



## GREEN BOAT PROJECT A Worldwide First

*RiverQuest's mission is to provide interdisciplinary river-based environmental education and adventure experiences to people of all ages, to transform their understanding of the world around them.*

**RiverQuest has created Explorer**, one of the first green passenger boats in the world to serve as its flagship vessel for river-based science education and public programming. The 150-passenger, 90'x25' boat will serve over 10,000 students a year while reducing emissions to air and water, implementing innovative propulsion technology and alternative fuels. It will also serve as a practical model for sustainable boating technology worldwide. The following objectives have guided the *Explorer* project from concept to reality:

- Serve as an **educational tool and real world example of sustainable design practices** for the students, teachers and the public that RiverQuest serves.
- **Minimize the impact of operations on the natural environment.**
- Showcase how **green building design** and environmentally friendly procedures can be utilized on a passenger vessel **while still maintaining operating efficiency and reliability.**
- Design and build a passenger vessel that implements the Leadership in Energy and Environmental Design (LEED™) process for all applicable systems.

Over **110 onboard systems** were investigated and the resulting vessel design

demonstrates a number of technologies that are new to the marine industry. The following are examples of the innovative features of RiverQuest's *Explorer*:

- Hybrid diesel-electric propulsion system and a power plant designed for the future addition of solar, wind or fuel cells.
- Large battery banks for zero emission operations - charged at dock or underway.
- Generator engine waste heat recovery.
- Excellent thermal insulation system.
- Low volatile organic coatings.
- Highly efficient interior and exterior lighting systems.
- Water efficiency and zero wastewater discharge.
- Energy management and control system.

### Project Team:

THE HEINZ ENDOWMENTS  
Carnegie Mellon



SIEMENS

PPAFFMANN+ASSOCIATES PC

Perkins Eastman



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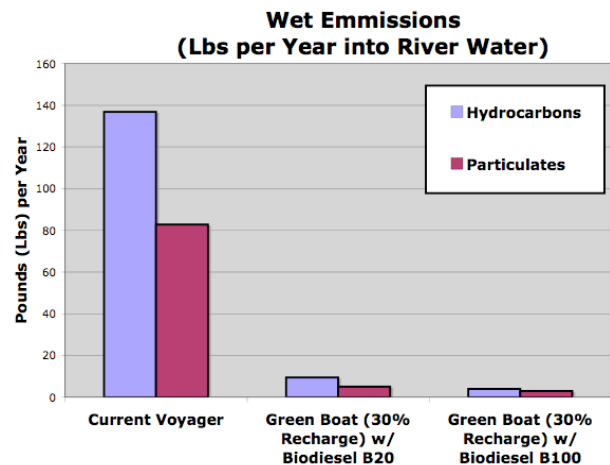
## GREEN BOAT PROJECT *Air and Water Quality*

**RiverQuest** provides river-based environmental education and public programming to thousands of children and adults every year on the rivers of Western PA and beyond the region. In designing *Explorer*, we sought to significantly reduce our impact to the air and water as compared with our baseline fleet of traditional diesel powered vessels, *Voyager* and *Discovery*. The goals are to improve our environmental performance and demonstrate environmental stewardship to our students and customers.

In spite of our environmental mission, the limitations of our current aging fleet have hindered stewardship for the environment. The majority of inland coastal and ocean vessels burns marine diesel fuel which burns hundreds of times dirtier than US highway diesel.

Air emissions modeling in Allegheny County suggests that diesel emissions are amongst

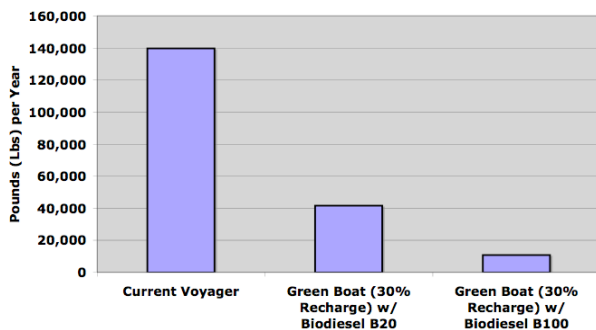
the worst in the US with human health risks over 500 times the US EPA acceptable levels. **Marine emissions from river commerce contribute as much as 30% of the overall diesel particulate matter in the region.**



*Explorer* will achieve significant reductions in both air and wet emissions, air emissions that are released underwater and captured by the river water, via:

- Hybrid diesel-electric propulsion system with state-of-the-art diesel engine technology.
- Use of biodiesel blended fuel.
- Use of 100% renewable electric power from the local grid to charge the battery banks while at dock.
- Future fuel cell, photovoltaic and micro wind turbine implementation.

**Carbon Dioxide Emissions  
(Lbs per Year)**



### Air and Water Quality Team:



CLEAN AIR TASK FORCE

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## GREEN BOAT PROJECT *Green Construction and LEED™ Processes*

**The Explorer design team** thoroughly researched US and global standards for designing an environmentally friendly and sustainable vessel, but found none that were comprehensive enough for the goals of this project. One of the most mature and flexible green design standards within industry today is the US Green Building Council's (USGBC) Leadership in Energy and Environmental Design or LEED™ standard.

Pittsburgh, a leader in green buildings for over ten years, has amongst the largest number of square feet of LEED™ certified space than any other city in the world, including the first certified convention center, historic building, university residence hall and children's museum. Our team determined that applying the LEED™ process to the design of *Explorer* was the best approach to holistically evaluate the boat design using an objective standard.



*Pittsburgh's David L. Lawrence Convention Center*

We also think it appropriate that Pittsburgh continue to set new trends in environmental thinking and practice in keeping with our history of global innovation.

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**RiverQuest's Explorer is the first boat to apply the LEED™ process to its design and**



**construction.** Many boat subsystems such as HVAC, lighting, interior design and materials, plumbing and windows are practically identical to buildings.

The project has required a close team effort with considerable education of our contracted shipyard and contractors about green material selection and construction techniques.

RiverQuest is following the entire LEED™ process and we expect that USGBC will provide official recognition of our efforts.

The LEED™ process has significantly changed our boat design approach for:

- **Windows** – Energy efficient custom architectural windows replace marine windows – for the same price.
- **HVAC** – Chiller size requirements have been reduced through energy modeling
- **Insulation** – Thermal breaks are added to wall construction.
- **Materials and Coatings** – Cabinetry is made from renewable materials that are new to the contractors building the boat and the industry.

### Green Construction Team:



**Perkins Eastman**





## GREEN BOAT PROJECT *Hybrid Propulsion System and Alternative Fuels*

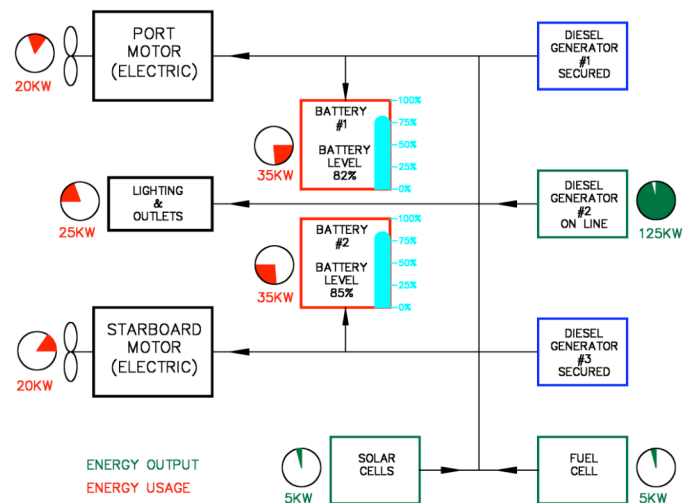
The most innovative aspect of RiverQuest's *Explorer* is the propulsion system. After a thorough evaluation of existing technology by the industry's leading alternative fuel marine engineers, Alion JJMA, the designers of the yet-to-be-built San Francisco Bay Area Water Transit Authority Fuel Cell Ferry, it was determined that a diesel-electric hybrid system was the best alternative. The flexibility and exceptional environmental performance of this design is coupled with high reliability and proven technology.

***Explorer* is one of the first vessels in the world constructed with this propulsion system design.**

The hybrid propulsion system being provided by Siemens Energy and Automation will combine the use of green power from shore with the world's most advanced diesel-electric power generation technology onboard. The engines will run on a biodiesel fuel blend and the system explicitly provides for the future addition of new power sources such as a fuel cell, solar panels and micro wind turbines. **The organization's reliance on imported oil will be significantly reduced through the use of domestic biodiesel.**

*Explorer* will reduce the total energy needed by the RiverQuest fleet to serve 10,000 students by over 35,000 kW-hrs per year or nearly 50%. Emissions of CO<sub>2</sub>, SO<sub>x</sub> and PM will be significantly reduced.

The design and construction of RiverQuest's green boat *Explorer* represents a significant national and international step for green boat design and the successful integration of energy and environmental goals within a defined operational marine context.



### Propulsion System Team:

**SIEMENS**



**ALION**  
SCIENCE AND TECHNOLOGY

**Carnegie Mellon**



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## GREEN BOAT PROJECT *Environmental, Energy & Sustainability Education*

**RiverQuest's core mission and competency is river-based science education.** As Pittsburgh Voyager, RiverQuest has been delivering award winning education programming for over ten years. *Explorer* will provide a revolutionary new platform from which to teach school groups and the public about the environment, alternative energy sources, and sustainability.

***Explorer* will become a powerful teaching tool for all who come on board**, whether for educational or tour programs or for after-hours charters and special events. The special ADA-accessible features will make this a vessel truly capable of serving the entire community.

As part of the curriculum development related to the new vessel, RiverQuest and our partners and expert education consultants will develop energy and sustainability modules to add to both our current core programs:

- *Environmental Science on the 3 Rivers*
- *Boats, Bridges & Water*

In addition we will be building a whole new series of **programming exclusively around green engineering, sustainability and energy that will complement the boat's interpretive signage** and hands-on learning opportunities. *Explorer* will also provide for significant program expansion due to increased capacity.

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### Education and Public Programming Team:



One of the four  
Carnegie Museums  
of Pittsburgh

Carnegie Mellon





## GREEN BOAT PROJECT *Technical Specifications*

### **Dimensions**

Length Overall:	90'-6"
Length on Deck:	89'-0"
Beam (molded):	26'-0"
Depth (molded hull):	10'-0"
Draft, Full Load:	5'-6"
Draft, Mean Normal Operating:	5'-0"
Maximum Air Draft:	40' above baseline
Gross Tonnage:	Less than 100

### **Passengers and Crew**

Passengers:	150
Crew:	20

### **Certifications**

Route:	Protected Waters
U.S. Coast Guard Classification:	Subchapter T

### **Capacities**

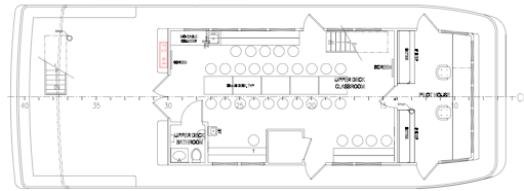
Fuel Storage Capacity:	2,000 Gallons
Potable Water Capacity:	1,800 Gallons
Black Water Capacity:	1,400 Gallons
Dirty Lube Oil Capacity:	200 Gallons

### **Materials**

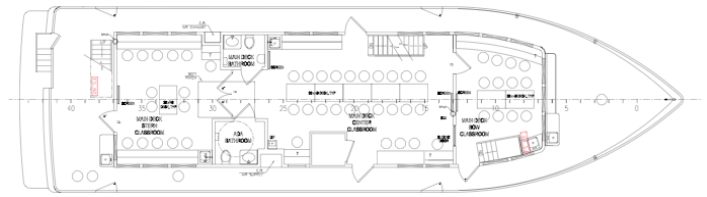
Hull:	100% recycled steel
Railing system:	Anodized aluminum
Custom cabinetry:	Wheat board

### **Major Systems**

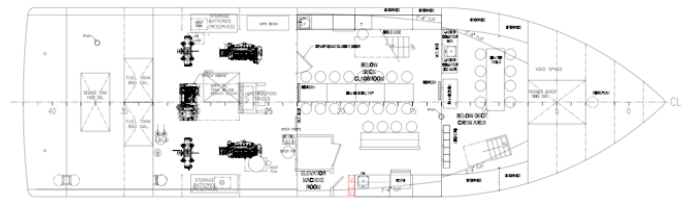
Propulsion System:	ELFA™, Siemens Hybrid Marine Propulsion System
Marine Paint System:	Sherwin Williams
Window System:	TRACO NX-200



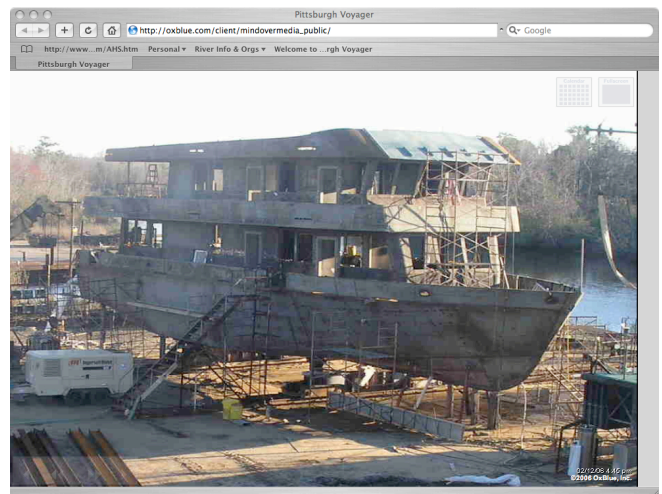
*Explorer Second Deck Arrangement*



*Explorer Main Deck Arrangement*



*Explorer Below Deck Arrangement*



Web cam photograph of *Explorer* under construction in Freeport, FL, February 12, 2006.

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