

PVA WATERS Program
We Are Taking Environmental Responsibility/Stewardship

PVA Best “Green” Business Practices

Executive Summary

Since its inception, the Passenger Vessel Association (PVA) has been offering its members the information they need to succeed.

That credo continues with an exciting new “voluntary” program that provides a comprehensive look at the “Green” movement, while offering realistic ideas for ways in which PVA members can easily adopt or expand environmentally friendly practices, which often result in saving money and generating a positive “buzz” from customers, employees, media, and the community.

PVA staff and expert volunteers worked for many months developing a “Best Green Business Practices” manual that will efficiently guide you through the often complex world of “Green” environmentalism. Through the use of case studies and concrete examples that are tailored specifically to the passenger vessel industry, this “living” document allows operators to quickly understand how environmentally friendly practices can be easily and cost-effectively adopted. The manual will also help members understand the positive impact that such practices have upon public opinion. Plus, many PVA operators will be pleased to know that they are already doing many of the things the program advocates.

Again, this program is voluntary and is intended to assist passenger vessel operators run cleaner, greener business operations without causing financial or operational strain. Because every vessel operation is different, this program, which will evolve over time, is expected to be used as a guide and operators should use those practices that make sense for their individual operation.

In addition to the electronic manual, accessible online at www.passengervessel.com/green, the PVA WATERS program includes an easy-to-use checklist for members to assess the level of their environmental stewardship. Using this checklist, members can get numerous “Green” ideas to improve or evaluate:

- Office Operations
- Power Sources
- Fuel Type and Consumption
- Galley Processes

- Engine Maintenance and Emissions
- Vessel Design and Construction
- Paperless Marketing Materials and Collateral
- Reservations and Ticketing
- Water Consumption
- Environmental Training

Upon implementing these, or any of the practices that best meet your operation's unique needs, vessel operators are encouraged to share this information with PVA. Please complete the PVA WATERS Best Green Business Practices Checklist to receive a PVA WATERS participation certificate and window sticker.

Passenger Vessel Association
 Alexandria, VA
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PVA thanks the following members who offered significant guidance in the development of the PVA WATERS Program:

Michael Borgstrom, Wendella Sightseeing Boats, Chicago, IL
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 Robin Trinko-Russell, Madeline Island Ferry Line, La Pointe, WI
 Kevin Stier, River Cruises, Scales Mound, IL
 Dan Yates, American Waterways, Inc., Portland, OR

We would also like to thank the PVA Membership Committee, under whose auspices this project falls, and especially its chair Terri Bernstein, B.B. Riverboats, Newport, KY, for her support and encouragement.

GREEN EVOLUTION

Why Go Green?

When asked why a growing group of passenger vessel operators were “going green,” the answers were surprisingly straightforward: “To save money,” and “because it’s the right thing to do.” Other reasons include promoting their business as environmentally responsible, and garnering recognition and acceptance by local business communities which are increasing pressure on business and industry to be greener, because let’s face it, no community wants a Superfund-worthy site in its neighborhood.

Another obvious reason for adopting greener practices is that our business, the passenger vessel industry, is very much dependent on the environment, arguably more so than many other industries. Weather can dictate our daily schedules determining whether or not a sailing can occur. Many of us are season-dependent, so climate plays a crucial role of when our “busy season” starts and ends. Inclement weather can devastate our operations, as those who suffered the wrath of Hurricanes Katrina and Rita in New Orleans and the Gulf Coast can attest.

But there are less obvious environmental factors that affect our day-to-day operations. Recent low water levels in the Great Lakes is proving to be an expensive—and logistically challenging—problem as docks and drafts are higher than the water levels are allowing.

By and large, employees want to work for an environmentally healthy and responsible company. According to a survey on green employment conducted by MonsterTRAK.com, a job site targeted at students and entry-level hires, 80 percent of young professionals are interested in securing a job that has a positive impact on the environment, and 92 percent indicated they would be more inclined to work for a company that is environmentally friendly. Offering positions to qualified job candidates to work in companies that are demonstrably “green” may provide vessel operators/owners an advantageous edge over other businesses competing for the same prospective employees.

Perhaps most important of all, our customers, the passengers who pay to ride our vessels, are affected by the environment in and around our operations. Dirty, smelly waterways are a turn-off, the absence of healthy wildlife is a disappointment, and when fresh breezes blowing off the bow are replaced by acrid air or landscapes that have turned dismal, business suffers. People want green. And, more and more, they are demanding it.

Case Study

*In Portland, OR, PVA Member **Dan Yates, President of American Waterways, Inc.**, learned that unless he implemented green business practices, his vessel, the Portland Spirit, could be cut off from the leads generated by Travel Portland and the Portland Oregon Visitors Association. Yates started with a recycling program, then added a series of initiatives that he has found has not only gained him business, but has saved money, and created enthusiasm among employees who are striving to be even greener.*

Finally, the law is on the side of responsible environmental stewardship. Federal and state laws are becoming more stringent when it comes to a cleaner, greener, marine environment. As PVA member Jeanne Grasso, partner in the law firm **Blank Rome** confirms, the laws do apply to passenger vessels and enforcement is getting more aggressive.

Use this document as a guideline to help you get started. It's voluntary, and is based on the best green business practices from vessel operators around the nation. Some ideas will work better than others based on the type of operation, location, size, and other factors. This document is intended to be a "living" guideline, meaning it will continue to change and adapt according to new situations, information, products, and concepts. As you adopt or adapt these practices, we encourage you to provide feedback on your experiences so that we all can learn from each other.

How to Go Green?

Saving money. Generating positive opinion. Doing the "right thing."

Whatever your politics or beliefs, implementing "green" business practices in your operation makes good sense. Around the nation, PVA vessel and associate members have adopted a greener way of running their operations and they have expressed extremely high levels of satisfaction in a number of areas as a result. Number one: they're saving money.

Perhaps you've been told that "green" practices will cost you. If so, you may have been talking to the wrong folks. PVA vessel members who have "gone green" have found that they are **SAVING** money, not spending it.

Some PVA vessel operators are choosing to reinvest some of the savings into other green initiatives, such as purchasing chlorine-free paper for marketing materials, investing in solar, or buying other products that initially may have been perceived as expensive, but realizing the impact that green practices have over the long run, have opted to adopt.

Maybe you've been under the impression that "green" practices are difficult and time-consuming. Wrong, again! PVA members are finding that implementing green practices is easier than they anticipated.

Some vessel members have reported they've received positive public recognition for their green efforts. PVA vessel members **RiverQuest**, a Pittsburgh-based operator of the *M/V Explorer*, was named the winner of the 2008 WorkBoat Environmental Award and **Yankee Roamer, Inc.**, Key West, FL, accepted the first honorable mention award for environmental practices aboard the *Yankee Freedom II*.

While "doing the right thing" is subjective, 100 percent of vessel operators surveyed said employees are striving to help the operation become more environmentally friendly and responsible, and several suggest that this effort creates a stronger bond between employees and management which fosters a better working atmosphere.

Getting Started

So, green operations are saving money, have good PR, happier employees, are getting business leads, and are complying with laws relating to the marine environment. What's not to like? And, more importantly, how can you get onboard to begin reaping these benefits, too?

To begin, you should assess your operation's current status. There are a number of factors to consider, including:

- Land-based Facilities
- Vessels
- Lighting
- Water Usage
- Cleaning Materials
- Waste Management
- Construction Materials
- Fuel
- Appliances and Equipment
- Supplies

Don't let this list overwhelm you. Each will be covered in turn. Perhaps the best way to start is to review one aspect that has affected everyone at home and in office—energy usage. Making changes in this area can quickly—and possibly significantly—save money.



Energy Conservation *Measure Your Impact*

“Portion of energy in buildings used inefficiently or unnecessarily: 30 percent.”
--U.S. EPA, ENERGY STAR Program

Your land-based business, like all businesses, emits energy. The question is, how much? Inefficiencies and energy drains can cost you significant amounts of money over the years, so it is important you understand where and why you may be paying more utility costs than you need to. However, in order to improve and reduce your operation's environmental impact, you must first assess your current impact. This can be done in two ways:

1. Hire a professional auditor—or contact your local utility company to locate one—to conduct an energy/environmental impact audit.
2. Conduct your own energy audit.

If you hire a professional auditor, the U.S. Department of Energy (DOE), and some state agencies, and electric companies offer information about locating an energy auditor. Try checking with your state to find an auditor near you. The DOE's web site,

<http://apps1.eere.energy.gov>, also provides considerations for you before an auditor arrives at your office.

The U.S. Environmental Protection Agency (EPA)'s Energy Star program also provides a wealth of information for owners of commercial buildings on energy management. EPA suggests a simple seven step plan to management energy in buildings. To access the EPA's plan, which is illustrated here, simply click on the links below.

EPA Energy Star Commercial Buildings & Plants Energy Management Plan

- STEP 1: [Make Commitment](#)
- STEP 2: [Assess Performance](#)
- STEP 3: [Set Goals](#)
- STEP 4: [Create Action Plan](#)
- STEP 5: [Implement Action Plan](#)
- STEP 6: [Evaluate Progress](#)
- STEP 7: [Recognize Achievements](#)



Source: U.S. Environmental Protection Agency

Learn More:

U.S. Environmental Protection Agency, Energy Star, Commercial Buildings & Plants
http://www.energystar.gov/index.cfm?c=business.bus_index

“Combined annual energy costs for U.S. commercial buildings (\$107.9 billion) and industrial facilities (\$94.4 billion): \$202.3 billion.”

--Energy Information Administration

Energy Audit Preparation

Before an energy auditor visits your business, try to identify existing problems such as condensation and uncomfortable or drafty offices. Make a list and share it with your employees to be sure it's complete. Give the list to your energy auditor. Have copies or a summary of the site's yearly energy bills. If needed, you can contact your utility company for these, or if you have an online account, you may be able to access past bills. Auditors use this information to establish what to look for during the audit. Auditors should examine the exterior of the building to determine its size features (i.e., wall area, number and size of windows). The auditor then will analyze occupant behavior:

- Number of hours that the office is occupied
- The average thermostat setting for summer and winter
- How many people work there?
- Unused office spaces

Addressing these areas may uncover simple ways to reduce your office's energy consumption. Plan to walk around with the auditor, ask questions, and point out any concerns that you may have. Remember, the beneficiary of identifying energy drains and inefficiencies is you since you may be paying the higher-than-needed utility bills. Auditors often use equipment to detect sources of energy loss, such as blower doors, infrared cameras, furnace efficiency meters, and surface thermometers.

Energy Auditor Selection

On its web site, the DOE's Energy Efficiency and Renewable Energy (EERE) suggests several places where you may locate professional energy auditing services. State or local government energy or weatherization offices may help you identify a local company or organization that performs audits. They may also have information on how to do your own audit. Your electric or gas utility may conduct residential energy audits or recommend local auditors. Also check the telephone directory under headings beginning with the word "Energy" for companies that perform residential energy audits.

Before contracting with an energy auditing company, you should take the following steps:

- Get several references, and contact them all. Ask if they were satisfied with the work.
- Call the Better Business Bureau and ask about any complaints against the company.
- Make sure the energy auditor uses a calibrated [blower door](#).
- Make sure they do [thermographic inspections](#) or contract another company to conduct one.

Learn More:

U.S. Department of Energy, Residential (may apply to small businesses)

http://apps1.eere.energy.gov/consumer/your_home/energy_audits/index.cfm/mytopic=11180

U.S. Department of Energy, Commercial/Retail

<http://www1.eere.energy.gov/buildings/commercial/retail.html>

U.S. Environmental Protection Agency, Energy Star, Buildings & Plants
http://www.energystar.gov/index.cfm?fuseaction=SPP_DIRECTORY.showSPPResults&s_code=ALL&company_type_id=ECO&ms_code=ALL

Conducting Your Own Audit

If you own your own building or commercial property and you'd rather not hire an auditor, you can conduct your own energy audit. After all, we're trying to save you money and it's not as difficult as it sounds. The Department of Energy (DOE) suggests that if you are diligent, you may identify problem areas in your office simply by following these steps:

1. Create a Checklist for Problems
2. Locate Air Leaks
3. Inspect Insulation
4. Check Cooling & Heating Equipment
5. Consider Lighting

Your checklist should be dated the day of your self inspection, and then saved to check against a future inspection to see if you've fixed the problems. This doesn't have to be fancy; a piece of paper, a pen, and a clipboard will suffice, but you may want to input your findings onto your computer for handy reference and ease of updating.

“Since 1990, 48 percent of the increase in U.S. carbon emissions can be attributed to increasing emissions from the building sector.”

--Stephanie Battles & Eugene Burns, Trends in Building-Related Energy and Carbon Emissions: Actual and Alternate Scenarios

Locating Air Leaks

First, make a list of obvious air leaks or drafts. DOE suggests that potential energy savings from reducing drafts may range from five percent to 30% per year. To know how much you're saving, refer back to your energy bills for the past 12 months (your energy company should be able to access your bills if you don't have copies on hand). Check for indoor air leaks, such as gaps along baseboards, edges of flooring and at junctures of the walls and ceiling. Air flow leaks often occur at these sites and should be checked thoroughly:

- Electrical outlets
- Switch plates
- Window frames
- Baseboards
- Gaps in Caulking and Weather stripping
- Attic hatches
- Wall- or window-mounted air conditioners
- Gaps around pipes and wires
- Foundation seals
- Mail slots
- Doors and windows

Checking doors and windows means rattling them to determine if they move since movement indicates a loose fit and allows air to flow through. Also, visibly check door and window frames. If you can see daylight around the frame, air is leaking through. Also ensure that windows are fully intact as cracks also air seepage. These areas should be addressed with caulk, or replacement with new ones that carry the EPA's Energy Star logo. An inexpensive, albeit temporary, fix is to install low-cost plastic sheets over leaky windows to reduce air leaks.

Having trouble finding leaks? Try this basic building pressurization test offered by the DOE:

1. First, close all exterior doors and windows
2. Turn off all combustion appliances such as gas burning furnaces and water heaters.
3. Then turn on all exhaust fans or use a large window fan to suck the air out of the rooms.

According to the DOE, this test increases infiltration through cracks and leaks, making them easier to detect. Use incense sticks or your damp hand to locate leaks. If you use incense sticks, moving air will cause the smoke to waver, and if you use your damp hand, any drafts will feel cool to your hand.

On the outside of your building, inspect all areas where two different building materials meet, including:

- All exterior corners
- Areas where the foundation and the bottom of exterior brick or siding meet.

Now that you've identified holes and penetrations in and around faucets, pipes, electrical outlets, and wiring, you will need to plug and caulk the holes. Look for cracks and holes in the mortar, foundation, and siding, and [seal](#) them appropriately. As already noted, check the exterior caulking around doors and windows, and see whether exterior storm doors and primary doors seal tightly.

Caution: When sealing any edifice, you must always be aware of the danger of indoor air pollution and combustion appliance "backdrafts." Backdrafting is when the various combustion appliances and exhaust fans in inside compete for air. An exhaust fan may pull the combustion gases back into the indoor working space. This can obviously create a very dangerous and unhealthy situation in the office.

In buildings where a fuel is burned (i.e., natural gas, fuel oil, propane, or wood) for heating, be certain that the appliance has an adequate air supply. Generally, one square inch of vent opening is required for each 1,000 Btu of appliance input heat. When in doubt, contact your local utility company, energy professional, or [ventilation](#) contractor.

The EPA cautions that "sick building syndrome" (SBS) can be exacerbated by inadequate air ventilation. SBS is used to describe building occupants who experience "acute health and comfort effects" that may be linked to spending time in buildings despite the absence of a specific illness or cause. Inadequate ventilation may be a factor and includes heating, ventilating, and air conditioning systems that do not effectively

distribute air throughout the building. Commercial building owners can find out more about SBS at <http://www.epa.gov/iaq/pubs/sbs.html>.

Inspecting Insulation

Insulation is designed to reduce the loss of heat and increase the efficiency of air conditioning to keep buildings cool. Depending on the age of the building, the current levels of recommended insulation may have changed. Adding insulation to your building is a relatively easy way to increase the efficiency of your building's energy usage.

The DOE suggests checking insulation in the attic and walls to determine if the levels are adequate for your needs and current levels. When checking the insulation levels in the attic, look for a vapor barrier (tarpaper, plastic sheets, etc.). If there is no vapor barrier, consider painting the interior ceilings with vapor barrier paint to reduce the amount of condensation/vapor that passes through the ceiling as too much moisture can reduce the insulation's effectiveness and may cause structural damage. Also, ensure that all ducts and pipes are properly sealed and caulked.

Checking the insulation levels in the walls can be a bit troublesome, but still doable. DOE's web site suggests starting with an exterior wall and turning off the circuit breaker and unscrewing the fuses for any outlets in the wall. Before going on, test the outlets to be sure that they are off to void electrical shocks. Tests can be done simply by plugging in a lamp to see if it works. After determining that the outlets are off, remove the cover plate of one outlet and GENTLY probe into the wall with a long, thin stick or screwdriver. Resistance indicates insulation. In ideal situations, the wall will be completely filled with insulation.

Case Study

*PVA members Kevin and Carrie Stier, **River Cruises**, Mt. Scales, IL, insulated the company's office walls with Nu-Wool Premium Cellulose insulation which uses recycled news paper with a fire retardant. Purchased at their local lumber yard, the insulation did cost a little more than some other brands, but they recouped some of that by installing it themselves in the attic and walls. The new insulation has resulted in significant savings—the Stier's energy bills are now half of what they would have been without the new insulation.*

Learn More:

U.S. Department of Energy, Residential (may also apply to small businesses)
http://apps1.eere.energy.gov/consumer/your_home/energy_audits/index.cfm/mytopic=11170

Nu-Wool Premium Cellulose Insulation (with 100% recycled newspaper as cellulose component)

<http://www.nuwool.com/>

U.S. Environmental Protection Agency Sick Building Syndrome

<http://www.epa.gov/iaq/pubs/sbs.html>



Getting Greener

Now that you have a general idea about where some of your company's energy dollars may have been lost, it's time to focus on what you can do now to start saving money by implementing "green" practices.

Green Team

The first thing to do is create a Green Team. Remember, one person was not responsible for wreaking environmental havoc on the planet, and one person can't fix everything alone. Working with an enthusiastic group of employees, from all departments, will net the best results for your organization's specific characteristics. Most vessel operators have found that holding regular meetings, with agendas and action items, has spurred positive reactions from the team.

Integration

For best results, integrate your green practices in with the business model you already have in place. Vessel operators are finding that by modifying their current practices— purchasing, scheduling, safety, security, hiring, etc.--to include a green "perspective" are making the most strides toward becoming environmental stewards in their community. One vessel operator advises colleagues around the nation to "rethink how you do everything by considering the effect of 'the way we've always done it' on the environment, and explore better, greener alternatives." That isn't as difficult as it sounds. For example, when purchasing goods, such as cleaning products, ensure that you are buying cleaners that are not harmful to your environment. Instead, opt for cleaners that do not contain chemicals that are known contaminants to waterways. Or, when decorating your vessel, choose materials such bamboo, for instance, that is sustainable (because it's so fast growing) rather than wood from ecologically fragile tropical rainforests such as teak or mahogany.

The information contained in this document has been compiled by a wide group of PVA vessel and associate members, as well as staff, affiliated organizations, and research gleaned from a variety sources ranging from scientific journals, books, periodicals, newspapers, and online sources from around the world. It's a starting point. Now, it's time to get started.

Lighting

By now, you've probably heard that incandescent bulbs, the traditional light bulbs that we're all familiar with, are inefficient. This is not surprising since the electric incandescent bulb hasn't changed much since Thomas Edison invented the first one back in 1879. Newer compact fluorescent light bulbs or CFLs, by comparison are much more energy efficient. In 2007, *Popular Mechanics* Magazine tested CFLs against incandescent bulbs and found that CFLs use less than one-third the amount of energy, produce equal amounts of "brightness" and last years longer. The longer life coupled with the energy savings means that by changing the bulbs in your business AND on your vessels, you'll save money. GE, a manufacturer of CFL and incandescent bulbs, claims that if every U.S. household were to replace just one traditional bulb with one its "Energy Smart" CFL bulbs, a "combined national total of \$600 million a year in energy costs"

would be saved, while providing “enough energy to light more than \$3 million homes for a year.”

Be advised, however, that CFLs do contain mercury and cannot be thrown in a trash can for disposal. For proper disposal methods for CFLs, go to earth911.org.

Also, there are a myriad of CFLs on the market and not all CFLs will suit every need. For example, if lights are to be dimmed, purchase a bulb made specifically for dimming. There are also CFLs designed for track or recessed lighting. For more information, go to http://www.energystar.gov/index.cfm?c=cfls.pr_cfls.

LIGHT OUTPUT EQUIVALENCY

To determine which ENERGY STAR qualified light bulbs will provide the same amount of light as your current incandescent light bulbs, consult the following chart:

INCANDESCENT LIGHT BULBS	MINIMUM LIGHT OUTPUT	COMMON ENERGY STAR QUALIFIED LIGHT BULBS
WATTS	LUMENS	WATTS
40	450	9-13
60	800	13-15
75	1,100	18-25
100	1,600	23-30
150	2,600	30-52

LEARN MORE AT energystar.gov

Source: U.S. EPA, ENERGY STAR Program

LED

CFLs aren't the only option. Some vessel operators are investing instead in LED or light emitting diodes bulbs. These bulbs are used in increasing frequency in traffic lights because they are long-

lasting and can stand up to weather. Even better, LEDs are extremely energy-efficient using only about 15 percent of the energy required for an incandescent bulb, according to an article in the *New York Times*.

Mariners know that conditions on and around waterways can be tough on equipment, but one manufacturer, Hella Marine claims that its CargoLED lamp is ideally suited for the damp conditions as the lamp is “completely sealed, it resists saltwater, vibration and impact” and uses just six watts of energy for a “glare-free, ultra-bright light.”

The problem, however, is that LEDs are currently very costly. While it has been estimated that the costs may be recouped in as little as two years for a bulb with an estimated life of 20 years (Taub, 2008), operators should consider all options before investing in LEDs.



◀ CargoLED lamp, a light emitting diode or LED, designed for harsh marine weather conditions.

Photo: Hella Marine, Inc., and Martin Flory Group Public Relations

⋮ indicates a member of the Passenger Vessel Association (PVA)

This could soon change. In the UK, Cambridge University researchers announced in January 2009 that they have developed a LED that costs far less than LEDs that are on the market now. Rather than spending \$75 to over \$100 a bulb, the new technology will allow bulbs to cost an estimated \$2.50 per bulb. Even better, the bulbs are expected to last up to 60 years while providing full illumination instantly, unlike CFLs that can take several minutes to provide bright light. Further, fossil fuel emissions can be cut as much as eight times the amount used currently. The British researchers have said that commercial prototypes are already in progress, and it's possible that the new, low-cost, high-efficient LEDs could be available as early as 2011.

Case Study

PVA member California's **Hornblower Cruises and Events**' Hornblower Hybrid, San Francisco, CA, showcases a host of green technologies, making it one of the greenest passenger vessels in the nation. The lighting throughout the vessel is LED, which requires a fraction of the energy of standard bulbs and provide an equal or greater amount of illumination.



◀Hornblower Hybrid offers numerous green features making it a model for other "green" vessels

Solar

At an interactive discussion at the PVA Annual Convention at MariTrends 2009 on "Avoiding Pitfalls When Going Green,"

attendees said that solar lights had been installed around the exterior of facilities to providing lighting at night, without any energy cost. This low-cost solution offers adequate lighting for late-night security and does not use fossil fuels.

Learn More:

ENERGY STAR: Lighting

http://www.energystar.gov/index.cfm?c=cfls.pr_cfls
earth911.org

Heating & Air Conditioning

If you have older, that is more than 15 years old, HVAC system, you may want to budget for a newer, more energy-efficient system. The newer systems can significantly reduce your energy consumption, so be sure to look for the ENERGY STAR label to purchase the one that will save you the most. In addition, change filters regularly, check ductwork for dirt streaks (near seams) as this could indicate air leaks and should be properly sealed. And, don't forget to insulate properly. Install a programmable thermostat so that you are not heating or cooling your office space when no one is there (nights or weekends). Finally, by adjusting your thermostat slightly, you can save substantially on your energy bills. You may save about 2% of your heating bill for each degree that you lower the thermostat for at least 8 hours each day.

Solar may be an option, too. Operating in the Great Lake Region, **Madeline Island Ferry Line**, La Pointe, WI, installed solar panels for the company's water heater which will also help preheat water for infloor heating. The renewable heat source will save the company over the long run as Wisconsin winters can be rather lengthy.



◀ *Solar panels collect sunlight and use it to generate energy.*

Green Offices

Green administrative decision-making goes a long toward become an environmentally responsible company, and once again, many of these decisions actually save you money.

When making purchases, consider the environmental impact on products and services and work with vendors to help you meet your goals. For example, when procuring goods from a vendor, ask if they'll take away the packaging waste such as empty containers. You can save on your own trash/refuse service, and likely keep waste from a landfill.

Office Equipment

ENERGY STAR rates office equipment. Before you buy new equipment, check to be sure that your copier, computers, and printers are energy-efficient...which will save you money on utility bills. And, if you have a kitchen in your office, is the refrigerator rated by ENERGY STAR for efficiency? These costs add up. According to the EPA, "ENERGY STAR qualified office and imaging products use 30-75% less electricity than standard equipment. And using less energy keeps utility costs down. Over the next five years, these products will save Americans almost 5 billion dollars."

Turning off electronics when not in use can save money. Even using the "standby" or "hibernate" mode can save you money. The EPA estimates you'll save up to \$75 or more per computer by activating system standby or hibernate features.

Turning off your office equipment when it's not in use will add quickly to your bottom line. Bruce Endries, a technology reporter for a New York state newspaper, used a meter to measure the wattage used by the type of computers, monitors and printers that many small business owners have in their offices. He figured out that a company running 20 computers and five laser printers, "running all the time", with one work shift Monday through Friday, is "wasting \$2,000 a year in electric costs." That's a small number compared to the \$2 million that the State of Massachusetts is saving by turning off computers when no one is using them, and reducing 5,000 tons of carbon emissions in the process. But, saving thousands of dollars a year simply by turning off office equipment when it's not in use is one of the easiest "green" practices you can implement, starting today.

Paperless

Every year, million trees are cut to be made into paper, fed into copiers, printers, and fax machines all over the world. Is this really necessary? With the advent of cyberspace, documents can be sent all around the world at the click of a button...without a single sheet of paper being used.

Look for ways you can reduce the amount of paper consumed by your office. Here are few ideas that other vessel operators are already doing:

- Share documents internally electronically via email
- Pay bills online
- Use direct deposit to pay employees and emailing electronic paystubs
- Use electronic training materials rather than printed manuals
- Purchase paper with recycled content; FSC (Forest Service Council) certified paper comes from managed forests, controlled sources, and recycled wood/fiber
- Use electronic devices for ferry reservations and management
- Discourage printing email with a friendly reminder: 🌱 [Please consider the environment before printing this e-mail.](#)
- Use soy-based inks for brochures and schedules
- Carefully review print runs of past printed marketing materials so as to not print more than you need (saves money, too!)

Consider This:

- 1 ton of uncoated virgin (non-recycled) printing and office paper uses 24 trees
- 1 ton of 100% virgin (non-recycled) newsprint uses 12 trees
- A "pallet" of copier paper (20-lb. sheet weight, or 20#) contains 40 cartons and weighs 1 ton
- 1 carton (10 reams) of 100% virgin copier paper uses .6 trees
- 1 tree makes 16.67 reams of copy paper or 8,333.3 sheets
- 1 ream (500 sheets) uses 6% of a tree

Learn More:

ENERGY STAR Office Equipment

http://www.energystar.gov/index.cfm?c=ofc equip.pr_office_equipment

Carbon Offsets

Despite your best efforts to reduce, reuse, and recycle, you'll still emit carbon dioxide. As a green company, you can offset your carbon consumption simply by purchasing carbon offsets. Being green has never been easier.

Recycling/Waste Reduction

Many communities offer curbside recycling or community recycling center for homeowners. But, commercial entities generate a tremendous amount of waste. In the city of Portland, OR, for example, 75% of landfill waste comes from businesses. And, a growing number of municipalities are requiring businesses to have recycling programs in place...and actively used. Some even impose fines for noncompliance.

As a green business, place recycling bins around the office, particularly near copiers, printers, and trash cans as a collection point to keep paper and cardboard out of the trash bound for the landfill.

Recycle print cartridges from printers (if available in your area, or check with the manufacturer for mail-in options).

Scrap metal should never be treated as trash. It's recyclable and a source of cash. Collect your scrap metal and sell it. One vessel operator even has a receptacle in the vessel's bar area to collect the tops of beer bottles, and periodically sells it as scrap metal.

Food waste can be a challenge. Some have found that their waste is someone else's treasure, such as coffee grounds are particularly desirable for composters. Check around to see if there's someone who wants your waste. Investigate composting options, but realize that there are special considerations regarding health and cleanliness concerns and you may need to check with local authorities before initiating a composting program.

Encouraging Green Behavior

Your employees arrive at the office each day, ready to work. How did they get there? Encourage “green” transportation methods—biking, carpooling, walking, mass transit—by offering incentives to those who leave the car behind.



◀ *Commuters ride bicycles to work.*





Greener Vessels

It's time to turn your attention to your vessel (or vessels). As you are well aware, your passenger vessels are enormous financial investment for you, as well as the source of your livelihood. The spike in fuel costs not long ago was painful for most operators and as a result, many explored other options for operating their vessels for least amount of money as possible.

Just as on your land-based facility, there are several areas to consider. Before making changes, however, it makes sense to assess your current status to attain a baseline. Robin Trinko-Russell, Madeline Island Ferry Line, La Pointe, WI, encourages vessel operators to perform an energy audit on vessels, just as was suggested for your land-based facilities. Trinko-Russell says that while you won't find the name of an energy auditor for passenger vessels in any phone book that should not discourage you. She says, "Boat crews must do trials to see what minimal operating RPMs are necessary to meet your posted schedules. Then, simply apply land-based ideas to your vessels and get as much historic data on operations as possible."

Propulsion is an area that bears a considerable amount of attention. For one, emissions are an issue. For another the cost to fill the vessel's fuel tank is an enormous budgetary concern. Increases in fuel costs can significantly cut into profit margins. You have recourses, though, that can help you keep fuel prices under control. For one thing, work with your crew and maintenance personnel about leaks need plugging, and how the generators are loaded, and how to best reduce the amount of energy used.

Power Sources

Engines

The EPA and the International Maritime Organization (IMO) have issued requirements regarding marine engines.

On May 6, 2008, the EPA finalized its emissions rules for marine engines. The engines in question are Tier 3 and Tier 4, which PVA Member Carl Micu, John Deere Power Systems, Waterloo, IA, explained a year earlier in a brilliant FOGHORN article to explain in depth of the then-proposed rule.

Regarding marine engines, emissions, and regulations mandated by the EPA for 2009 through 2018, Micu said, the new EPA rule regulates any engine installed on a new vessel flagged or registered in the U.S. and applies to replacement engines and rebuilt engines as well.

After explaining that Category 1 engines are the smallest, with a displacement range of 0.9 L/cylinder to 7 L/cylinder; Category 2 engines are mid-sized, with a displacement range of 7 L/cylinder to 30 L/cylinder; and that Category 3 engines are the largest, with displacement of greater than 30 L/cylinder and are not regulated by this rule, Micu said:

Between 2009 and 2018, the proposed Tier 3 standard will reduce nitrogen oxide (NOx) plus hydrocarbon (HC) output by 20 percent and particulate matter (PM) by 50 percent from current Tier 2 levels. Between 2014 and 2017, the proposed Tier 4 standard will reduce NOx output by 80 percent and PM output by 90 percent from current Tier 2 levels.

An engine's category will determine when it has to become compliant with the appropriate Tier requirements. However, the EPA breaks it down further within each category and spells out which horsepower ranges have to meet what emissions standards in each model year. The details for each engine category are found in the following charts:

Tier 3 Standards and Timing for Category 1 Engines					
Power Density and Application	Displacement (L/cyl)	Maximum Engine Power	Model Year	PM (g/kW-hr)	NOx + HC (g/kW-hr)
all	disp < 0.9	kW (hp) < 19 (25)	2009	0.4	7.5
		19 ≤ kW < 75 25 ≤ hp < 100	2009	0.30	7.5
			2014	0.30	4.7
Commercial engines with kW/L ≤ 35 (hp/L ≤ 47)	disp < 0.9	kW (hp) ≥ 75 (100)	2012	0.14	5.4
	0.9 ≤ disp < 1.2	all	2013	0.12	5.4
	1.2 ≤ disp < 2.5	kW (hp) < 600 (805) 600 ≤ kW < 3700 805 ≤ hp < 4962	2014	0.11	5.6
			2018	0.10	5.6
	2.5 ≤ disp < 3.5	kW (hp) < 600 (805) 600 ≤ kW < 3700 805 ≤ hp < 4962	2014	0.11	5.6
			2013	0.11	5.6
	2013	2018	0.11	5.6	
			0.10	5.6	
	3.5 ≤ disp < 7.0	kW (hp) < 600 (805) 600 ≤ kW < 3700 805 ≤ hp < 4962	2013	0.11	5.6
			2012	0.11	5.6
	2012	2018	0.10	5.6	
	2012	2012	0.11	5.6	
Commercial engines with kW/L > 35 (hp/L > 47) and all recreational engines	disp < 0.9	kW (hp) ≥ 75 (100)	2012	0.15	5.8
	0.9 ≤ disp < 1.2	kW (hp) ≥ 75 (100)	2013	0.14	5.8
	1.2 ≤ disp < 2.5	kW (hp) ≥ 75 (100)	2014	0.12	5.8
	2.5 ≤ disp < 3.5	kW (hp) ≥ 75 (100)	2013	0.12	5.8
	3.5 ≤ disp < 7.0	kW (hp) ≥ 75 (100)	2012	0.12	5.4

Tier 3 Standards and Timing for Category 1 Engines					
Power Density and Application	Displacement (L/cyl)	Maximum Engine Power	Model Year	PM (g/kW-hr)	NOx + HC (g/kW-hr)
all	disp < 0.9	kW (hp) < 19 (25)	2009	0.4	7.5
		19 ≤ kW < 75 25 ≤ hp < 100	2009	0.30	7.5
			2014	0.30	4.7
Commercial engines with kW/L ≤ 35 (hp/L ≤ 47)	disp < 0.9	kW (hp) ≥ 75 (100)	2012	0.14	5.4
	0.9 ≤ disp < 1.2	all	2013	0.12	5.4
	1.2 ≤ disp < 2.5	kW (hp) < 600 (805)	2014	0.11	5.6
			2018	0.10	5.6
	2.5 ≤ disp < 3.5	600 ≤ kW < 3700 805 ≤ hp < 4962	2014	0.11	5.6
			kW (hp) < 600 (805)	2013	0.11
	3.5 ≤ disp < 7.0	600 ≤ kW < 3700 805 ≤ hp < 4962		2013	0.11
			kW (hp) < 600 (805)	2012	0.11
	600 ≤ kW < 3700 805 ≤ hp < 4962	2018		0.10	5.6
		2012	0.11	5.6	
Commercial engines with kW/L > 35 (hp/L > 47) and all recreational engines	disp < 0.9		kW (hp) ≥ 75 (100)	2012	0.15
	0.9 ≤ disp < 1.2	kW (hp) ≥ 75 (100)	2013	0.14	5.8
	1.2 ≤ disp < 2.5	kW (hp) ≥ 75 (100)	2014	0.12	5.8
	2.5 ≤ disp < 3.5	kW (hp) ≥ 75 (100)	2013	0.12	5.8
	3.5 ≤ disp < 7.0	kW (hp) ≥ 75 (100)	2012	0.12	5.4

Tier 3 Standards and Timing for Category 2 Engines					
Power Density and Application	Displacement (L/cyl)	Maximum Engine Power	Model Year	PM (g/kW-hr)	NOx + HC (g/kW-hr)
Commercial engines	7.0 ≤ disp < 15.0	kW (hp) ≤ 3700 (4962)	2013	0.14	6.2
	15.0 ≤ disp < 20.0	kW (hp) ≤ 3300 (4425)	2014	0.34	7.0
			2014	0.27	8.7
	20.0 ≤ disp < 25.0	kW (hp) ≤ 3700 (4962)	2014	0.27	9.8
	25.0 ≤ disp < 30.0	kW (hp) ≤ 3700 (4962)	2014	0.27	11.0

Tier 4 Standards and Timing for Category 1 and 2 Engines						
Power Density and Application	Displacement (L/cyl)	Maximum Engine Power	Model Year	PM (g/kW-hr)	NOx (g/kW-hr)	HC (g/kW-hr)
Commercial only	all	600 ≤ kW < 1400 805 ≤ hp < 1877	2017	0.04	1.8	0.19
Commercial only	all	1400 ≤ kW < 2000 1877 ≤ hp < 2682	2016	0.04	1.8	0.19
Commercial and recreational	all	2000 ≤ kW < 3700 2682 ≤ hp < 4962	2016	0.04	1.8	0.19
Commercial and recreational	disp. < 15.0	kW (hp) ≤ 3700 (4962)	2014	0.12	1.8	0.19
	15.0 ≤ disp < 30.0		2014	0.25	1.8	0.19
	all		2016	0.06	1.8	0.19

Source: Carl Micu, John Deere Power Systems, FOGHORN Magazine, July 2007

PVA Legislative Director Ed Welch reports that the EPA regulation applies mainly to engine manufacturers. Below is an excerpt from his 2008 article in the July issue of FOGHORN Magazine:

For the most part, the [EPA] regulations apply directly only to engine manufacturers. Assuming that the cleaner engines will be more expensive to produce, vessel owners will be affected primarily in the pocketbook. However, certain parts of the rule are of specific interest to vessel owners and operators. For instance, even after the requirement for category 4 engines with aftertreatment systems, the regulation permits one to replace an existing Category 3 marine engine with another of like characteristics, assuming that there is no category 4 engine with appropriate physical or performance characteristics to repower the vessel. Also, the owner and operator of a vessel equipped an engine with a selective catalytic reduction system requiring the use of urea or other reductants must report to the EPA if the vessel is operated without these products. Finally, the rule says that if an existing vessel is modified and the value of the modifications exceeds 50 percent of the vessel prior to the project, the vessel will be considered to be “new,” thereby requiring the installation of new cleaner-emission engines.

In addition, vessel owners and builders will have to ensure that a required emission label is visible when the engine is installed; if it is not, they will need to obtain a duplicate label from the engine manufacturer and install it in a location where it can be easily seen. They will also have to make sure that a tier 4 engine has a label near the fuel inlet stating that ultra-low-sulfur fuel is required.

The EPA’s intentions are clear: reduce emissions generated by marine engines. The phase-in strategy allows vessel owners to upgrade or replace their engines over many years so as to not to overly burden operators financially.

Learn More:

Caterpillar

<http://www.cat-marine.com>

Cummins

<http://marine.cummins.com>

John Deere Power Systems, Marine Engines

http://www.deere.com/en_US/rg/productsequipment/productcatalog/marine/index.html

MTU/Detroit Diesel

<http://www.detroitdiesel.com/Off-Highway/MtuDetroitDiesel/en/index.aspx>

Hybrid

Traditionally, passenger vessels have been fueled by marine diesel fuel. But that could be changing. Already, there are several PVA vessel operators who are using alternative means to get their vessels moving. The first hybrid ferry appeared on the scene in our nation in late 2008 in San Francisco, CA, to ply the Bay Area.

A hybrid drive “means there is more than one type of power source which can turn the shaft via an electrical interconnection,” according to engineering science advisor Chris McKesson. This could be batteries, generators, or a combination of both power sources. In addition, other energy sources such as fuel cells, wind, solar, or hydropower may come into play.

As in automobiles, hybrids draw on power sources on an as needed basis, with fuel efficiency being the primary objective. McKesson writes, “In the case of a vessel, the demands of the ‘hotel’ load and ‘propulsion’ load can be coupled together electrically and powered by a combination of power sources including generators, batteries, and alternative power sources. This will permit an operator to ‘tune’ his operation into an extremely fuel efficient mode as opposed to traditional mechanically geared propulsion systems.”

Solar

Solar panels on vessels make sense as vessel often operate under direct sunlight. But would solar panels work? According to one vessel operator, they most certainly do when used in locations that offer a great deal of strong, peak sunlight. The panels can be expensive, but if you’re looking for a renewable source of energy with zero emissions, including solar as part of your power mix may be a good idea.

Case Study

*PVA vessel member **Body Glove Cruises**, of Kona, HI, installed solar panels on the *Bimini* of its 65’ vessel, *Kanoa II*, in 2007 to charge batteries while underway. The operation specializes in taking passengers to observe marine life, and the solar power allows the *Kanoa II* to shut down its main engines so that passengers can view the marine animals and fish in comfort without the annoyance of loud engine noise that can frighten marine life.*

Fuel

There are a number of fuels that can—and are—used on vessels:

- Diesel
- Ultra Low Sulfur Diesel
- Biodiesel
- Hydrogen
- Liquefied Natural Gas (LNG)
- Compressed Natural Gas (CNG)

Diesel fuel used by mariners has come under fire over concerns of pollutants and emissions. One result has been the regulations by the Environmental Protection Agency on marine engines. Others are looking at the fuel itself to make changes.

A study done at the Rochester Institute of Technology questioned whether claims by the petroleum industry, which suggested that cleaner marine fuels would actually worsen environmental concerns by producing more greenhouse gases. Creating a model, the researchers proved that while cleaner fuels initially greenhouse gas emissions during production, they reduce the greenhouse gas emission during the vessel's operation which creates an "almost net zero greenhouse gas impact."

"Cleaner fuels are expected to reduce sulfur and particulate emissions, however, greenhouse gas (GHG) emissions may increase because of the additional refining energy required to produce these fuels—residual oil, marine gas oil and marine diesel oil," RIT professor and study author James Winebrake said. "Our study provides a total fuel cycle emissions analysis to help quantify these emissions tradeoffs."

PVA associate member **Germanischer Lloyd (GL)** is also reviewing marine fuel for all sectors of the commercial maritime community. At its 57th annual meeting, the Marine Environment Protection Committee (MEPC) of the International Maritime Organization at GL's headquarters, the group centered much of its discussion on reducing harmful emissions and vowed that "marine fuel will get better." (more to come from Stephen Gumpel)

Ultra Low Sulfur Diesel or ULSD will be required by the EPA when Tier 4 engine regulations come into effect in 2014, but some states may require it sooner. Vessel operators in Alaska may find themselves needing to switch to this fuel earlier, as did operators in California.

As its name implies, ULSD (also known as S15) has a maximum sulfur content of 15 parts per million (ppm) compared to Low Sulfur Diesel (S500) which has a considerably larger sulfur content of 500 ppm, which is more than a 95% reduction in sulfur. The cleaner burning ULSD, coupled with Tier 4 engines, the proposed Tier 4 standard will reduce nitrogen oxide (NOx) output by 80 percent and particulate matter (PM) output by 90 percent from current Tier 2 levels, according to Carl Micu of PVA associate member **John Deere Power Systems**.

Though regulations aren't yet requiring them to do so, some operators are using this cleaner fuel now which is readily available in many major coastal areas according to Brian King, of **Elliott Bay Design Group**, and a noted expert in green vessels. In the Bay Area, the **San Francisco Water Emergency Transit Authority (WETA)** has added two new vessels, *Gemini* and *Pisces*, that use a blend of ULSD and biodiesel.

Bio-fuels are also attracting attention in the marine community. As the price of fuel has been extremely volatile which has burdened most passenger vessel operators, some operators have chosen to explore other options. PVA vessel member **Washington State Ferries** (WSF), the largest ferry system in the U.S., which consumes 17 million gallons of diesel fuel annually on its 22 ferries, is testing the use of **bio-fuels**. According to WSF's Shawn DeVine, this large-scale project—the Biodiesel Research and Demonstration Project—is aimed at conserving fuel, reducing pollutants, and saving money, will work with regional partners in the Puget Sound area.

As the largest ferry system in the nation, Washington State Department of Transportation (WSDOT) Ferries Division/Washington State Ferries is committed to providing safe and reliable marine transportation to its 24-million annual passengers. The ferry system uses approximately 17 million gallons of diesel fuel annually on its 22 operating vessels, making it a significant diesel fuel user in the Puget Sound area.

Biodiesel made from animal fats, cooking greases and vegetable oils (canola and soybeans) was used in three 87-car ferries beginning in March 2008 and ended in February 2009. According to DeVine, the biodiesel “contains almost no sulfur and reduces toxic pollutants and could potentially reduce greenhouse gas emissions into the atmosphere from our fleet.”

The scientific test used a variety of biodiesels, ranging from “a five percent blend (B5) of biodiesel and ultra-low sulfur diesel. As the demonstration progresses, biodiesel blends are increased to a 10 percent (B10), followed by a 20 percent blend (B20).” DeVine wrote in a FOGHORN article published in December 2008. “In addition to testing different percentages of biodiesel, the ferry system is also testing three different types of biodiesel feedstocks: soy, canola, and tallow (high-cloud point).”

While the test results are still being reviewed, early findings showed that the use of biodiesel could work. One of the vessels, running on a B20 blend of soy-based biodiesel experienced no “operational performance.” A final report is expected in June 2009.

Other vessel operators have reported problems with using biodiesel in colder climates, however, and biodiesel blends may not provide the same level of consistent energy per gallon, so before embarking on this path, talk to your engine manufacturer.

Case Study

“The [car ferry] Issaquah’s performance has been remarkable thus far. There have been no problems with filter clogging which was experienced in Washington State Ferries’ (WSF) previous biodiesel pilot project in 2004,” project manager Paul Brodeur, Ferries Division Director of Vessel Maintenance, Preservation and Engineering at WSF said. “There is no noticeable difference in this [B20] fuel type as compared to burning ultra-low sulfur petroleum diesel.”

Learn More:

Washington State Ferries Biodiesel Research and Demonstration Project
www.wsdot.wa.gov/Ferries/Environment/biodiesel.

On the flip side, some critics have taken issue with bio-fuels. Some are concerned with growing plants for fuel rather than food, while others feel that other fuel options may be a better fit for the marine industry. In Seattle, Brian King says that he and some other engineers aren't "as enthusiastic" about bio-fuels as they once were and suggests that passenger vessel operators carefully consider all fuel options before deciding to use bio-fuels.

Hydrogen fuel cell propulsion technology involves pumping hydrogen and oxygen, into a fuel cell that converts it into efficient energy to run the electric motor. The only emissions are water vapor and heat. The heat is absorbed through the engine so that there is no displaced heat or vapor into waterways.

In Illinois, Captain Kevin Stier dreams of converting his passenger vessel to hydrogen, but the conversion is costly so the dream remains out-of-reach.

That could change. In 2003, **San Francisco Water Emergency Transit Authority** (WETA) received funding for the construction of a ferry that would work off hydrogen fuel cells. Engineers are looking into the future possibility of using wind wave and sun power to produce hydrogen for the fuel cells.

Liquefied natural gas (LNG) and **compressed natural gas (CNG)** are being used in marine vessels, including some ferries, around the world, although usage in the United States is somewhat limited.

Is CNG really better? CNG is natural gas under pressure which remains clear, odorless, and non-corrosive, and can be used as a fuel. A 2002 study of passenger ferries in San Francisco, that included input from PVA vessel members **Golden Gate Ferries, Vallejo/Baylink Ferry System** and **Blue and Gold Fleet**, reviewed, among other factors, emissions of CNG. The study concluded that emissions from CNG in vessels are reduced compared to Tier II engines. Researchers found the results "complex" in that Nox, SO₂ and particulate matter pollutants, as well as reduced amounts of CO₂ emissions, but that methane and nitrous oxide (N₂O) emissions were higher. Overall, though, the study authors, Farrell and Glick, said that "passenger ferries are an attractive mode choice for the introduction of CNG as a transportation fuel."

To date, only one passenger vessel operator has answered that challenge. In Virginia, a 150-passenger ferry is fueled by CNG, the only such ferry operated in the U.S. The ferry, a paddle-wheel powered by a CNG system with a Caterpillar 300-hp spark ignited engine, is operated by Hampton Roads Transit in Hampton, VA. The "fast, economical" ferry was built using CNG "for improved air quality."

Currently, there are no known passenger vessels in the U.S. in operation using LNG as fuel.



Case Study

San Francisco **Water Emergency Transit Authority's** Gemini and Pisces are among the most environmentally responsible ferries operating in the U.S. today. The vessels were put into service in 2009 and surpass WETA's emission mandate of 85% better than EPA emission standards for Tier II (2007) marine engines. Other innovative measures to protect the bay and marine life include low-wake, low-wash hulls, solar panels, operating on a blend of biodiesel and Ultra Low Sulfur Diesel fuel, and forward searching sonar for avoiding whale strikes. Gemini and Pisces also include space for 34 bicycles to encourage passengers to reduce their carbon footprint as well.



◀ **WETA's** Gemini and Pisces ferries are among the nation's most environmentally responsible passenger vessels. The engines surpass Tier II emission mandates, is has solar panels, operates on a blend of biodiesel and ULSD fuel, and its hull is designed to

create low-wake, low-wash.

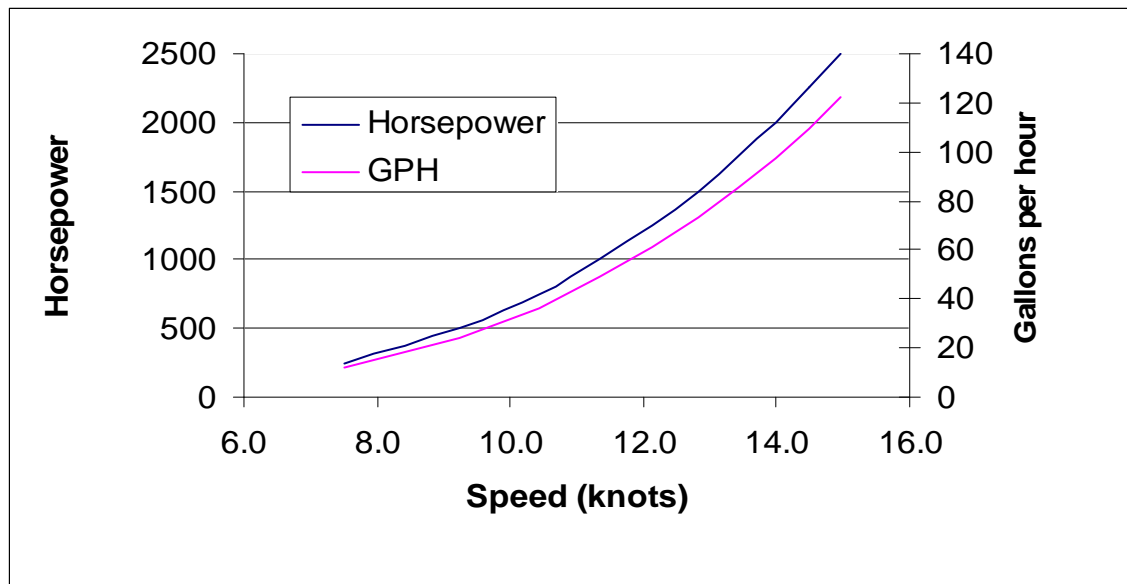
Photo: San Francisco Water Emergency Transit Authority.

Other Options

Even you choose to continue to use the same fuel that you've been using in your vessel, you can still be green making one simple change: slow down. Slowing down saves money. In fact, according to Brian King, an engineer with **Elliott Bay Design Group**, Seattle, WA, reducing your vessel's engine speed by just two knots can reduce your fuel consumption by as much as a third.

At Madeline Island Ferry Line, Robin Trinko-Russell worked with the vessel engineer, pulled traffic (trips made by the vessel by month) data, pulled all the vendor information (gallons of fuel added by date per vessel), then calculated the data based on engine hours to come up with a starting baseline for making improvements in fuel conservation, and saving money.

Speed Kills



Displacement vessel example

14 knots consumes 90 gallons per hour

12 knots consumes 60 gallons per hour

A 33% reduction in fuel consumption

Source: Brian King, PE, **Elliott Bay Design Group**, 2008

Case Study

Operating on Lake Superior, **Madeline Island Ferry Line**, La Pointe, WI, has pulled back on its throttle, and is happy with the results. The ferry slowed its rpm from 1500+ to 1375, and reduced the gallons of fuel used by about 17%...and is still able to make published schedule arrivals and departures.

Water

Conservation

Due to our livelihood, and the view from our offices which may or may not be on land, we may sometimes become immune to the wondrous nature of water, and possibly even take it for granted. But, consider the following facts about the types and quantities of water on Earth:

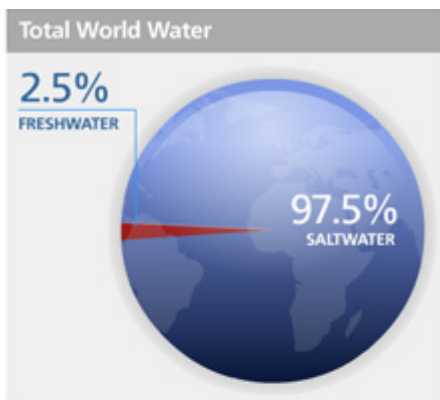
- 97% of the planet's water is salt water in seas and oceans;
 - Nearly 2% of Earth's water is frozen in polar ice sheets and glaciers;
 - 30% of the world's freshwater is stored underground in the form of groundwater
 - Groundwater constitutes about 97% of all the freshwater that is potentially available for human use.
 - Freshwater lakes and rivers contain an estimated 0.3 percent of the world's freshwater
 - Only a fraction of one percent is available for drinking, irrigation, and industrial use
- Sources : United Nations Environment Programme; National Geographic Magazine 2002

The last fact, the very small percentage of potable, or drinking water, available gives one pause for thought, particularly when one considers that the world's population is growing

exponentially at a staggering rate which will put an enormous strain on the availability of clean, safe drinking water. Therefore, we should be mindful of how and where we use potable water.

On land, we should make every effort to conserve water used for irrigating the landscaping around our commercial property (grass, flower beds, trees, etc.). Planting native plants, grasses, shrubs, and trees helps to lessen the need for vast amounts of water as native vegetation is already adapted to the natural levels of water. In addition, overwatering landscaped areas can cause run-off of chemicals applied to plantings...which end up in the waterways and cause damage to marine vegetation, marine life, and water quality. If possible, skip applying chemicals (fertilizers and pesticides) to your landscaping.

While our vessels are surrounded by water on the outside, we're also reliant on water on the inside as well, especially in the heads and galleys. Potable water is important to crew and guest comfort, but water conservation is imperative to being green.

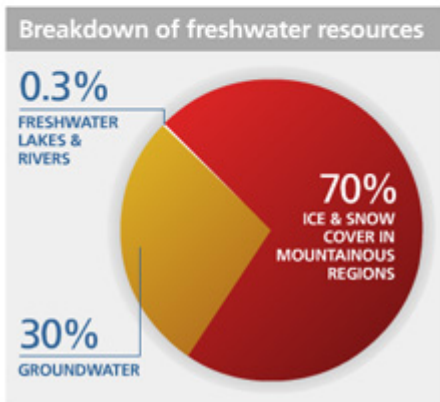


First, it's not always necessary to have potable water for everything onboard. For example, toilets can be filled with water from the river/lake/etc. in which you are plying, rather than drinkable water.

Source: UNEP

“The total volume of water on Earth is about 1.4 billion km³. The volume of freshwater resources is around about 2.5% of the total volume. The total usable freshwater supply for ecosystems and humans is less than 1 percent of all freshwater resources.”

**--United Nations Environment Programme
UNEP**



Case Study:

Wendela Sightseeing Cruises in Chicago changed from using potable water in their toilets and urinals to using non-potable sea water from the river and lake. This change has resulted in conservation of nearly 600 gallons of water every week. This not only saved money, it also reduced the operation's consumption of water that is suitable for drinking, which certainly aren't needed in toilets and urinals.

Second, leaky faucets and running toilets (on land as well as on vessels) not only waste water, but it can cost money too. According to the EPA, a leaky faucet that drips can waste as much as 3,000 gallons of water each year, and a leaky toilet can waste up to

200 gallons of water a day! That's a lot of money—and water—to flush away. Not sure if you have a problem? Try these tips from the EPA:

Leaky Faucet: If you're unsure whether you have a leak, read your water meter before and after a two-hour period when no water is being used. If the meter does not read exactly the same, you probably have a leak.

Leaky Toilet: To tell if your toilet has a leak, place a drop of food coloring in the tank; if the color shows in the bowl without flushing, you have a leak.

Check your water bill to see what you're paying now, then check again after you've made the fixes, or replacements, and you'll see that you've saved money. Fixes, even replacements, are inexpensive compared to the long-term costs you'll be making if you don't.

Also, are your toilets low-flow ones? If the toilets in your operation date back before 1992, then you're probably using at least 2 gallons more a flush than a newer version that uses a miserly 1.6 gallons (or less! PVA associate member **Headhunter** sells a head that uses a mere one gallon). There are even "smart" toilets on the market that only use as much water as is needed per use.

Products for the heads are also areas for "greening" up your operation. Toilet paper, towels, and soap should be reviewed. In the case of toilet paper, it has recently been reported that softer paper comes only from virgin timber—not recycled—and that millions of trees in North America, including the crucial boreal forests of Canada needed to help naturally regulate the amount of carbon dioxide in the atmosphere, and Latin American are cut to manufacture softer toilet paper. Switching to products that are made from recycled fibers is a greener alternative.

The same principle applies to paper towels. Buying towels made of recycled materials is greener. Regarding the debate over paper or air dryers, arguments can be either way. If your vessel (or land-based facility) generates its electricity from a source other than mainly fossil fuels (solar, wind, fuel cells) then a hand dryer could be considered very green. Otherwise, towels comprised of recycled materials and place a bin to collect paper waste for recycling.

A third option is use to cloth towels in the restrooms, which are then washed and reused without generating any waste going into landfills.

Case Study

*In Portland, OR, PVA vessel **American Waterway, Inc.** employees take turns--on a rotational basis--taking home the towels in the restrooms and laundering them. The idea to do this wasn't mandated by management. The company's Green Team, comprised of employees on all levels, volunteered to do a load dirty towels at their own homes to reduce the amount of waste that paper towels generate.*

Learn More:

[Headhunter, Inc.](#)
[Headhunterinc.com](#)

If you've got a galley, then it's likely that you're using vast quantities of water. A few simple water conservation tips can help to scale back the amount of water used, and save money on your water bill. According to the Southwest Florida Water Management District, restaurant kitchens typically use 5,800 gallons of water every day. As a vessel operator, your usage in the galley may be less if you're only serving one or two meals a day. The Southwest Florida Water Management District offers restaurants these tips for conserving water used:

Kitchen

About half of the water used in restaurants is used in the kitchen areas.

- Turn off the continuous flow used to wash the drain trays of the coffee/milk/soda beverage island. Clean thoroughly as needed.
- Reduce the flow to dipper wells (troughs) for ice cream and butter scoops, and other frequently used utensils.
- Adjust ice machines to dispense less ice if ice is being wasted.
- Presoak utensils and dishes in basins of water, rather than in running water.
- Replace automatic shut-off spray nozzles, which can use as much as 4.5 gallons of water each minute, with low-volume nozzles using 2.0 gallons per minute.
- Do not use running water to melt ice in bar sink strainers.
- Turn off food preparation faucets that are not in use. Consider installing foot triggers.
- Do not allow water to flow unnecessarily. Consider using automatic shut-off faucets at bar sinks.

Dishwasher hints

- Wash only full loads in the dishwashers.
- Replace the spray heads to reduce flow.
- Turn dishwashers off when dishes are not being processed.

Be water thrifty

- Reuse the rinse water from the dishwasher as flush water in garbage disposal units.
- Use water from the steam table, instead of fresh water, to wash down the cook's area.
- Serve water only upon request.



Discharge

In the April 2009 issue of FOGHORN, PVA Manager of Membership and Public Affairs Jen Wilk reported that since February 6, 2009, passenger vessel operators have had to abide by the EPA's "Vessel General Permit (VGP) for Discharges Incidental to the Normal Operation of a Vessel." For many PVA vessels, compliance with the VGP simply requires operation of vessels using good marine practices and maintenance procedures, which the EPA calls "Best Management Practices." The VGP also details requirements for corrective actions, inspections, recordkeeping and reporting.

PVA created the *PVA Manual for Compliance with the EPA Vessel General Permit (VGP) for Discharges Incidental to the Normal Operation of a Vessel*, which can be accessed by logging onto the “Members Only” section of the PVA webpage www.passengervessel.com and clicking on the “Member Download Area.” Having an operation-specific copy of the *PVA Manual* gives crew a tool and helps demonstrate understanding of the requirements of the VGP.

Learn More:

U.S. Environmental Protection Agency Vessel General Permit for Discharges Incidental to the Normal Operation of a Vessel.

www.epa.gov/npdes/pubs/vessel_vgp_permit.pdf.

Passenger Vessel Association’s “*PVA Manual for Compliance with the EPA Vessel General Permit (VGP) for Discharges Incidental to the Normal Operation of a Vessel*” Access via www.passengervessel.com, “Members Only” section, “Member Download” Area

Wastewater can also be treated. PVA member **AJT/Agrimond** offers a system that reclaims black water by treating and disinfecting it with no dumping, pumping, handling, or discharge. Marine Dragonfly was first introduced to the passenger vessel industry several years when a PVA vessel member contacted AJT/Agrimond about installing a system in a Florida vessel because there were no pump-out facilities in the area where the operation was located, and as a result, trying to pump out the black water was a complicated and arduous task. The Marine Dragonfly system easily converts the black water to gray water which can be used for cleaning decks and the exterior of the boat.

Learn More:

Agrimond LLC

<http://www.agrimond.com/>

Case Study

*In 2006, PVA vessel member Indian **River Queen**, Cocoa, FL, was the first passenger vessel to use the Dragonfly system which was necessary because the area had no facilities that allowed the 261-passenger vessel to pump out its black water. “It worked great,” owner Penny Flaherty said. “It was really our only option--the only solution that made sense for our situation.” In late 2008, her local marina added a pump-out station so Flaherty has the choice of using that, or the Marine Dragonfly system.*

Dining: Galleys & Snack Bars

Appliances

Galleys, as well as onshore kitchens, can generate large amounts of energy...which can lead to high energy bills. If you haven’t already done so, it’s time to seriously consider upgrading your equipment with energy-efficient appliances. Luckily, the EPA’s ENERGY STAR program has done a lot of the work for you by identifying and rating the most energy-efficient commercial-grade appliances, including ovens, dishwashers, fryers, hot food holding cabinets, refrigerators, and freezers. How much money can still save you? Plenty! For example, purchasing a commercial grade ENERGY STAR refrigerator may

cost about \$100 more than a conventional one upfront, but you'll save about \$100 a year on your energy bills.

Learn More:

EPA ENERGY STAR Commercial Grade Appliance Lists

http://www.energystar.gov/index.cfm?c=bulk_purchasing.bus_purchasing#comapp

Preheat?

Even with the more energy efficient appliances in place, there may be room for still more energy—and money—reductions. There's a debate going on that may put environmentalists at odds with culinary artists. The issue is preheating ovens prior to cooking food. According to some, unless you're baking (desserts, for example), then preheating an oven for meats and vegetables is unnecessary, especially since opening the oven door allows all the heat to exit the oven while placing the meat and vegetables in. It's better, some say, to place the uncooked food in a cold oven, turn it on, and don't open it again until the food is cooked. Experimenting is the best way to decide if preheating an oven—which equates to allowing the vessel's engines to idle, needlessly using fuel while the vessel sits empty at the dock—is required for your operation and menu.

Food

A growing trend in the U.S. is the notion of eating fresh foods. This can mean organic, locally grown, or seasonal foods. Providing any or all of these can help qualify your operation as "green." Here's what each means:

- **Organic**—No chemicals, pesticides, genetically modified, added hormones, or antibiotics were used to grow/raise the food. Some researchers have contended that additives are contributors to poor health.
- **Locally Grown**—While "local" is objective (depending your location, local may be within 100 miles, or within a regional area), the trend is for buyers to purchase food grown or raised close by, rather than having it trucked or flown in from hundreds or thousands of miles away which means that more energy—and carbon dioxide—were expended to get the food to the table.
- **Seasonal**—Foods that are offered in season, are perceived (often rightly so) as being fresher, and therefore more healthful. Try offering a changing menu that features seasonal foods that takes advantage of the freshest foods available for the season.

Menus

What you serve is equally important to the green community. Seafood is becoming a hotbed of debate as fears about overfishing and decline fish populations make headlines around the world. In 2006, a Canadian-led study concluded that "Human-dominated marine ecosystems" are having a devastating effect on ocean fisheries. According to Dalhousie University researcher Boris Worm, "marine biodiversity loss is increasingly impairing the ocean's capacity to provide food, maintain water quality, and recover from perturbations," (Worm, 2006) and that his research showed an astonishing one-third of seafood species have already collapsed. Reports such as this have caused some diners to seriously rethink their dinner fare when ordering seafood. On the heels of Canadian study, and other similar ones, several environmental groups, including the Monterey Bay Aquarium, and collaborated to create a chart of seafood that is acceptable for consumption due to sustainability levels, versus ones to steer clear from. Operators who

serve seafood, and wish to be considered “green,” would do well to offer a menu that features seafood that is sustainable. Seafood is considered sustainable based on a number of factors, including those described by Earth Easy:

Status of wild populations - native stocks should be abundant enough to sustain fisheries.

Fishing method - hook and line, for example, is preferred to trawling; on-shore fish farming is safer than net pens in the open water; string and rack shellfish farming is preferred to ground culture.

By catch - wasted catch of fish other than the target species.

Impact on natural habitat - spawning grounds, sea bottom, kelp beds require protection.

Management initiatives - which increase the odds of fisheries remaining sustainable.

Source: Sustainable Seafood, Earth Easy.

Case Study

Hornblower Cruises & Events, which operates *Adventures at Seas*, *Alcatraz Cruises*, and *Statue Cruises*, is following Monterey Bay Aquarium’s guidelines for serving only sustainable seafood on its dining cruises.

The list of sustainable seafood, as distributed by the Monterey Bay Aquarium, should be consulted by your chefs to develop a menu of acceptable fish to serve on your vessel and should be noted on your printed menu, and understood by the service staff.

Sustainable Seafood

Best Choices

Abalone (farmed)
 Barramundi (U.S.)
 Catfish (U.S.)
 Caviar/sturgeon (farmed)
 • Char, Arctic (farmed)
 Clams (farmed)
 Clams, softshell
 Cod, Pacific (bottom longline)
 Crab, Dungeness
 Crab, stone
 Crawfish (U.S.)
 Halibut, Pacific
 Lobster, spiny (Australia, Baja, U.S.)

- Mackerel, Atlantic
- Mahimahi (U.S. pole/troll)
- Mullet (U.S.)
- Mussels (farmed)
- Oysters (farmed)
- Pollock, Alaska
- Sablefish/black cod (Alaska, Canada)
- Salmon (Alaska wild)
- Salmon, canned pink/sockeye
- Sardines (U.S.)
- Scallops, bay (farmed)
- Shrimp, pink (Oregon)
- Shrimp (U.S. farmed)
- Spot prawn (Canada)

Squid, longfin (U.S.)
 Striped bass (farmed)
 Tilapia (U.S.)
 • Trout, rainbow (farmed)
 • Tuna, albacore (Canada, U.S.)
 Tuna, skipjack (pole/troll)
 Tuna, yellowfin (U.S. pole/troll)
 Wreckfish

- Indicates fish high in heart-healthy omega-3s and low in contaminants.

OK Choices

Basa/swai/tra/Vietnamese catfish
 Clams (wild)
 Cod, Pacific (trawl)

- Crab, blue
- Crab, king (U.S.)
- Crab, snow/tanner
- Flounder/sole (Pacific)
- Haddock (hook-and-line)

Herring, Atlantic
 Lobster, American/Maine
 Mahimahi (U.S. longline)
 • Oysters (wild)

Sablefish/black cod (CA, OR , WA)
• Salmon (Washington wild)
Scallops, sea (Canada, U.S.)
Shrimp (U.S. wild)

Shrimp, northern (Canada, U.S.)
Squid (except U.S. longfin)
• Swordfish (U.S.)
Tilapia (Latin America)

Tuna, yellowfin (U.S. longline)
• Tuna, canned white/albacore
• Indicates fish high in mercury or PCBs.

Worst

• Chilean seabass
Cod, Atlantic
Crab, king (imported)
Crawfish (China)
Flounder/sole (Atlantic)
• Grouper
Haddock (trawl)
Halibut, Atlantic

Mahimahi (imported longline)
Monkfish
• Orange roughy
Rockfish (Pacific trawl)
• Salmon, farmed or Atlantic
• Shark
Shrimp/prawns (imported)
Skate

Snapper, red or imported
• Swordfish (imported)
Tilapia (Asia)
• Tuna, bigeye (longline)
• Tuna, yellowfin (imported longline)
• Tuna, bluefin
• Indicates fish high in mercury or PCBs.

Source: Monterey Bay Aquarium

- **900,000 metric tons of wasted fish - 28% of the annual catch - is tossed overboard because the caught fish are not the desired species.**
 - **4 kilograms of 'bycatch' are discarded by Gulf Coast shrimpers for each kilo of shrimp kept.**
- Source: USA Today**

Materials

Paper or Plastic?

What you present to passengers can be a factor to how “green” your operation is viewed. For example, using Styrofoam products are a big “no-no” as the material does not break down in landfills, nor can it be reused. Products that can be recycled or reused are a greener alternative. And, products that are manufactured to be biodegradable using components such as corn and vegetable starch, some of which can break down in composts in just a few weeks, are excellent alternatives to plastic. There are dozens of companies that sell such cutlery products on the Internet. Simply search for biodegradable cutlery.

If you do choose to use plastic, check to be sure that the products that you’re using are able to be recycled in your area. And, place recycling bins in conspicuous places for both your customers and crew to deposit the spent plastic products.

Operators should also consider using paper products—made from recycled materials—for cups or plates, which can be recycled. Menus should be printed on paper made of recycled materials, and operators should note that fact on the menu for diners to see.

Plastic Facts:

Plastic is made from petroleum and it does not break down. If you sell plastic water bottles on your vessels, then you should also provide a means for recycling the empty bottles. Consider these facts about the innocuous water bottle:

- **30 billion plastic water bottles were sold in the United States in 2005**
- **In 2005, only 12% of water bottles were recycled**
- **25 billion bottles were "landfilled, littered or incinerated," according to USA Today**

--Source: USA Today, June 7, 2008.

Vessel Design

If you're in the enviable position of designing a new vessel, then you may want to incorporate as many "green" elements as possible as these factors often pay dividends in the end. According to PVA associate member **Elliott Bay Design Group**, a marine architectural firm based in Seattle, "ships are inherently green in many respects." By this they mean that many fixtures onboard a vessel is already "low-flow" which helps to reduce the amount of water stored onboard, and energy usage may be minimized due to space considerations. But, there a number of areas that vessels can be designed to be greener. Be warned: not all of these areas are voluntary. As the world becomes increasing environmentally aware, mandated regulations are being imposed in all sectors of the commercial maritime arena, including the passenger vessel industry.

The U.S. Green Building Council (USGBC) in Washington, DC is the authoritative voice in green building standards for edifices on land. Its third party certification program, the Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ encourages and accelerates global adoption of sustainable green building and development practices through the creation and implementation of universally understood and accepted tools and performance criteria. Currently, there are no green standards for vessels but in Pittsburgh, **RiverQuest** has instituted many LEED criteria into the construction of its new vessel *Explorer* which has earned LEED certification, the first known passenger vessel to do so. PVA supports crafting a vessel "LEED-type" standard, which would promote green construction and maintenance practices.



◀RiverQuest's Explorer is one of the nation's "greenest" passenger vessels.

Let's start with some definitions. Global warming potential (GWP) and ozone depleting potential (ODP) are two widely accepted indicators of environmental impact. In the 2008-09 winter edition of *Proceedings*, published by the U.S. Coast Guard, an article by four Elliott Bay Design Group (EBDG) employees, Brian King, Joseph Payne, Ryan Roberts, and Christina Villiott, define GWP as "the ratio of the warming caused by a substance to the warming caused by a similar mass of carbon dioxide." In other words, it measures how much a given mass of **greenhouse gas** is estimated to contribute to climate change.

ODP, according to the EBDG team, is "a number that refers to the amount of ozone depletion caused by substance." They explain further: "An ozone-depleting substance is a compound that contributes to stratospheric ozone depletion." You are probably well aware that ozone-depleting substances are a serious threat to the earth's atmosphere, and as such were addressed by the Montreal Protocol to be completely phased out by 2030. In addition, the Clean Air Act has placed restrictions on the handling and storage of substances, including coolants that are known to contribute to ozone depletion.

The International Maritime Organization's (IMO) Green Passport Program is an inventory of all materials potentially hazardous to human health or the environment, used in the construction of a ship, and accompanies the ship throughout its working life. Produced by the shipyard at the construction stage and passed to the purchaser of the vessel, the document enables any subsequent changes in materials or equipment to be recorded. Successive owners of the ship maintain the accuracy of the Green Passport and incorporate it all relevant design and equipment changes, with the final owner delivering it, with the vessel, to the recycling yard. The program is expected to be mandatory in 2010.

Source: International Maritime Organization, imo.org

Green design means that the vessel lessens its impact on the environment in as many ways possible. Here are some design elements to consider when building a new a new vessel that are currently in use by PVA members:

Hull Design: Low-wake, low-wash hulls protect marine mammals; Catamaran hulls are fuel-efficient to conserve fuel

Materials: Steel and aluminum are recyclable, and aluminum's lightweight construction may result in fuel conservation.

Paints & Covering: Low or zero volatile and organic compounds (VOCs) such as those offered by PVA associate member **Sherwin-Williams**; Vinyl coatings have no harmful chemicals to enter waterways during application and do not harm people applying it.

Carpeting: Wool, which is practical and sustainable, and carpets made of recycled materials are better alternatives than synthetic carpeting. Also, glues that adhere to carpets may be harmful. Inter-locking carpet tiles mean worn pieces can be replaced without adding significantly to landfills.

Windows: Energy-efficient

Heat Recovery: To recover and recycle heat waste from the engine
Insulation: Thermal insulation for energy-efficiency
HVAC: Reduced chiller size and non-ozone depleting refrigerants
Cabinetry & Surfaces: Renewal materials, such as wheat grass for cabinets; countertops made of recycled glass and plastic bottles
Plumbing: water-efficient toilets and fixtures such ones available through PVA associate member Headhunter.
Lighting: CFLs or LEDs; Natural lighting; occupancy sensors (lights go off when there's no movement in a room or area)
Solar: Supplementary power source
Wind: Turbines to charge batteries to power navigation tools, lights, and electronics
Adhesives/Chemicals: Using screws in place of adhesives allows for easier recycling later (materials laced with chemicals and adhesives may be rejected at recycling plants)

Maintenance

Now that you've got green equipment and practices in place, how will you maintain them? The greenest ways possible, of course!

Many vessel operators already do some of the more important green maintenance tasks, such as oil filters and systems that extend the time needed between oil changes. Using less oil is not only more environmentally responsible, but it saves operators money.

Hydraulic oils that are non-polluting and vegetable-oil based are biodegradable and easy to recycle.

A bilge system that uses microbes to “eat” oily bilge water and incidental spills is biodegradable and requires no additional disposal costs for the operator.

Eco-friendly cleaning products, which are becoming increasingly available, reduce the amount of harsh chemicals entering the waterways. To further reduce waste—and save money--purchase products in bulk containers. This means less waste is headed to a landfill, you pay less per ounce, and the carbon dioxide used to get more of the cleaner is lessened also.

A filtration system, such as puraDYN® efficiently cleans the oil in the engine to extend oil drain intervals, reduces frictional engine wear, reduces new oil purchases, cuts down on oil-related maintenance costs, as well helps to keep the engine running cooler and more efficiently.

Learn More:

PuraDYN
<http://www.puradyn.com/>

CITGO Clarion Green A/W Oils
http://www.docs.citgo.com/msds_pi/C10027.pdf

BIO-SOK® Bilge Maintenance System
http://www.oilspillrem.com/marina_oil_cleanup.html

References

- Alcoa. Make an impact: heating energy and savings tips. Retrieved on January 29, 2009, from http://www.alcoa.com/makeanimpact/en/tips/tips.asp?cat_id=at_home_heating
- Battles, S. & Burns, E. (2000). *Trends in Building-Related Energy and Carbon Emissions: Actual and Alternate Scenarios*. Summer Study on Energy Efficiency in Buildings. American Council for an Energy-Efficient Economy. Washington, DC.
- California Energy Commission. (2006) Compressed natural gas (CNG) as transportation fuel. Sacramento, CA: Consumer Energy Center.
- Conservatree. (n.d). How much paper can be made from a tree? San Francisco, CA. Retrieved on February 19, 2009, from www.conservatree.com/learn/EnviroIssues/TreeStats.shtml
- DeVine, S. (2008, December). Washington State Ferries Test Bio-fuels in a Large-Scale Project. FOGHORN, 13.
- Earth Easy. (n.d.) Sustainable seafood. Retrieved on March 1, 2009, from http://www.eartheasy.com/eat_sustainable_seafoods.htm.
- Endries, B. (2008, August 23). Save Money: Turn off the computer. The Daily Star. Retrieved on December 11, 2008, from www.thedailystar.com/lifestyles/local_story_236041520.html
- Energy Information Administration. (2007). 2003 CBECS Detailed Tables, Table C4A, Expenditures for Sum of Major Fuels for All Building, 2003. Washington, DC.
- Gable, C. & S. (n.d.) Ultra Low Sulfur Diesel 101. About.com. Retrieved on March 3, 2009, from <http://alternativefuels.about.com/od/thedifferenttypes/a/ulsd.htm>
- Gashler, K. (2008, June 7). Thirst for bottled water unleashes flood of environmental concerns . The Ithaca (N.Y.) Journal. Retrieved on March 1, 2009, from http://www.usatoday.com/news/nation/environment/2008-06-07-bottled-water_N.htm
- Gumpel, S. (2008, April 1). Marine Fuel Will Become Better: GL Customers Discuss MEPC Decisions. *GL New, Views, Clues*. London.
- Hampton Roads Transit. (n.d.) Paddlewheel Ferry. Retrieved on March 6, 2009, from www.gohrt.com.
- Hasek, G. (2008, February 8). Millennials seek out companies that care about the environment. *Green Lodging News*. Retrieved on February 8, 2008, from <http://www.greenlodgingnews.com>.
- International Maritime Organization. (n.d.). Recycling of ships. London.
- Kaufman, L. (2009, February 26). Mr. Whipple Left It Out: Soft Is Rough on Forests. New York Times.
- King, B. (2008). *Proceedings of PVA Annual Convention at MariTrends 2008: Going Green in the Passenger Vessel Industry*. Alexandria, VA: PVA.
- King, B., Payne, J., Roberts, R., & Villiott, C. (2008-09). Green Vessel Design: Environmental best practices. *Proceedings*, 7-12. Winter. U.S. Coast Guard: Washington, DC.

- Levy, A. (2009, January 29). Great bright hope to end battle of the light bulbs. The Daily Mail. London. Retrieved on February 1, 2009, <http://www.dailymail.co.uk/sciencetech/article-1131183/Scientists-invent-2-bulb-60-years--theyre-greener-eco-bulbs.html?ITO=1490>
- Masamitsu, E. (2007, May). The best compact fluorescent light bulbs: PM lab test. *Popular Mechanics*.
- McKesson, C. (2007, July). Hybrid propulsion. *Foghorn*, 12.
- Micu, C. (2007, July). EPA marine emissions for 2009-2018. *FOGHORN*, 18.
- Monterey Bay Aquarium. (2009). Seafood WATCH. Retrieved on March 1, 2009, from <http://www.montereybayaquarium.org/cr/seafoodwatch.aspx>.
- Montaigne, F. (2002, September). Water pressure. National Geographic Magazine.
- Rainbolt, K. (2008). Certified green. *FOGHORN*, 6-7.
- Rainbolt, K. (2008). A LEED-er Emerges. *FOGHORN*, 8-9
- Rainbolt, K. (2007, December). 2007 Vessel review/2008 vessel preview. *Foghorn*, 11.
- Rainbolt, K. (2003, July). Bay Area to Operate World's First Fuel Cell Vessel. *FOGHORN*, 6.
- Redman, Farrell, Corbett, et. al. (2002). Passenger ferries, air quality, and greenhouse gases: Can system expansion result in fewer emissions in the San Francisco Bay Area? CALSTART.
- Rochester Institute of Technology (2008, September 9). Fuel Emissions From Marine Vessels Remain A Global Concern.
- The Sherwin-Williams Company. (n.d.) Green solutions. Retrieved on February 9, 2009, from <http://www.sherwin-williams.com/pro/green>
- Southwest Florida Water Management District. (n.d.) Water Conservation: Restaurant Checklist. Brooksville, FL. Retrieved on March 7, 2009 at <http://www.swfwmd.state.fl.us/conservation/waterwork/checklist-restaurant.html>
- Sherwood, K. (2008, September). Opposites Attract. *FOGHORN*, 6-8.
- Staff Writers. (2008, September 12). State workers urged to turn off computers -- and save the planet. Boston Globe. Retrieved on December 11, 2008, from www.boston.com/news/local/breaking_news/2008/09/state_workers_u.html
- Taub, E. (2008, July 28). Fans of LEDs say this bulb's time has come. New York Times. New York. Retrieved on January 9, 2009, from <http://www.nytimes.com/2008/07/28/technology/28led.html>
- United Nations-Water Statistics. (n.d.) Water resources: Graphs and maps. http://www.unwater.org/statistics_res.html
- U.S. Environmental Protection Agency. (200X). *ENERGY STAR: Buildings & Plants*. Washington, DC.
- U.S. Environmental Protection Agency, ENERGY STAR Program. (2007). *Useful Facts and Figures*. Washington, DC.

U.S. Environmental Protection Agency. (n.d.) ENERGY STAR: *Office equipment*. Washington, DC.

U.S. Environmental Protection Agency. (1991). Indoor Air Facts No. 4 (Revised) Sick Building Syndrome. Washington, DC. Retrieved on January 29, 2009, from <http://www.epa.gov/iaq/pubs/sbs.html>

U.S. Environmental Protection Agency. Compact fluorescent bulbs. Washington, DC. http://www.energystar.gov/index.cfm?c=cfls.pr_cfls

U.S. Environmental Protection Agency. (n.d.) Use your water sense. Washington, DC. Retrieved on February 16, 2009, from <http://www.epa.gov/watersense/water/simple.htm#flush>

U.S. Green Building Council. (n.d.) LEED Rating Systems: What is LEED? Washington, DC. Retrieved on March 3, 2009, from www.usgbc.org/DisplayPage.aspx?CMSPageID=222

Welch, E.. (2008). EPA finalizes tougher emission rules for marine engines. *FOGHORN*, 10-13.

Welch, E. (2007). Know the laws on sewage disposal from vessels. *FOGHORN*, 26-28.

Wilk, J. (2009, April). EPA Issues Final Vessel Permit for Discharges: PVA Provides Guidance Manual. *FOGHORN*, 30.

Worm, B., Barbier, E., Beaumont, N, et al. (2006). Impacts of biodiversity loss on ocean ecosystem services. *Science*, 314 (5800), 787-790.

Yates, D. (2008-09, Winter). Sustainability: The good, the bad, and the green. *Proceedings*, 61-64.