CLIA at 35:

Steering a Sustainable Course

CRUISE LINES INTERNATIONAL ASSOCIATION, INC.

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Steering a Sustainable Course

CLIA

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CRUISE LINES INTERNATIONAL ASSOCIATION (CLIA)

When you think of a cruise, don't clear, blue, pristine oceans come to mind? We at the Cruise Lines International Association are doing all we can and more to ensure this picture does not change. 2010 marks the 35th anniversary of CLIA, and we are celebrating thirty-five years of progress toward innovating new technologies and operating our ships in ways that minimize the impact cruising has on the environment. Our industry has a vested interest in protecting the environment, because it is upon our beautiful oceans that we sail.

Ocean liners have always had a simple appeal: enjoy the clean open air and sea breeze while traveling to a special destination. This was true for the first transatlantic luxury liners and remained true as ocean liners began the transformation in the 1970s into what we know today as cruise ships – destinations in and of themselves.

The cruise industry recognizes and appreciates our responsibility to minimize our environmental impact. CLIA has made great strides in our 35 years to become a leader in the maritime industry with responsible practices and innovations that are reducing environmental impact. Cruising is not what it used to be. New technologies, such as eco-friendly slick hull coatings that allow ships to move more efficiently through water, have evolved right alongside the list of amenities. It would be hard to invent a story of such innovation and change.

We have invested millions of dollars in research and technology to ensure we are steering a sustainable course as we look ahead to our next 35 years and beyond. For example, we are proud that our advanced wastewater systems produce water cleaner than what is discharged from most municipalities, our efficient engine technologies conserve fuel and minimize air emissions, and our many energy conservation programs, including LED light bulbs and extensive recycling procedures reduce energy and allow for reutilization of resources.

Our story is all about growth and the evolution of the modern cruise industry. Along with our impressive growth - 118 new ships since 2000, and average annual growth in passengers of 7.4 percent since 1980 - comes with it an impressive responsibility to protect the fragile natural environments in which we operate.

The faces behind the ships make it all happen. People are at the core of our environmental progress; from welders at the shipyards where our hulls are laid, the manufacturers that supply our energy efficient equipment such as solar panels, the environmental officers and engineers aboard our ships, to the recycling sorters below deck and so on, our environmental achievements are a credit to the men and women who have pledged a career in the cruise ship industry.

This report will demonstrate how far we have come in 35 years. In the end, we at CLIA believe that industries have a social responsibility to protect and nourish the environments in which they operate, and we strive to push innovation forward to become better environmental stewards every day.

ALASKA CRUISE ASSOCIATION

Protecting Alaska's pristine wilderness and spectacular marine environment is our highest priority and we take pride in the significant progress cruise lines have made in recent years.

The cruise industry continues to be the leader in utilizing the most technologically advanced and environmentally beneficial wastewater treatment systems in Alaska, including technology the State of Alaska characterizes as "systems that produce a very high quality discharge, much higher, for example, than the great majority of shore-based municipal sewage treatment systems."

In 2002, the Alaska Legislature imposed the highest standards in the world for wastewater discharge from large cruise ships. In response, the industry invested hundreds of millions of dollars to develop and install onboard technology to comply with the standards. The cooperative effort between the State of Alaska and the cruise industry has led to the use of the best, most advanced, wastewater treatment facilities in the state.

The industry has participated in numerous studies with both the state and federal government to better understand how treated effluent mixes with the receiving body of water. In 2002, the Alaska Science Panel reviewed more than 200 samples and developed a formula to calculate receiving water concentrations. More recently, the industry participated in a near- field discharge dispersion study in Skagway, Alaska to determine the effects of dispersion in a slack-tide "worst case" scenario in a very enclosed waterway. The industry also participated in a workshop with the State of Alaska to evaluate current and emerging technology. This work is continuing with the creation of a new science panel.

Communicating the industry's success in protecting the environment remains a high priority. In the last several years, numerous groups have been addressed and hundreds of community leaders have participated in ship tours to see the advanced systems first hand. The Alaska Cruise Association partners with conservation organizations to showcase our environmental record.

In Alaska the cruise lines will continue to lead in responsible environmental stewardship.

ALASKA CRUISE ASSOCIATION

EUROPEAN CRUISE COUNCIL and PASSENGER SHIPPING ASSOCIATION

Europe has become the center of gravity for the global cruise sector over recent years and despite the challenging economic climate, the European cruise market continues to grow.

The challenge for the European cruise sector is to ensure this growth goes hand in hand with the protection of the environment – minimizing negative impacts while improving positive impacts and supporting sustainable tourism.

At European and international levels, the cruise industry is engaged in ongoing, active and constructive discussions in key areas such as climate change, air emissions and the discharge of waste.

On the issue of waste, the European Cruise Council (ECC) has recognized the environmental threat of eutrophication in the Baltic Sea and has taken practical action. Member cruise lines operating in the Baltic have advanced wastewater treatment systems or marine sanitation devices on board their ships. However, following contact with the Helsinki Commission, which works to protect the marine environment of the Baltic Sea, and other environmental organizations in the region, cruise companies have voluntarily agreed to discharge blackwater ashore at Baltic ports if they can provide adequate reception facilities. The ECC are working with all interested groups to ensure appropriate reception facilities are in place in the shortest possible time. The Council is also in discussion with the EU Commission on revision of the 2005 Sulfur Directive in 2011 and on the related issue of the possible future proposals to IMO for further Emissions Control Areas within Europe.

Marine wildlife conservation efforts and scientific research are also high priorities and cruise lines have partnerships with a number of organizations, including the World Wildlife Fund to support protected marine areas within the Mediterranean.

European Cruise Council

PASSENGER SHIPPING ASSOCIATION

NORTH WEST & CANADA CRUISE ASSOCIATION

The thrill of cruising through fjords, glaciers, and along the narrow and spectacular Inside Passage that connects Washington, British Columbia, the Yukon and Alaska has added to the allure and fascination of the Pacific Northwest for over a century. It is one of the world's most popular cruise vacation destinations. While Canada's east coast and the historical cities of Quebec offer cruise passengers the opportunity to experience dramatic scenery, diverse cultures and natural wildlife.

Cruise ship operations are subject to city/port, provincial/state, federal, and international laws and regulations. They must comply with environmental standards and laws set by the International Maritime Organization (IMO), various maritime classification societies, as well as national and regional regulations and agreements.

Innovative, cost-efficient and environmentally responsive cruise ships start on the drawing board. The challenge is to find the most advantageous technological design that will meet the requirements for fuel efficiency and provide outstanding passenger experiences, while meeting and in many cases exceeding regulatory requirements.

The cruise industry is continually working to ensure a safe and sustainable cruise ship environment. The primary attraction of the areas visited is their pristine beauty, so preserving it is essential.

Just as the size of ships has grown, so has the technology relating to ships. There have been great advances in navigation, safety, propulsion and environmental technology. While representing only .002 percent of all ocean-going vessels worldwide, the cruise industry is on the cutting edge of environmental protection and technology development.

North West & Canada Cruise Association member lines are at the forefront of these developments, serving as a model for cruise ships in other jurisdictions. Collectively they have invested over $100 million on wastewater purification systems that treat water to standards higher than most land-based operations. Additionally, cruise lines have invested in cleaner burning fuels and gas turbine engines that reduce air emissions and the development of shore power in Seattle, Vancouver and Juneau. They have adopted aggressive programs of waste minimization, waste reuse and recycling, waste stream management and shore side waste disposal.

NORTH WEST & CANADA CRUISE ASSOCIATION

FLORIDA-CARIBBEAN CRUISE ASSOCIATION

The Florida-Caribbean Cruise Association (FCCA) and its member cruise lines are committed to supporting sustainable tourism in our partner destinations where our ships call through programs and policies that protect the natural environment. The FCCA works with Caribbean and Latin American governments as well as private sector organizations to implement programs and launch initiatives that promote responsible environmental practices.

"The FCCA member lines and their employees are committed to the highest environmental standards through cutting-edge environmental policies, procedures, technologies, and through a variety of programs that engage partner communities" said Micky Arison, Chairman & CEO, Carnival Corporation and former FCCA Chairman. "These measures are vital to preserving the natural environment of the destinations to which we bring our guests, as well as the waters on which we sail."

The FCCA supports environmental sustainability through several initiatives. An example is our Environmental Outreach Program that for that for more than a decade has worked with destinations and crew members to organize annual beach clean-ups in partner destinations, including the Cayman Islands; Cozumel, Mexico; Belize; Nassau, Bahamas and St. Croix, U.S.V.I. The clean-up projects are designed to reinforce the cruise industry's partnership and tangibly demonstrate the FCCA member lines' concern for the destinations they visit.

The FCCA has also partnered with Cozumel, Mexico, and Belize to develop environmental stewardship policies to formulate environmental practices to sustain both cruise and land based tourism. The FCCA has signed landmark memorandums of understanding with both destinations and continues to work with all destinations on environmental practices.

In the last 14 years, more than 30 Caribbean and Latin American destinations participated in the FCCA's environmental poster competition. This competition focuses on having the youth of our partner destinations reinforce and develop ideas to protect the environment.

As part of the FCCA's Membership programs working in conjunction with FCCA's insurance broker, AON, all tour operators are held to a very high environmental and safety standard as is in keeping with the member lines corporate policies.

FCCA FLORIDA-CARIBBEAN CRUISE ASSOCIATION

EXECUTIVE SUMMARY

In the 35 years since the Cruise Lines International Association (CLIA) was established, our industry has made significant progress in reducing our environmental impact by implementing responsible practices and investing in new technologies. Put simply, CLIA believes that it is our responsibility to protect the environment in which we operate. This report describes how far we have come in 35 years.

Regulations

As a global industry, cruise ships are primarily regulated at the international level, however flag states (countries where ships are registered), and port states (countries where our ships visit), regulate the industry as well. Cruise ships are regularly inspected by both the ship's flag and port state to ensure that all of these requirements are being met. Regulations affect not only the way cruise ships are built, but also how ships manage waste and reduce air emissions and energy consumption. CLIA members not only meet all applicable international, federal, state, and local regulations, but in many ways exceed these requirements.

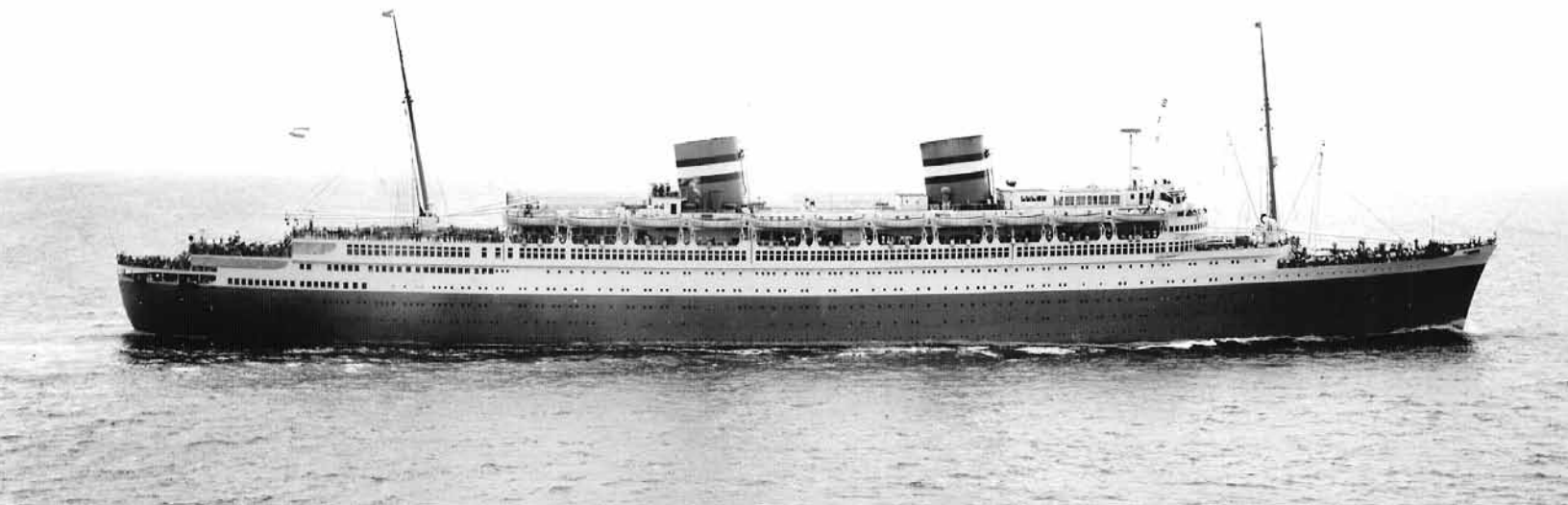
Waste Management

The management of wastewater is a complex and vitally important element of cruise ship operations. Blackwater (water from toilets and medical facility drains) and graywater (water from cabin sinks and showers, laundry, galleys and spas) discharge is often regulated to a higher standard than most land-based facilities. Our industry adopted its own set of stringent wastewater practices that go beyond the rules and regulations. For example, while regulations permit the discharge of untreated blackwater 12 nautical miles from shore, as a policy CLIA members treat all blackwater using equipment certified to meet the standards set by the U.S. Coast Guard or using an advanced wastewater purification system.

Cruise ships have adopted rigorous programs to tackle waste disposal in an eco-friendly manner, including doing all we can to minimize the potential waste coming on board ships. We also take extensive measures to recycle as much waste as possible. Passengers are even encouraged to separate their own waste by using on-board collection bins. CLIA lines recycle approximately 80,000 tons annually, comprised largely of paper, plastic, aluminum cans and glass. Other waste, such as hazardous waste and oily bilge water receive special treatment as well.

Emissions Reduction

CLIA members have been systematically reducing air emissions, including sulfur oxides, nitrogen oxide, carbon dioxide and particulate matter, as more fuel



efficient ships have come into service. In the near future, international regulations will further reduce sulfur limits, helping to reduce air emissions across all oceans. To meet these standards, we have been investing in new technologies that manage the use of energy more effectively, such as testing the first-ever cruise ship engine exhaust gas scrubber and developing engines that run more efficiently.

Cruise lines often work alongside ports to reduce waste and emissions. This is best demonstrated by the use of shore power, a relatively new technology in the cruise ship arena, which involves a ship connecting to shore-side power and shutting down its own engines while in port. A handful of ports on the North American west coast are now equipped with the necessary facilities for ships to 'plug-in' when they are in port. CLIA members are involved at the international level to explore a universal approach toward shore power, to overcome current obstacles, which involve the source of shore power, the connection adapter itself, as well as electrical disparities from one country to the next.

Energy Consumption and Reduction

Other innovations can help ships conserve energy. Eco-friendly hull coatings make ships' hulls smoother but the design itself can also be modified into a bulbous bow, for example, that generates a bow wave slightly earlier. Both result in an energy saving by reducing resistance. Other innovations include heat recovery that allows heat to be collected from one system aboard a ship and used for another, and innovative air conditioning systems that run more effectively and utilize technology that minimizes the amount of energy used to cool a room when it is not occupied. Ships are now using energy- efficient light bulbs that generate less heat. One of the latest innovations to be found on cruise ships is solar panels. Because ships spend so much time under the bright sun, solar panels are a good source of supplementary energy.

Partnerships

In addition to working with ports, CLIA turned to Conservation International in 2003 to serve as an environmental advisor to make recommendations on how to further minimize the cruise industry's environmental footprint and to maximize positive outcomes for nature conservation in key regions where the industry operates.

Save a Tree – Download for Free

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PART I:

Regulatory Framework

CHAPTER 1
REGULATIONS

The cruise industry is truly a global industry, with Cruise Lines International Association (CLIA) member lines carrying more than 14 million passengers per year to destinations all around the globe. Appropriately, the cruise industry is primarily regulated at the international level, however flag states (countries where ships are registered), and port states (countries where our ships visit), regulate the industry as well.

This sophisticated matrix of regulations affect not only the way cruise ships are built, but also how operators manage a host of issues, from waste handling to overboard discharge and energy consumption. It is our everyday goal to be an innovative leader developing the highest environmental standards and practices so that CLIA members meet, and very often exceed, each and every regulatory requirement.

Cruise ships are regularly inspected to ensure the requirements are being met. Shipping classification societies - independent expert organizations - inspect cruise ships for compliance with the many applicable rules and requirements. Flag states, port states and other external organizations also regularly inspect, examine and audit all aspects of cruise ship environmental compliance and operations. To ensure compliance, our ocean-going ships all have senior-level staff on board whose responsibilities include 24-hour compliance with the many different regulations ships' encounter as they travel from one destination to another.

The cruise industry is truly a global industry. Appropriately, the industry is primarily regulated at the international level, although flag states and port states regulate the industry as well.

INTERNATIONAL REGULATIONS

The multi-layered set of regulations begins at the international level with agencies that are a part of the United Nations: the International Maritime Organization (IMO), International Labour Organization (ILO) and World Health Organization (WHO). The IMO specifically regulates the shipping industry and in the 35 years since CLIA was established there have been many updates in this regulatory framework. The most important of these initiatives related to the environment is the adoption of the IMO Convention for the Prevention of Pollution from Ships (MARPOL) which sets strict standards for all commercial vessels to prevent ship-generated pollution. The result of considerable efforts by IMO member governments, MARPOL and its six annexes are continually updated to reflect current technological capabilities.

As a non-governmental consultative organization to the IMO, CLIA and our members are also active participants in deliberations at the IMO's London-based headquarters and in its technical committees. For example, we are closely participating in the development of future air emissions standards to reduce the industry's carbon footprint. Cruise

Cruise ships are regularly inspected to ensure the requirements are being met. Our ocean-going ships all have senior-level staff on board whose responsibilities include 24-hour compliance with the many different regulations.

lines are an important voice to include since many of the most recently built ships have installed cutting edge technologies to reduce emissions significantly.

CLIA members are working closely with the international community at IMO to reduce the carbon output of all ships, including cruise ships. One of the first steps is to develop a methodology of quantifying energy consumption. This is called the Energy Efficiency Design Index (EEDI). In the future this index will be used to measure the required reduction of carbon output.

Compliance with all of these international regulations is monitored by both the ship's flag and port state, which in the U.S. is the U.S. Coast Guard.

NATIONAL REGULATIONS

On top of all of the international regulations, each ship that visits a country's port must comply with that country's own environmental regulations. In the U.S., the Oil Pollution Act of 1990 helped bring attention to environmental issues at sea, which together with the federal Clean Water Act and Act to Prevent Pollution from Ships introduced strict liability and criminal penalties for illegal discharges.

More recently, in 2009 the U.S. Environmental Protection Agency's new Vessel General Permit under the National Pollution Discharge Elimination System (NPDES) came into force. This permit imposes additional controls on the discharges from ships in U.S. waters, including a number that were previously not covered in the U.S. Clean Water Act. As a result, everything from rain water runoff to engine cooling water, discharged into U.S. waters is regulated.

Another update in 2009 was the joint decision by the U.S. and Canadian governments to petition the IMO to establish an Emissions Control Area (ECA) that would cover the whole of North America. The creation of this ECA is driven by public health goals aimed at reducing the emission of

sulfur oxides, nitrogen oxides, and particulate matter from large vessels through the use of low sulfur fuels or other equivalencies. CLIA members have not only tested cutting edge emissions reduction technology, but have also been responsible for driving its development forward. This demonstrates our dedication to reducing these emissions, and through such actions, we are actively working on methods to support the public health goals of the ECA and have been making progress toward this end.

It is important to note that regardless of where a ship may be flagged, if it visits a U.S. port, it must comply with all applicable federal regulations.

STATE & LOCAL REGULATIONS

The regulatory framework does not end at the national level since individual states in the U.S. have also put in place their own rules governing the environment. In some instances, state measures go above and beyond those put in place on an international or federal level.

In Alaska, for instance, legislation passed in 2006 set future wastewater rules for cruise ships that are among the most stringent worldwide and far exceed regulations placed on most shore-side municipal wastewater treatment facilities.

The cruise industry is no less dedicated to meeting local requirements. In fact, the cruise lines received a strong endorsement from the particularly environmentally sensitive state of Alaska. In 2009, the Alaska Department of Environmental Conservation submitted a report to the legislature that read, "Cruise vessels are environmentally aware, and have sound environmental systems and operational practices in place to minimize environmental impacts."

CLIA REQUIREMENTS

In ways large and small, CLIA member cruise lines have taken a number of actions not required by law to help reduce our environmental footprint. The cruise lines have a variety of environmentally innovative programs in place that go further than just responding to regulations placed on our ships.

Our commitment to meet and exceed requirements is exemplified by CLIA's own Waste Management Practices and Procedures. In 2001, CLIA lines adopted these practices and procedures with an eye toward identifying ways to go above and beyond requirements. In fact, they recommend procedures that exceed those required under the U.S. Clean Water Act and MARPOL. For instance, while international regulation allows for the discharge of untreated blackwater (sewage) beyond 12 nm (nautical miles) from shore, our cruise ships treat all blackwater prior to discharge wherever they sail worldwide. The cruise lines have agreed to incorporate all of the waste stream standards into their legally required and enforceable Safety Management Systems, which are inspected by port states such as the U.S. Coast Guard.

CHAPTER 2

CLASSIFICATION SOCIETIES AND NOTATIONS

Passing scheduled and unscheduled inspections by flag and port states is only one small way that CLIA ships demonstrate compliance with environmental regulations.

Classification Societies are authorized to act on behalf of numerous flag administrations to verify that ships comply with MARPOL and other statutory instruments adopted by the IMO and following ratification by its member states. This verification covers a wide range of environmental impacts, including oil pollution, sewage, garbage, exhaust emissions, ballast water and others. The verification regime comprises initial plan approval and on-board surveys, as well as surveys held at periodic intervals to ensure compliance is maintained.

Classification Societies also provide ship operators with the opportunity to demonstrate that their ships exceed the IMO requirements by offering Class Notations that are awarded if prescribed environmental requirements taking the form of Rules and Regulations are met. For example, Lloyd's Register has developed the Environmental Protection (EP) Class Notation that has a number of core requirements and supplementary characters that cover all major environmental impacts, including the installation and operation of ballast water treatment systems; the treatment of swimming pool water before it is discharged to the sea; the installation and operation of oily water separators with a discharge standard that exceeds the IMO limits; the use of environmentally friendly refrigerant gases and/or natural substances, which do not deplete the ozone layer; antifouling coatings that are not harmful to marine organisms, and others.

Classification Societies act on behalf of flag states to verify that cruise ships comply with MARPOL and other standards.

Many CLIA members further demonstrate their commitment through independent certification of their environmental management system (EMS) against ISO 14000: 2004, which represents best practice both internationally and in the U.S. The ISO 14001:2004 standard is based upon the cornerstone of demonstrating continual improvement. Hence, cruise lines are always looking for opportunities to improve their ships' performance and thus reduce their environmental impact. ISO 14001:2004 certification provides regulators, customers and

other stakeholders with assurance that the cruise line sector is running a sound business by continuously proving their environmental credentials to the society.

CLIA members have received numerous recognitions from classification societies.

One of our members was the first cruise operator to receive Bureau Veritas' Six Golden Pearl Label, the highest notations and certifications for Quality Health & Environment for cruise vessels. Six ships in its fleet have the notations.

Another has received Bureau Veritas' first Energy Efficiency Design notation. This recognizes that adjustments to the design of the ship have saved more than 10 percent in energy consumption compared to a conventional ship of the same size.

Some CLIA members have applied for the "Green Ship Notation" from Italian class society, Registro Italiano Navale (RINA). Twenty-one ships have qualified from six different member lines. One operator's entire fleet has the Italian class society's Energy Saving Index, which helps cruise owners reduce the energy they use.

In 2008 RINA launched Green Plus, an environmental performance index which covers all aspects of the vessel's impact on the environment including carbon emissions. It is awarded to those ships that have made a significant investment in design solutions, onboard equipment and operational procedures that make an environmental impact, including engine design and the use of alternative fuels. One of our members has taken up this challenge, receiving the notation for three of its ships.

Classification societies will continue to challenge our members to raise the bar even higher as they lead the forefront of environmental development and innovation.

PART II:

Waste Management

CHAPTER 3

WASTEWATER MANAGEMENT

Wastewater management is a complex and vitally important element of cruise ship operations. In some locales, blackwater (water from toilets and medical facility drains) and graywater (water from cabin sinks and showers, laundry, galleys and spas) discharge from cruise ships is regulated to a higher standard than any other vessel and most land-based facilities. In many areas of the world, the treated wastewater discharged from a cruise ship is cleaner than that discharged from municipal facilities.

On the international level, MARPOL (International Convention for the Prevention of Pollution from Ships) sets standards of compliance for pollutants but the many layers of regulation make this issue increasingly complex. For instance, many of the areas our ships visit require different levels of effluent water quality. Furthermore, these requirements continue to evolve and be updated. The U.S. has federal standards that differ from MARPOL but many states have enacted their own standards.

To illustrate the extent to which these requirements affect a ship and its crew, a piece of equipment that was developed to fulfill a requirement in one region may not be sufficient elsewhere. Imagine if one state required different tail lights on your car than another. While it is possible to conform to different speed limits with the same vehicle, it would be quite challenging and burdensome to stop at each border to change the tail lights. Remarkably, however, our member cruise lines comply with all applicable regulations.

CLIA's Waste Management Practices and Procedures add even another level of detail. The cruise industry has gone beyond the rules and regulations in its discharge procedures by adopting our own set of stringent wastewater practices.

For example, while U.S. and international regulations permit the discharge of untreated blackwater 12 nautical miles from shore, as a policy CLIA members have committed to treat all blackwater prior to discharge. All blackwater is treated using equipment certified to meet the standards for Type II Marine Sanitation Devices, which is a tool approved by the U.S. Coast Guard for all vessels in U.S. ports, or using an advanced wastewater purification

Blackwater and graywater discharge from cruise ships is regulated to a higher standard than any other vessel and most land-based facilities. Often, the treated wastewater discharged from a cruise ship is cleaner than that discharged from municipal utilities.

system (AWPS, also referred to as an Advanced Wastewater Treatment system, or AWT).

CLIA's Waste Management Practices and Procedures also state that treated blackwater will not be discharged within 4 nautical miles from land, and at speeds below 6 knots, unless processed by an AWPS. No matter what, any and all discharge always takes place in accordance with local laws and regulations, since there are some jurisdictions that do not allow for such discharge.

HOW AN ADVANCED WASTEWATER PURIFICATION SYSTEM WORKS

With so much focus on wastewater treatment systems, let's take a closer look at how one of these systems works, keeping in mind that not all treatment systems work in precisely the same way.

Blackwater and graywater, which is 98 percent of the total amount of water used onboard, is mixed together in a tank, which then proceeds into a filtering drum. At this point, the large solids are taken out. From there, it goes into a bioreactor, a large mixing tank complete with bacteria which consume the organic material. These bacteria are the key as they consume a great deal of the biomass aided by the mixing in of extra air.

To remove any remaining solids, polymer and coagulant are then added. This addition causes the remaining solids to float to the top of the tank where they are skimmed off. The solids then go into a bioresidual tank where they are discharged outside of 12nm while the ship is travelling at a speed of more than 6 knots. The latter is in fact more likely to be closer to 20 knots where the dilution rates are in the order of millions to one.

The resulting water is "clean," and it goes from the flotation units to the polishing filter for final cleaning. Lastly, it goes to the ultraviolet disinfection units which kill any remaining bacteria and make the water suitable for discharge. As a final check, a monitor ensures that if there is any water exceeding allowed limits, it will be automatically returned to the system for treatment rather than being discharged.

REGIONAL CHALLENGES

The ever-changing rules and regulations that govern shipping must remain a constant focus as cruise lines test and adopt even more sophisticated systems to meet not just current but future wastewater requirements. Future changes in Alaska and the Baltic Sea demonstrate the extent of the complexities of this topic.

The Alaskan wastewater rules mentioned in chapter one earlier impose the strictest standards on wastewater discharge. The cruise industry is testing systems and working with equipment manufacturers to make systematic improvements in order to meet these standards, which have since been extended to 2015. This extension should provide sufficient time for manufacturers to have the technology capable of providing 100 percent compliance for our ships that visit Alaska. In advance of the 2015 implementation, the State of Alaska's monitoring system found that among 3,378 tests conducted

The cruise industry has gone beyond the rules and regulations in its discharge procedures by adopting our own set of stringent wastewater practices.

in 2009, the cruise industry scored a remarkably high 98.2 percent compliance rate with the future standards. We continue to work with the Alaska Department of Environmental Conservation to ensure that the most advanced and effective technologies are used to protect this fragile environment.

However, the Baltic Sea presents a different set of challenges. The sea is suffering from eutrophication, a process where high nutrient concentrations lead to intense algae growth and oxygen depletion. The eutrophication is caused by an overabundance of nutrients in the water and is a result primarily from agricultural runoff. Though passenger ships are responsible for less than 0.05 percent of nutrients in the Baltic, the cruise industry is doing all that it can to contribute to an overall solution.

The Helsinki Commission, the group responsible for addressing this issue, submitted a proposal to the IMO to restrict discharge from passenger ships unless treated to remove 80 percent of nutrients. Otherwise, discharge must occur on shore. The specific challenge is that most port facilities throughout the Baltic Sea are currently unable to deal with the volume of wastewater discharged from a single cruise ship. Nor do they meet an 80 percent nutrient reduction in their own treatment. While CLIA ships have volunteered to restrict discharge if adequate port reception facilities for nutrients are available shore-side, we are working closely with the IMO to establish the best way forward.

Our members are committed to being at the forefront of environmental development, and many innovative systems first tested aboard our ships, are now being installed in other sectors of the shipping industry. AWPS and our involvement and dedication to solving regulatory challenges in Alaska and the Baltic Sea are just a few examples of this commitment.


GLASS BOTTLES ONLY
ALUMINUM CANS ONLY

CHAPTER 4
RECYCLING

For many of us, recycling has become a part of everyday life; it is a simple matter of separating trash and setting it on the curb or dropping it at a local collection site. But for cruise ships it is nowhere near as simple. Being a floating resort community, everything has to be stored on the ship until it can be offloaded at suitable shore-side facilities, which are not always available at every port of call. CLIA members have adopted rigorous programs both on our ships and within company structures ashore, to ensure we maintain the highest standards and tackle waste disposal in the most eco-friendly manner possible. Ships must have dedicated storage facilities for such waste to ensure there is no contamination of food storage and processing facilities.

CLIA's own Waste Management Practices and Procedures, which all members have agreed to incorporate into their respective legally-enforceable safety management systems, covers the disposal of certain wastes, including solid waste and hazardous waste. The onboard environmental officer makes sure that all staff are fully trained in the organization of waste disposal.

CLIA members have a zero discharge policy for trash. The crew is under strict instruction to dispose of everything properly. As required by MARPOL, all cruise lines have signs in place reminding passengers not to throw anything into the sea.

It is not, however, always easy to regulate our passengers' trash and recycling habits while on board. Yet we do all we can to request our guests assist us with recycling. Collection bins are placed throughout the ship to encourage passengers to separate waste into glass/cans, plastic/paper and food.

Discharging of wet garbage is done by legally authorized garbage handling companies. All garbage picked up is recorded in a record book and its offloading is certified by a MARPOL receipt. After careful checking for paper and plastics, food waste goes through a pulper and is then discharged at sea well away from shore.

CLIA's own Waste Management Practices and Procedures, which all members have agreed to incorporate into their respective legally-enforceable safety management systems, covers the disposal of certain wastes, including solid waste and hazardous waste.

RECYCLING

Our policy is to minimize potential waste that comes on board, for example by partnering with our suppliers to reduce packaging, and recycle as much as possible. So while on the one hand we are proud of how much our lines recycle, on the other hand our continued aim is to minimize the waste generated. The ultimate goal is to recycle less because less is produced.

All cruise lines are taking extensive measures to recycle waste that is generated on board their ships, including water, glass and garbage, and have installed the most advanced equipment on our ships with this end in mind. CLIA estimates that in a given year our lines recycle roughly 80,000 tons, comprised largely of paper, plastic, aluminum cans and glass.

On board a ship, recyclable material is separated by below deck equipment designed to handle different waste products. For example, aluminum, such as cans, is compacted into bricks, and once onshore is sent for recycling. Plastics are also compacted and glass goes through crushers; they are then also sent to onshore recycling facilities. Paper and cardboard are shredded and may be incinerated if

there is too much volume to store it. The resulting ash is either landed shore side or discharged at sea in accordance with international waste regulations well offshore.

Since onshore recycling facilities vary from port to port, CLIA lines inspect the facilities often to make sure recycling takes place as contracted.

Despite the limited storage space available, both recycling equipment and systems are being constantly developed with increasing success. For instance, one member line has a fleet wide average of offloading about 1.5 pounds of waste per person per day, whereas the average U.S. household produces 4-5 pounds of waste per person per day.

HAZARDOUS WASTE

All hazardous waste is landed in accordance with local requirements. In the U.S., this is in accordance with the Resource Conservation and Recovery Act, and carefully monitored, manifested and vendors thoroughly vetted. Cruise lines have taken additional steps to reduce hazardous waste streams.

For example, lines are phasing-out perchloroethylene (perc), the traditional chemical used in dry cleaning, and housekeeping chemicals no longer use any form of phosphates. Photography onboard is moving towards digital, which lessens the need for developing chemicals (silver) and printing materials such as ink. Where developing chemicals are still used, the waste is passed through silver recovery units and then discharged ashore to certified handlers as an industrial waste. Finally, used lights and batteries are landed for special recycling as are photocopying and laser print cartridges.

CLIA estimates that in a given year our lines recycle roughly 80,000 tons, comprised largely of paper, plastic, aluminum cans and glass.

CHAPTER 5

WASTE OIL

Bilge water is the name given to the oily water that collects in the ships' bilges at the bottom of the hull. Waste oil is an incidental result of normal operation of various machinery, the engines and lubricated seals.

Regulators require that discharged bilge water should contain less than 15 parts per million (ppm) of oil but CLIA members are often able to improve on that standard by cleaning the water closer to 2 ppm.

Bilge water treatment systems work by pumping the oily water into a tank where gravity separation leads to the oil being drained off the top. It then moves into a holding tank to be discharged ashore or incinerated. The remaining water goes through the oily water separator. About 5 cubic meters (m3) of water an hour goes through the separator and the result is water with at least less than 5 ppm of oil, although this is more often closer to 2 ppm. This water is then held in another tank to go through a further process before it is discharged.

To ensure the water meets the requirement of being less than 15 ppm oil when it is discharged, "white boxes" have been fitted to monitor the content of oil in the water. A three-way valve operates such that in the event that the oil content exceeds 15 ppm, the water will be automatically redirected back to the holding tank and recycled for further cleaning.

The "white box" also records the amount of water discharged, its content, and the date and time of discharge. The oily water discharge valve is locked closed when in port and only the environmental officer

Regulators require that discharged bilge water should contain less than 15 parts per million (ppm) of oil but CLIA members are often able to improve on that standard by cleaning the water closer to 2 ppm.

The new ships being built today are designed to be as ballast free as possible.

and chief engineer have a key. It will be unlocked for discharge only once the ship goes outside 12 nautical miles.

While cruise ship operators always strive to avoid any oil leakage, equipment such as thrusters, sterntubes, broken hydraulic lines, winches and pumps are all possible culprits of leakage. The industry is now actively involved in replacing traditional oils with lubricants that are environmentally sensitive.

Conventional oil will take more than a year to biodegrade by 50 percent, whereas a readily biodegradable lubricant will biodegrade more than 60 percent within 28 days. Manufacturers have already started to release such lubricants for a range of uses from sterntube and gear oils to controllable pitch propeller systems.

BALLAST WATER

Ballast water is carried on ships to ensure stability, trim and structural integrity, while also reducing bending moments. Whereas ballast water on cargo ships often compensates for the absence of a delivered cargo, on cruise ships it plays a much more minor role.

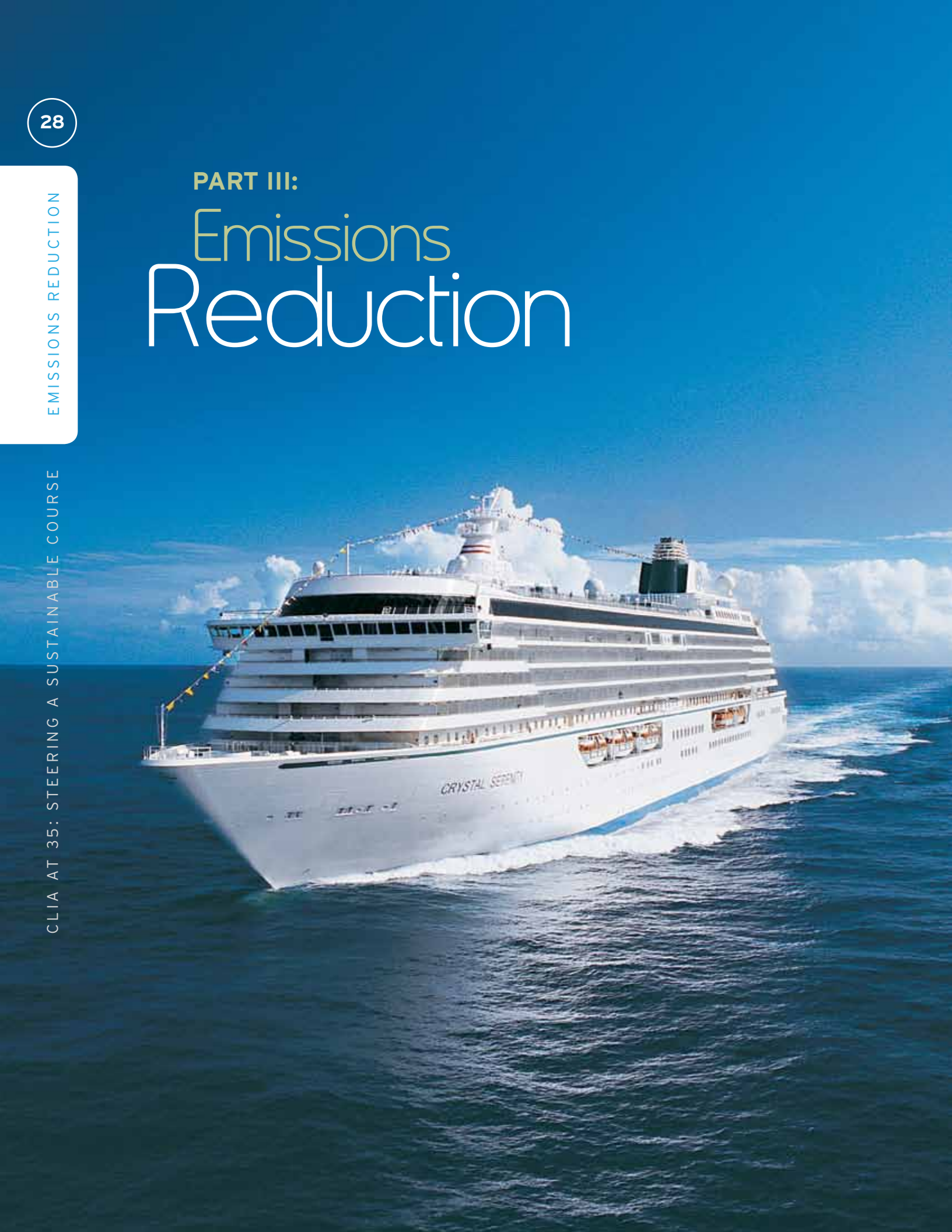
The new ships being built today are designed to be as ballast free as possible, so as to avoid discharging water with invasive species (non-native plant and fish life that can inadvertently be transferred from one body of water to another, and in some cases, present risks to the non-native body of water). In some ships it is highly unlikely that discharge of ballast will ever be necessary due to the way they are now designed to allow for greater liquids management.

Existing ships may have to take on or discharge ballast water but will rarely do so in a different marine environment, given the nature of their itineraries. When you take up and discharge wastewater in the same ecological zone, it is less likely that any invasive species will be discharged in the ballast water. For example, the majority of ships remain in one region for half of the year (for example the Caribbean) and reposition for the other (for example the Mediterranean). It is more likely that if a ship does have to discharge or take on ballast, it would do so out in open water and away from land.

Despite this, international regulations will be requiring all ships to install expensive ballast water treatment systems in the coming years. A number of manufacturers are looking at different solutions. One uses a sediment removal system which takes out sediment and biota during uptake, the process of pumping water in to fill a ballast tank. An electronic cell then decimates bacteria and organisms.

PART III:

Emissions Reduction



CHAPTER 6

AIR: EMISSIONS, SCRUBBERS, ALTERNATIVE FUELS

The existence of international meetings, such as the 2009 Copenhagen Summit, demonstrates the increasing concern on the impact that green house gas emissions can have on climate change. With heads of state from around the world focused on emissions reduction, the cruise industry must also be involved in tackling this challenge.

CLIA members have undertaken many initiatives to reduce the cruise industry's carbon footprint. Our members have been systematically reducing air emissions, including sulfur oxides, nitrogen oxide, carbon dioxide and particulate matter, as more fuel efficient ships have come into service and new technologies have enabled us to manage the use of energy more effectively.

EMISSIONS REQUIREMENTS

As with wastewater, MARPOL sets the standards for controlling air emissions. CLIA is an active participant in these meetings at the IMO, where the issue of global warming is addressed. Again, just like with wastewater, there are also national and local regulations, many of which focus on the sulfur content of the types of fuel ships can use. These may vary from one part of the world to another.

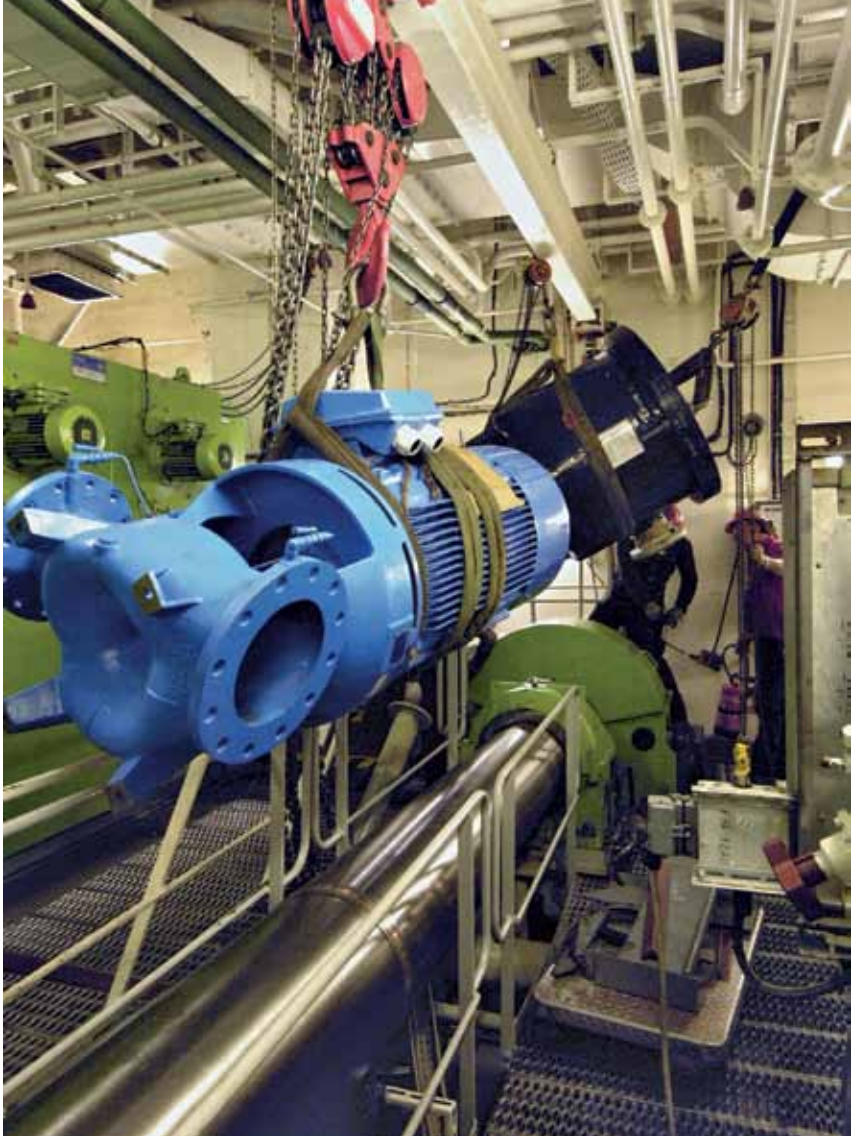
New MARPOL rules will reduce global sulfur limits to 0.1 percent in the Baltic and North Sea, and new European Union rules will cap sulfur content in marine gasoil to 0.1 percent. By 2020, new limits set by MARPOL will require globally 0.5 percent low sulfur fuel, from current 2.5 percent - 2.7 percent levels, which is a huge environmental step to reduce air emissions across all oceans.

Some of the most significant regulatory proposals are Emissions

We are making progress by testing technology, such as the first-ever cruise ship engine exhaust gas scrubber, utilizing waste heat recapture and using slick, non-toxic hull coatings that reduce drag so ships consume less energy and fuel for propulsion.

Control Areas (ECA), where specific sulfur, nitrogen oxide and particulate matter restrictions are in place and exceed the global reductions prescribed by MARPOL. ECAs impact many of the most popular cruise destinations. An emission control area requirement is scheduled to come into force along the North American coastline in 2012.

CLIA supports the public health goals of ECAs. Our members are searching for solutions which allow us to meet all regulatory requirements with the most innovative environmental solutions. Oftentimes, we work alongside ports by participating in their programs to improve air quality.



TECHNOLOGICAL ADVANCES

We have been making progress toward this end by testing technology, such as the first-ever cruise ship engine exhaust gas scrubber, utilizing waste heat recapture and using slick, non-toxic hull coatings that reduce drag so ships consume less energy and fuel for propulsion. Members have also been investing in engine technology as another way to reduce emissions significantly. Sensors and similar monitoring systems can also be used to monitor emissions from a ship's funnel and engine room.

Even before the North American ECA was proposed, one member began testing the use of an engine exhaust gas cleaning system, commonly referred to as a "scrubber", as a means to remove or drastically reduce particulate matter and sulfur oxide in engine emissions.

Sea water scrubbers provide an alternative to low sulfur fuels by using the natural chemistry of seawater to remove sulfur oxide and particulate matter emissions. The seawater can then be treated to remove harmful components before it is discharged. Scrubbers also offer a degree of flexibility in the approach to achieving emissions reduction goals. The U.S. Environmental Protection Agency (EPA) has said that an alternative approach, such as scrubbers, can be used to achieve the same results as using clean fuel on board. This statement is in line with guidance from the IMO.

The manufacturer believes that the system offers a more cost effective option to the use of low sulfur distillate fuels. The initial results are promising in terms of what manufacturers may achieve in the future. Fitted into the ship's funnel, the scrubber works by neutralizing scrubbed acidic gases using the carbonate and bicarbonate in seawater. Early testing showed it eliminated up to 75 percent of sulfur dioxide and 57 percent of the particulate matter emitted by the ship's diesel generator.

CLIA members have undertaken many initiatives to reduce the cruise industry's carbon footprint.

ALTERNATIVE TYPES FUEL

Given the new regulations capping the sulfur content of fuels in ECAs and European Union ports, ships will have to carry different grades of fuel – sometimes as many as three types. While in the past ships have been able to use heavy fuel oil (HFO), they will now be using low sulfur fuel oil or gasoil. This is likely to impact storage arrangements for such fuels, and the possible need to switch from one to another when entering an ECA or a specific port.

Experts have raised concerns over some properties of low sulfur fuels. First, data prepared by one classification society indicates that some low sulfur marine gasoil and marine diesel oils are not in compliance with IMO engineering safety requirements. Second, the risks of switching between HFO and low sulfur distillate fuels are considered higher than between HFO and low sulfur HFO fuel given some of the issues with viscosity and lubricity. CLIA members are continuing to invest substantial amounts of time and money in considering the options that present the safest and most effective solutions.

WIND TURBINES

In a constant search for environmental solutions, one CLIA member has tested two different wind turbines on one of its ships. It went well until the ship entered inclement weather. With the ship steaming 20 knots in one direction and the winds blowing 60 knots in the other, success was limited. Undaunted, they are looking at another option and will continue to do so as new technologies emerge. This is just one more example of how this is a time of initiative and innovation. In many cases both cruise lines and manufacturers are pushing boundaries of technology and designing solutions as they go along.

SOME SOLUTIONS PRESENT CHALLENGES

However, as the previous example starts to show, not every innovative approach will work. One member looked into using biodiesel, a cleaner-burning diesel fuel made from natural, renewable sources such as vegetable oils, and became the world's single largest end user of biodiesel in 2006 and 2007. But, three years later it no longer uses the fuel. The reason for this is simple. Evidence began to emerge that the increased demand for biofuels was causing an increase in prices for staples such as corn and sugar. In addition, concerns were being raised about increased deforestation in order to cultivate the crops for biodiesel production.

CHAPTER 7
ENGINES

With the IMO having set standards to reduce emissions, CLIA members have been working closely with our executive partners and engine manufacturers to develop engine technology that can meet these requirements.

New and innovative engine designs are an essential part of our effort to minimize our carbon footprint and energy consumption of cruise ships. Newer engines may have numerous benefits, including helping ships run more fuel efficiently, meet emissions standards, and power it with less noise or vibration.

ENGINE TYPES

As far as different engine designs and configurations are concerned, there are many potential propulsion method options available, from diesel-electric combinations, gas turbines, solar and wind energy, to even nuclear power.

For example, in a diesel-electric system, the engine is connected to an electrical generator that can create electricity to provide propulsion and the power supply necessary for passengers and crew. On the other hand, common rail engine systems control the amount of fuel injected into the diesel engine to ensure maximum performance and reduced fuel consumption. In these systems, the pressure of the diesel fuel injected into the engine is not dependent on the engine's speed or load. The emissions benefits are also considerable as the resulting smoke free exhaust gas systems are beneficial to the environment.

Additionally, technology has been developed that includes fuel-water emulsion, humid air motors and exhaust gas recirculation.

While today's engines meet the Environmental Protection Agency's Tier I emission standards for marine diesel engines as adopted by MARPOL, tomorrow's engines will meet the more stringent Tier II standards coming in 2011. Tier III technology, however, does not yet exist despite the fact that engines produced in 2016 and beyond may have to meet the standard.

New and innovative engine designs are an essential part of our effort to minimize our carbon footprint and energy consumption of cruise ships.

EFFICIENCY AND INNOVATION

Cruise lines, engine manufacturers and shipyards cooperate closely to develop solutions that not only reduce energy consumption at a time when conservation of energy supplies is essential, but also reduce emissions. This is a constant challenge especially as the size and subsequent propulsion requirements of cruise ships continue to increase.

To this end, one of our members has introduced solar power on its ships, which feeds into a central electrical grid and to generate electricity to power the elevators. This solar power can be used to provide power to other systems, including lighting, therefore decreasing demand on the engines. The use of solar power on cruise ships will be discussed in more detail in chapter 14.

Other possible future options include the use of liquefied natural gas (LNG). Engine manufacturers have begun to develop systems that use LNG as an alternative to heavy fuel oils. LNG has much to offer in terms of emission reduction but poses a number of roadblocks in terms of storage. For instance, to remain liquid LNG needs to be stored at minus 162 Celsius. Thus, storage tanks would need to be well insulated, which in turn requires the availability of more space on board. One promising way to overcome this is to use duel fuel options, by combining gas and diesel.

Lastly, the use of fuel cell technology is an emerging technology that the industry is currently studying. The potential emissions benefits are substantial since the fuel cell converts the source fuel (natural gas) into electricity and water.

A new alternative that is emerging within the cruise ship industry is the ability to "plug in" while in port, connecting the ship to shore-side power and shutting down its own engines, also known as "cold ironing."

CHAPTER 8
SHORE POWER

Cruise ships serve as hotels for their guests whether the ships are in transit or in port. Operationally, however, there is one key difference: ships need their own power system to generate the electricity needed for the hotel load. Thus, ships need to run their engines and generators to produce the necessary power.

A new alternative that is emerging within the cruise ship industry is the ability to "plug in" while in port, connecting the ship to shore-side power and shutting down its own engines, also known as "cold ironing."

Once a cruise ship is "plugged in" at port, shore power has the potential to reduce the overall emissions a ship would generate. Though it is still early in terms of its deployment at cruise ports, our industry is supportive of the potential benefits of shore-based power. The industry is engaged at the international level in discussions regarding the adoption of a standard for cold-ironing connections and other technical elements, so that every ship fitted for shore-based power could connect at any equipped port around the world.

A number of ports on the North American west coast are now equipped with the necessary facilities for ships to 'plug-in' when they are in port. As of April 2010, five cruise ship berths in North America featured this ability. The first port to make this available was Juneau, Alaska, where the hydroelectric power provides a clean source of energy.

Although the use of shore power is not mandatory at this time, ports do have to meet air quality targets and the cruise lines and ports are working together to find solutions which may include this option.

While it has obvious advantages, there are a number of issues that still need to be overcome before shore power is more widely used.

First, shore power should be shown to be the best environmental solution at a specific port. In locations such as Juneau, Alaska, where there is an abundance of hydroelectric power, it can be very environmentally beneficial. However, the source for the shore power must be cleaner than what a ship would generate. In some cases, the power source may be less environmentally acceptable. Like most environmental issues, it is vital to study the matter holistically.

Second, the industry is engaged at the international level in discussions regarding the adoption of a standard for cold-ironing connections and other technical elements. While basic standards for voltage and connection of electric cables have been established in North and Latin American ports, in Europe the story is altogether a different one. For starters, the power generated ashore is 50 cycle, unlike the cruise ships and North and Latin America where it is 60 cycle. This means a frequency converter is required which uses more energy and requires more space. Because cruise ships call on more than one port, and sometimes more than one berth at a specific port, these issues raise serious logistical challenges.

Third, there are significant cost considerations that both the cruise lines and ports must take into account. Most new cruise ships are now built with the possibility of connecting to shoreside power but older ships have to be retrofitted with the necessary onboard receptors, at a cost of between $1 million to $2 million. Even so, until there are enough ports with connection facilities, this may not be the best solution. Also, the ports must weigh the value of spending millions of dollars on facilities for ships that typically come into port for only 10 hours per week, and often only for a limited season of four to five months.

Fourth, there is the potential for huge and intermittent surges on the power grid to cause problems for local residents. In the Pacific Northwest ports, such problems can usually be avoided as ships typically come in on weekends when businesses are generally closed and local power demand is lower. However, it is still something to keep in mind.

Despite these challenges, projects from as far afield as Venice to Gothenburg are under consideration in Europe. Ports, manufacturers and cruise lines are all working together to find alternatives to diesel engines as a source of power when in port.

As another avenue of innovation, manufacturers are looking at engines that can use either natural gas or liquefied natural gas (LNG) while in port which could be supplied by truck or a gas line at the dock where the connection would take place. This addresses concerns over particulate matter as well as reducing emissions.

EXAMPLES OF ABOVE & BELOW DECK ENVIRONMENTAL PROGRAMS

1. Efficient, fuel-saving bulbous bow
2. Utilizing shore-based power, where available
3. Optimized power management systems
4. Efficient AC and heating systems
5. Slick, eco-friendly hull coatings
6. Energy-saving window coatings

7 Waste heat recovery & reuse systems

8 Advanced wastewater purification systems

9 Efficient engines, including diesel-electric engines

10 Use of low sulfur fuels

11 Water use minimization systems

12 Passenger environmental videos

13 Rigorous recycling programs

14 High-efficiency appliances

15 Testing exhaust gas scrubbers

16 LED lighting

PART IV:

Energy Consumption and Reduction

CHAPTER 9
COATINGS

The use of certain paints on a cruise ship can have dual benefits. Perhaps most obvious, there are more eco-friendly paint options available now, but paints can also help a ship move more efficiently through the water, thereby reducing energy consumption.

Paints and varnishes are also the target of recent IMO and European Union regulations. The IMO's Marine Environment Protection Committee (MEPC) agreed to guidelines for a volatile organic compound (VOC) management plan. VOCs are found in paints and varnishes and are released to the atmosphere as the paint dries. In Europe, there are regulations governing the environmental release of VOCs found in paints. Similarly, there are also new IMO rules on the internal coating of ships' ballast tanks to protect them against corrosion.

The MEPC also agreed on guidance regarding best practices for removing harmful tin-based paints (TBTs) from ship hulls. Paints that contain TBTs are extremely toxic to marine life. CLIA members have already phased out TBTs in favor of other, more eco-friendly, alternatives.

Likewise, CLIA members have committed to using paints and varnishes that are both energy efficient and environmentally friendly. In particular, our members have been investing heavily in paints used to coat ships' hulls. We have been working closely with paint manufacturers to develop and apply environmentally friendly hull coatings that make ships' hulls smoother. A smooth hull reduces resistance as a ship moves through the water, resulting in a decrease of energy consumption. Estimates are that these smooth hull coatings reduce fuel consumption by as much as 5 percent.

Some organisms can become attached to ship hulls and can increase a ship's drag through the water, thereby increasing fuel consumption. This is known as hull fouling. According to a survey carried out for a major paint manufacturer, antifouling products are on the increase. The product works by preventing organisms from adhering to the ship's hull. The hull would appear as liquid and therefore invisible to them. Some paints are specially designed for use on ships travelling at a certain speed, which ensures that the organisms wash off spontaneously.

CLIA ships have tested other innovative foul-release coatings, including those using non toxic fluoropolymers or silicon coatings. Some coatings are estimated to give as much as five years additional protection, with resulting reductions in energy use and carbon dioxide emissions.

These new generation paints provide a myriad of environmental benefits but they also have benefits in reducing the amount of time ships have to spend in dry dock. This can significantly reduce costs. While dry docking is mandatory under international regulations, ships can save time if the ship's hull is still relatively clean.

Other advantages include the fact that less paint is necessary than with previous products. In addition, newer processes used to remove old paint and dispose of it are of less potential damage to the environment and present less of a hazard to shipyard workers employed to remove or dispose of the paint.

CLIA members have committed to using paints and varnishes that are both energy efficient and environmentally friendly. In particular, we have been investing heavily in paints used to coat ships' hulls.

CHAPTER 10

HULLS

CLIA members have already made significant energy savings due to their close cooperation with ship yards, consultants and manufacturers over innovative hull designs. This relationship has led to the cruise industry being at the forefront of developing new and more energy efficient hull forms.

While one possible solution to burning less fuel is simply to slow down, modification of hull designs may offer a more innovative solution and one that ensures that CLIA members can maximize the amount of time passengers can spend in port.

For example, an optimized bulbous bow design (a protruding bulb at the bow of a ship just below the waterline that reduces drag and improves efficiency and fuel use), as compared to the traditional V-shape bow without bulbous bow, generates a bow wave slightly earlier, resulting in an energy saving of up to 15 percent through reduced resistance. Another advance was the introduction of the ducktail design which makes the stern of the ship more hydrodynamic, reducing drag and minimizing the ship's wake.

One of our members reports that the combination of optimum hull design and advanced propeller technology has resulted in energy savings of 8 percent in comparison to conventional configurations.

In another example, in conference with consultants, one of our lines used computational fluid dynamics (CFD) models to create a more holistic approach to the hydrodynamic quality of ships. CFD can be used to optimize use of bow thrusters and fin stabilizers.

Model testing, including wind tunnel and tank trials, have been used to optimize hull designs that have lower resistance and burn less fuel on our members' new ships.

In moving the longitudinal centre of buoyancy of the ship, it has been possible to improve the flow of water to the propeller. If ground flat, welding seams create a smooth hull surface which will reduce skin friction resistance. Azipod propulsion systems, which pull rather than push the ship through the water, also reduce the resistance of the ship travelling through the water.

Modification of hull designs offers innovative solutions to save energy.

Improvement of hull form has also improved propeller efficiency allowing the use of smaller propellers which in turn take less energy to be turned.

Other methods of reducing energy involve adjusting the speed profile of the itinerary, sailing with currents and avoiding bad weather where possible, using software to optimize vessel trim.

CHAPTER 11

WASTE HEAT RECOVERY/REUSING HEAT

One interesting way to reduce energy consumption that doesn't receive much recognition is heat recovery, which allows heat to be collected from one system aboard a ship and used for other purposes. This eco-friendly technique has become increasingly important both in terms of keeping costs down and reducing emissions.

Even the most efficient engine will produce some sort of waste energy. For instance, modern diesel-electric engines produce upwards of 50 percent waste energy that can be used in other ways. CLIA members have invested in trying to turn that waste energy into productive use on board ships.

One way to recover lost heat energy is to install heat exchangers which turn water into steam. Technologies can then be installed that use steam generated from the engines to create fresh water for drinking, or for heating areas of the ship, such as passenger cabins. Additionally, some of the water used to cool the engines can be used in evaporators to distill fresh water for heating the domestic hot water and to supply the air conditioning system.

Other energy-saving practices use waste heat from main engine exhaust, boiler exhaust, other equipment exhaust or cooling cycles. A few innovative methods cruise lines are considering and investing in involve the use of adsorption chillers to make chilled water from heat, and integrated bio-waste dryers, which do not need additional energy for drying but uses the waste heat energy in the exhaust from the incineration process.

Heat recovery allows heat to be collected from one system aboard a ship and used for other purposes, such as heat exchangers turning water into steam.

CHAPTER 12

LIGHTING

For the most part, all of the practices and innovations described until now remain invisible to our cruise guests. However, lights play a major part in the ambience of a ship. Our lines work hard to present a relaxing, visually appealing environment, while also consuming less energy.

Since our members' cruise ships vary in size, a ship can have 30,000 to 80,000 light sources with up to five hundred different light bulb types. Many of these fixtures are operated 24 hours a day, which results in an average of 8,000 hours of operation a year. Calculated with 50,000 light sources, a cruise ship has about 400 million operating hours per year for the combined number of light bulbs. Most of these light bulbs need to be changed every year, accumulating for significant maintenance time.

One of our members has been working with a manufacturer to conduct an in-depth study of onboard lighting. The results show that in the past, lighting accounted for 20 to 40 percent of the total energy balance excluding propulsion. Due to conservation efforts, lighting on newer ships accounts only for 10 percent of power consumed.

With figures like these it is easy to see why the industry is using more efficient lighting technology, which reduces energy consumption, cost and maintenance. Member lines are already engaged in replacing thousands of halogen and incandescent light bulbs with energy-efficient LED (light-emitting diodes) and fluorescent lights. These new-age lighting systems are lightweight, have a much longer life expectancy and use a fraction of the energy of incandescent light bulbs.

These lights also generate less heat, resulting in a reduction in the amount of air-conditioning required. Incandescent bulbs, for example, are the most inefficient type of lighting, because as much as 90 percent of their energy is given off as heat and not as light.

These energy savings, however, must work in tandem with the interior design of the ship. Designers sometimes prefer to use halogen energy saver lamps, which offer a 30 percent savings while still maintaining the aesthetic appeal of an incandescent light bulb. Also, when electronic ballast, a device intended to limit the amount of current in an electric circuit, are used with fluorescent lights, their life span doubles.

The use of intelligent lighting systems can reduce the total energy used by up to one third. Automatic lighting control systems are designed to adjust the ship's external lighting in accordance with the current sunlight intensity. They also have an automatic dark-activated sensor that switches on all the ship's external lights at dusk.

More efficient lighting technology reduces energy consumption. Member lines are already replacing thousands of halogen and incandescent light bulbs with energy-efficient LED (light-emitting diodes) and fluorescent lights.

As in many hotels nowadays, some new ships are being built with key-card holders so that lights and other electrical devices can only be turned on when the cabin is occupied.

The introduction of larger ships doesn't necessarily equate to mega-sized energy use. Recently, a 45 percent energy savings in lighting was achieved on one of the world's largest cruise ships through the use of more efficient lamps, and sensors that controlled the light aboard the ship.

CHAPTER 13

HVAC

Heating, ventilation and air conditioning (HVAC) systems are the largest consumer of energy aboard ships after propulsion. With cruise ships operating in both temperature extremes, from the cold of Alaska to the hot and humid environments of the tropics, demands on HVAC systems vary significantly. However since the majority of our member lines' itineraries involve warm environments, air conditioning systems come under the most pressure.

In an air conditioning system, chillers remove heat from a liquid; in this case it is water. This cold water is then distributed to coils in air handling units, which in turn distribute cool air to all areas on the ship. Air conditioning chiller units on the market today operate much more efficiently than previous generations due to the development of both the compressor itself and the chiller plant control system. A typical cruise ship water chiller plant consists of four or five identical chiller units.

In the past, chilled water was pumped around the ship at all times. However in new ships, the systems are designed to pump only the amount of chilled water required for the cooling demand, which results in energy savings.
For example, on a 2,500 passenger cruise ship, chiller compressors would consume 15-20,000 mWh annually but today's technology can save up to 20 percent of that power consumption. By retrofitting, such improvements can also be implemented on older ships. Ships also focus on the fan efficiency of air conditioning systems as they use a great deal of energy to push the air around the ship. Engineers make sure the duct work is correctly sized and that there are minimal bends or constrictions to make disbursing air more efficient.

With fresh air being needed in public spaces generally only to ensure passenger comfort, CLIA members have begun to utilize technology

In the past, chilled water was pumped around the ship at all times. In new ships, the systems are designed to pump only the amount of chilled water required for the cooling demand, which results in energy savings.

that minimizes the amount of energy used to cool a room when it is not occupied. For example some of our ships have timers installed to switch the air-conditioning off after the final show in the theater. Other ships use carbon dioxide sensors to help determine the number of people in a room. When there are less people, the control system will slow down and stop pumping fresh air into the space.

One supplier has come up with what is called an 'energy saving management plan' for one of our cruise line members. By looking at the whole system, how much energy is used where and when, it is possible to make savings in different places. It is estimated that it is possible to reduce the overall consumption of HVAC systems on one ship by between 3 and 4 percent. Translating this into energy not used and fuel not burned means significant savings.

Some examples of how this can work include fitting sensors in cabins so that when the balcony doors are open, the amount of air-conditioning being used is automatically reduced. Another way uses tinted glass windows. These special coatings reduce the amount of heat transferred from outside into the cabins and public rooms and hence the air-conditioning required to cool the rooms. The glazing still allows natural light to enter the ship, but filters out 99.9 percent of UV rays and has the additional advantage of protecting the vessel's interiors and furnishings.

The industry continues to explore ways to achieve additional reductions in HVAC system energy usage. To this end, a chiller that uses no electricity and no refrigerant is now being tested. Using waste heat from the generators, the system will produce enough chilled water to manage part of the cooling load on the ship. It is estimated that this type of system, together with the ship's overall energy saving management scheme, should reduce consumption by about another 8 percent.

CHAPTER 14
SOLAR PANELS

One of the latest innovations to be found on cruise ships is solar panels. Some CLIA members are installing solar panels in order to make maximum use of the sun's rays while cruising round the globe and help decrease the demand on the ship's engines, as we discussed in an earlier chapter. The use of solar energy will undoubtedly grow in the coming years, and CLIA members are proud to play a leading role in investing in solar powered technology for the shipping industry.

Solar power works by turning light and heat energy from the sun into an electric current, which can then be harnessed for power. Because cruise ships spend so much time under the bright sun, solar panels are a good source of supplementary energy for ships. For example, tiles can be fitted above a solarium and can then serve the dual purpose of harnessing sunlight for power and providing shade to passengers using those facilities.

One of CLIA's member lines has installed 21,000 square feet of solar paneling, which is sufficient to provide power for two of the principal public spaces on the ship. Another of our lines is using solar power to feed into the main electrical grid of the ship and power the elevators. The ship generates 65kW of power per hour to do this, which is enough to power 12 elevators. This represents the equivalent power of 7,000 LED lights.

The cost of installing such technology is quite substantial. For instance, this investment can run upwards of $750,000 in solar power for a single ship. However, the technology continues to evolve and as it does, current tiles can be replaced with new and improved models as they become available.

Because cruise ships spend so much time under the bright sun, solar panels are a good source of supplementary energy for ships.

PART V:

Partnerships

CHAPTER 15

CONSERVATION INTERNATIONAL

In 2003, CLIA joined forces with Conservation International (CI) to establish the Ocean Conservation and Tourism Alliance (OCTA) as part of our strong commitment to address how we can preserve the waters on which we sail. The aim is to minimize the cruise industry's environmental footprint and to maximize positive outcomes for nature conservation in key regions where the industry operates.

Under the terms of the alliance, CI acts as an advisor to the industry on key environmental and conservation efforts of joint interest including wastewater management, the ramifications of climate change to the industry and destination stewardship. A 2003 CI report, A Shifting Tide: Environmental Challenges and Cruise Industry Responses, found that cruise lines' environmental management practices went beyond prevailing regulations. The report also identified opportunities for the cruise industry to take a leadership role in promoting sustainable tourism.

In 2004, the OCTA Alliance announced creation of an independent Science Panel to evaluate cruise industry wastewater management practices. The seven-member panel of marine science experts was chaired by Dr. Sylvia Earle. The work of the OCTA Science Panel culminated in 2006 with a set of recommended actions such as expanded adoption of advanced wastewater treatment systems, and avoidance of wastewater discharges in coral reef areas and other sensitive marine environments.

In 2008, CLIA and CI signed a three-year agreement to renew the OCTA Alliance. Under the renewed partnership, CI provided CLIA with a set of maps highlighting sensitive marine habitats in the Caribbean Basin. Additionally, CI conducted a comparative analysis of the OCTA Science Panel recommendations and EPA regulations and assessment findings relevant to cruise industry wastewater management.

In one of the first joint efforts between the cruise industry and

As part of our strong environmental commitment, CLIA joined forces with Conservation International.

CONSERVATION INTERNATIONAL

conservation organizations on climate change policy, CLIA and CI worked jointly in 2009 to develop a white paper for submission to the 59th Session of the International Maritime Organization's Marine Environment Protection Committee. The paper set forth recommendations on market-based policies that would reduce greenhouse gas emissions while promoting conservation of tropical forests and marine ecosystems.

A growing priority for the OCTA Alliance is to ensure the environmental quality and overall sustainability of the cruise destinations that CLIA members depend on for long-term business success. A foundation for this work is the 2006 CI report, From Ship to Shore: Sustainable Stewardship in Cruise Destinations, which examined the shared responsibilities among cruise lines, governments, civil society, and shore operators to manage the growth of tourism in sensitive ecosystems.

An example of CI's efforts with leading cruise lines and with other key travel and leisure industries can be found in the Mesoamerican Reef Tourism Initiative (MARTI), a CI partner effort founded to advocate for sustainable tourism planning and development in Mexico, the Caribbean, Belize and Honduras.

Striking a balance between tourism and conserving the environment is vital yet challenging. Cozumel, Mexico, is the world's most visited cruise destination and its coast is part of the Mesoamerican Barrier Reef System, one of the world's most endangered reef systems.

CI, Cozumel's Department of Tourism and the Florida-Caribbean Cruise Association witnessed the culmination of a 12-month partnership in 2008 with the signing of a groundbreaking conservation agreement by cruise industry leaders representing government, private sector, civil society and cruise lines as part of MARTI.

By facilitating this agreement the partners set in motion, for the first time ever, a major environmental

initiative that will help preserve some of the most endangered biodiversity on the planet living in the world's most visited cruise destination.

On peak days the island receives up to nine cruise ships which can bring more than 10,000 visitors in one day. Through shared responsibility, the impact of the industry can be managed and the destination preserved. The agreement provides a framework to facilitate the sustainability of cruise tourism through concerted action by all those involved.

Through a series of focus groups and a multi-stakeholder workshop that brought together more than 80 cruise industry leaders to define high priority environmental issues related to cruise calls and reach consensus on collaborative actions, a number of lines of action emerged. The key is in developing an action plan which is a representation of the voice of the people and presenting practical ways to tackle the issues.

As the program is developed, CI and CLIA are working to enhance environmental awareness and education of cruise ship passengers, tour operators, service providers and the local community; improve island management of tourism infrastructure, including improving island traffic and waste management; and foster increased protection for Cozumel's reef system and promoting consistent application and enforcement of laws and regulation.

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