year round	1980	2011	44	L'Isle-aux-Grues – Montmagny
CAN - Quebec	*Jos-Deschenes II*	Public-Société des traversiers du Québec	432	110	River St. Lawrence	Year round	2018		6	Tadoussac – Baie-Sainte-Catherine
CAN - Quebec	*Joseph-Savard*	Public-Société des traversiers du Québec	367	35	River St. Lawrence	Year round	1985		39	L'Isle-aux-Coudres – Saint-Joseph-de-la-Rive
CAN - Quebec	*Ivan-Quinn*	Public-Société des traversiers du Québec	45	2	River St. Lawrence	Year round	2009		15	Île d'Entrée–Cap-aux-Meules
CAN - Quebec	*Lomer-Gouin*	Public-Société des traversiers du Québec	590	54	River St. Lawrence	Year round	1971		53	Québec-Lévis - Urban
CAN - Quebec	*Mecantina II*	Public-Société des traversiers du Québec	12	2	River St. Lawrence	Year round	1989		35	Harrington Harbour - Chevery
CAN - Quebec	*Peter-Fraser*	Public-Société des traversiers du Québec	70	12	River St. Lawrence	**seasonal**	2012		12	l'Île-Verte (de)
CAN - Quebec	*Radisson*	Public-Société des traversiers du Québec	375	58	River St. Lawrence	**seasonal**	1954	1985	70	L'Isle-aux-Coudres-Saint-Joseph-de-la-Rive
CAN - Quebec	*Saaremaa 1*	Public-Société des traversiers du Québec	600	110	River St. Lawrence	Year round	2010		14	Traverse Matane – Baie-Comeau – Godbout
CAN - Quebec	*Les Eaux scintillantes*	Public-Société des traversiers du Québec	16	0	River St. Lawrence	**seasonal**	1989	2017	35	Harrington Harbour - Chevery QB Urban
CAN - Quebec	*Rivière Saint-Augustin*	Public-Société des traversiers du Québec		0	River St. Lawrence	**seasonal**	2020		4	Harrington Harbour - Chevery QB Urban
CAN - Quebec	*Alexandrina-Chalifoux*	Public-Société des traversiers du Québec	367	75	River St. Lawrence	Year round	1980	1996	44	Tadoussac – Baie-Sainte-Catherine QB
CAN - Quebec	*Desgagnes, Bella*	Private - Relais Nordik TRANSPORT DESGAGNES INC	381	0	River St. Lawrence	**seasonal**	2008	2013	11	up to 12 Ports on mouth of St. Lawrence River
CAN - Quebec	*C.N.M Evolution*	Private - Chantier Meridien Industrie	150	30	River St. Lawrence	Year round	1997		27	Rimouski and Forestville Quebec **Jet Boat**
CAN - Quebec	*L'Héritage 1*	Pirvate Compagnie de Navigation des Basque	195	42	River St. Lawrence	**seasonal**	1973		51	Trois-Pistoles –Les Escoumins
CAN - Quebec	*Trans-Saint-Laurent*	Private Clarke Inc	400	100	River St. Lawrence	**seasonal**	1963		61	Rivière-du-Loup–Saint-Siméon
Quebec GL Ferries 22		**18 Public and 4 private**				**7 Seasonal 15 Year-round**				

Registry	Vessel Name	Ownership	Capacity Pas	Capacity Aut	Operational area	Operating season	Year Built	Upgrade	Age	Terminal Locations -
CAN - Ontario	*Amhurst Islander II*	MTO Owned Op Loyalist Township	300	40	Sheltered	Year-round	2021		3	Amhurst to Millhaven
CAN - Ontario	*Chi-Cheemaun*	Private Owen Sound Transportation	530	138	Open Lake	**seasonal**	1974		50	Tobermory/Bruce Peninsula, Ontario
CAN - Ontario	*City of Algonac*	Private Walpole Algonac Ferry Ltd	165	12	River St. Clair	Year-round	1990		34	Walpole, Ontario & Algonac NY St. Clair River **Cross Border**
CAN - Ontario	*Columbia V (The)*	Private Amherstburg Ferry Company	28		River St. Lawrence	Year-round	1946		78	Bois Blanc Island & Amherstburg, Ontario
CAN - Ontario	*Darrell, William*	Public Horne Island Minstry of Transport	97	11	River St. Marys	**seasonal**	1952		72	Wolfe Island, Ontario and Cape Vincent NY **Cross Border**
CAN - Ontario	*Frontenac Howe Island*	Public Ontario Ministry of Transport	49	15	Sheltered	Year-round	2004		20	Howe Island, Ontario - Cable Ferry
CAN - Ontario	*Frontenac II*	Private Amherst Island Ferry Service	276	40	River St. Lawrence	Year-round	1962		62	Amherst Island and Millhaven, Ontario
CAN - Ontario	*Glenora*	Public Government of Ontario	117	21	Sheltered	Year-round	1952		72	Glenora — Adolphustown, Ontario
CAN - Ontario	*Indian Maiden*	PublicGovernment of Ontario??	70		Sheltered	Year-round	1987		37	Cedar Point to Christian Island, Ontario
CAN - Ontario	*Inglis, William*	Public Toronto Parks, Forestry and Recreation Division	394		Sheltered	**seasonal**	1935	2012	89	Toronto, Ontario area islands
CAN - Ontario	*Jilmaan*	Public Owen Sound Mgt.- Out of Service	400	40	Long term lay-up	Long term lay-up	1992		32	Pelee Island, Ontario
CAN - Ontario	*Mcbride, Sam*	Public Toronto Parks, Forestry and Recreation Division	975	0	Sheltered	**seasonal**	1939	1973/2008	85	Toronto, Ontario area
CAN - Ontario	*Ongiara*	Public Toronto Parks, Forestry and Recreation Division	220	10	Sheltered	Year-round	1963	2008	61	mainland to Hanlan's Point and Wards Island
CAN - Ontario	*Pelee Islander*	Public vessel Owen Sound Mgt.	268	14	Open lake	**seasonal**	1960		64	Pelee Island, Ontario
CAN - Ontario	*Pelee Islander II*	Public vessel Owen Sound Mgt.	399	34	Open lake	**seasonal**	2018		6	Pelee Island, Ontario
CAN - Ontario	*Quinte Loyalist*	Public Amherst Island Ferry Service	117	21	River St. Lawrence	Year-round	1954		70	Amherst Island and Millhaven, Ontario
CAN - Ontario	*Rennie, Thomas*	Public Toronto Parks, Forestry and Recreation Division	975	0	Sheltered	**seasonal**	1951	2008	73	Toronto, Ontario area islands
CAN - Ontario	*Simcoe Islander*	Public MTO Owned	12	2	Long term lay-up	Long term lay-up				
CAN - Ontario	*Simcoe Islander II*	Public MTO owned Op Township of Frontenac	12	6	River St. Lawrence	Year-round	2022		2	Wolfe Island to Simcoe Island, Ontario - Cable Ferry
CAN - Ontario	*Ste. Claire V (The)*	Private Amherstburg Ferry Company	28	16	River St. Clair	Year-round	1997		27	Bois Blanc Island & Amherstburg, Ontario
CAN - Ontario	*Walpole Islander*	Private Walpole Algonac Ferry Ltd.	85	9	River St. Clair	Year-round	1986		37	Walpole Island Ontario & Algonac MI St. Clair River **Cross Border**
CAN - Ontario	*Wolfe Islander III*	Public Government of Ontario	294	50	River St. Lawrence	Year-round	1975		49	Kingston to Wolf Island, Ontario
CAN - Ontario	*Wolfe Islander IV*	Public Government of Ontario	399	80	River St. Lawrence	Year-round	2021	2024	3	Kingston to Wolf Island, Ontario
CAN - Ontario	*Graham, Sandy*	Public Beausoleil First Nation	98	28	Sheltered	Year-round	1957		67	Cedar Point to Christian Island, Ontario
	A new vessel on order	Public Beausoleil First Nation					2024			Cedar Point to Christian Island, Ontario
CAN - Ontario	*Hornell VC, David*	Public		150	Sheltered	Year-round	2005		19	Billy Bishop City Airport Toronto, Ontario
CAN - Ontario	*Trillium*	Public Toronto Parks, Forestry and Recreation Division	800	0	Long term lay-up	Long Term lay-up	1910		114	Toronto, Ontario area
CAN - Ontario	*Marliyn Bell I*	Public	200	15	Sheltered	Year-round	2009	2022	25	Billy Bishop City Airport Toronto, Ontario
CAN - Ontario	Howe Island Foot Ferry	Public MTO owned Op Township of Frontenac	12	3	Sheltered	Year-round	1946		78	Howe Island, Ontario East End - Cable Ferry
Ontario - GL Ferries 28		**22 Public and 6 Private**				***7 Seasonal 16 Year-round**				
						***Long term lay up not included**				
Canada GL Ferries 50		**40 Public and 10 Private**				***13 Seasonal 34 Year-round**				

United States GL Ferries										
No Indiana GL Ferries										
Illinois GL Ferries										
Registry	**Vessel Name**	**Ownership**	**Capacity Pas**	**Capacity Aut**	**Operational area**	**Operating season**	**Year Built**		**Age**	**Terminal Locations -**
U.S. Illinois	*Alpha*	Private Wendella Sightseeing Company Inc.	56	0	Chicago River	seasonal	1999		25	Various docks in Chicago Harbor - Water Taxi
U.S. Illinois	*Bravo*	Private Wendella Sightseeing Company Inc.	95	0	Chicago River	seasonal	2001		23	Various docks in Chicago Harbor - Water Taxi
U.S. Illinois	*Lila*	Private Wendella Sightseeing Company Inc.	340	0	Chicago River	seasonal	2012		12	Various docks in Chicago Harbor - Water Taxi
U.S. Illinois	*Linnea*	Private Wendella Sightseeing Company Inc.	340	0	Chicago River	seasonal	2010		14	Various docks in Chicago Harbor - Water Taxi
U.S. Ilinois	*Ouilmette*	Private Wendella Sightseeing Company Inc.	202	0	Chicago River	seasonal	2001		23	Various docks in Chicago Harbor - Water Taxi
U.S. Illinois	*Wendella*	Private Wendella Sightseeing Company Inc.	340	0	Chicago River	seasonal	2007		17	Various docks in Chicago Harbor - Water Taxi
U.S. Illinois	*Wendella LTD*	Private Wendella Sightseeing Company Inc.	150	0	Chicago River	seasonal	1992		32	Various docks in Chicago Harbor - Water Taxi
U.S. Illinois	*Wendella Sunliner*	Private Wendella Sightseeing Company Inc.	97	0	Chicago River	seasonal	1961		63	Various docks in Chicago Harbor - Water Taxi
Total Illinois GL ferries 8		**8 Private**				**8 Seasonal**				

Registry	Vessel Name	Ownership	Capacity Pas	Capacity Aut	Operational area	Operating season	Year Built	Upgrade	Age	Terminal Locations -
US - Michigan	*Anna May*	Private D/B/A Star Line St. Ignace, MI	150	0	Sheltered	**Year-round**	1947	2014	77	Mackinac Island, St. Ignace, Mackinaw City
US - Michigan	*Badger*	Private - Interlake	600	180	Open Lake	seasonal	1953		71	Ludington MI - Manitowoc WI
US - Michigan	*Beaver Islander*	Private Beaver Island Boat Company	172	9	Open Lake	seasonal	1962		62	Beaver Island & Charlevoix
US - Michigan	*Cadillac*	Private D/B/A Star Line St. Ignace, MI	150	0	Open Lake	seasonal	1990		34	St. Ignace & Mackinaw Island
US - Michigan	*Capt. Shepler*	Private Scheplers	265	0	Open Lake	seasonal	1986	2021	38	St. Ignace & Mackinaw Island
US - Michigan	*Champion*	Private Champion auto ferry	50	12	River St. Clair	**Year-round**	1985		39	Algonac to Harsen's Island MI
US - Michigan	*Corsair*	Private Star D/B/A Line St. Ignace, MI	190	12	Open Lake	seasonal	1955		69	St. Ignace & Mackinaw Island
US - Michigan	*Drummond Islander III*	**Public** Eastern Upper Peninsula TRSP Authority	149	24	River St Marys	**Year-round**	1989		35	St Marry's River MI Drummond Island
US - Michigan	*Drummond Islander IV*	**Public** Eastern Upper Peninsula TRSP Authority	149	32	River St. Marys	**Year-round**	2000		24	St Marry's River MI Drummond Island
US - Michigan	*Emerald Isle*	Public Beaver Island Transpo Authority	293	20	Open lake	seasonal	1997		27	Beaver Island & Charlevoix - Rural
	new boat coming	Public Mackinaw Island Transport Authority	vesssel to meet FTA							
US - Michigan	*Felicity*	Private Scheplers	150	0	Open Lake	seasonal	1972		52	Mackinac Island, St. Ignace, Mackinaw City
US - Michigan	*Grand Island*	Private Grand Island Ferry		0	Sheltered	seasonal	1989		35	Munising, MI to Grand Ils M - Open pontoon boat
US - Michigan	*Hope (The)*	Private Scheplers	150	0	Open Lake	seasonal	1975		49	St. Ignace & Mackinaw Island
US - Michigan	*Joilet*	Private Star Line St. Ignace, MI	150	0	Open Lake	seasonal	1993		31	Mackinac Island, St. Ignace, Mackinaw City
US - Michigan	*Kristen D.*	Private Plaunt Transportation, Inc	80	17	Open Lake	seasonal	1987		37	Cheboygan to Bois Blance Island MI
US - Michigan	*La Salle*	Private Star Line St. Ignace, MI	150	0	Open lake	seasonal	1987		37	Mackinac Island, St. Ignace, Mackinaw City
US - Michigan	*Mackinac Express*	Private D/B/A Star Line St. Ignace, MI	350	0	Open lake	seasonal	1987		37	Mackinac Island, St. Ignace, Mackinaw City
US - Michigan	*Marquette II*	Private D/B/A Star Line St. Ignace, MI	330	0	Open lake	seasonal	2005		19	Mackinac Island, St. Ignace, Mackinaw City
US - Michigan	*Middle Channel*	Private Champion auto ferry	149	14	River St Clair	seasonal	1997		27	Harsens Island, connecting M-154 to the mainland
US - Michigan	*Mishe Mokwa*	Private Manitou Island Transit Park Concession	110	10	Sheltered	seasonal	1966		58	North and Manitou Islands, Leeland MI
US - Michigan	*Miss Margy*	Private Scheplers	281	0	Open lake	seasonal	2015		9	Mackinac Island, St. Ignace, Mackinaw City
US - Michigan	*Neebish Islander III*	**Public** Eastern Upper Peninsula TRSP Authority	150	15	River St. Marys	**Year-round**	2022		2	St Mary's River MI Neebish Island
US - Michigan	*North Channel*	Private Champion auto ferry	100	12	River St. Clair	seasonal	1967		57	Harsens Island, connecting M-154 to the mainland
US - Michigan	*Radisson*	Private D/B/A Star Line St. Ignace, MI	317	0	Sheltered	seasonal	1988		36	Mackinac Island, St. Ignace, Mackinaw City
US - Michigan	*Sacre Bleu*	Private Scheplers	150	0	Open lake	seasonal	1959		65	Mackinac Island, St. Ignace. Mackinaw City
US - Michigan	*South Channel*	Private Champion auto ferry	100	12	River St. Clair	seasonal	1973		51	Algonac, Mi and Harsens Island, Mi
US - Michigan	*Straits of Mackinac II*	Private D/B/A Star Line St. Ignace, MI	500	0	Open lake	seasonal	1969		55	St. Ignace & Mackinaw Island -
US - Michigan	*Sugar Islander II*	**Public** Eastern Upper Peninsula TRSP Authority	140	24	River St. Marys	**Year-round**	1995		29	Sugar Island & Sault Ste. Marie
US - Michigan	*Welcome (The)*	Private Scheplers	97	0	Open lake	seasonal	1969		55	Mackinac Island, St. Ignace, Mackinaw City l
US - Michigan	*William Richard*	Private Scheplers	210	0	Open lake	seasonal	2020		4	St. Ignace & Mackinaw Island -
US - Michigan	*Wyandot*	Private Scheplers	265	0	Open lake	seasonal	1979		45	St. Ignace & Mackinaw Island -
US - Michigan	*Charlevoix (Cable Ferry*	**Public** Charlevoix Transportation Authority	28	4	sheltered	seasonal	1926		98	Charlevoix Lake Ironton Michigan
US - Michigan	*Huron*	Private Star Line St. Ignace, MI	330	0	Open lake	**Year-round**	1955		71	Mackinac Island, St. Ignace, Mackinaw City
US - Michigan	*Ottawa*	Private Star Line St. Ignace, MI	500	0	Open lake	seasonal	1950s		71	Mackinac Island, St. Ignace, Mackinaw City
US - Michigan	*Isle Royale Queen IV*	Private National Park Service concession	15	0	Open lake	seasonal	1980		44	Copper Harbor, M to Isle Royale National Park
US - Michigan	*Chippewa*	Private D/B/A Star Line St. Ignace, MI	250+	0	Sheltered	seasonal	1962	2025	62	Mackinac Island, St. Ignace, Mackinaw City
US - Michigan	*Ranger III*	**Public** National Park Service	90 maximum	0	Open Lake	seasonal	1958		66	Houghton MI to to Isle Royale National Park
US - Michigan	*Miss Lauren*	**Public** Little Traverse Bay Ferry non-profit 501(c)(3)	30	0	Sheltered	seasonal	2020		4	Petosky, MI to Bay Harbor MI and Harbor Springs, MI
Total Michigan GL Ferries 37		**7 Public and 31 Private**				**30 seasonal 7 year-round**				

Minnesota GL Ferries										
Registry	**Vessel Name**	**Ownership**	**Capacity Pas**	**Capacity Aut**	**Operational area**	**Operating season**	**Year Built**	**Upgrade**	**Age**	**Terminal Locations -**
US - Minnesota	*Sea Hunter III*	Private Grand Portage Isle Royale Transportation Lines	70	0	Open lake	seasonal	1985		39	Grand Portage, MN & Isle Royale National Park MN to MI
US - Minnesota	*Voyager II*	Private Grand Portage Isle Royale Transportation Lines	49	0	Open Lake	seasonal	1970		54	Grand Portage, MN & Isle Royale National Park MN t
Total Minnesota GL ferries 2		**2 private vessels**				**2 seasonal**				
New York GL Ferry	Queen City Bike Ferry	Public Erie Canal Harbor Development Corporation	49	0	Sheltered	Seasonal	2015		9	Buffalo's inner and outer harbor.
Total New York GL Ferries 1		**1 Public**				**1 seasonal**				
Ohio GL Ferries										
Registry	**Vessel Name**	**Ownership**	**Capacity Pas**	**Capacity Aut**	**Operational area**	**Operating season**	**Year Built**	**Upgrade**	**Age**	**Terminal Locations -**
US - Ohio	*Carlee Emily*	Private Kelleys Island Ferry Boat Line	149	0	Open Lake	seasonal	1987		37	Marblehead to Kelly's Island OH
US - Ohio	*Juliet Alicia*	Private Kelleys Island Ferry Boat Line	149	0	Open Lake	seasonal	1969		55	Marblehead to Kelly's Island OH
US - Ohio	*Shirley Irene*	Private Kelleys Island Ferry Boat Line	150	60	Open Lake	**Year-round**	2003		21	Marblehead to Kelly's Island OH
US - Ohio	*Carmen Lee*	Private Kelleys Island Ferry Boat Line	148	36	Open Lake	seasonal	2022		2	Marblehead to Kelly's Island OH
US - Ohio	*Kayla Marie*	Private Kelleys Island Ferry Boat Line	149		Open Lake	seasonal	1970		54	Marblehead to Kelly's Island OH
US - Ohio	*Jet Express*	Private Put-in-Bay Boat Line Company (The Jet Express)	380	0	Open Lake	seasonal	1989		35	Islands in Lake Erie - US
US - Ohio	*Jet Express II*	Private Put-in-Bay Boat Line Company	395	0	Open Lake	seasonal	1992		32	Islands in Lake Erie - US
US - Ohio	*Jet Express III*	Private Put-in-Bay Boat Line Company	149	0	Open Lake	seasonal	2001		23	Islands in Lake Erie - US
US - Ohio	*Jet Express IV*	Private Put-in-Bay Boat Line Company	147	0	Open Lake	seaslonal	1995		29	Islands in Lake Erie - US
US - Ohio	*Islander*	Private Miller boat line	380	16	Open Lake	seasonal	1983		41	Put-in-Bay & Middle Bass Island & Catawba OH
US - Ohio	*Market, Mary Ann*	Private Miller boat line	600	28	Open Lake	seasonal	2021		3	Put-in-Bay & Middle Bass Island & Catawba OH
US - Ohio	*Market, William*	Private Miller boat line	500	20	Open Lake	seasonal	1993	2016	31	Put-in-Bay & Middle Bass Island & Catawba OH
US - Ohio	*Put-in-bay*	Private Miller boat line	600	26	Open lake	seasonal	1997	2010	27	Put-in-Bay & Middle Bass Island & Catawba OH
US - Ohio	*South Bass*	Private Miller boat line	250	20	Open lake	seasonal	1989		35	Put-in-Bay & Middle Bass Island & Catawba OH
Total Ohio 14 GL Ferries		**14 Private vessels**				**13 seasonal 1 year-round**				

No Pennsylvania GL Ferries										
No Vermont GL Ferries										
Wisconsin GL Ferries										
Registry	**Vessel Name**	**Ownership**	**Capacity Pas**	**Capacity Aut**	**Operational area**	**Operating season**	**Year Built**	**Upgrade**	**Age**	**Terminal Locations -**
US - Wisconsin	*Bayfield*	Public Town of La Point, WI	150	25	Sheltered	seasonal	1952		72	Bayfield to Madeline Ils / Apostle Islands
US - Wisconsin	*Madelin*	Public Town of La Point, WI	150	20	Sheltered	seasonal	1984		40	Bayfield to Madeline Ils / Apostle Islands
US - Wisconsin	*Island Queen*	Public Town of La Point, WI	150	15	Sheltered	**Year round** ice permitting	1966		58	Bayfield to Madeline Ils / Apostle Islands
US - Wisconsin	*La Pointe*	Public Town of La Point, WI	150	20	Sheltered	seasonal	1987		37	Bayfield to Madeline Ils / Apostle Islands
US - Wisconsin	*Nichevo II*	Public Town of La Point, WI	150	10	Sheltered	seasonal	1962		62	Bayfield to Madeline Ils / Apostle Islands WI
US - Wisconsin	*Karfi*	Private Washington Island Ferry Line	49	0	Open Lake	seasonal	1967	2012	57	Washington Island to Rock Island WI
US - Wisconsin	*Eyrabakki*	Private Washington Island Ferry Line	149	18	Open lake	seasonal	1970		54	Washington Island to North Port WI
US - Wisconsin	*Madonna*	Private Washington Island Ferry Line	149	28	Open lake	**Year-round**	2020		4	Washington Island to North Port WI
US - Wisconsin	*Nobel, Robert*	Private Washington Island Ferry Line	149	20	Open lake	seasonal	1979		45	Washington Island to North Port WI Rual
US - Wisconsin	*Richter, Arni J.*	Private Washington Island Ferry Line	149	20	Open lake	**Year-round**	2003		21	Washington Island to North Port WI
US - Wisconsin	*Washington*	Private Washington Island Ferry Line	149	22	Open lake	seasonal	1989		35	Washington Island to North Port WI
US - Wisconsin	*Lake Express*	Private Lake Express Ferry	250	46	Open lake	seasonal	2004		20	Milwaukee, WI to Muskegon, MI
US - Wisconsin	*Island Clipper*	Private Voight's Marine Service, LLC	149	0	Sheltered	seasonal	1987		37	Gills Rock, WI Washington Island, WI
Total Wisconsin GL Ferries 13		**5 public and 8 private ferries**				**10 Seasonal 3 Year-round**				
Total U.S. 76 GL Ferries		**13 public and 63 private**				**65 Seasonal 11 Year-round**				
Total 126 GL Ferries		**53 Public and 73 Private**				***78 Seasonal 45 Year-round**				
						*Long term lay-up not included				