

American Association of Port Authorities
Environmental Improvement Award Application
Stakeholder Awareness, Education and Involvement Category

*Environmental Initiatives at Seaports
Worldwide: A Snapshot of Best Practices*
White Paper

Port of Portland

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INTRODUCTION — PAPER HIGHLIGHTS

The Port of Portland (Port) and the International Institute for Sustainable Seaports (I2S2) partnered to develop a white paper describing a broad array of environmental initiatives at seaports across the globe. The white paper entitled, *Environmental Initiatives at Seaports Worldwide: A Snapshot of Best Practices*, was first released in 2010. It addressed the geographic, community, financial and regulatory drivers that impact port decision-making related to sustainability through an assessment of current environmental management initiatives. In 2013, the Port and I2S2 partnered again to create an updated version of the white paper, adding new information about environmental initiatives at seaports and assessing trends within the industry since the first white paper was developed.

This award application describes the goals and objectives of the white paper as well as the methodology for collecting the information and how the white paper meets the American Association of Port Authorities Environmental Improvement Award criteria for the Stakeholder Awareness, Education and Involvement category. The 2013 version of the white paper is included with the award submission materials and it can also be directly accessed at: <http://www.getf.org/wp-content/uploads/2011/06/2013-Update-Environmental-Initiatives-Worldwide-UPDATE-August-2013-Final-II.pdf>.

GOALS AND OBJECTIVES

A primary objective of the white paper was to provide the Port of Portland, the international port community and the public with a greater awareness of how seaports around the globe are managing natural resources, adopting new operating methods, and planning for sustainability. The paper also provides readers with a better understanding of the geographic, community, financial and regulatory factors that lead each port to their implementation decisions. The goal of the project was to provide a document of reference for

ports seeking to gain knowledge of how environmental initiatives have been implemented at other ports.

DISCUSSION

BACKGROUND

Starting in 2009, the Port of Portland (Port) initiated a process with the City of Portland (City) to annex an undeveloped property on West Hayden Island with the intent of preparing it for future development of a new marine terminal. As initial discussions with the City unfolded, both the Port and the City identified a need for more information that would help both parties understand the state of green initiatives and sustainable development at seaports around the globe. The Port needed a third-party backed, comprehensive document to create a common knowledge base to inform City and Port staff discussions about environmental initiatives that would be best suited for a new port facility on West Hayden Island. The Port partnered with the International Institute for Sustainable Seaports (I2S2), an organization formed through a partnership between the Global Environment and Technology Fund (GETF) and the American Association of Port Authorities (AAPA). I2S2 is a nonprofit center of excellence that is designed to support port authorities, tenants and members of the maritime community implement sustainable practices. With grant funding from the Port, I2S2 authored a white paper entitled, *Environmental Initiatives at Seaports Worldwide: A Snapshot of Best Practices 2010*.

The white paper represented the findings from research conducted by the Port and I2S2 that focuses on activities that influence, affect, or are in response to environmental management and sustainable development in the port sector. Though the white paper was funded by the Port to support a specific process to annex a Port property for new marine

terminal development, it was designed with the intent that any information gathered by the Port and I2S2 would be shared with the broader port industry as well as the general public.

In 2013, the Port once again partnered with I2S2, providing funding to complete an update to the white paper that reflected current environmental initiatives in the port sector, the effects of regulatory changes, and overall trends since the publication of the original white paper in 2010.

OBJECTIVES AND METHODOLOGY

OBJECTIVES

A primary objective of the white paper was to provide the Port, the international port community and the public with a greater awareness of how seaports around the globe are managing natural resources, adopting new operating methods and planning for sustainability. The paper also provides readers with a better understanding of the geographic, community, financial and regulatory factors that lead each port to their implementation decisions.

METHODOLOGY

The Port and I2S2 conducted research to collect the findings included in the white paper. The Port could have produced a white paper on green initiatives at port facilities on its own or with the help of a private sector consultant, but partnering with I2S2 brought tremendous value to the final product. It added third-party, industry-respected credibility and expertise. I2S2 is also well-networked with ports around the globe, which facilitated the collection of the best available information, and positions I2S2 as a reliable and universal source of information to share the findings of the white paper with other ports.

The original version of the white paper provided a snapshot of practices during the summer and fall of 2009. The research consisted of interviews, internet research, literature reviews and information from other publicly available reports. The interviews were used to populate responses to a questionnaire that addressed the topics of air quality, climate change, water quality, waste minimization, dredging, energy conservation, natural resources, sustainability and environmental management systems.

Ports were identified to participate in interviews according to membership records provided by AAPA and the International Association of Ports and Harbors. The research was divided up into three regions – U.S. Pacific Northwest, North America, and other ports globally. I2S2 researched initiatives at ports globally, while Port of Portland staff collected information from North American ports. The ports included in the research effort ranged from coastal to inland ports and represented a variety of sizes and commodities handled. The white paper did not seek to inventory every environmental initiative at every port. It provides a snapshot in time using a selection of different types of ports to provide a representative sample of best practices and it also identifies larger trends within the industry.

The 2013 update to the white paper provides readers with more current information and a greater ability to gauge the level of change in the advancement or decline of sustainability efforts. The original version was developed in the midst of the global economic crisis with its associated aversion to risk and a drawdown in resources which would otherwise have supported some environmental initiatives. In addition to a rapidly evolving economic landscape, regulatory change has occurred since the original white paper was completed. For example, the North American Emissions Control Area, implemented by the International Maritime Organization, has now taken effect which mandates the amount of sulfur permitted in fuels for ships in North American coastal waters.

ENVIRONMENTAL BENEFIT

The white paper provides comprehensive and up-to-date information to give the port industry a reflection of best environmental and sustainability practices as well as the factors that influence them. The white paper specifically identified the following factors:

- Cohesion between environmental and engineering departments
- External political climate
- Public engagement methods
- Size of the port
- Operations and operational capacity
- Resources available to devote to environmental initiatives
- Regulatory climate of geographical area

A key finding of the white paper is that these influencing factors along with the geographical characteristics of a port make each port unique in terms of which environmental initiatives will prove successful. The myriad of examples documented in the report are designed to help the reader understand the circumstances under which a particular initiative may be well-suited to their operation and which factors may make the initiative challenging. For example, the white paper describes the types of operations that currently use on-shore power to reduce pollutant emissions and provides examples of regulations that have driven the practices as well as examples of successful funding partnerships. It also describes the operational situations in which the practice does not work well, along with the substantial costs where grants are not available for installation.

The white paper provides additional value beyond a discussion of the factors that make a particular environmental initiative successful. It also serves as a reference for ports who wish to contact other ports that have implemented a green initiative to learn more about how and why the project was implemented.

Without sharing this information, other ports facing the same critical decision points as the Port of Portland, would equally be faced with the daunting task of educating themselves about the benefits and challenges of a variety of environmental initiatives and measuring them against their port's unique characteristics. Reliable data and information leads to the ability to make informed decisions and take action.

INDEPENDENT INVOLVEMENT AND EFFORT BY THE PORT

With the support of I2S2, the Port spearheaded the effort to produce the white paper and its subsequent updated version. The Port provided the financial support necessary to create a universal source of information about port environmental initiatives worldwide.

Developing a white paper of this kind is not a regulatory requirement, nor was it mandated by any other formal process. The Port's decision to independently seek out and obtain the best available information to guide planning efforts for a new marine terminal development demonstrates a deep and broad commitment to cutting edge environmental stewardship.

CREATIVITY OF THE SOLUTION OR PROGRAM

Developing the white paper was the solution to the Port's need for more information to support a future marine terminal development. Commissioning a report to be completed by a third-party, private consultant could have achieved this objective. However, partnering with and funding the study through I2S2 provided greater transparency for the public annexation

process and it resulted in a publicly available and distributed work that can be used by other ports seeking answers to similar questions.

PROJECT OUTCOMES AND TRANSFERABILITY TO OTHER PORTS

I2S2's involvement in producing the white paper allowed the information to be spread far and wide. For the 2013 update alone, I2S2 and/or Port staff has presented the findings and recommendations to a broad array of groups interested in seaport sustainability over the course of the last year, including:

- U.S. Department of Commerce Chinese Green Port Delegation - July 2013
- U.S. Embassy staff in Beijing, China - August 2013
- Coasts, Oceans, Ports, Rivers Institute Conference - August 2013
- American Association Port Authorities, Environment Committee Conference - September 2013
- U.S. Department of Transportation Secretary Foxx, Asia-Pacific Economic Cooperation Meeting in Tokyo, Japan - November 2013
- Gulf Ports Environmental Summit - Corpus Christi, Texas - January 2014
- Green Marine GreenTech Conference, St. John, New Brunswick, Canada - June 2014

In addition to presenting the information at conferences, events and to key stakeholders, the white paper is also posted to a number of different stakeholders' websites and/or referenced in written works of the following organizations:

- National Renewable Energy Laboratory
- Portcompliance.org (a tool developed through a partnership between National Center for Manufacturing Sciences and U.S. Environmental Protection Agency - Region 2)
- East Bay Environmental Network

- TEN ECOPORT Project
- Tourisme Quebec
- The Suffolk Coastal District Council (UK) 2013 Air Quality Progress Report
- Australian Department of Sustainability, Environment, Water, Population and Communities
- City of Portland, Oregon, Bureau of Planning and Sustainability (in support of the West Hayden Island annexation process)

The Port and I2S2 have also heard anecdotally from other ports that have used the white paper in their own planning processes. The Port of Seattle, for example, is evaluating underwater grading to reduce the amount of traditional dredging.

COST EFFECTIVENESS OF THE ACTIVITY OR PROGRAM

I2S2 could not have undertaken conducting research and producing the white paper without financial support from the Port of Portland. Although the Port may have been able to produce a white paper on its own, partnering with I2S2 and tapping into the organization's expertise and connections to the international port community yielded far greater efficiency in conducting research and gaining access to the best available information. Sharing the findings of the white paper with other ports and professional trade organizations is a key function that aligns with I2S2's mission, which provided further efficiencies in the delivery of findings of the white paper to other stakeholders. The white paper is a resource available to other ports at no cost.

CONCLUSION

The Port of Portland is deserving of the American Association of Port Authorities Environmental Improvement Award due to the initiative it demonstrated in collecting

information that is highly beneficial to the global seaport industry. The Port initially showed its commitment to responsible environmental management by pursuing the collection of information that would set the stage for a transparent local public process related to its West Hayden Island property. The Port further displayed its deep commitment to environmental stewardship by partnering with the International Institute for Sustainable Seaports (I2S2) and designing the information collection and sharing process such that it would result in a free and easily accessible resource for the broader port industry to assist ports in the pursuit of their own environmental initiatives.

The information resource developed by the Port with I2S2's assistance fills a unique niche in the knowledge base of the worldwide port community. The 2013 update of the document further provided the industry with a greater understanding of the current opportunities, challenges and trends in environmental initiatives that may not have been so readily available in any other form. Reliable data and information leads to the ability for ports to make informed decisions and take action.

Project Summary

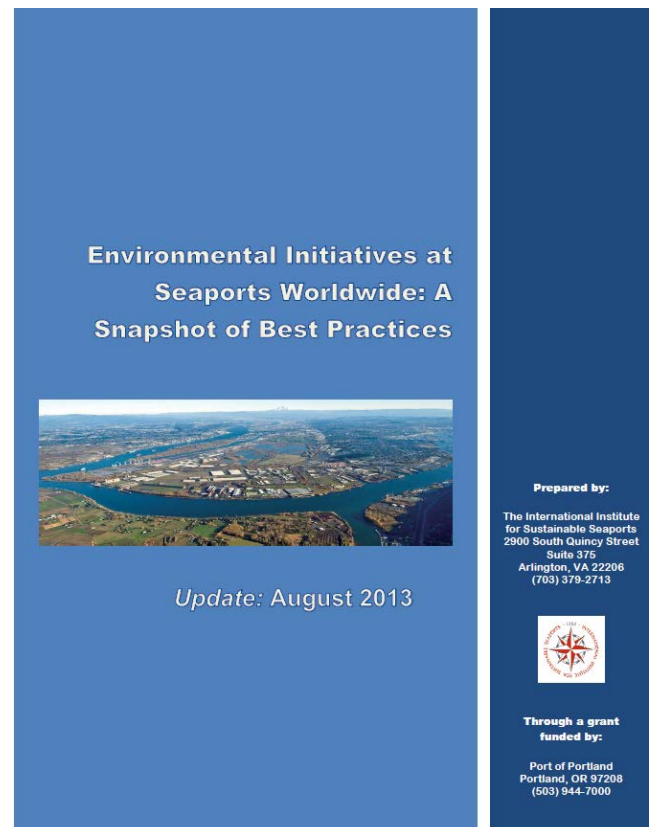
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Environmental Initiatives at Seaports Worldwide: A Snapshot of Best Practices White Paper Port of Portland

The Port of Portland (Port) and the International Institute for Sustainable Seaports (I2S2) partnered to develop a white paper describing a broad array of environmental initiatives at seaports across the globe. The white paper entitled, *Environmental Initiatives at Seaports Worldwide: A Snapshot of Best Practices*, was first released in 2010. It addressed the geographic, community, financial and regulatory drivers that impact port decision-making related to sustainability through research and assessment of current environmental management initiatives based on interviews, online research, literature reviews and other publicly available reports. In 2013, the Port and I2S2 developed an updated version of the white paper, adding new information about environmental initiatives and assessing trends within the industry since the first release of the initial white paper. The Port and I2S2 have personally delivered the findings of the white paper to conferences and other key stakeholder groups and it is publicly available in many locations online.

The Port's involvement in the development of the white paper and its subsequent update, meet the award criteria as follows:

- **Nature of benefits to environmental quality** - The white paper provides ports facing critical decision points with a resource to educate their staff and decision-makers about the benefits and challenges of a variety of environmental initiatives and the ability to evaluate them against their port's unique characteristics.
- **Level of independent involvement and effort by the port** - The Port funded and spearheaded this effort with the support of I2S2. Though the white paper was originally developed to support a local public process, it was not a regulatory requirement and was designed to additionally benefit the broader port industry.
- **Creativity of the solution** – The Port chose to work with I2S2 due to the tremendous value and credibility it added to the process. It also provided an enhanced ability to publicly share the findings of the white paper.
- **Apparent project results** – The findings of the white paper have been presented at numerous conferences, for many stakeholder groups, shared on other organizations' websites and referenced in other works. A more detailed description appears in the full award application.
- **Cost effectiveness** – The Port provided funding for the initial white paper and the update. Partnering with I2S2 yielded efficiencies due to the organization's expertise and connections to the international port community. The white paper is a resource available to other ports at no cost.
- **Transferability to the port industry** – This project was designed specifically to allow the Port's own information collection efforts to benefit ports across the globe. The findings of the white paper have been presented at conferences and with stakeholder groups internationally and are publicly available.



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Environmental Initiatives at Seaports Worldwide: A Snapshot of Best Practices



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I2S2 Executive Director Ms. Noeleen Tillman acknowledges the valuable assistance and partnership provided by Mr. Richard Vincent, Environmental Project Manager at the Port of Portland for his leadership in supporting this White Paper and the assistance provided by Ms. Nina Ruhter, I2S2 Environmental Engineer, in preparing the various drafts of the report, interviewing and researching/accessing port literature for statutory citations and keeping the project on schedule.

The Institute for Sustainable Seaports (I2S2) is a non-profit center of excellence specifically designed to support port authorities, their tenants and members of the maritime community implement sustainable practices – ensuring economic vitality, while protecting environmental quality and community integrity. I2S2 is a partnership between the Global Environment & Technology Foundation, a 501 c (3) not-for profit and the American Association of Port Authorities.

Established in 1891, the Port of Portland owns four marine terminals, five industrial parks, and three airports — all located in the heart of the Pacific Northwest, with easy access to the region's major rivers, railways, and roads. At the Port of Portland, sustainability is central to its approach in achieving its public mission: to enhance the region's economy and quality of life by facilitating efficient cargo and air passenger access to national and global markets. The Port strives to make business decisions that support long term economic health, integrate community values, and reflect a deep and broad commitment to environmental stewardship.

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EXECUTIVE SUMMARY

In April 2010, the International Institute for Sustainable Seaports (I2S2)¹ prepared a White Paper on port environmental initiatives entitled *Environmental Initiatives at Seaports Worldwide: A Snapshot of Best Practices*.² Funding for the project was provided through a grant from the Port of Portland. The objective of the research was to provide a greater awareness and understanding of how ports sustainably manage their operations and development. The anticipated result was a better understanding of the geographic, community, financial and regulatory drivers that impact port decision making related to sustainability.

In the spring of 2013, I2S2 received a second grant from the Port of Portland to update the original findings. *2013 Update – Environmental Initiatives Worldwide: A Snapshot of Best Practices* provides readers with an assessment of current environmental management initiatives at ports and the ability to gauge change (if any) in the advancement or decline of sustainability efforts, as demonstrated by a limited sampling of ports around the world.

A major finding in the first White Paper and reinforced in this recent research, is that each port – no matter where it is located – has a unique set of geographic, political, community, operational, regulatory and financial circumstances that shape and define its environmental and sustainability initiatives. Therefore, each port has taken a slightly different approach to environmental initiatives, based on their unique circumstances. Examples of such differences include unique local regulatory requirements (special air emissions or stormwater regulations), the lines of business (auto, cruise, container, break-bulk, bulk, etc.); management (i.e., landlord port, facility operator or a combination); the type of operations that are managed (i.e. marine terminals, airports, real estate and industrial developments, tunnels, bridges and ferries, etc.); geography of the seaport on a freshwater river system, estuary or saltwater harbor (this determines what environmental conditions are encountered and how they are handled). This finding is particularly important when considering and evaluating potential applications of processes, approaches and technologies mentioned in this report and for reviewing programs that a particular port has taken to minimize environmental impacts or enhance environmental initiatives at their particular location.

This White Paper represents a snapshot of current environmental initiatives in use at ports around the world during the spring of 2013. It is important to note that there continues to be a range of definitions with respect to environmental initiatives, “GreenPort” and sustainability. These references are used at times interchangeably throughout this paper, as that is how they are referenced in the literature researched. As noted in the body of the report, the majority of ports posted their own unique definition of sustainability as it pertained to their individual strategic goals and objectives. Often times this was referred to as “environmental initiatives” or “GreenPort.” In some cases, environmental activities were highlighted as efforts to go “beyond compliance”; in others activities were undertaken in response to current or future regulations.

¹I2S2 is a partnership between the Global Environment & Technology Foundation, a 501 c (3) not-for profit and the American Association of Port Authorities.

² <http://ecbiz103.inmotionhosting.com/~getfor5/wp-content/uploads/2011/06/FINAL-Environmental-Initiatives-at-Seaports-Worldwide-April-2010.pdf>.

This must all be taken in context for the purpose of understanding the efforts highlighted in this paper.

The results of this research reflect a port sector that has started a healthy recovery from the economic recession of 2008. In fact, several ports are experiencing a “boom” in business, in some cases from sectors that were unexpected (e.g. U.S. oil transfers to US refineries). In 2009, ports were re-evaluating their ability to continue sustainability projects that did not provide a quantitative benefit to the enterprise. Although environmental compliance requirements were not compromised, initiatives not required by agreement or regulation were evaluated very cautiously due to the fiscal realities that were affecting the industry. In that business and economic environment of furloughs and redundancies, funding for projects that did not present a ready return on investment was not considered. These projects were “left on the shelf.”

That period of scaling back provided an opportunity for ports to re-prioritize investments, taking a more strategic and regional approach to sustainability as defined in economic, environmental and community terms. Even as global competitors, ports found opportunities to collaborate with each other for overall environmental improvements on a regional basis. Current research showed an increased sharing of best practices and lessons learned in sustainable development and operations, evidenced by the priority given to this subject in professional trade journals, association websites and at professional conferences.

Highly regarded institutions such as the American Association of Civil Engineers (ASCE) and others have included sustainable port development in their guidance documents. Investments made by ports in their neighboring communities and with their tenants and customers are trending toward more sustainable, economically beneficial long-term projects.

The current research also demonstrates that ports continue to make significant, measurable progress on environmental goals. Many ports reported achieving their annual targets on water conservation, energy conservation, waste reduction and recycling over the past three years. As such, ports have moved beyond the “traditional” environmental initiatives and “low hanging fruit” and into more comprehensive, strategic sustainable planning. This includes the development of more detailed guidance on sustainable operations, port management and investment in regional, community based approaches to sustainability. Several ports have developed their own set of internal development guidelines or are using those presented by various associations.

Air quality and stormwater management were cited as the two major areas where ports have placed significant resources over the past few years. The International Maritime Organization (IMO) officially designated waters off North American coasts as an area in which stringent international emission standards apply for ships, resulting in an increase in shore power and a variety of incentive programs to reduce emissions. Stormwater permits are being renewed with increased monitoring and testing, lower benchmarks and discharge limits. With drought scenarios evident worldwide, stormwater is now considered a water “supply” and regulatory management approaches emphasize infiltration, storage and reuse. Although these requirements have been challenging for some ports to meet due to their physical characteristics, several innovative approaches to stormwater management are identified.

Dredging programs, from major channel deepening projects to accommodate the larger, post-Panamax vessels and “super” post Panamax vessels, to frequent channel maintenance requirements have created the need for more creative mitigation and stewardship of natural resources. Reuse of dredge material for habitat restoration, beach replenishment and other beneficial applications has increasingly become the go-to approach in sediment management plans for the ports researched.

Lastly, the research reflected a majority of ports having some type of “Green Port” or sustainability program in place with regular public reporting on those green initiatives. The GreenPort phraseology has emigrated from the U.S., where it was originally coined, to all over the world. There are now GreenPort initiatives in India, Bangladesh, Africa, China and the Middle East and include community benefit programs, waste reduction, energy and greenhouse gas (GHG) reduction and air and water quality improvement initiatives.

BACKGROUND & INTRODUCTION

Increasing regulatory oversight, increasing challenges to development and increasing labor and fuel costs are just some of the issues facing ports and their communities today. These factors have made it necessary to change the traditional way of doing business. The port and maritime sector has recognized the need for a “sustainable” course of action that allows for economic benefit without affecting the integrity of the environment and their surrounding communities. Ports have integrated practices into their operations that reduce both costs and negative impacts to the environment and improve surrounding communities, while strengthening their economic position.

In 2009, the International Institute for Sustainable Seaports (I2S2) received a grant from the Port of Portland to conduct research on environmental management practices in the international seaport community, which resulted in the White Paper entitled *Environmental Initiatives at Seaports Worldwide: A Snapshot of Best Practices 2010*. In 2013, I2S2 received a similar grant from the Port of Portland to update the initial research.

This document represents the results of that research and focuses on activities that influence, affect or are in response to environmental management and sustainable development in the port sector. It presents background on and provides context for the practices that ports have used to decrease environmental and community impacts - despite operating in resource-intensive industries - and highlights innovation and progress made toward sustainable development. It is with that intent that readers can gauge the level of change (if any) in the advancement or decline of sustainability efforts as demonstrated by a small sample of ports around the world. This White Paper by no means attempts to identify and catalog all environmental, sustainable or “GreenPort” activities at ports. The objective is to provide a “snapshot” of ports ranging from coastal ports, to inland ports and from U.S. ports to international ports and highlight the various innovative initiatives being implemented, as well as present any notable trends.

There are a number of opportunities and challenges at any given port. There can only be individual solutions based on individual circumstances.

-Port of Houston Authority

A major finding in the 2010 White Paper and reinforced in this update, is that each port has a unique set of geographic, political, regulatory, community, operational and financial circumstances that shape and define their environmental initiatives. Therefore, each port has taken a slightly different approach to environmental initiatives, based on their unique circumstances. Examples of such differences include unique local regulatory requirements (special air emissions or stormwater regulations), lines of business (auto, cruise, container, break-bulk, bulk, etc.); management (i.e., landlord port, facility operator, or a combination); type of operations that are managed (i.e. marine terminals, airports, real estate and industrial developments, tunnels, bridges and ferries, etc.); and geography of the seaport on a freshwater river system, estuary, or saltwater harbor (this determines what environmental conditions are encountered and how they are handled).

APPROACH

I2S2 collaborated on this effort with Port of Portland staff (who conducted research on ports in the northwestern region of the U.S.). I2S2 conducted extensive research and drew from collective knowledge to report on the sustainable, environmental practices of a sampling of ports in U.S. and the worldwide port community. The objective was to compile information about environmental initiatives at seaports worldwide. The data was gathered from interviews, internet research and other publicly available reports. I2S2 limited its review mainly to members of the International Association of Ports and Harbors (IAPH) and the American Association of Port Authorities (AAPA). The information collected by the Port of Portland and I2S2 has been combined into this report.

For this project, I2S2 and Port of Portland staff performed a literature review and conducted interviews to provide a basis for examining the current state of environmental initiatives and best operating practices in the port community; these findings were used to update information previously recorded in the 2010 White Paper. Researchers utilized a questionnaire jointly developed by I2S2 and the Port of Portland that addressed a range of issues identified in the 2010 White Paper related to sustainable port operations and environmental initiatives. The questionnaire was updated to include additional questions based on regulatory changes enacted since 2010 (see Appendix A). The questionnaire was the template for internet research and interviews with appropriate and available personnel and included the following environmental areas:

- Air Quality
- Water Quality
- Waste Minimization
- Dredging
- Energy Conservation and Renewable Energy
- Natural Resources
- Sustainability (or GreenPort as defined by an individual port)
- Environmental Management Systems

A list of the ports that were considered as part of this review is found in Appendix B.

SNAPSHOT OF THE INDUSTRY: PORT SUSTAINABILITY

Research conducted for this White Paper found, as in the fall of 2009, that ports around the world are demonstrating a commitment to environmental stewardship and sustainable port operations through a variety of actions, mandates and initiatives. These actions continue to be influenced by issues such as evolving environmental regulations, increased pressure from communities, stakeholders and financial realities following the recent global economic crisis.

“People, Planet, Profit” is the focus the Port of Antwerp takes to its strategic planning³ and was a consistent thread among most ports throughout the research. In their literature, ports identified incorporation of the triple bottom line (biophysical, social and economic) as an essential focus in decision-making for current business operations and any future development.

In the fall of 2009, ports were forced to re-evaluate their ability to continue non-regulatory environmental projects. Those not required by agreement or regulation were not initiated. Some ports went through major reorganizations and had to put any “out of the box” initiatives on hold. Funding for projects that did not represent an initial return on investment were not considered. However, several ports interviewed in the spring of 2013 indicated that the economic outlook was now positive and there was a significant increase in both bulk and break bulk activity. In fact, these ports stated they were experiencing a “boom” in business, in some cases from unexpected sectors (e.g. U.S. oil transfers from the Bakken Shale).

Compliance with environmental regulations has been the traditional driver for ports to incorporate environmental considerations into their activities and plans. Compliance is considered to be a non-negotiable aspect of business operations and the decision to go beyond compliance has become part of ports’ long-term business planning. Making the strategic and significant financial commitment to ISO14001 certification is one example of integrating environmental initiatives, economic benefits and community drivers into the business planning process. The Ports of Corpus Christi⁴ and Virginia⁵ are two examples of ports that are including ISO14001 certification as part of their long-term budget forecasting.

Corporate Social Reporting (CSR) and Global Reporting Index (GRI) continue to be used mainly by non-U.S. ports. Those ports filing CSR or GRI reports (e.g. Port Metro Vancouver B.C., Port of Rotterdam and Port of Dublin) expressed commitment to incorporating community and stakeholder concerns into their financial and environmental goals. Several international ports publish annual CSR reports quantifying their sustainability activities as related to operations and development. Port Metro Vancouver B.C. is one of the few organizations that use both the Balanced Scorecard and CSR. Ports such as the Port of Portland annually publish their environmental program objectives and performance toward targets in addition to sharing highlights on specific projects and initiatives.

International ports are still active in the World Ports Climate Initiative (WPCI), with several new members added recently (Ports of Vigo, Spain and Mejillones, Chile). Members of the WPCI are actively working on a variety of projects targeting climate change issues through activities and using tools that can be applied worldwide. These resources include guidance for measuring a port’s carbon footprint, guidance for increasing intermodal transport of cargo and reducing truck transport, “green” lease templates and the testing innovative Cargo Handling Equipment (CHE).⁶

³ <http://www.portofantwerp.com/en/sustainability-report>.

⁴ Interview with Sarah Garza, Port of Corpus Christi May 24, 2013

⁵ <http://www.portofvirginia.com/environment/iso-14001-certified.aspx>.

⁶ <http://wpci.iaphworldports.org/index.html>.

With respect to air quality, U.S. ports, particularly those with air quality compliance attainment requirements, have been very aggressive in retrofitting or replacing CHE with hybrid technology, low sulfur fueled and electrification. Since the original research was done, more ports have initiated a “clean trucks” program. A few of the mandatory programs have met with significant legal challenges regarding jurisdiction, legality and diversion of public funds.

Incentive programs for shippers to use low sulfur fuel, shore power for cruise ships and anti-idling strategies were initiatives identified among ports globally to address air quality. In addition to focusing on ocean going vessels, trucks and CHE, ports are considering all operations for air quality improvement. The Ports of Long Beach and Houston recently completed dredging projects with the majority of the dredge work done hydraulically, powered by on-shore electricity instead of diesel engines.

Water conservation, recycling and non-hazardous waste management continue to be prominent sustainability goals. These focus areas have, in large part, been integrated into worldwide port culture. Every port researched had some degree of waste recycling program. In some cases, water conservation is now a mandatory part of many stormwater management plans.

A number of ports indicated they have conducted energy audits, completed greenhouse gas (GHG) inventories, instituted carpooling incentives and worked with their local municipality for bike lanes and increased public transportation to support energy conservation. Ports have also completed re-lamping projects on terminals and installed real time monitoring capabilities for energy usage on terminals. Several ports highlighted their specific efforts to conserve water and energy.

As noted in the research conducted in 2009, much of the information about community programs focused on mitigation projects involving natural resource enhancement. In some cases, these projects were categorized as part of a port’s sustainability or environmental program. In interviews with several ports, these mandatory initiatives were considered a benefit to the community while also fulfilling regulatory requirements and designed with multiple purposes in mind.

RESEARCH HIGHLIGHTS

The information below details noteworthy examples of sustainable approaches and practices derived from various interviews with port personnel and literature reviews of a limited sampling of ports as noted.

Air Quality

Emissions associated with goods movement create challenging air quality issues. Emission sources in and around ports include Ocean Going Vessels (OGVs), cargo handling equipment, locomotives, and trucks. As a result, environmental regulations have required air quality control measures to contain or eliminate harmful air pollutants. In some cases, ports researched have gone beyond compliance and many of the air quality control measures currently being implemented are the result of pro-active, voluntary actions.

Since the prior version of this report, new regulations have been promulgated on the local, national and international front. Whether in the U.S., the European Union, or Oceania, air quality regulations have impacted the way ports do business.

For example, the International Maritime Organization (IMO) officially designated waters off North American coasts and inland waterways as an area in which stringent international emission standards will apply for ships. On March 26, 2010, the IMO amended the International Convention for the Prevention of Pollution from Ships (MARPOL), designating specific portions of U.S., Canadian and French waters as an Emission Control Area (ECA). The area of the North American ECA includes inland waterways, waters adjacent to the Pacific coast, the Atlantic/Gulf coast and the eight main Hawaiian Islands. Internationally, mandatory treaty provisions to reduce GHG emissions from international shipping were adopted at IMO in July 2011 by the Parties to Annex VI of the MARPOL Convention.⁷

Within the U.S., January 1, 2011 was the start date for non-road equipment manufacturers to begin using diesel engines that comply with the U.S. Environmental Protection Agency's (EPA) Tier 4 interim (4i) emissions regulations. With some exceptions, Tier 4i regulations apply to all nonroad diesel engines 175 horse power and greater – the power range most often used to power construction and industrial equipment, such as excavators, loaders, cranes, mining trucks and agricultural equipment.⁸

The State of California promulgated regulations that require diesel trucks and buses that operate in California to be upgraded to reduce emissions. Heavier trucks were required to be retrofitted with particulate matter (PM) filters beginning January 1, 2012 and older trucks must be replaced starting January 1, 2015. By January 1, 2023, nearly all trucks and buses will need to have 2010 model year engines or equivalent. All drayage trucks with model year 2006 or older engines hauling cargo that is destined to or coming from California's ports or rail-yards need to be upgraded by 12/31/2013.⁹

In addition, California landmark legislation effective January 1, 2014 requires half of all container, refrigerated cargo and cruise ships calling at the ports of Long Beach, Los Angeles, Oakland, San Francisco, San Diego and Hueneme to shut down auxiliary engines and use onshore electricity to power their onboard systems at berth. The purpose of the "At-Berth Regulation" is to reduce emissions from diesel auxiliary engines on container ships, passenger ships and refrigerated-cargo ships. The regulation applies to an operator of a container vessel or refrigerated cargo vessel fleet whose vessels cumulatively make 25 or more visits annually to any single specified port. It also applies to an operator of a passenger-vessel fleet whose vessels



Port of Oakland On-Shore Power Project

⁷ <http://www.imo.org/MediaCentre/PressBriefings/Pages/28-eca.aspx>.

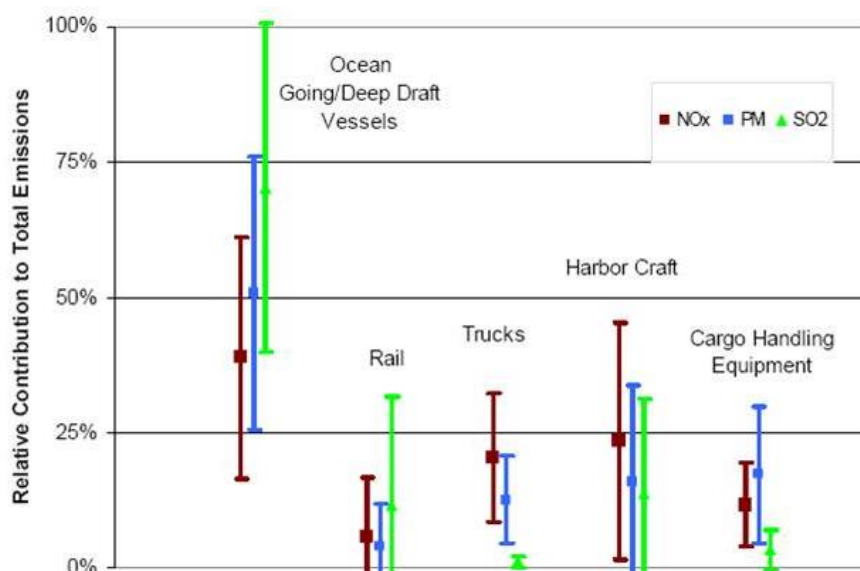
⁸ <http://www.epa.gov/otaq/nonroad-diesel.htm>.

⁹ <http://www.arb.ca.gov/msprog/onroad/porttruck/porttruck.htm>.

cumulatively make five or more visits annually to any single port.¹⁰ As of the date of this report, the State of California is the only jurisdiction in the world where shore power will be required.

Example Incentive Programs for Ocean Going Vessels:

In response to air quality concerns and regulations, ports, their customers and stakeholders have explored new and innovative strategies to reduce air quality impacts from operations at port facilities. The nature and magnitude of emissions can vary greatly between ports (as based on the type and scale of operations). Research during the spring of 2013 showed that of the ports researched (large and some medium-sized), virtually all had completed an air emission inventory (including greenhouse gas (GHG) emissions)¹¹ to determine the level, source and composition of pollutants.



* U.S. Environmental Protection Agency Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories Final Report April 2009

OGVs typically account for majority of air pollution associated with port facilities.¹² The recently defined ECAs require OGVs to switch to cleaner burning fuels as they enter the protected areas. However the ECAs do not extend worldwide. Requiring OGVs to switch to cleaner fuel while at berth (at ports outside of the ECA regulated waters) can improve the air quality around the port area. In the case of the Port of Hong Kong where there is no ECA in place, 17 shipping lines have agreed to voluntarily switch to burning cleaner fuels instead of high-sulfur fuels while their vessels are berthed at the port.¹³ The fuel switch initiative pertains only to ships that are berthed. Once back on the ocean, ships could switch back to using high-

¹⁰ <http://www.arb.ca.gov/ports/shorepower/faq/faq.htm#2>.

¹¹ As cited in available literature.

¹² <http://www.epa.gov/sectors/sectorinfo/sectorprofiles/ports/ports-emission-inv-april09.pdf>.

¹³ <http://www.theicct.org/blogs/staff/hong-kong-takes-important-first-step-regulating-shipping-emissions>.

sulfur fuel, which is less expensive and works better with older generation engines.¹⁴ However, the global fuel sulfur content in fuel is changing. The allowable sulfur content was reduced from 4.5% to 3.5% in 2012 and will decrease again to 0.5% in 2020.

To incentivize carriers to use the low sulfur fuel, the Port of Venice initiated a successful voluntary low-sulfur fuel program. Through their Blue Flag Program, the Port has seen emissions reduced by 43% over the past three years.¹⁵ Other international ports, including the City of Dubai City Maritime Authority, which has primacy over Dubai ports, partnered with the United Arab Emirates Shipping Association on draft legislation to reduce the sulfur loading by 80% by the year 2020.¹⁶ The Port of Singapore also has a voluntary fuel switching program that includes a financial incentive (15% concession in fees).¹⁷ The Port of Gothenburg implemented a financial incentive program for shippers to meet the Port's "green shipping criteria" and for those shippers who voluntarily switch to low-sulfur fuel.¹⁸



Port Metro Vancouver B.C. has promoted its emission reduction goals for OGVs that enter the Port and rewards those who excel in environmental stewardship. Vessels may qualify for one of three levels of reduced fees based on implementing a corresponding emission reduction option within a given category. The reduced rates are designed to provide a wide variety of technology and fuel options to vessels in order to promote and build awareness around a number of alternative emission reduction practices. This includes not only fuel alternatives, but also energy efficiency, certification by a third party (e.g. Clean Shipping Index), use of shore power and reduction in greenhouse gases. In addition, as acknowledgement and encouragement of shipping partners who advance the goal of bringing cleaner ships to Vancouver, carriers can receive the Blue Circle Award. This award is for participants in the Port's "Eco Action Program for Shipping", and is reserved for only the highest emission reduction achievements.¹⁹

In the case of U.S. ports, the Port of Seattle participates in the At-Berth Clean (ABC) Fuels Program which encourages voluntary reduction of vessel emissions by incentivizing use of low sulfur fuels above and beyond ECA requirements. Since 2009, participants have received over \$2.6 million in incentives from the Puget Sound Clean Air Agency, which administers the program through funding from the Port of Seattle. The 2011 Puget Sound Maritime Emissions Inventory verifies the success of the program, which has eliminated more than 39% of sulfur dioxide emissions and 34% of diesel particulate matter in the harbor. The Port of Seattle provides tiered incentives that average \$2,250 to use low-sulfur fuel in vessels' auxiliary engines for each call.²⁰

¹⁴ <http://www.legco.gov.hk/yr12-13/english/panels/ea/papers/ea1022cb1-50-1-e.pdf>.

¹⁵ http://www.port.venice.it/files/page/pdvbrochuregreenport2_5.pdf.

¹⁶ <http://www.dmca.ae/en/Environment/EnvironmentalServices.aspx?GenericContent=air.emissions>.

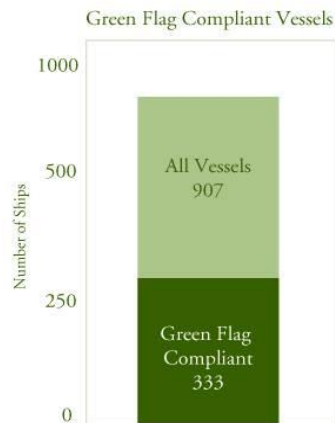
¹⁷ http://www.mpa.gov.sg/sites/circulars_and_notices/pdfs/port_marine_circulars/pc11-03.pdf.

¹⁸ <http://www.portofgothenburg.com/About-the-port/Sustainable-port/>.

¹⁹ <http://www.portmetrovancover.com/en/environment/initiatives/Air/EcoAction.aspx>.

²⁰ Interview with Janice Gedlund, Port of Seattle March 6, 2013.

In southern California, a voluntary vessel speed reduction program that extends to within 20 nautical miles has been implemented at the San Pedro Bay and San Diego Bay Ports. OGVs must reduce speeds to 12 knots (15 knots for cruise ships calling in San Diego) in an effort to reduce air emissions. In May 2013, ten shipping lines received the first Green Flag Award. Since July 2012, this program has encouraged vessel operators to assign the cleanest ships to the Port of



Long Beach. Through the Green Flag Program, participants were awarded \$2.5 million in dockage fee discounts in 2012 and the Port awarded \$135,000 in incentives. The Port of Long Beach credits the program for helping cut diesel pollution from all port-related operations by 75%. The Port refunds the dockage fee if the vessel operator has met all the requirements of the Green Flag Program.

On the U.S. East Coast, the Port of Virginia offers their “GO” Vessel Program, which provides operational incentives to commercial containership lines. The GO Vessel Program encourages the use of alternative fuel/hybrid technologies developed locally to the Port that, when implemented, result in a voluntary reduction in emissions from at-berth operations.²¹

The Environmental Ship Index (ESI) is an international clean ship indexing program developed through the International Association of Ports and Harbors (IAPH) World Ports Climate Initiative (WPCI).²² Shipping lines voluntarily register their vessels in the ESI program and provide quarterly data updates. Operators can register as few or as many of their vessels as they chose. Each vessel registered in the ESI receives a score based on performing better than IMO regulations. The Index scores NOX and SOX emissions directly and proportionally and gives a fixed bonus for documentation and management of energy efficiency. Ports using the ESI include Ports of New York and New Jersey, Los Angeles, Rotterdam, Dubai and Antwerp.

On-Shore Power

Ports have worked with their customers to install on-shore power (cold ironing) to reduce air pollutants emitted while a ship is at berth. To be a viable candidate for cold ironing, a ship must visit a port frequently, spend a sufficient number of hours in berth and have an ample power demand while docked. These factors contribute to significant energy consumption and therefore offer a greater potential for emission reductions. Infrastructure issues also influence the feasibility of shore power.



On-shore power installation

²¹ <http://www.portofvirginia.com/environment/fuel-switching-incentive-program.aspx>.

²² <http://esi.wpci.nl/Public/Home>

In addition, there has been some controversy surrounding power generation energy sources that supply on-shore power. If the source of the electrical power generation is not “clean,” there is a question on the overall reduction of emissions from a regional/global perspective. Given the power demand for shore-power is significant; there is the possibility that emissions will be “relocated” from the port to the power generation source. In places like California for example, the power generation mix is cleaner (over 80% of natural gas, hydro, renewables) versus the national average (50%),²³ making shore-power an alternative for emission reduction.

The number of U.S. ports installing shore power at cruise terminals has increased from the 2009 research to include the Ports of Seattle, San Diego, San Francisco and Juneau. Cruise ship operators have made investments in their vessels to enable them to “plug-in” at ports as well as in the on-shore infrastructure where a cruise line is “home ported.” Port Metro Vancouver B.C. estimated as of June 2013, they had over 100 cruise ship calls at the port utilizing on-shore power.²⁴

While the number of ports investing in cruise terminal on-shore power increased in the U.S., the number of international ports investing in on-shore power for their cargo terminals grew over the past three years. This included the Ports of Oslo, Antwerp, Stockholm, Kotka, Venice and several others. The Port of Gothenburg won an exclusive international environmental award for their on-shore power program²⁵ and partnered with the Ports of Antwerp, Amsterdam and Hamburg and the World Ports Climate Initiative (WPCI) to develop a website for on-shore power information. The On-Shore Power Supply (OPS) website was developed for port authorities, terminal operators and shipping companies considering introduction or expansion of the technology.²⁶

In the U.S., only a few ports have installed on-shore power at their cargo terminals. However, with the advent of the State of California’s “At Berth Shore Power Regulation” that number will increase considerably (for ports along the California coast). This regulation applies to operators of container vessel or refrigerated cargo vessel fleets whose vessels cumulatively make 25 or more visits annually to any single specified port. It also applies to passenger-vessel fleet operators whose vessels cumulatively make five or more visits annually to any single port in California.

Also within the U.S., Totem Ocean Trailer Express (TOTE) partnered with the Port of Tacoma in 2010 to provide infrastructure at the TOTE Tacoma Terminal for on-shore power. The partners received a \$1.5 million U.S. EPA grant and leveraged funds through in-kind contributions from the Port and direct matching funds from TOTE. TOTE also uses redesigned roll-on/roll-off vessels powered by diesel electric motors in series, reducing diesel and greenhouse gas emissions up to 90%.²⁷

²³ <http://www.energyalmanac.ca.gov/index.html>.

²⁴ Interview with Carmen Ortega, Port Metro Vancouver (B.C.) June 13, 2013

²⁵ <http://www.youtube.com/watch?v=WWgRKNW-OgM>.

²⁶ <http://www.ops.wpci.nl/>.

²⁷ <http://www.portoftacoma.com/shorepower>.

Several ports interviewed stated that shore power was infeasible for their cargo terminals because of the limited or infrequent number of dedicated calls ships make at their port. Unless there are consistent, frequent calls made by a vessel it is difficult to achieve a return on such a significant capital investment. Additionally, shipping lines that own and operate the vessels bear major additional costs associated with retrofitting the ocean-going ships so that they can plug into on-shore power at berth. Most cold-ironing for commercial cargo vessels has occurred at terminals where the carrier has a stake in the long-term lease or ownership of the facility (outside of the State of California At Berth regulations). In these situations, the carrier has both a long-term terminal commitment and long-term control of a dedicated fleet, making cold-ironing investments a reasonable investment.

There are a number of infrastructure considerations that factor into determining the costs for installing on-shore power at a port. This includes the cost of supplying high-voltage power; the necessity of transformers, switchboards and control panels; the need for frequency converters and the length of underground cable conduits and canalization. For vessels, on-board infrastructure costs considerations include the electrical distribution system; switchboards and control panels; cable reel system (also possible on the quay, depending on design) and transformers (if not available on quay).²⁸

In the U.S., cost for the shore-side infrastructure and vessel retrofit can be substantial. For example, the cost for shore power covering 11 berths on six terminals at the Port of Oakland was approximately \$70 million. The overall combined estimated cost for the Port and the private sector was approximately \$85 million. To offset some of the cost born by the Port, the Bay Area Air Quality Management District & U.S. Maritime Administration (MARAD) contributed \$12.8 million to the project; and an additional \$19.9 million will be provided to the port by grants from the California Air Resources Board and the Metropolitan Transportation Commission/Federal Highway Administration.²⁹

On-shore power for harbor craft has been found by many ports to provide significant emissions reductions for the amount of money invested in infrastructure. The Port of Portland, in partnership with Shaver Transportation, constructed an on-shore power facility for Shaver's tug boats servicing the Portland and Vancouver Washington harbors, as well as the lower Columbia and Willamette River system.³⁰ Massport currently maintains two power stations extending shore-to-ship power for up to four vessels at the Boston Fish Pier ("the Fish Pier") in South Boston, the home of Boston's commercial fishing fleet. Currently, 13 fishing vessels regularly dock at the Fish Pier and additional berthing space is available to accommodate visiting vessels and future growth of the fishing vessel fleet. The fishing vessels operate on-board diesel generators approximately 10 to 14 hours per day when docked to supply electricity for all on-board service needs.³¹

²⁸ <http://www.ops.wpci.nl/>.

²⁹ <http://www.portofoakland.com/newsroom/pressrel/view.asp?id=294>.

³⁰ Interview with Richard Vincent, Port of Portland June 4, 2013

³¹ www.massport.com/environment/Documents/.../Sustainability_Report.pdf.

Cargo Handling Equipment, Off-Road Vehicles

In the U.S., the replacement or retrofit of older transport and cargo handling equipment is a common practice among the ports interviewed and increased significantly since first researched in 2009. Most U.S. ports have some form of replacement/retrofit program for diesel and gasoline fleet vehicles with hybrid and alternative fuel powered vehicles. For Cargo Handling Equipment (CHE) like yard tractors, cranes, straddle carriers and reach stackers, ports are testing and using electric hydraulic hybrid motors, as well as full electrification.

In some cases, there have been challenges with new technologies. For example, the Port of Houston concluded an unsuccessful demonstration in 2010 for a hybrid terminal tractor where the tractor was not able to successfully perform in the demanding port environment.³² However, a 20-truck fleet powered by hydrogen fuel cells will begin a demonstration project at the Port in the fall of 2013 to determine if the vehicles can improve air quality and still provide enough heavy lifting to handle cargo. In the largest demonstration project of its kind, the electric fleet will unload containers from ships at the Port and deliver them to a Wal-Mart warehouse.³³



Balqon Electric Terminal Tractor

Initiatives such as the Technology Advancement Program (TAP) – a partnership between the Port of Long Beach and Los Angeles, the California Air Resources Board and the Environmental Protection Agency – has accelerated the availability of innovative clean technologies designed to improve air quality at ports.³⁴ Examples of technologies demonstrated at the Ports of Los Angeles and Long Beach include the Balqon Electric Terminal Tractor, a hydrogen electric/hybrid fuel cell truck, a hybrid yard hostler and a compressed natural gas (CNG) drayage truck.³⁵

Repowering projects at ports researched have mostly focused on large equipment such as Rubber Tired Gantry cranes (RTGs), diesel powered ship-to-shore cranes and harbor craft such as tugboats, ferries, pilot boats and workboats. The Port of Los Angeles is currently using the Foss Maritime Diesel/Electric Tugboat, the first hybrid technology that allows for the tugboat to switch to battery power during idling.³⁶

The Ports of New York/New Jersey, Corpus Christi and Long Beach are examples of a few ports that retrofitted locomotives at their ports to decrease diesel emissions. Retrofits of existing CHE with emission reduction devices has been implemented at a number of ports through the support of grant funding (within the U.S.) from the U.S. EPA and its Diesel Emission Reduction Act (DERA), Smart Growth Programs and the American Recovery and Reinvestment Act (ARRA).

³² Kenneth Gaithright, Port of Houston Authority presentation July 18, 2013.

³³ <http://fuelfix.com/blog/2013/04/15/port-of-houstons-test-trucks-handle-like-golf-carts/>.

³⁴ <http://www.cleanairactionplan.org/programs/tap/>.

³⁵ <http://www.cleanairactionplan.org/programs/tap/techdemos.asp>.

³⁶ Lisa Wunder, Port of Los Angeles presentation July 23, 2013.

A DERA grant is assisting the Port of Portland to repower the *Dredge Oregon* with new auxiliary and main engines over a two year period. This dredge operates on the Columbia River maintaining the channel under contract to the U.S. Army Corp of Engineers. The new engines meet EPA Tier III Emissions standards and will reduce greenhouse gas emissions by approximately 40% and diesel particulate emissions by over 80%. The newer, more efficient



The Port of Portland's dredge, the Oregon

engines reduce fuel consumption and therefore also reduce operating costs.

European ports have also begun to upgrade their equipment, many choosing electrification for their CHE, as well as natural gas and biodiesel. Canadian ports, which do not have the benefit of the government grants made available to U.S. ports, have been slower to upgrade and/or retrofit their CHE.³⁷

However other international ports have developed policy changes to upgrade or retrofit their equipment.

As part of their environmental policy, the Port of Yokohama has defined a commitment to purchase all new hybrid cargo handling equipment, for example.³⁸ Also, the Chinese Ministry of Transport is developing incentives for ports to change over to all electric CHE.³⁹ Electric RTGs are in high use at most Chinese ports and one of the largest worldwide suppliers of electric RTGs is a Chinese company.

Alternative fuels are widely accepted approach to reducing emissions. Ultra low sulfur diesel (ULSD) is used by ports throughout the U.S. At the Port of Tacoma, APM Terminals switched to ULSD for its on-terminal equipment.⁴⁰ While the use of ULSD is a commonly used approach to lower emissions for non-road equipment in the U.S., its use internationally is not universal. For example, countries like China, Brazil and Nigeria do not have the distribution and refining capabilities for ULSD⁴¹ and therefore cannot use the new Tier IV compliant engines which require use of ULSD.⁴²

Drayage Truck Emission Reduction Programs

Since the initial 2009 research was conducted, several U.S. ports have developed truck emission reduction programs. These programs all have the same goal of reducing truck emissions that occur as a result of port activities. As with other environmental initiatives, there is no one-size-fits-all approach that works for all ports.

³⁷ Interview with Christine Rigby, Port Metro Vancouver (B.C.) June 3, 2013

³⁸ http://www.yokohamaport.co.jp/e.df.hp.transer.com/info/environment/environment_friendly/.

³⁹ Mr. Li Hongyin, Deputy Director-General Bureau of Water Transport, Ministry of Transport Presentation July 24 2013.

⁴⁰ http://www.pugetsoundmaritimeairforum.org/uploads/PSMAF_AEI_projects_rw_SPREADS.pdf.pdf.

⁴¹ Mark Fritzon, Stewart Stevenson Engines interview July 17, 2013.

⁴² Mark Fritzon, Stewart Stevenson Engines interview July 17, 2013.

Both the Port of Long Beach and the Port of Los Angeles (now considering zero emission trucks) launched their mandatory truck programs at the same time (2008), yet each had a different



Port of Long Beach

approach that worked for their business operations and stakeholders - such as tenants who operate the container facilities.⁴³ Short haul drayage trucks account for a significant amount of air pollution at these ports.⁴⁴ According to a 2008 drayage options analysis performed by the Boston Consulting Group (BCG) for the Port of Los Angeles, the drayage system at the Port imposed between \$500 million and \$1.7 billion in costs for the public each year through operational inefficiencies (e.g. impact on truckers and trucking companies of truck under-

utilization, traffic congestion and lack of driver health/benefits); city/community costs (e.g. road maintenance, environmental damage, vehicle and driving safety and residential impacts from truck traffic and parking); and public health (premature death, hospital admissions, workday and school-day loss and restricted activity).⁴⁵ Most drayage trucks servicing the Ports of Los Angeles and Long Beach were independently owned and operated and the equipment was older and thereby more polluting.⁴⁶

Some ports and municipalities have been met with legal challenges when implementing their mandatory truck programs. The Ports of Los Angeles and Long Beach are examples of ports that have been met with legal and organized labor challenges to their mandatory truck replacement programs.

The Port of Seattle's mandatory clean truck program will require 80% of all trucks entering port facilities to meet emission standards for engine-year 2007 by the end of 2015. Trucks that do not meet the required emission standards will be turned away at the terminal gates.⁴⁷

"The drayage truck replacement effort has been one of the greatest clean air success stories in recent years in southern California."

- Barry Wallerstein, Executive Officer at the South Coast Air Quality Management District

In comparison, a number of ports have instituted a voluntary truck replacement program and do not turn drivers away if the truck does not meet certain standards (i.e. 2007 level engine standards). Through significant outreach, trucks have voluntarily been replaced at some ports with newer cleaner trucks where there has been port, state and/or federal (EPA) grant funding made available. The Port of Baltimore's voluntary drayage truck replacement program recently announced replacement of 50 older, short-haul drayage trucks with newer, cleaner trucks under a program supported by federal and state funds.⁴⁸

⁴³ <http://www.portofhouston.com/inside-the-port-authority/environmental-stewardship/air-quality/>.

⁴⁴ <http://www.polb.com/civica/filebank/blobdload.asp?BlobID=3759>.

⁴⁵ http://www.portoflosangeles.org/ctp/CTP_Analysis.pdf.

⁴⁶ Interview with Tim DeMoss, Port of Los Angeles May 24, 2013.

⁴⁷ <http://www.portseattle.org/Environmental/Air/Seaport-Air-Quality/Pages/Clean-Trucks.aspx>.

⁴⁸ http://www.mpa.maryland.gov/_media/client/eBroadcast/2013/061313.pdf.

The Port of Houston Authority initiated their clean truck replacement program in 2009. Through a partnership with the Houston-Galveston Area Council and the Environmental Defense Fund, the Port Drayage Truck Bridge Loan Program received \$9 million from the EPA's DERA Smart Way Program.⁴⁹ The Port Authority's commitment of \$50,000 was instrumental in securing the Smart Way Program grant and allocated a Guaranteed Loan Program for applicants with soft credit profiles. On average, four trucks a month, or 50 trucks a year, have been approved for funding.⁵⁰

Support for most U.S. port truck replacement programs has come from the EPA Smart Way program, which was established to award non-profit organizations and local governments (including port authorities) competitive grants to create national, regional, state, or local financing programs that provide financial incentives (e.g., low-cost loans, rebates, etc.) to vehicle/equipment owners for the purchase of eligible vehicle replacements, idle reduction technologies and emission control retrofits.⁵¹ A number of U.S. states (e.g. California, Oregon, Texas) also grant funding to support truck replacement or CHE retrofits.⁵²

Since the initial research in 2009, ports made significant progress in decreasing engine idling by relieving congestion at peak times. Secure, expedited check-in procedures at marine facilities has resulted in less truck congestion, reduced idling at gates and less pollution. For example, as part of their Clean Air Action Plan (CAAP), terminal operators from the Ports of Los Angeles and Long Beach created PIERPASS to address multi-terminal issues such as congestion, security and air quality. Under the program, all international container terminals at the two ports established five new shifts per week. As an incentive to use the new off-peak shifts and to cover the added cost of the shifts, a Traffic Mitigation Fee (TMF) is required for most cargo movement during peak hours (Monday through Friday, 3 a.m. to 6 p.m.).⁵³



Port of Southampton UK: Three OCR Gate systems integrated into radiation portals for US Customs.

This approach has been used by other ports around the U.S. and internationally to stagger trucks and reduce idling time and truck congestion. For example, Massport has decreased the dwell time for containers from five days to two days in order to encourage turnover and free up space. To reduce the possibility of trucks idling on city streets before container pick up or drop off, the Port instituted an efficient gate processing system and extended the gate operating hours. Pre-gates are available to process

⁴⁹ <http://www.epa.gov/smartway/>.

⁵⁰ <http://www.portofhouston.com/inside-the-port-authority/environmental-stewardship/air-quality/>.

⁵¹ <http://www.epa.gov/smartway/financing/>.

⁵² <http://www.epa.gov/smartway/financing/govt-funding.htm#state>.

⁵³ <http://pierpass.org/>.

several trucks at any one time, which reduces truck queuing and idling time. With computers and remote cameras, Massport's Conley Terminal dispatchers can process a trucker's request for pick-up or drop-off within a couple of minutes and then direct the truckers to the appropriate location for the container within the terminal. Recently, Massport implemented the Tideworks Technology® Mainsail Terminal Operating System Forecast module. This system provides Conley Terminal customers with real-time web-based access to the terminal's database. The application is used by trucking companies, brokers, consignees and shippers to retrieve immediate data such as the ability to check container availability, bookings and vessel schedules.⁵⁴

Other initiatives funded by the EPA, such as reversible automated gates systems and extended gate hours have helped to reduce truck idling times at the Ports of Savannah, New Orleans, New York/New Jersey and Seattle. Advanced gate systems speed the flow of trucks by automatically recognizing and giving clearance to their drivers and cargo. Terminal appointments can be granted to reduce waiting time giving carriers and shippers access to real-time information about their containers.⁵⁵

Water Quality

Stormwater management is the leading water quality issue facing ports (and most other industries) today. "All drains lead to the ocean" is a community reminder that stormwater, landscaping runoff, agricultural and farming runoff all lead to waterways. This is no less evident at ports where stormwater runoff from cargo handling operations can run directly into adjacent waters.

To help encourage increased stormwater management applications, government regulators have taken aggressive steps. In the State of Maryland, government regulators have instituted a "rain tax" to combat pollution that comes when dirty rainwater flows off buildings, pavement and roads. This is the case for the Port of Baltimore where polluted stormwater runoff has been a major problem for the Chesapeake Bay. The revenue from the rain tax goes for the creation of wetlands to corral water-borne nutrients that harm the bay and the restoration of streams damaged by erosion from land development.⁵⁶



Paddlers tow the floating wetland into place at Port of Baltimore

Municipal Separate Storm Sewer System (MS4) permits throughout the U.S. are in the process of being renewed and have become more restrictive with each permit cycle. U.S. ports are encountering additional regulatory challenges as state environmental agencies develop Total Maximum Daily Load (TMDL) implementation plans for water quality-impaired water bodies

⁵⁴ <http://www.massport.com/port-of-boston/Conley%20Terminal/GateandYardAutomatedSystem.aspx>.

⁵⁵ <http://www.epa.gov/region1/eco/diesel/sp-management.html>

⁵⁶ <http://www.cbf.org/>.

that must be submitted to EPA for approval. Once a TMDL is completed and approved, states are obligated to incorporate the TMDLs into stormwater permits. This process generally leads to more restrictive levels of constituents allowed in stormwater runoff from port facilities.

Ports in the U.S. operated under different permit structures that include:

- General National Pollutant Discharge Elimination System (NPDES) stormwater permits held by the ports for port managed operations;
- General NPDES stormwater permits held by the tenants for tenant managed operations;
- NPDES Municipal Separate Storm Sewer System (MS4) permits for the port-owned systems, regardless of industrial activities or tenant operated facilities;
- A combination of these approaches.

In order to avoid stormwater discharges altogether, ports are looking to infiltrate stormwater on site. A major challenge at ports, like many industrial locations, is the limited opportunity for infiltration given most of the surface area at port facilities is impervious, must support heavy loads, has little available grade and may be restricted by legacy subsurface contamination. In addition, property owners are concerned with the quality of stormwater runoff that is being infiltrated. Nonetheless, Low Impact Design (LID) was universally included in the stormwater management programs and permits for ports throughout the U.S. When infiltration of stormwater is not a possibility, ports are employing the use of treatment devices such as oil/water separators, filter systems, cyclonic devices, or the use of retention ponds. In some cases, ports have replaced many of the traditional Best Management Practices (BMPs) with more innovative approaches. For example, the Port of Tacoma is using bio-retention at two of its maintenance facilities. By using this approach, significant reduction in oils and grease, total and dissolved metals and zinc (from metal roofs and downspouts) has been achieved in a heavy industrial setting.⁵⁷



Completed Terminal 6 auto storage yard at Port of Portland with porous pavement

Ports have evaluated the use of pervious pavement for use on portions of their facilities where infiltration can be achieved and the nature of the operations allow for lighter surface loads, such as auto import facilities. The Port of Portland installed 35 acres of porous asphalt and adjacent bio swales to absorb rainwater and runoff from the adjacent non-porous blacktop. The cost for porous asphalt installation was greater than conventional pavement; however, there were significant savings (\$255,000) from reduced permitting requirements (both initial construction-related and on-going discharge related) and the construction of outfalls to the river. In addition, the traditional stormwater system of collection basins and subsurface piping were not necessary.⁵⁸

The first line of defense, employed by a number of the ports researched, was education of employees, tenants and contractors on stormwater management. The majority of ports

⁵⁷ Interview with Jason Jordon, Port of Tacoma March 8, 2013

⁵⁸ Interview with Richard Vincent, Port of Portland June 4, 2013

researched had a stormwater management plan. Ports in every region of the U.S. reference stormwater in their environmental literature as a major area of focus.⁵⁹ Ports like Corpus Christi, Port of Portland, Massport and Houston have included stormwater management in their Environmental Management System (EMS). The EMS framework provides a mechanism to check and verify that education on stormwater management was conducted for all employees.

Ports are collaborating with communities to address stormwater pollution and test out new innovative approaches that could be used at port facilities. For example, the Maryland Port Administration was the winner of the 2012 Smart, Green & Growing Award for Sustainable Infrastructure and Innovation in Stormwater Management. Approximately 3,250 square feet of asphalt was removed at a local school to



Port of Long Beach Marina Trash Skimmer

construct two "bio-retention" areas using a new innovative design. Together, the treatment areas capture and naturally treat runoff from one acre (43,560 square feet) of the remaining asphalt parking lot, reducing the amount of polluted stormwater running into the Chesapeake Bay.⁶⁰ This partnership was used to offset environmental impacts associated with the Port's marine terminal redevelopment projects, where these types of stormwater treatment practices are not practical



The Port of Vancouver: Rain Garden in a Box

due to site conditions and limited space. Bioretention facilities provide a natural area where runoff is first collected and filtered through a bed of soil and plants, removing pollutants such as phosphorus and nitrogen that have negative impacts on the health of a water system.

Another example of regional collaboration to support stormwater management includes a partnership between the Port of Los Angeles (POLA) and Port of Long Beach (POLB) on their Water Resources Action Plan (WRAP). The WRAP, developed in 2009, is supported by both ports to address water and sediment quality issues within their respective port districts. Both Ports work cooperatively and with the federal, state and local regulators to improve water quality. One unique aspect of the WRAP is the Technology Assistance Program (TAP), where emerging and innovative stormwater management technologies are tested for application.⁶¹

The Port of Vancouver USA utilizes a homegrown innovation: *Rain Garden in a Box* to treat zinc pollution in stormwater from galvanized metal roofs and downspouts on the terminal. The "Grattix," named after the two port employees that developed the stormwater treatment system,

⁵⁹ As noted in available literature.

⁶⁰ <http://www.mpa.maryland.gov/>.

⁶¹ http://www.polb.com/environment/water_quality/wrap.asp.

functions as a rain garden and is built using food grade plastic 250 gallon totes. Inside, a layer of drain rock is added, followed by an under-drain piping system. This is filled-in using a sand filter layer and amended soil consisting of sand and compost. The finishing touches include adding plantings and bark mulch. The plantings used are rushes and sedges, which can dry out in the summer months and withstand ponding in the winter months. During a pilot study of the Grattix from 2008 to 2011, the port environmental team collected inlet and outlet samples of stormwater and continuously found 90% to 95% zinc reduction. The only maintenance involved was periodically replacing the mulch layer, making the Grattix cheap, easy to make and most importantly, effective in maintaining the health of the Columbia River and surrounding wildlife.⁶²

The Port of Vancouver USA also leads the way in having one of largest stormwater bio-filtration facility in world. The Port's Terminal 2 stormwater bio-filtration facility treats stormwater runoff from 50 acres at one of the Port's five marine terminals, handling 18 cubic feet per



Port of Vancouver USA Bio-retention Facility

second, making it the first of its kind. After treatment, water is released into the Columbia River. The entire structure is approximately 23,650 square feet and construction took only 62 days to complete. Effluent water quality data collected in 2010-2012 has shown vastly improved removal of total and dissolved copper, zinc and turbidity.⁶³ Through these facilities and other applications, the Port of Vancouver treats over 99% of its stormwater runoff from its property.

In Australia, one of the driest climates on earth, stormwater discharges in urban areas has created significant pollution problems in streams and in

the ocean. Draining stormwater directly into streams and oceans traditionally has been the only method for disposing of stormwater runoff; however today, stormwater is important part of the water “supply” and management approaches emphasize infiltration, storage and reuse. Similar to the LID approach in the U.S. is Australia's Water Sensitive Urban Design (WSUD) and is included as part of the stormwater management regulatory scheme. The Port of Brisbane has installed bioswales and gross pollutant traps as part of its WSUD/stormwater management program. The port ensures that all its tenants adhere to the port's WSUD guidelines and provides support through additional stormwater improvement devices.⁶⁴ In addition to swales and traps, other WSUD improvement devices include retention ponds, infiltration trenches and rain gardens.⁶⁵

⁶² <http://www.portvanusa.com/environment/rain-garden-in-a-box-helps-treat-stormwater-runoff/>.

⁶³ <http://www.portvanusa.com/environment/largest-stormwater-bio-retention-facility-in-world-calls-port-of-vancouver-home/>.

⁶⁴ Interview with Craig Wilson, Port of Brisbane May 22, 2013

⁶⁵ http://wsud.melbournwater.com.au/content/treatment_measures/treatment_measures.asp

Similarly, European watersheds are also being impacted by stormwater runoff. Areas in Europe have seen some of its worst droughts in recent years. The recognition that stormwater is an important part of the water supply is becoming more central to the management of stormwater and water quality. For example, in Port areas directly controlled by the Venice Port Authority, rainwater is collected and conveyed to a treatment plant located offsite. The plant uses filtering cartridges to retain particles and absorb pollutants (including heavy metals, nutrients and hydrocarbons). The filtering process removes oil, grease and surface foam. Once it has been filtered, the water is conveyed into the lagoon.⁶⁶ Overall, the Port treats over 95% of its stormwater off-site.

European efforts to combat water pollution from port activities include Clean Baltic Shipping or the “CLEANSHIP” program, which is part of the Action Plan of the European Union Strategy for the Baltic Sea Region.⁶⁷ The CLEANSHIP program is designed to develop common environmental standards for the Baltic Region and to contribute to the development of a sustainable port index (through the International Association of Ports and Harbors). In addition, the CLEANSHIP effort will develop best practices, pilot technical solutions for shore side power, LNG supply and sewage reception at ports.



The Rhine River runs through several countries and has some of the most stringent water quality standards in the world; and therefore, ports in that region are subject to intense monitoring and oversight.⁶⁸

In Israel, the Port of Ashdod unloads millions of tons of bulk cargos annually including sulfur, grains, petroleum coke, fertilizers and other materials. All new bulk and general cargo terminals are now designed with drainage systems that are graded away from the face of the berth and lead to settling pits. This assures that all cargo debris on the terminals are absorbed by the pits and not washed into the harbor.⁶⁹

Another area of water quality improvements has been in the handling of ballast water. Ballast water provides stability and maneuverability to a ship. Usually ballast water is pumped out of ballast tanks when a ship is receiving or discharging cargo. Large ships can carry millions of gallons of ballast water. The ballast water inside a ship can carry invasive species that are pumped into ballast tanks along with the water.

Within the U.S, ballast water discharge regulations are governed by the EPA, Coast Guard, states and localities; the IMO, European Maritime Safety Agency and sovereign countries regulate ballast water discharge outside the U.S. Ballast water issues are prevalent in the U.S. Great

⁶⁶ <https://www.port.venice.it/en/water.html-0>

⁶⁷ <http://www.clean-baltic-sea-shipping.com/project/background>.

⁶⁸ http://webworld.unesco.org/water/wwap/pccp/cd/pdf/case_studies/rhine2.pdf.

Waste Minimization

⁶⁹ <http://www.ashdodport.co.il/ENGLISH/CORPORATE-SOCIAL-RESPONSIBILITY/ENVIRONMENT/Pages/projects.aspx>

Lakes and strict regulations are in place to prevent introduction of invasive species. Most ports in the U.S. defer to the federal regulations and do not have specific ballast water regulations or requirements.

U.S. West Coast ports, in conjunction with steamship lines, universities, the U.S. Coast Guard and state and federal regulators, are members of the Pacific Ballast Water Working Group. This group meets regularly to collaborate on issues surrounding ballast water discharges in an effort to promote development and implementation of safe, economical, effective management of aquatic nuisance species associated with West Coast shipping.⁷⁰

At the Port of Baltimore, The Maritime Environmental Resource Center provides testing facilities, information, and decision-making tools to address ballast water issues facing the international maritime industry, especially as they impact the Chesapeake Bay. The Center provides technology developers/vendors with facilities and expertise for evaluating ballast water treatments and other environmental innovations. The Center offers a unique mobile testing barge with the ability to evaluate ballast water treatment systems in various parts of the Chesapeake region, such as Baltimore, Norfolk, and Washington DC, where salinity and other conditions vary greatly.⁷¹

Waste minimization and recycling continue to be included in ports' environmental and sustainability goals. Every port researched had some degree of recycling and waste minimization program that has become integrated into their organizational culture and, in some cases, through regulation or local ordinance. Several ports indicated that municipal ordinances drive their programs to achieve various levels of materials recovery for recycling.

Many ports include reduce-reuse-recycle policies as part of their environmental management program. The inclusion of waste minimization and recycling into these programs requires ports to identify measurable targets and objectives for their activities in order to track success and identify areas of improvement.

The research found that most ports have strong construction materials recycling programs in place. The Port of Long Beach has invested in an onsite cement crusher as their construction and demolition projects are generally of a large scale and provide excellent opportunities for cost-effective recovery of large quantities of construction debris including metal, wood, concrete and asphalt.⁷²



Dunnage waste

The Port of Houston Authority maintains a dunnage recycling program. One of the largest waste products generated at the Port of Houston Authority is dunnage materials mainly composed of mahogany or teak. Recognizing the potential value of

⁷⁰ <http://www.psmfc.org/ballast/>.

⁷¹ <http://www.mpasafepassage.org/projectFiles/water.pdf>

⁷² <http://www.polb.com/environment/leed/default.asp>.

these materials, the Port of Houston Authority implemented an innovative dunnage recycling program with the Texas Correctional Industries (TCI), which uses it to make furniture, chain link fencing and razor wire, which are then sold back to the Port of Houston Authority and other tax-supported entities. In 2009, 252 tons (21%) of dunnage was recycled, saving the port about \$125,000 to \$135,000 annually from this initiative.⁷³

In 2010, Port Metro Vancouver, B.C. implemented a Sort Smart waste management program at their Canada Place office to promote waste diversion and the principles of reduce, reuse and recycle. This program includes a robust recycling system for paper, glass, metals and plastics. In April 2010, the port introduced a composting service for organic waste, diverting 2,970 kg of organics from the landfill in just eight months.⁷⁴

The majority of ports researched and interviewed were fairly large organizations with administrative components that generate large quantities of office-related waste (paper, cardboard, etc.). Recycling programs for these waste streams were common; many ports have in-house recycling programs and participate with local municipalities to maximize their recycling efforts.

Dredging

Dredging activities are conducted at ports to maintain and deepen existing channels and berths and to develop new facilities. In the U.S., environmental regulations for dredging activities are extensive and obtaining permits for even maintenance dredging projects can take years. Because of this, water quality issues pertaining to turbidity and endangered species promulgated in-water work restrictions that influence the way ports plan for and conduct dredging projects. A delay in permitting, designing or contracting can delay a project until the next in-water work period, often causing project delays of up at least a year. Delays such as this have significantly increased the cost of projects and operations.



Maintenance dredging, Port of Oriel, Ireland

The authorization and requirements for dredging, while fairly consistent across the U.S., are affected by a port's geographic location. Freshwater river ports and saltwater ports have distinct habitats. Because of this, permit requirements are differentiated by the endangered species, ranging from fish, marine mammals and avian species, found at different port geographic locations.

⁷³ <http://www.clean-baltic-sea-shipping.com/project/background>.

⁷⁴ http://portmetrovancover.com/Libraries/ABOUT_Corporate/PMV_2010SustainabilityReport.sflb.ashx.

In the spring of 2013, several of the ports researched had major channel deepening projects in process. According to the literature review, these deepening projects are designed mainly to accommodate the larger, post-Panamax vessels, and “super” post Panamax vessels. These “super” post Panamax vessels will not be able to go through the Panama Canal until it is upgraded

The majority of ports researched had sediment management programs in place that provided guidelines for dredging and placement of dredge material (e.g. the Ports of Los Angeles and



Turbidity curtain deployment during dredging at Port of Hong Kong

Long Beach WRAP).⁷⁵ Testing for turbidity and endangered species (if identified) was consistent across the ports researched. If endangered species are present or there are particular water quality concerns, the use of silt turbidity curtains are often required. In some instances, to limit impacts to endangered species, a biologist is required to observe dredging operations. This is rare, but adds to project costs, lengthens schedules and can impact operations. U.S. ports conduct sampling to determine how sediment and surface sediment will be handled and managed. Sand covers are required in areas where surface sediments are above screening levels in Portland. Several of the ports noted that biological testing for micro invertebrate species in sediment is becoming a common requirement.

Where feasible, ports are working together with their tenants and other stakeholders with respect to sediment management. The Port of San Diego has maintained a very successful partnership with the U.S. Navy over the past several years. Through the San Diego Integrated Natural Resources Plan, the Port and the Navy work cooperatively on studies, reclamation and beneficial re-use projects. This has saved time, extends the benefits of limited funding and provides a coordinated approach for local stakeholders and regulators.⁷⁶

Ports have also developed internal departmental partnerships where departments coordinate capital programs and dredging requirements to create a synergy to provide greater opportunities for beneficial reuse and disposal options, thereby saving time and money.

Ports within the Puget Sound in the State of Washington, participate in the Dredged Material Management Program (DMMP), a coordinated multi-agency approach to management of dredged materials. The cooperating agencies include the U.S. Army Corps of Engineers-Seattle District, EPA Region 10, Washington State Department of Ecology and Washington State Department of Natural Resources.

Since the initial research conducted in 2009, more ports responded affirmatively to the question of whether they have a robust beneficial reuse program in place as part of their sediment

⁷⁵ <http://www.portoflosangeles.org/environment/wrap.asp>.

⁷⁶ Interview with Eileen Maher, Port of San Diego May 24, 2013

management plan(s). In Europe, about 90% of the dredged material is disposed of or re-used by five countries (Belgium, France, Germany, the Netherlands and the United Kingdom). As such, these countries came together to form the Dutch-German Exchange (DGE), an informal bilateral platform for exchanging knowledge, information and experiences in the field of dredged material management. The participants of DGE represent organizations involved in regulating and advising on sediment and especially on dredged material management (government departments and agencies; port authorities). The DGE focuses on exchanging best practices on integrating sediment and dredging issues into river basin management plans and marine spatial planning, maintenance dredging, use and relocation of dredged material, and working with cooperating on join projects.⁷⁷

In the U.S. the states of Alabama, Florida, Louisiana, Mississippi, Texas and the EPA, National Oceanic and Atmospheric Administration (NOAA) and the Department of Interior (DOI) partnered to develop tools to support effective sediment management in the Gulf Region through the Gulf Regional Sediment Management Master Plan (GRSMMP). The Plan focuses on more effective use of dredged material and other sediment resources for habitat creation and restoration.⁷⁸ Examples of beneficial re-use of sediment materials include the upland disposal of dredged material for bird habitat, which avoids adverse impacts of increased turbidity on sea grass beds. Other examples include wetlands restoration, capping of landfills, beach replenishment, land reclamation, brownfields, and artificial reefs.



Dredging at Port of Honfleur, France

A unique alternative to frequent dredging is the employment of underwater grading. Underwater grading uses a self-propelled barge or a barge that is anchored and winched in order to maneuver an I-beam that hangs down at a targeted depth. The I-beam pushes or pulls clean sediments from high spots into adjacent low spots within a permitted berthing area. The Port of Portland has conducted underwater grading as an alternative to dredging and the Port of Seattle is currently working toward a permit to implement this approach.⁷⁹

Energy Conservation and Renewable Energy

Over the past three years, the emphasis on energy conservation and renewable energy has been significant. Ports, along with most major industries, have looked for opportunities to reduce their energy expenditures as part of business efficiency and thereby reduce their GHG emissions. The EPA has recommended a variety of actions, including energy conservation projects,

⁷⁷ <http://www.sednet.org/download/DGE-Objectives-March2011.pdf>

⁷⁸ http://www.gulfmex.org/wp-content/uploads/2011/09/HCRT_GRSMMMP_case_studies_chapter.pdf

⁷⁹ Interview with Ralph Graves, Port of Seattle March 6, 2013

sustainable building initiatives, and renewable energy use to achieve GHG emission reduction.⁸⁰ Associations like the World Ports Climate Initiative (WPCI) have developed tools to support air quality modeling at ports and analyzed the co-benefits of an air pollutant reductions strategy on the reduction of GHGs.⁸¹

Ports have performed some type of energy audit and for example initiated projects to re-lamp terminals and other high lighting demand work areas. A majority of ports (U.S. and abroad) employ a “LEED™” type of design criteria to any new construction, thereby including a certain degree of energy efficiency and conservation measures into project design and construction.

In 2010, the Venice Port Authority moved forward with several major energy initiatives including LED technology to illuminate their passenger port. Compared with the conventional systems, the new 23 meter spotlights enabled the port to save 70% more energy. The Port also installed 18,000 square meters of solar panels on the rooftops in the Port's cruise facilities. The panels cover the cruise terminal's power needs and when the cruise season finishes, the Port sells back the power absorbed in peak periods.⁸² The Port of Venice is also demonstrating the wide-scale use of biomasses (algae) to generate power and heat and make the Port of Venice energy-independent.⁸³ The experimental tanks will generate 500KW of peak capacity with oil derived from algal pulp. If successful, the project can be rapidly scaled up to 50MW. The entire Port currently consumes 7MW.

The use of solar power was evident in almost all ports researched, ranging from parking area



Port of West Sacramento solar roofs

covers to covering warehouse roofs. Some ports have been more aggressive due to their geographical location. For example, in 2010, the Port of West Sacramento became the first port to have 100% of its power needs supplied by solar energy. The installation of solar power has cut the Port's energy costs by more than \$20,000 annually and will eliminate more than 34 million pounds of carbon-dioxide emissions over 25 years. The system consists of 3,536 solar panels covering 90,000 square feet

on the rooftops of two rice warehouse buildings. With a 25-year power purchase agreement, it was installed by Pacific Power Management (PPM) at no cost to the port.⁸⁴

⁸⁰ <http://www.epa.gov/oaintrnt/ghg/>

⁸¹ http://wpci.iaphworldports.org/iaphtoolbox/GreenG_main.html

⁸² <https://www.port.venice.it/en/energy.html>

⁸³ <https://www.port.venice.it/en/energy.html>

⁸⁴ <http://www.environmentalleader.com/2010/03/15/port-of-west-sacramento-powered-100-by-solar-energy/>.

European ports are utilizing wind energy at a greater rate than U.S. ports. There is a major effort underway from ports in the United Kingdom (UK) to lead in wind energy. Over the next twenty years, analysts predict that most UK ports will gain significantly from this low-carbon industry.⁸⁵



An offshore wind farm in North Hoyle, UK

Plans to create the world's biggest offshore wind farm off the coast of Britain were approved for the massive Triton Knoll site - 288 giant wind turbines off the Lincolnshire coast. It will dwarf Britain's current largest offshore facility, the 175-turbine London Array in the Thames Estuary.

In 2009, research showed that Japan was poised to lead the way for port offshore wind farms but implementation slowed down as a result of the poor economy and the lack of government incentives.⁸⁶

Offshore wind feasibility assessments have been done by ports in many regions within the U.S. In some cases, efforts to place offshore wind farms have been met with strong stakeholder opposition, mainly for aesthetic reasons. One example is the Cape Wind Project, an approved offshore wind farm on Horseshoe Shoal in Nantucket Sound off Cape Cod, Massachusetts. The wind farm may become the first offshore wind energy project in United States coastal waters producing up to 420 megawatts of clean, renewable energy in a 24 square mile area. Great controversy has surrounded the project since its initiation in 2001 with lawsuits, protests and millions of dollars in outreach from both points of view. However, as of June 2013, financing was secured to begin construction of the project.⁸⁷

The main focus for many ports relative to wind energy is the investment in port infrastructure to receive wind turbine equipment for delivery into the U.S. Wind energy production in many regions of the U.S. has contributed to a boom at ports whose infrastructure, storage and laydown areas can handle the giant turbine equipment coming in from China and other worldwide locations.



Off-loading of wind turbine components at the Port of Vancouver, USA

Many U.S. ports are implementing energy conservation and renewable energy strategies at their facilities and conducting outreach to their tenants to support these efforts. Different approaches are being used, including a number of partnerships with local utilities and tenants. The Port of San Diego initiated an innovative program in partnership with the Local Governments for

⁸⁵ <http://www.bloomberg.com/video/how-wind-power-is-reviving-britain-s-ports-QNcWAZoyQw~oLaRf9d4h2A.html>.

⁸⁶ http://www.mlit.go.jp/english/2006/k_port_and_harbors_bureau/13_windpower/index.html.

⁸⁷ <http://www.politico.com/story/2013/06/cape-wind-project-energy-offshore-93255.html>.

Sustainability (ICLEI) and San Diego Gas & Electric (SDGE) through their Green Business Challenge in 2010. Today, the Port of San Diego's Green Business Network (re-launched) is a voluntary program that works with local businesses around San Diego Bay to green their operations and track their successes. Those efforts are highlighted through a media campaign and an awards celebration that recognizes participants for their environmental leadership and commitment to energy efficiency. Successes to date include a reduction by Port businesses (tenants) in their greenhouse gas emissions by 843 metric tons.⁸⁸



Starting in 2009, the Port of Long Beach initiated a grant program to mitigate port-related air pollution. The program was designed to improve community health by reducing greenhouse gases and particulate emissions. The program provided grants (\$5.4M) to support projects within or near the City of Long Beach that will reduce greenhouse gas emissions or reduce their impacts. Projects included renewable power such as solar and wind, tree planting, alternative transportation and the replacement of traditional equipment and lighting with energy-efficient alternatives.⁸⁹

In addition to community programs like the grant mitigation program, the Port of Long Beach recently launched a groundbreaking energy policy to guide efforts that will secure a more sustainable and resilient supply of power as demand grows. The policy declares that the Port will implement measures to increase efficiency, conservation, resiliency and renewable energy in collaboration with port tenants, utilities, other city departments, industry stakeholders, labor unions, the Port of Los Angeles and others. The energy policy was created in anticipation of increasing demand for electricity at the Port with air quality improvement programs such as on-shore power, which has a high energy demand.⁹⁰

The Port of Portland ranked tenth in the nation in the Local Governments category under the EPA's Green Power Partnership program. The Port began purchasing Renewable Energy Credits (RECs) in 2009 and now purchases 100% renewable energy through RECs. The port also ranked 21st in the nation for power purchases among other organizations that purchase 100 % renewable energy. This equated to over 75 million kilowatt hours of energy from renewable sources.⁹¹



Port Metro Vancouver, B.C. also purchases energy and carbon offsets. In 2011, Port Metro Vancouver's purchase of 1,265 tons of carbon offsets from Pacific Carbon Trust covered greenhouse gas emissions associated with owned and operated buildings, fleet of marine vessels and road vehicles, business travel, paper consumption and solid waste and employee commuting.⁹² This supports the Port's on-going goal of becoming carbon neutral.

⁸⁸ <http://www.portofsandiego.org/environment/2871-port-of-san-diego-recognizes-waterfront-green-businesses.html>.

⁸⁹ <http://www.polb.com/environment/grants/default.asp>.

⁹⁰ <http://www.polb.com/news/displaynews.asp?NewsID=1171>.

⁹¹ <http://www.portofportland.com/publications/PortCurrents/post/Powerful-praise-from-EPA.aspx>

⁹² <http://pacificcarbontrust.com/newsroom/news-releases/pacific-carbon-trust-helps-port-metro-vancouver-corporate-operations-become-carbon-neutral/>.

Natural Resources

Port operations affect and are affected by natural resources by virtue of their geographic locations. Wetland and shoreline management is a universal issue that all ports encounter in both day-to-day operations and during project development and construction. Salt water, estuary and freshwater locations present different challenges that prevent the use of a “one size fits all” solution to management of these unique environments. Each solution must be tailored to the specific ecosystem that is impacted by the specific operational and development activities conducted by a particular port.

Ports engage in natural resource management on a daily basis. This may consist of routine management, implementing mitigation projects or managing for invasive species. As reflected in the 2010 White Paper, ports continue to be engaged in a variety of mitigation projects with an



*Wetlands restoration at Heron's Head
Park, Port of San Francisco*

emphasis on natural resources that stem from port development. Since the original White Paper was completed in 2010, ports have looked for more creative approaches to manage the balance between operations, development and natural resources. The Port of Los Angeles is currently working with regulators to develop and implement a “programmatic” mitigation plan that would provide credits for development over the next ten years. This is different

from the traditional approach where mitigation projects are implemented on a project by project basis. This

way, a port can have access to mitigation credits in reserve (banked) even though development projects have not yet been identified. This represents a more proactive approach in order to ensure appropriate, approved options are available once development projects are ready for implementation.⁹³

Most ports in the U.S. participate in some form of purchasing mitigation credits for development. For example, the Port of New York/New Jersey participates in the Richard B. Kane mitigation bank, along with three other New Jersey transit-related agencies.⁹⁴ Bank credits are restricted for use by transportation-related impacts from the four New Jersey state transportation agencies.

The establishment of mitigation banks has several benefits, including the ability to quickly respond to natural resource requirements for development projects. Mitigation bank projects can also support large, high-quality wetlands that have significant biological benefits compared to several small, disconnected wetlands. The mitigation credit and mitigation banking approach has been used frequently by international ports. Port Metro Vancouver, B.C. Canada has been using

⁹³ <http://www.portoflosangeles.org/mitigation/Prospectus.pdf>.

⁹⁴ <http://www.mitigationbanking.org/pdfs/rpkmb.pdf>.

a habitat banking program since 1991. They do not administer the banking program but coordinate with regulators to verify that the mitigation “action” is valid and consistent with the habitat banking requirements.⁹⁵

As part of their mitigation credit scheme for the building of their new Maasvlakte 2 Terminal, The Port of Rotterdam is constructing an offshore seabed protection area and a dune compensation area. Apart from the dune compensation project, the Port will develop three new nature and recreation areas within the context of the Rotterdam Main Port Development Project.⁹⁶ Another international example is the Port of Antwerp, which received several awards for their programmatic approach to a form of mitigation banking.⁹⁷

Several ports have successfully established mitigation banks by creating or enhancing wetlands on their properties prior to the need for the mitigation. The Port of Vancouver USA is a partner on the 154-acre Columbia River Wetland Mitigation Bank. This mitigation bank is located on the north side of Lower River Road on the Port’s Parcel 6 and provides a highly effective way to preserve valuable habitat and ensure responsible development by improving wetlands in the Lower Columbia River watershed. The arrangement gives the Port a financial interest in the outcome. The Port receives 20 % of the revenue from each credit sold through the bank. It also gets a discounted rate to use the bank for its own mitigation. Units of restored, created, enhanced or preserved wetlands resulting from wetland mitigation banking are expressed as “credits,” and can then be purchased by both public and private sectors to offset development impacts to wetlands within a pre-approved service area.⁹⁸



154-acre Columbia River Wetland Mitigation Bank Port of Vancouver, USA

Generally, wetland mitigation projects are completed by a port to comply with regulatory requirements when development projects are undertaken. The projects are usually completed on port owned properties; however, some projects have been completed at offsite locations. Onsite wetland mitigation sites are managed and maintained by the ports and have often been integrated into their stormwater management plans. Projects range from formal wetland mitigation and shoreline protection programs to issues handled on a case-by-case or project-by-project basis. Different scenarios were identified for development and management of mitigation projects, including in-house programs that design, construct and provide long-term management and monitoring of mitigation sites.

⁹⁵ <http://www.portmetrovanancouver.com/en/environment/initiatives/HabitatBankingProgram.aspx>.

⁹⁶ http://www.maasvlakte2.com/uploads/maasvlakte_2_the_sustainable_port.pdf.

⁹⁷ <http://www.portofantwerp.com/en/news/port-antwerp-wins-prestigious-2013-environmental-world-ports-award-1>.

⁹⁸ <http://www.portvanusa.com/environmental-services/wetland-bank/>.

For example, the Port of Seattle over the last decade has participated in more than 180 acres of wetland and aquatic habitat restoration, and completed one and a half miles of stream improvements. The Port also restored over 30 acres of intertidal and saltwater habitat and added or re-introduced over 34,000 native plants in project areas. More than half of these projects were voluntary (not related to development) to support the Port's conservation objectives.⁹⁹

The Port of Portland has one of the more comprehensive natural resource management programs. Initiatives include aggressive invasive species controls, projects to reduce wildlife mortality and voluntary initiatives to create habitat for threatened species. The port also actively manages over 800 acres of wetland mitigation sites. As part of its commitment to sustainability and transparency, the Port publishes its Mitigation Management Program report which provides an update on the activities for all Port mitigation sites and other natural areas. For each site, the annual report provides permits and agreements, background, mitigation plan, success criteria, permit requirements, activity update, site performance, action plan, documentation list, operating budget and a figure or aerial photograph of the site.¹⁰⁰

Buffer zones, where feasible, offer an approach to creating a protective distance between port operations and development and wildlife habitats. Not all ports have the ability to construct buffer zones because of their physical location and surroundings. Where there is opportunity, buffer zones have met with positive community response. For example, the Port of Brisbane reserves about 35% of the Port's total land area as

conservation/buffer areas. The Port has installed nest boxes within some of these green spaces, which are audited on an annual basis. The constructed bird roost is also included in the buffer area. The bird roost is managed via a Shorebird Management Plan and bird counts are taken on a monthly basis.¹⁰¹



Port of Miami

The Port of Houston Authority maintains a three mile buffer zone around its Bayport Terminal that includes 20 foot berms at the perimeter of the buffer.¹⁰² Massport is seeking approval to construct a new 4.5-acre community open space to be built and maintained as a buffer for their proposed Conley Terminal Project. This mitigation measure will serve as a significant noise and visual buffer for adjacent residents and create a valuable new amenity for the neighborhood.¹⁰³

Endangered species requirements affect many of the ports researched. In 2012, Port Miami relocated over 175 corals to the designated Coral Habitat Area located on the northeast corner of the port. This is the third successful coral relocation project conducted by the port. The

⁹⁹ <http://www.portseattle.org/Environmental/Water-Wetlands-Wildlife/Pages/Wetlands-Habitat.aspx>

¹⁰⁰ http://www.portofportland.com/Miti_Home.aspx.

¹⁰¹ Interview with Craig Wilson, Port of Brisbane May 22, 2013

¹⁰² Interview with Mark Vincent, Port of Houston Authority June 16, 2013

¹⁰³ Environmental Notification Form, Massport May 2013.

monitoring of more than 40 acres of mangrove restoration at Oleta River State Park – an ideal habitat for birds and aquatic species – continues with a 100 % success rate.

Sustainability

Consistent with the findings of the 2010 White Paper, there continues to be a range of definitions with respect to “sustainability.” In some cases local jurisdictions (e.g. cities) have instituted a definition of sustainability that includes a port’s operations. In other cases, ports have used a definition developed by an association (e.g. International Association of Ports and Harbors (IAPH), American Association of Port Authorities (AAPA) and EcoPorts).

The research showed the majority of ports posted their own unique definition of sustainability as it pertained to their strategic goals and objectives. For example, the Port of Portland’s sustainability policy is built on the traditional triple bottom line concept: *“The port recognizes that our actions today affect and influence the lives of future generations and the environment where we live and work. The Port is operating sustainably when we make business decisions that support long-term economic health, integrate community concerns into our work and reflect a deep and broad commitment to environmental stewardship.”*¹⁰⁴

Another example is the Port of Virginia’s environment and sustainability program, which is also centered on a triple bottom line approach and was recognized in April 2013 for a Governor’s Gold Medal Award.¹⁰⁵



*Port of Virginia Authority
Gold Medal Winner 2013*

The definition of sustainability was often intertwined and/or interchanged with environmental initiatives and/or singled out as community enhancement initiatives. For example, as part of its sustainability initiative, the South Carolina Ports Authority allocated over \$1 million to the Low Country Alliance for Model Communities (LAMC) in North Charleston. The goals of the project are to increase healthy and energy efficient homes, preserve affordability, retain local families living within LAMC neighborhoods and increase long-term community control of neighborhood resources. The South Carolina State Ports Authority Community Management Plan allocated the funds to replace or renovate homes and construct efficient homes in vacant lots.¹⁰⁶

In recent years, public and private partners at the Port of Antwerp have been working to develop a close collaboration. Under the motto “Strong through Collaboration,” the Port and its stakeholders developed a vision for the future of the port. The underlying theme for all stakeholders is sustainability and is emphasized in the port’s Sustainability Report. *A Sustainable Path through the Port* takes a holistic look at goods movement routing through the

¹⁰⁴ http://www.portofportland.com/PDFPOP/Env_Home_Policy.pdf.

¹⁰⁵ <http://blog.portofvirginia.com/my-blog/2013/04/vpas-sustainability-program-earns-gold-medal-for-excellence.html>.

¹⁰⁶ <http://www.pledgeforgrowth.com/documents/PEOPLE.pdf>.

Port of Antwerp.¹⁰⁷ As such, the Port was awarded the 2013 World Ports Environmental Award.¹⁰⁸

In Brazil, Port Santos includes as part of their sustainability efforts maintaining the Escola Santos Brazil Formare School, which provides vocational training for low-income young people. This initiative aims at social inclusion and professional training in port and logistic careers for young people in the region.¹⁰⁹

The Port of San Diego has worked with the community of Barrio Logan to install a large community sign at the entrance to the downtown area. Trucks from the Port have historically gone through the neighborhood to access the freeway, creating air quality and noise issues for local residents. The proposed sign is part of a Port Access Project and expands over the main downtown shopping area. The sign is a visual deterrent for truckers so they will utilize industrial roads instead of the pedestrian-heavy downtown neighborhood roads. The Port sponsored project also includes crosswalk enhancements, lane adjustments and beautification improvements in the community near the port's Tenth Avenue Marine Terminal.¹¹⁰

Most international ports subscribe to a Corporate Social Responsibility (CSR) sustainability reporting scheme which is a form of corporate self-regulation integrated into a company's business model. The goal of CSR is to embrace responsibility for the company's actions and encourage a positive impact through its activities on the environment, consumers, employees, communities, stakeholders and all other members of the public sphere. This is usually done through an annual-report process where an organization posts the information in some public venue (e.g. organization's website). Often times, organizations use the format developed by The Global Reporting Initiative (GRI), a non-profit organization that promotes economic, environmental and social sustainability. GRI produces the world's most widely used sustainability reporting framework to enable a drive towards greater transparency. The framework sets out the principles and indicators that organizations can use to measure and report their economic, environmental, and social performance. Several international ports use the GRI guidelines to do their sustainability reporting such as the Ports of Antwerp, Rotterdam, Auckland and Tianjin. Cosco Shipping Lines, Neptune Orient Lines and Hanjin also report annually on the GRI database.¹¹¹

As a sustainable port, we look at our operations in an all-inclusive manner, enhancing our profitability while existing responsibly within our larger community.
-Port of Vancouver USA

Many ports in the U.S. also do some type of self-reporting in the area of sustainability. For example, the Port of Seattle published its 25 Year Environmental Goals which identifies the Port's major environmental and stewardship goals.¹¹² The research demonstrated that a fair

¹⁰⁷ <http://www.sustainableportofantwerp.com/en/content/sustainable-path-through-port>.

¹⁰⁸ <http://www.portofantwerp.com/en/news/port-antwerp-wins-prestigious-2013-environmental-world-ports-award>.

¹⁰⁹ <http://www.santosbrasil.com.br/en-us/responsibility/social-responsibility>.

¹¹⁰ <http://www.portofsandiego.org/community-service/3262-design-for-barrio-logan-community-sign-unveiled.html>.

¹¹¹ <https://www.globalreporting.org/Information/about-gri/Pages/default.aspx>

¹¹² <http://www.portseattle.org/environmental/Pages/default.aspx>

number of ports maintain some sort of “GreenPort” program and have reported publicly on their green port initiatives.

Although not a standard that allows for certification, ISO 26000 provides guidance on the underlying principles of social responsibility - recognizing social responsibility and engaging stakeholders - the core subjects and issues pertaining to social responsibility and on ways to



*Port of Antwerp World Ports
2013 Environmental Award*

integrate socially responsible behavior into the organization.¹¹³ This standard has been used by Dubai World Ports and the Port of Cardiff, UK.

As reported in 2010, the Port of Sydney has been using its Green Port Guidelines and other examples of sustainable building criteria to inform the design, construction and operation of port and tenant operations. Both the Port of Sydney and the Port of Brisbane require any new construction to be five-star Australian Building

Greenhouse Rating (ABGR) and five-star certification from the Green Building Council of Australia’s Green Star rating scheme (similar to the U.S. Green Building Councils LEED™ Certification). The Port of New York/New Jersey, Long Beach, Los Angeles and Massport are additional examples of ports that have developed their own sustainable design and construction guidelines.

A collaboration of ports along the U.S. West Coast is developing Sustainable Design and Construction Guidelines for Industrial Maritime Development. The West Coast Ports Collaborative members include the Ports of Portland, Seattle, Vancouver US, Tacoma, Long Beach, Los Angeles and San Diego. These standards provide detailed strategies for ports to consider during design and construction.

In its Sustainability Framework, the Port of Cape Town states “the Sustainability Framework for the Port of Cape Town has therefore been developed to add value and to guide the port planning process, corporate social investment programs and environmental management and to propose rigorous and appropriate means of engaging stakeholders during each of these processes.”¹¹⁴

Still others use frameworks developed by associations or professional organizations.

Associations such as the World Association for Waterborne Transport Infrastructure (PIANC), a global organization that provides guidance for sustainable waterborne transport infrastructure for ports and waterways, has developed green guidelines for port infrastructure development.¹¹⁵



The American Association of Civil Engineers/American Council of Engineering Companies/American Public Works Association Institute for Sustainable Infrastructure (ISI) Rating System applies to all types of infrastructure projects in the civil

¹¹³ <http://www.iso.org/iso/home/standards/iso26000.htm>

¹¹⁴ <https://dspace.ist.utl.pt/bitstream/2295/763566/1/Sustainability%20Framework.pdf>.

¹¹⁵ <http://www.pianc.org/aboutpianc.php>.

engineering industry. Its stated aim is “to enhance the sustainability of the nation’s civil infrastructure.” The ISI Rating System is performance-based (specifying outcomes rather than prescriptive measures) and is scalable for size and complexity of projects.¹¹⁶

ESPO, the European Seaports Organization, developed their Green Guide¹¹⁷ that provides guidance on environmental management and sustainability. The Ecoport 8 Project, founded by South East Europe Transnational Cooperation Programme, aims to improve the environmental quality of ports in Italy, Bulgaria, Greece, Romania, Albania and Montenegro, where there is inconsistent national environmental regulation by providing tools and guidance for each port’s specific geographic area.¹¹⁸

Environmental Management Systems (EMS)

Ports worldwide continue to implement Environmental Management Systems (EMS) or similar programs. The majority of ports that utilize EMS limit the systems to specific properties, operations, or programs. The Port of Portland’s EMS covers all operations (marine, aviation, industrial and commercial properties) managed directly port-wide. The port uses its EMS to manage and prioritize significant environmental aspects of its operations through five focused environmental programs with associated objectives. The programs are: Air Quality, Energy Management, Natural Resources, Water Resources and Waste Minimization. Progress toward objectives and associated targets are reported on annually.¹¹⁹

ISO 14001 is the most recognized environmental management framework worldwide. Several U.S. ports are ISO 14001 certified; however, the majority of ISO 14001 certified ports are international (non-U.S. ports). Ports in Europe (e.g. Port of Dublin), Asia (e.g. Manila South Harbor Port), Mexico (e.g. Port of Lazaro Cardenas), Central America (e.g. Port Santa Marta), South America (e.g. Port of Santos Brazil), Africa (e.g. Port d’Ehoala) and the Middle East (e.g. Port Dubai) maintain their certification of this standard and have made it a priority to secure ISO certification.¹²⁰ Since its promulgation, the ISO 50001 Energy Management Standard has also gained momentum in the international port community.

“As stated in our Commission approved Environmental Policy, the involvement of all hands in this program will help the Port comply with all environmental regulations, prevent pollution from our operations, and facilitate continual environmental improvement in the years to come. Your personal contributions to the implementation of an Environmental Management System at our Port are greatly appreciated.”

- *Port of Corpus Christi message to employees*

Some U.S. ports, such as the Port of Corpus Christi, have made a business decision to expand and maintain their ISO 14001 certification. This represents a long-term financial commitment by

¹¹⁶ <http://www.asce.org/Sustainability/ISI-Rating-System/>.

¹¹⁷ http://www.espo.be/images/stories/Publications/codes_of_practice/espo_green%20guide_october%202012_final.pdf.

¹¹⁸ <http://ecoport8.eu/main.php?f=execution&id=partner&id2=1&r=home>.

¹¹⁹ http://www.portofportland.com/Env_Home.aspx.

¹²⁰ <http://www.ecoport8.com/map>

the Port. The Port of Houston Authority recently expanded its EMS to its Bayport Terminal in addition to the Barber's Cut Terminal, receiving full ISO 14001 certification for both locations.

Currently, the Port of Virginia Authority is the only port in the nation to have all its container terminals certified under the standards set forth in the ISO 14001 environmental certification process.¹²¹

Massport's Conley Terminal received ISO 14001 certification in 2003 and maintains its certification. Ports like Los Angeles, New York/New Jersey, San Diego, Portland and Seattle maintain an EMS but have not pursued certification. The Port of Portland's EMS has been evaluated by an independent third party for ISO 14001 conformance; however, the Port is currently evaluating the benefits of formal certification.¹²²



Port of Virginia

In Asia, the UN-funded Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) has developed a comprehensive code for ports combining health and safety, quality and environmental management. The Port Safety, Health and Environmental Management System (PSHEMS) provides a framework for the integration of safety, health and environmental



PEMSEA is a GEF/UNDP Regional Programme

programs into the daily activities of ports. Where ports are compliant to the PSHEMS code and consistent with the requirements of ISO 14001, OHSAS 18001 and ISO 9001, they can achieve Level 1 PSHEMS recognition. To encourage continuous improvement, there are two additional levels for ports to strive for. These are Level 2 -

Recognition for Proficiency in PSHEMS and Level 3 - Recognition for Performance Excellence in PSHEMS. PSHEMS was developed and demonstrated at the Ports of Bangkok in Thailand and Tanjung Pelepas in Malaysia. PEMSEA is currently working with the Laem Chabang Port in Thailand to develop its PSHEMS.¹²³

Lastly, the EcoPorts Foundation (EPF), a non-profit organization established in 1999 by a group of eight large European ports for the benefit of ports and port communities, provides for a certification in proactive environmental management called the Port Environmental Review System (PERS). PERS defines a basic standard of good practice for the seaport sector and is the only port-sector specific environmental management standard that incorporates the main generic requirements of recognized environmental management standards (e.g. ISO 14001).¹²⁴ A significant number of European ports subscribe to the PERS system.

¹²¹ <http://blog.portofvirginia.com/my-blog/2013/04/vpas-sustainability-program-earns-gold-medal-for-excellence.html>.

¹²² Interview with Richard Vincent, Port of Portland June 4, 2013

¹²³ <http://www.pemsea.org/>.

¹²⁴ <http://www.ecoport.com/map>

Several seaports were also certified by the European Union's Eco-Management and Audit Scheme (EMAS). EMAS is open to every type of organization eager to improve its environmental performance. It spans all economic and service sectors and is applicable worldwide. This is a voluntary instrument which acknowledges organizations that improve their environmental performance on a continuous basis.¹²⁵

¹²⁵ <http://www.ecoports.com/>.

Appendix A

Questionnaire

Questionnaire 2013

1. What steps is your port taking in operations, planning and development to help reduce air emissions?

- Has the Emission Control Area (ECA) and the resulting fuel requirements changed your plans to implement or change how you implement shore-based power for vessels using your facilities?
 - What are your plans for future ECA requirements?
- Do you have a vessel incentive program for cleaner burning engines on vessels?
- Do you have truck program?
 - If so, have you experienced implementation challenges? (i.e. legal, union, etc.)
 - What have been the opportunities/benefits?
 - Do you have incentives for program?
 - Who funds the incentives?
- Have you completed emission-related retrofits or engine replacements for cargo handling equipment or purchased electric equipment?
 - Has this been a good investment?
 - What has worked?
 - What has not worked?
 - Do you or your tenants utilize alternative fuels such as LNG, CNG, LPG, ULSD, biodiesel, etc.?
 - If yes, do you have any lessons learned?
- Do you have a Green House Gas (GHG) program?
 - What have been the benefits so far?
 - Challenges?
 - Do you provide incentives to departments/operations/tenants?
- What types of funding sources have you utilized for your air program initiatives (i.e. grants fees, fees, other?)
- Have you implemented any new technologies for facility power supply (i.e. onsite solar, wind etc.)?

2. How does your port address water management, conservation and discharge concerns including: stormwater management, ballast water treatment, Vessel General Permits (VGP)?

- Is your port part of a Municipal Separate Storm Sewer System (MS4) permit?
- Has your port installed any water quality infrastructure (swales, storm filters, cyclonic devices, planters, etc.) aimed at improving stormwater runoff quality?
- Have you been required to treat stormwater from your facilities? Are the systems passive or have you had to pump stormwater through a filtration system?
- What if any, is the extent of your use of Low Impact Development (LID) on marine facilities?
- Have you been required to consider hydro modification on your facilities?
- Do you infiltrate stormwater through your facilities?
 - If so, how? (Drywells, swales, infiltration basins, etc.)?

- Do you have onsite sanitary treatment? Can you use the effluent onsite following treatment?
- Has your port implemented innovative water conservation or reuse processes using grey water or non-potable rain water groundwater?
- Have you set specific water conservation goals (e.g. reduce water consumption by 15%)
 - How was your baseline determined?
- Is your port involved in ballast water treatment? If so what is your involvement?
- Does your port operate any vessels that fall within the VGP program?

3. What techniques does your port use to minimize the generation of waste and manage the waste that is generated?

- Does your program go beyond what is required by your region's specific regulations?
- Do you partner with tenants/local communities as part of your reduction/minimization goals?

4. What are some of the techniques used by your port to minimize the amount of energy used, i.e. energy conservation and renewable energy techniques?

- Do you employ techniques such as:
 - On-site renewable energy sources?
 - Purchase energy from green sources from your power provider?
 - Energy conservation program?
 - Re-lamping?
 - Energy audits?

5. Please describe ways in which your port manages natural resources within its boundaries both in water as well as in the upland areas. This includes work done to mitigate for disturbed wetlands, bank stabilization projects, restoration of in water habitats, invasive species issues etc.

- Do you participate in mitigation banks?
 - Do you own or administer mitigation banks?
- Have you ever mitigated for impacts to the flood plain beyond balance cut and fill requirements (i.e. environmental function such as structure, debris, etc.)?
- Have you established or do you participate in (buying, creating, selling, banking) ecological service credits (i.e. wetland, grassland, forest, etc.)?
- Are undeveloped properties that are planned for future development managed as natural habitat or maintained to avoid future development/habitat conflicts in the interim period between acquisition or creation (i.e. dredge material placement) and development?
- Do you maintain natural areas as buffers with surrounding communities?
- What current documentation is required regarding natural resource conservation management (e.g. mitigation plans, NEPA, CEQA, covenants, easements, etc.)?

6. Is your port currently utilizing any sustainable development practices in the development of new facilities?

- Does your port have an official sustainability policy?
 - If so, does the policy include all port operations?
- Do you subscribe to LEED requirements for buildings?
 - If so, at what level (e.g. silver)?
- Do you file a CSR report?
- Do you participate in any national, regional, state, local or industry wide sustainability efforts?

7. Please provide some examples of environmental practices that you feel should be used but are currently not being practiced.

8. Does your port utilize an EMS?

- If yes, is it ISO certified or was it created to ISO standards but has not gone through the certification process?
 - If so, why did you decide to get your program certified?
 - If not certified, why not?
 - How are objectives and targets developed? Who developed them? Who approved them?
- Are you certified by a third party other than ISO?
- Is your certification port-wide or restricted to an operational fence line?

9. Does your port perform dredging activities? Do you have a sediment management program?

- What sampling is required to perform dredging at your port and what authority requires it?
- What studies are required to get authorization to dredge (entrainment, hydrodynamic modeling – other studies?)
- Do you have sediment management requirements in your permits (e.g. caps, underwater grading as an alternative to dredging)?
- How do you maintain your berths – e.g. suction dredging or clamshell?
- Do you have monitoring requirements during dredging (turbidity, endangered species)?
- How do you ensure depth during dredging (i.e. controlling over-dredging)?
- Do you have any alternative technologies/approaches to avoid/minimize dredging requirements?
- Do you have to conduct post dredging leave surface sampling?
- Do you beneficially reuse dredge material?
 - If so, for what purpose?

- Where is your dredge material placed (in water placement, confined disposal facility, upland, etc.)?

10. What are some examples of innovative environmental programs (out of the box) that your port chose against implementing and why? Do you feel this was the right decision? Why or why not?

- Have the current economic conditions influenced your environmental and sustainability programs?

11. Has your port tried any environmental programs or procedures that you are no longer using? If so, what were they and why were they abandoned?

12. Do you have any “good neighbor” agreements with adjacent neighbors/communities (e.g. traffic lighting, noise)?

- Have you implemented any projects that were of benefit for the community that may or may not be part of your mitigation strategy/plan?
- Have you entered into an agreement to only develop a section of developable land in order to secure support for development (e.g. West Hayden Island)?
- Have you established on-going advisory groups (not required by regulation) made up of members from the community in order to formalize and coordinate stakeholder involvement?
- Is it an official approving authority?

Appendix B

List of Ports

List of Ports



Port of Anchorage, Alaska
www.portofalaska.com

The Port of Anchorage is the gateway for commerce in Alaska. An estimated 90% of the merchandise goods for 85% of Alaska's populated areas pass through their facilities. Additionally, the Port is one of only 19 commercial ports around the nation designated as a Department of Defense Strategic Seaport.

Associated British Ports, United Kingdom
www.abports.co.uk

The UK's leading ports group, Associated British Ports (ABP) owns and operates 21 ports in England, Scotland and Wales and handles approximately a quarter of the country's seaborne trade. The group's activities include rail terminal operations (Hams Hall), ship's agency, dredging (UK Dredging Ltd) and marine consultancy (ABPmer). Each port also offers a well-established community of port service providers.

Port of Auckland, New Zealand
www.poal.co.nz/

The Port of Auckland provides a full range of cutting-edge cargo-handling and logistics services at two seaports – one on the east coast adjacent to the Auckland central business district, the other on the west coast in Onehunga – and a strategically located inland port at Wiri, South Auckland. Auckland Seaport is New Zealand's largest container port, handling more than 800,000 20-foot equivalent container units (TEU) per annum.

Port of Baltimore, MD
www.mpa.maryland.gov

Strategically located in the Mid-Atlantic region of the U.S. East Coast, Baltimore sits in the center of the enormous Washington/Baltimore Common Market. This inland location makes it the closest Atlantic port to major Midwestern population and manufacturing centers and a day's reach to 1/3 of U.S. households. The Port of Baltimore is ranked as the top port among 360 U.S. ports for handling autos and light trucks, farm and construction machinery, imported forest products, imported sugar, imported aluminum and imported gypsum. Baltimore ranks second in the U.S. for exported coal, and imported iron ore. Overall Baltimore is ranked ninth for the total dollar value of international cargo and 11th for international cargo tonnage.

Port of Brisbane, Australia
www.portbris.com.au

The Port of Brisbane, located in the lower reaches of the Brisbane River, is one of Australia's fastest growing container ports and Queensland's largest general cargo port. It is managed and developed by the Port of Brisbane Pty Ltd (PBPL), under a 99-year lease from the Queensland Government. The Port of Brisbane includes the main shipping channel across Moreton Bay which extends 90 km north to Mooloolaba and is dredged to maintain a depth fourteen meters at the lowest tide.

Port of Canaveral, FL
www.portcanaveral.com

Port of Canaveral is a cruise, cargo and naval port in Brevard County, Florida. It is one of the busiest cruise ports in the world with nearly 2.8 million multi-day cruise passengers passing through annually.

Port of Cape Town, SA
www.ports.co.za/cape-town.php

Cape Town is a major African container port, second in South Africa only to Durban, and handles the largest amount of fresh fruit. Fishing has a significant place in the economic activity of the port, affecting the ship repair industry in particular, with large Asian fishing fleets using Cape Town as a transshipment logistics and repair base for much of the year. The emerging oil industry in West Africa has also become a significant factor for the port's repair and maintenance facilities.

Port of Charleston, SC
www.port-of-charleston.com

The South Carolina State Ports Authority, established by the state's General Assembly in 1942, owns and operates public seaport facilities in Charleston and Georgetown, handling international commerce valued at more than \$63 billion annually while receiving no direct taxpayer subsidy. An economic development engine for the state, port operations facilitate 260,800 jobs across South Carolina and nearly \$45 billion in economic activity each year. Home to the Southeast's deep-water port, the South Carolina Ports Authority is the industry leader in productive operations, big ship handling, efficient market reach and environmental responsibility.

Port of Cork, Ireland
www.portofcork.ie

The Port of Cork is the key seaport in the south of Ireland and is one of only two Irish ports which service the requirements of all six shipping modes i.e. Lift-on Lift-off, Roll-on Roll-off, Liquid Bulk, Dry Bulk, Break Bulk and Cruise. .

Port of Corpus Christi, TX
www.portofcorpuschristi.com

As the primary economic engine of the Coastal Bend, Port Corpus Christi is the fifth largest port in the United States in total tonnage. The Port's mission is to "serve as a regional economic development catalyst while protecting and enhancing its existing industrial base and simultaneously working to diversify its international maritime cargo business." Strategically located on the western Gulf of Mexico, with a straight 45' deep channel, (with a channel improvement project permitted and authorized to 52') the Port provides quick access to the Gulf and the entire United States inland waterway system. The Port delivers outstanding access to overland transportation with on-site and direct connections to three Class-1 railroads and uncongested interstate and state highways. The Port is protected by a state-of-the-art security department and an award-winning Environmental Management System.

Port of Dublin, Ireland
www.dublinport.ie

Port of Dublin, located in the heart of Dublin City, at the hub of the national road and rail network, is a key strategic access point for Ireland and in particular the Dublin area. Dublin Port handles almost 50% of the Republic's trade, two thirds of all containerized trade and is the largest of the three base ports on the island of Ireland.

Port of Everett, WA
www.portofeverett.com

The Port of Everett is a natural deep-water port located 25 miles north of Seattle on the Puget Sound. It is one of two ports in Snohomish County, along with the Port of Edmonds. The Port provides the closest shipping facilities to the Far East and Alaska of any U.S. port, and is located

near the Strait of Juan De Fuca on the Puget Sound.

Port of Göteborg, Sweden
www.portofgothenburg.com

The Port of Göteborg is the largest port in Scandinavia, with over 11,000 vessel calls each year. Almost 30 per cent of Swedish foreign trade passes through the port. The Port of Gothenburg can offer a very wide range of routes, with traffic to over 130 destinations throughout the world. There are direct routes to the USA, India, Central America, Asia and Australia. The Port of Gothenburg is also the only port in Sweden with the capacity to receive the very largest ocean-going container vessels. A total of 24 rail shuttles depart each day, offering companies throughout Sweden and Norway a direct, environmentally wise link to the port and the opportunity to utilize the broad range of routes.

Port of Helsinki, Finland
www.portofhelsinki.fi

Helsinki's port is Finland's main sea port, specializes in unitizing cargo services for Finnish companies engaged in foreign trade. Helsinki is also the busiest passenger port in Finland, with diverse services to Tallinn, Stockholm, Travemünde, Rostock, Gdynia and St. Petersburg. It specializes in unitized cargo traffic, containers, trucks and trailers. The Port of Helsinki provides a general setting. Cemented collaboration with our partners ensures the result. Successful cooperation makes the port of Helsinki efficient, effective and sound.

Marine Department, Hong Kong Special Administrative Region, Hong Kong, China
www.mardep.gov.hk

The HKCTOA was established in 1999 by the container terminal operators of Kwai Tsing Port of Hong Kong. Its mission is to promote the Port of Hong Kong as the key container hub port of the region providing premier service to the container shipping industry. Currently there are nine container terminals in the Kwai Tsing Port. All terminals are financed, built, owned and operated by five private operators. The largest of the five ranks as the biggest independent container terminal operator in the world.

Port of Houston Authority, TX
www.portofhouston.com

The Port of Houston is a 25-mile-long complex of diversified public and private facilities located just a few hours by ship from the Gulf of Mexico. The port is consistently ranked 1st in the United States in foreign waterborne tonnage; 1st in U.S. imports; 1st in U.S. export tonnage and 2nd in the U.S. in total tonnage. The Port of Houston is made up of the public terminals owned, managed and leased by the Port of Houston Authority, and the 150-plus private industrial companies along the 52-mile long Houston Ship Channel. Each year, more than 200 million tons of cargo move through the Port of Houston, carried by more than 8,000 vessels and 200,000 barge calls.

Kenya Ports Authority, Mombasa, Kenya
www.kpa.co.ke

The Port of Mombasa is the gateway to East and Central Africa and is one of the busiest ports along the East African coastline. The port provides direct connectivity to over 80 ports worldwide and is linked to a vast hinterland comprising Uganda, Rwanda, Burundi, Eastern Democratic Republic of Congo, Northern Tanzania, Southern Sudan, Somalia and Ethiopia by road

Port of Le Havre, Port Autonome du Havre, France
www.havre-port.fr/en

The Port of Le Havre is the leading marketplace for foreign trade and shipping in France. The port boasts more than 6,000 port calls each year, or thirty arrivals and departures of seagoing vessels each day (close to 40% of all the container ships, 35% of all the bulk carriers, 10% of all the ferries and 10% of all ro-ro ships).

Port of Long Beach, CA
www.polb.com

The Port of Long Beach is the second busiest seaport in the United States, with trade valued annually at more than \$140 billion moving through it. The port supports more than 30,000 jobs in Long Beach, 316,000 jobs throughout southern California and 1.4 million jobs throughout the United States. The Port of Long Beach is leading gateway for trade between the United States and Asia.

Port of Longview, WA
www.portoflongview.com

The Port of Longview has been operating since 1921 and today has eight marine terminals and waterfront industrial property located on the deep-draft Columbia River, 66 miles from the Pacific Ocean in southwest Washington State. Cargo handling specialties include all types of bulk cargos and break bulk commodities such as steel, lumber, logs, pulp, paper, wind energy, project and heavy-lift cargo.

Port of Los Angeles, CA
www.portoflosangeles.org

The Port of Los Angeles is located in San Pedro Bay, 20 miles south of downtown Los Angeles. It encompasses 7,500 acres of land and water along 43 miles of waterfront. The port features 24 passenger and cargo terminals, including automobile, break-bulk, container, dry and liquid bulk and warehouse facilities that handle billions of dollars' worth of cargo each year.

Massport, MA
www.massport.com

At the Port of Boston, Massport carries on New England's proud tradition as a world trade leader by offering regular shipping services to Europe, Asia and elsewhere. The Port of Boston also hosts privately owned petroleum and liquefied natural gas terminals, which supply more than 90% of Massachusetts' heating and fossil fuel needs. Two ship repair yards, public and private ferry operations, marinas and Coast Guard's Sector Boston also call the port home.

Port of Montreal, Canada
www.port-montreal.com

The Montreal Port Authority (MPA) is an autonomous federal agency created under the terms of the Canada Marine Act. The port provides first-rate facilities to sea and land carriers, to terminal operators and to shippers. The MPA directly operates a passenger terminal and its own railway network, which includes more than 100 kilometers (60 miles) of track and provides transcontinental railways with direct access to almost every berth.

Namibian Ports Authority, Namibia
www.namport.com.na

Namport, operating as the National Port Authority in Namibia since 1994, manages both the Port of Walvis Bay and the Port of Lüderitz. The Port of Walvis Bay is situated at the west coast of Africa and provides an easier and much faster transit route between southern Africa, Europe and the Americas. Namibian Ports Authority also manages a Syncrolift (dry dock facility) with vessels up to 2,000 tons that can be lifted for repairs and operates two floating docks with lifting capacity of 8,000 tons each.

Port of New Orleans, LA
www.portno.com

The Port of New Orleans is at the center of the world's busiest port complex – Louisiana's Lower Mississippi River. Its proximity to the American Midwest via a 14,500-mile inland waterway system makes New Orleans the port of choice for the movement of cargoes such as steel, rubber, coffee, containers and manufactured goods.

Port Authority of New York/New Jersey
www.panynj.gov

The Port Authority of New York/New Jersey conceives, builds, operates and maintains infrastructure critical to the New York/New Jersey region's trade and transportation network. These facilities include America's busiest airport system, marine terminals and ports, the PATH rail transit system, six tunnels and bridges between New York and New Jersey, the Port Authority Bus Terminal in Manhattan and the World Trade Center. Its area of jurisdiction is called the Port District, a region within a radius of approximately 25 miles of the Statue of Liberty

Port of Oakland, CA
www.portofoakland.com

The Port of Oakland oversees the Oakland seaport and Oakland International Airport. The Port's jurisdiction includes 20 miles of waterfront from the Bay Bridge through Oakland International Airport. The Oakland seaport is the fifth busiest container port in the U.S.; Oakland International Airport is the second largest San Francisco Bay Area airport offering over 300 daily passenger and cargo flights; and the Port's real estate includes commercial developments such as Jack London Square and hundreds of acres of public parks and conservation areas. Together, through Port operations and those of its tenants and users, the Port supports more than 73,000 jobs in the region and nearly 827,000 jobs across the United States. The Port of Oakland was established in 1927 and is an independent department of the City of Oakland.

Port of Portland, OR
www.portofportland.com

The Port of Portland's marine terminals export the largest amount of wheat from the United States and the third largest amount in the world. It is also the twenty-fifth largest port for tonnage, fifth largest auto import gateway in the country, the largest mineral bulk port on the U.S. West Coast and the 17th largest port for cargo containers in the United States. Over twelve million tons of cargo moves through the Port of Portland-owned and operated facilities each year.

Port of Rotterdam, Netherlands
www.portofrotterdam.com

Rotterdam is the largest logistic and industrial hub in Europe for incoming and outgoing trade in crude oil, oil products and coal. Five ultramodern refineries in the port convert crude oil into a wide range of fuels. Rotterdam is also an important supplier of electricity. The power plants located in the port – based on coal, natural gas, total energy, wind and waste incineration – have a combined capacity of 3000 megawatt.

Port of San Diego, CA
www.portofsandiego.org

The Port of San Diego is the fourth largest of the 11 ports in California. The port oversees two maritime cargo terminals, two cruise ship terminals, 18 public parks, the Harbor Police Department and the leases of hundreds of tenant and sub tenant businesses around San Diego Bay.

Port of Seattle, OR
www.portseattle.org

The Port of Seattle is a key builder of road and rail infrastructure, partnering with other agencies to improve freight traffic from Tacoma to Everett. The Port of Seattle is a public enterprise offering diverse career opportunities across five operating divisions and 52 departments. The

seaport is made up of 1,543 acres of waterfront land and nearby properties including container terminals, general purpose/cargo terminals, foreign trade zone, break-bulk cargo and refrigerated cargo and storage.

Port of Tacoma, OR

www.portoftacoma.com

The Port of Tacoma is a major center for container cargo, bulk, break-bulk, autos and heavy-lift cargo. Created by Pierce County citizens in 1918, the Port of Tacoma has become one of the largest container ports in North America and one of the top 50 in the world. The port encompasses about 2,400 acres of land on the Tacoma Tideflats. Located on Commencement Bay, a natural deep-water harbor in South Puget Sound, the port is ideally situated for creating jobs through Pacific Rim trade.

Port of Tokyo, Japan

www.kouwan.metro.tokyo.jp

The Port of Tokyo is one of the largest Japanese seaports and one of the largest seaports in the Pacific Ocean basin having an annual traffic capacity of around 100 million tons of cargo and 4,500,000 TEUs. The port is also an important employer in the area having more than 30,000 employees that provide services to more than 32,000 ships every year.

Port of Vancouver, WA

www.portvanusa.com

The Port of Vancouver USA, the second-largest port on the Columbia River, is a thriving seaport at the gateway to the Northwest, and an invaluable partner to a broad range of shippers and manufacturers. The Port of Vancouver USA contains five terminals along with the largest mobile harbor crane in North America which is typically used to unload wind energy equipment. The port handled 4.6 million metric tons of cargo in 2012, more than 57 % in grain exports.

Port Metro Vancouver, Canada

www.portmetrovanancouver.com

Positioned on the southwest coast of British Columbia in Canada, Port Metro Vancouver is Canada's largest and busiest port, a dynamic gateway for domestic and international trade and tourism and a major economic force that strengthens the Canadian economy. Port jurisdiction covers more than 600 kilometers of shoreline and extends from Point Roberts at the Canada/U.S. border through Burrard Inlet to Port Moody and Indian Arm and from the mouth of the Fraser River, eastward to the Fraser Valley, North along the Pitt River to Pitt Lake and includes the north and middle arms of the Fraser River.

Port of Venice

www.port.venice.it

Port of Venice is strategically located at the top end of the Adriatic Sea, at the intersection of the main European transport corridors and of the Motorways of the Seas (MoS). The Port of Venice is also the northernmost terminal of the MoS that cross the Eastern Mediterranean and connect Central Europe with North Africa and the Middle East.

San Francisco Port Commission, CA
www.sfport.com

The Port of San Francisco is a semi-independent organization run by a five-member commission, appointed by the Mayor and approved by the Board of Supervisors and specializes in break bulk and dry bulk cargo, ship repair and ferry services.

Shanghai International Port Group – Terminal Operator Shanghai, China
www.portshanghai.com.cn

The Port of Shanghai is situated in the middle of the 18,000km-long Chinese coastline, where the Yangtse River, known as “the Golden Waterway”, flows into the sea. Expressway and state-level highways lead the port to the national highway network to all regions of the country. The annual import and export trade through Shanghai, in terms of value, accounts for a quarter of China’s total foreign trade.

Sydney Ports Corporation, Australia
www.sydneyports.com.au

Sydney Ports Corporation, owned by the Government of New South Wales, is responsible for the management, development and operation of seaport facilities within metropolitan Sydney and two minor seaports located in Eden and Yamba. Sydney Harbor supports 11 berths, including dry bulk, bulk liquids, general cargo and cruise terminal facilities covering a total of 103 acres located in Walsh Bay, Glebe Island/White Bay, Barangaroo and the Overseas Passenger Terminal at Circular Quay.

Tampa Port Authority, FL
www.tampaport.com

The Port of Tampa handles nearly 40 % of all cargo moving in and out of the state of Florida. The Port handles bulk and break-bulk cargos, including phosphate, steel and petroleum, as well as in the shipbuilding industry. This includes vehicles and oversized project cargos.

Appendix C

Acronyms

Name	Acronym
American Association of Civil Engineers	ASCE
American Association of Port Authorities	AAPA
American Council of Engineering Companies	ACEC
American Public Works Association	APWA
American Recovery and Reinvestment Act	ARRA
Air Protection Plan	PPA (Fr.)
Australian Building Greenhouse Rating	ABGR
Best Management Practices	BMPs
Carbon Dioxide	CO ₂
Cargo Handling Equipment	CHE
Clean Air Action Plan	CAAP
Corporate Social Reporting	CSR
Corporate Social Responsibility	CSR
Diesel Emission Reduction Act	DERA
Dredge Material Management Program	DMMP
Emission Control Area	ECA
Environmental Management System	EMS
Environmental Protection Agency	EPA
European Seaport Organization	ESPO
Global Reporting Index	GRI
Greenhouse Gas	GHG
Institute for Sustainable Infrastructure	ISI

Name	Acronym
International Association of Ports and Harbors	IAPH
International Convention for the Prevention of Pollution from Ships	MARPOL
International Institute for Sustainable Seaports	I2S2
International Maritime Organization	IMO
International Organization for Standardization	ISO
Local Governments for Sustainability	ICLEI
Low Country Alliance for Model Communities	LAMC
Low Impact Design	LID
Municipal Separate Storm Sewer System	MS4
National Pollutant Discharge Elimination System	NPDES
Nitrogen Dioxide	NO2
Occupational Health and Safety Assessment Series	OHSAS
Ocean Going Vessels	OGVs
Particulate Matter	PM
Partnerships in Environmental Management for the Seas of East Asia	PEMSEA
Port of Long Beach	POLB
Port of Los Angeles	POLA
Port Safety, Health and Environmental Management System	PSHEMS
Renewable Energy Credits	RECs
Rubber Tired Gantry Cranes	RTGs

Name	Acronym
San Diego Gas & Electric	SDGE
Sulfur Dioxide	SO ₂
Texas Criminal Industry	TCI
Total Maximum Daily Load	TMDL
Totem Ocean Trailer Express	TOTE
Traffic Mitigation Fee	TMF
Ultra Low Sulfur Diesel	ULSD
United Kingdom	UK
Water Resources Action Plan	WRAP
Water Sensitive Urban Design	WSUD
World Association for Waterborne Transport Infrastructure	PIANC
World Ports Climate Initiative	WPCI