WG150 'Sustainable Ports'

A Guidance for Port Authorities

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1 Preface

Increasing environmental awareness creates new challenges for the development of ports. In addition, climate change calls for adaptation measures that aim at minimizing impacts of e.g. rising sea levels and increased flood water heights but safeguard accessibility of ports and waterways and also safeguard future sustainability for the social and natural environmental conditions. International and national legislation for new ports or extensions of existing ports are incorporating these issues and are increasingly based on strict regulations aiming at creating designs with minimized environmental impact and sustainable operations in the long-term. The regulations are enforced through a system of permits in which certain construction and operation methods are predefined including (large-scale) mitigation and compensation measures. In many cases, the environmental issues and (long-term) impacts of port construction and operation are unknown during the planning and design stages of the port. Assumptions may be made on the basis of worst case scenarios, leading to associated mitigation measures. Furthermore, proposed environmental and sustainability measures in the various planning studies and provided permits are new and have not been tested to their full potential nor is their effectiveness monitored in the field.

Green Ports are widely regarded as 'the answer' to the above mentioned challenges. However, there is no clear and comprehensive description of what a Green Port actually is. Environmental Issues of Ports have been studied in great detail before, but there is a need for a step forward towards an integrated approach in which all separate measures, including climate change adaptation and mitigation measures, are merged into the concept of a single package: the Green Port. With a focus on seaports this report presents, through collection of existing views and global trends, a comprehensive definition of what a Green Port actually is and how it relates to its stakeholders. Its basic philosophy is that green growth is seen as a prime economic driver. When applying this mind shift in port development and port operation, green ports have a better and more sustainable future than ports that manage their bussiness in a field of tension to meet existing regulations and that continuously need to defend their license to operate. The report gives guidance on the need for and how to adopt the green ports philosophy and refers to best practices of 'climate change mitigation and adaptation' and 'environmental friendly and sustainability issues' from existing ports and their effectiveness and economic potential to be used as examples for other ports.

I hope that the report truly will inspire port managers worldwide and that it will make a change that contributes to the well being of the individual ports as well as the regions and the logistic chains that they serve.

Tiedo Vellinga
Professor Ports and Waterways
Chairman PIANC Working Group 150

PIANC
TV to coordinate inputs from presidents of PIANC

IAPH
As President of the International Association of Ports and Harbors (IAPH) and Executive Director of the Port of Los Angeles, I am proud to participate in the development of Sustainable Ports. Ports around the world are starting to recognize the benefits of a "Green Port" philosophy, an approach in which ports drive economic growth while acting socially responsible and sustaining our environment. IAPH is fully committed to such a philosophy, and w ants to lead the way towards sustainable practices, including promoting cleaner technologies and reducing air emissions. While we hope our progress to date in greening our own practices

inspires ports around the world, we are well aware of the work that lies before us. Sustainable Ports is a landmark step in continuing to green transportation operations internationally, one that we at the IAPH hope will allow all ports to realize their full economic potential in the most socially responsible and sustainable manner possible.

Sincerely,
Geraldine Knatz, Ph.D.
President of the International Association of Ports & Harbours (IAPH)

2 Summary

Ports are nodal points or hubs in the transport network whose industrial and business areas add value to the transported goods. This report written by a world-wide group of PIANC and IAPH members has its focus on the sustainable development and green growth of ports, and the related logistic chain and added value activities.

The pursuit of global prosperity has been the desire of humanity throughout history, and in the course of doing so, human civilization has been shaped by several major transformations. These transformations, however, had consequences. The conclusion of the report “Limits of Growth”, published by the Club of Rome in 1972, could be the first formal reference to the global needs toward sustainable practices. Since then the United Nations and his agencies have developed a great effort to promote an environmental conscience in leaders and people in general.

Today, the idea of sustainability is generally accepted to cover much more than strictly environmental issues. The Triple Bottom Line (TBL) is a concept that extends the frame of sustainability to include social and economic aspects. The TBL refocuses the measurement of corporate performance from the perspective of a shareholder (predominantly financially driven) to that of a stakeholder (anyone affected by the actions of a firm) and coordinates three interests: "people, planet, and profit."

An important next step in this development is the upcoming drive towards Green Growth. Reflecting on reality, it has become clear that the world needs a new growth paradigm that can promote economic development to better meet its needs, while at the same time, ensure climatic and environmental sustainability. While economic activities and environmental protection are conventionally perceived as two separate domains adversely affecting each other, green growth calls for a conceptual shift to recognize that both can be achieved complementarily.

Transport is an important theme related to green growth. Transport has a substantial impact on the environment and much public investment is related to transport infrastructure. Therefore, greening of transport and transport infrastructure will be one of the key drivers for development in the next decades. Ports as nodal point or hubs in this network can contribute substantially to this development. In a green growth or green port strategy, sustainability is an economic choice based on a proactive long term vision.

Ports must plan and manage their operations and future expansions (growth) in this way in order to cope with the limited or decreased environmental space and increased interactions between port and cities. By accommodating this in harmony with the surrounding cities and nature, green growth can clearly be seen as an economic driver.

The purpose of this report is to create awareness about the advantages of implementing a green port philosophy and about what this philosophy means at present for ports around the world. This is done by supplying tools and guidance that show how proactive environmental measures can contribute to obtaining consent for future operations and developments, how opportunities can be created through own initiatives (thereby remaining ahead of legislation), and how green growth can be realized.

This report aims to contribute thus in the shift of thinking away from a reactive `ports or nature/environment´ approach towards a proactive `ports and nature/environment approach´ that add value through stakeholder participation. The Green Port concept not only changes the role of the port authority, but also the way in which operations are done. Under this concept, the

port operates pro-actively and beyond legislation in a way based on a long term vision.

Key elements in this concept are:
- Long term vision which strives towards an acceptable ecological footprint;
- Transparent stakeholder participation and stakeholder approved strategies to operate and grow;
- Shift from sustainability as a legal obligation to sustainability as an economic driver (economic development and sustainable development as complementary factors);
- Actively sharing knowledge with other ports and stakeholders;
- Continuous strive towards innovation in process and technology.

Key issues that are dealt with are:
- Environmental quality (soil, water, air and noise);
- Habitat and integrity of ecosystems;
- Energy efficiency and energy transition (from fossil towards clean fossil towards renewables);
- Materials and waste management;
- Climate change mitigation and adaptation;
- Stakeholder involvement & corporate social responsibility;
- Co-operation with private sector, public authorities, NGO's, academic world and other ports.

The report aims to create awareness and make the difference for a number of parties:
- Port authorities and port operators: key players who make the shift from a traditional landlord position to an orchestrating coordinator and front runner to make the paradigm shift;
- Public authorities: recognize the need of the port managers and facilitate and consolidate the change;
- Consultants and contractors: incorporate the sustainable design principles (including socio-economic issues) in the port development projects;
- Financers: understand the role of the port authorities in order to develop adequate packages to finance the green port developments;
- NGO's: stimulate their external input to enhance and inspire the green port concept.

As this initiative was taken within PIANC and IAPH, it builds upon initiatives already taken within these organizations. Other initiatives in relation to green ports as part of sustainable ports were taken by different regional organizations or authorities such as the European Commission, or within the frame of different projects.

In today's increasing complex world the green port strategy is a strategy to accommodate the future development of the port in harmony with the region and natural system. Important aspects of Green Port strategy are:
- Efficiency and sustainability as complementary drivers
- Pro-active approaches like:
    - Working with Nature
    - Corporate Social Responsibility
    - Stakeholder participation
    - Responsible innovation
- Attract frontrunners, which attracts other frontrunners and better prepares the port for any future.

Sustainable thinking includes long term thinking. Sustainability pays. This gives the best guarantee for the license to operate and to grow and make environmental permitting

procedures the follow-up paperwork that consolidates the agreed practices.

From the concept of the Green Port that is introduced, the role of the Port Authority is described and the different environmental and sustainability issues in ports and the related logistic chains, and how these are dealt with in a Green Port are explained. Institutional and social aspects are dealth with and the report concludes with a list, including relevant web links, of references and case studies that illustrate the concepts and highlight practices of frontrunners in the green ports arena. For the main conclusions and recommendations reference is made to Chapter 7 of this report.

3 Introduction

3.1 Focus

Ports are central points or hubs in the transport network whose industrial and business areas add value to the transported goods. Increasingly, they are also centres of energy production and ports of departure for the offshore industry. This report has its focus on the sustainable development and green growth of ports, and the related logistic chain and added value activities.

3.2 Scope and Purpose

The purpose of this report is to create awareness about the advantages of implementing a green port philosophy and about what this philosophy means at present for ports and port authorities around the world and community support for port growth. This will be done by supplying tools and guidance that show how proactive environmental measures and strategies can contribute to obtaining consent for future operations and developments, how opportunities can be created through own initiatives (thereby remaining ahead of legislation), and how green growth can be realized.

Accordingly, this report aims to contribute in the shift of thinking away from a reactive `ports *or* nature/environment´ approach towards a proactive `ports *and* nature/ environment approach´, away from an approach based on short term thinking towards an approach starting from a long term vision. Indeed, if we don´t know where we want to go, it makes very little difference that we make great progress.

The Green Port concept not only changes the role of the port authority and its tenants & stakeholders, but also the way in which operations are done. Under this concept, a port operates pro-actively and beyond legislation in a way based on a long term vision.

Key elements in this concept are:

- Long term vision which strives towards an acceptable ecological footprint;
- Transparent stakeholder participation and stakeholder approved strategies to operate and grow;
- Shift from sustainability as a legal obligation to sustainability as an economic driver (economic development and sustainable development as complementary factors);
- Actively sharing knowledge with other ports and stakeholders;
- Continuous strive towards innovation in process and technology.

Key issues that will be dealt with are:

- Environmental quality (soil, water, air and noise);
- Habitat and integrity of ecosystems;
- Energy efficiency and energy transition (from fossil towards clean fossil towards renewables);
- Materials and waste management;
- Climate change mitigation and adaptation;
- Stakeholder participation & corporate social responsibility;
- Co-operation with private sector, public authorities, NGO's, academic world and other ports.

A port authority in itself does not produce many impacts on the environment, most are the result of the tenants' operations i.e. companies and industry operating in and around the port area and related transport logistics companies, However, the port authorities influence the extent of the impacts through the drafting of sustainable port rules and -regulations to which operators need to adhere.

Not included in the scope of the report are safety and security. Although in a holistic approach they need to be integrated, the report will not deal with these issues. The report mainly focuses on the green aspects of port development and port operation from a sustainability perspective.

3.3 Background and Green Growth Initiative

The pursuit of global prosperity has been the desire of humanity throughout history, and in the course of doing so, human civilization has been shaped by several major transformations. These transformations, however, had consequences. The industrial revolution led to an era of quantity-oriented, fossil fuel-dependent, expansionary growth based on an extensive input of labour and capital. This industrial revolution played a key role in bettering the lives of millions of people across the globe. Nevertheless, it is equally clear that it also brought about widespread environmental degradation, concentrations of greenhouse gases leading to the challenge of climate change, rapid global population growth, unsustainable consumption habits and other pressures on the Earth's limited natural resources.

The conclusion of the report “Limits of Growth”, published by the Club of Rome in 1972, could be the first formal reference to the global needs toward sustainable practices. Since then the United Nations and his agencies have spent a great effort to promote an environmental conscience in leaders and people in general. Two such efforts were the creation of the United Nations Environment Programme (UNEP) in 1972 and the setup of a World Commission on Environment and Development, chaired by Gro Harlem Brundtland. The World Commission produced the report called “Our Common Future: A global agenda for change”, best known as The Brundtland Report (published in 1987). This document was the first to use the term "sustainable development", defined as: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". This definition has been broadly adopted by many institutions.

Today, the idea of sustainability is generally accepted to cover much more than strictly environmental issues. The Triple Bottom Line (TBL) encompassing people, planet, profit is a concept that extends the frame of sustainability to include social and economic aspects. The TBL refocuses the measurement of corporate performance from the perspective of a shareholder (predominantly financially driven) to that of a stakeholder (anyone affected by the actions of a firm) and coordinates three interests: "people, planet, and profit." When there is a balance between these three ‘P’s, there is sustainability.

An important next step in this development is the upcoming drive towards Green Growth. Reflecting on reality, it has become clear that the world needs a new growth paradigm that can promote economic development to better meet its needs, while at the same time, ensure climatic and environmental sustainability. This now is the key message in the recently published OECD’s “Green Growth Strategy Synthesis Report: Towards Green Growth”.

While economic activities and environmental protection are conventionally perceived as two separate domains adversely affecting each other, green growth calls for a conceptual shift to recognize that both can be achieved complementarily. Under this new paradigm, challenges such as climate change and energy crisis are no longer considered as problems that need to be addressed, but as opportunities for new growth and job creation. Unlike the past labour and capital intensive methods of production, the driving factors of green growth are new ideas, transformational innovations and the state-of-the-art technology.

Transport is an important theme related to green growth. There is no prosperity without business and there is no business without transport. Transport has a substantial impact on the

environment and much public investment is related to transport infrastructure. Therefore, greening of transport and transport infrastructure will be one of the key drivers for development in the next decades. This can be achieved by improving the transport efficiency and reducing the footprint of the transport infrastructures and modalities.

Ports as nodal points or hubs in this network can contribute substantially to this development. In a green growth or green port strategy, sustainability is an economic choice based on a proactive long term vision.

As ports are typically located along coasts, estuaries, river deltas and/or canals and ports are connected to cities and nature, the interactions of transport system, natural systems and social system are eminent. Sustainable port strategies consider the integration of these different systems to be fundamental. In sustainable port strategies, the planning and managing of port activities is done by looking at the activity's effect on all systems and in cooperation with the stakeholders belonging to these systems.

Port authorities and their (private) tenants must plan and manage their operations and future expansions (growth) together in order to cope with the limited or decreased environmental space and (in some cases) increased interactions between port and cities/nature. By accommodating this planning in harmony with the surrounding cities and nature, green growth can clearly be seen as an economic driver.

3.4 Target Audience

The report aims to create awareness and make the difference for a number of parties:

- Port authorities: key players who make the shift from a traditional landlord position to an orchestrating coordinator/director and front runner to make the paradigm shift;
- Public authorities: recognize the need of the port managers and facilitate and consolidate the change;
- Consultants and contractors: incorporate the sustainable design principles (including socio-economic issues) in the port development projects;
- Financiers: understand the role of the port authorities in order to develop adequate packages to finance the green port developments;
- NGO's: stimulate their external input to enhance and inspire the green port concept.

Indirectly, the report is targeted at the users of the port, the cargo owners, the (logistic) service providers (truck, rail, inland and sea) and the general public.

3.5 Line-up with Global Initiatives

Worldwide, several initiatives are being deployed with the objective to promote or to develop the concept of Green/Sustainable Ports.

As this initiative was taken within PIANC and IAPH, it builds upon initiatives already taken within these organizations. Other initiatives in relation to green ports as part of sustainable ports were taken by different regional organizations (e.g. ESPO) or authorities such as the European Commission, or within the frame of different projects.

3.6 The Green Port as a Strategic Choice

In today's increasing complex world, the green port strategy is a strategy to accommodate the future development of the port in harmony with the region and the natural system. Important aspects of the Green Port strategy are:

- Efficiency and sustainability as complementary drivers
- Pro-active approaches such as:
    - Working with Nature (PIANC), Building with Nature (EcoShape), Engineering with Nature (USACE)
      In essence, adopting these philosophies means doing things in a different order. Instead of developing a design and then assessing its environmental impacts – an approach which inevitably revolves around damage limitation and is ultimately not sustainable – they advocate the following steps:
        1. Establish project need and objectives
        2. Understand the environment
        3. Make meaningful use of stakeholder engagement; identify win-win options
        4. Prepare project proposals/design to benefit navigation and nature
    - Corporate Social Responsibility (CSR)
    - Stakeholder involvement and participation
    - Responsible innovation
- Attract front runners in port operations and shipping but also development (contractors) and hinterland logistics which attracts other and stimulates new frontrunners and better prepares the port for any future developments.

Sustainable thinking includes long term visions and provides benefits both for port (operations) growth and the attraction/creation of new markets, industries and products.

This gives the best guarantee for the license to operate and to grow in conjunction with environmental permitting procedures that consolidate and reflect agreed practices.

3.7 Definition of a Sustainable Port

The Working Group "A sustainable port is one in which the port authority together with port users, proactively and responsibly develops and operates, based on an economic green growth strategy, on the working with nature philosophy and on stakeholder participation, starting from a long term vision on the area in which it is located and from its priviliged position within the logistic chain, thus assuring development that anticipates on the needs of future generations, for their own benefit and the prosperity of the region that it serves."

3.8 Report Structure

From the concept of the Green Port that is introduced in this chapter, the role of the Port Authority will be described in chapter 4. Chapter 5 explains different environmental and sustainability issues in the ports and the related logistic chains, and how these are dealt with in a Green Port. The chapter also refers to tools that can support the implementation of the Green Port strategy. Chapter 6 deals with institutional and social aspects. Chapter 7 summarizes the conclusions and recommendations, and the report concludes with a list, including relevant web links, of references and case studies that illustrate the concepts and highlight practices of front runners in the Green Ports arena.

3.9 Related PIANC Reports

This report is related to various other PIANC reports:

- WG 136 on "Sustainable Navigation"
- WG 100 on "Dredging Management Practices for the Environment – a structured and selected approach"
- WG 108 on "Environmental Aspects of Dredging and Port Construction Around Coral Reefs"

- WG 158 on “Master plans for the Development of Existing Ports”
- WG 159 on “Renewable Energy for Maritime Ports”
- Task Group 2 report ‘Towards a Sustainable Waterborne Transportation Industry’

This report is also related to the initiatives that IAPH undertakes in the frame of the World Port Climate Initiative (WPCI).

The World Ports Climate Initiative.
Under the International Association of Ports and harbours (IAPH) the so-called World Ports Climate Initiative (WPCI) has become an international platform of ports to address global warming and air quality issues. The mission of WPCI is to:

- Raise awareness in the port community of need for action
- Initiate studies, strategies and actions to reduce GHG emissions and improve air quality
- Provide a platform for the maritime port sector for the exchange of information thereon
- Make available information on the effects of climate change on the maritime port environment and measures for its mitigation and adaptation

Within the WPCI, the following projects have been initiated which are lead by participating ports or groups of ports:

1. Carbon Foot Print: tools to support ports to make their carbon footprint.
2. On-shore Power Supply: guidance and good practice with regard to On-shore power supply.
3. Environmental Ship Index: a tool to reward clean shipping.
4. Intermodal Transport. Guidance and strategies that can be applied to enhance intermodal transport
5. Low Emission Yard Equipment: guidance and good practise.
6. Sustainability in Lease Agreements: guidance and good practise.
7. LNG as a fuel: information exchange and coordination of further implementation for ports

4 Roles of the Port Authorities

Port authorities have different instruments at hand for implementing environmental programs and initiatives from a sustainability perspective. Though the institutional context is different in each country, a number of universal instruments can be identified to realize sustainable development toward the direction of a green port.

Below an overview is given of the relevant roles, which are not necessarily applicable to all ports. They will be illustrated in chapter five, within the different environmental themes.

4.1 Port Authority as Manager of Port Areas

Ports are responsible for the development of the area assigned to them and are considered area-manager from this perspective. An important instrument to exercise this role is strategic planning, also called Master Planning. In some countries, Master Planning is a formal task that is legally assigned to port authorities, and in other countries is taken up voluntary/naturally by port authorities.

4.2 Port Authority as Estate Owner

In most countries around the world, port authorities own the land in ports (landlord-based model). Through concession/lease agreements (partly also in the hands of public authorities), the land is rented out to private operators (tenants) and or public bodies. While in theory, lease agreements provide an exceptional opportunity to include environmental conditions, it turns out to be a bit more difficult to bring theory into practice.

Competition among ports and commercial short term views are often difficult barriers to be overcome. However, inclusion of sustainability criteria in lease agreements can contribute to:

1. The facilitation of environmental permitting procedures and compliance issues (where port authorities can take up a role as well) can be facilitated;
2. The definition and agreement of environmental performance standards;
3. The prevention of excessive corrective costs in solving environmental problems can be prevented; and
4. The efficient transition towards a more sustainable port exploitation (if all port actors are involved).

4.3 Port Authority as Economic Developer

Ports are responsible for a sustainable economic development of their area and thus develop commercial activities. The provision of good environmental services towards shipping lines can make the difference when these are making choices between ports. Offering a green component in a green logistic chain can be an added value for instance when choices are made for Fair Trade products. Or a clear and strong permitting and inspection framework can be an added value for shippers who want to avoid that there goods are ending up in places (associated) with environmental problems.

4.4 Port Authority as Facilitator of / Key Player In the Logistic Chain

Port authorities play a key role in the management of waterborne traffic to and from the ports (e.g. coordination of shipping, assignment of berths, management of nautical access of port infrastructure, etc.) and can as such contribute to an efficient and effective logistic chain (e.g. less waiting time, better planning, slow steaming, etc.). This goes hand in hand with environmental care (improving air quality) and thus can contribute to greening the logistic chain, e.g. by developing soft (I.T. and other) infrastructure such as port community systems (PCS).

Towards the hinterland, port authorities can take up a role by taking initiatives in organizing sustainable cargo flows towards the hinterland (e.g. CO_2 reduction based bonuses). They can provide access from the port to the national and international rail and inland barge infrastructure, and in cooperation with public authorities responsible for this infrastructure, opt for integrated sustainable logistic solutions.

4.5 Port Authorities as Administrators

Port dues (e.g. for ships) can be differentiated on the basis of environmental criteria, thus *encouraging* ship operators and shippers to use ships with less environmental impact (e.. the ESI-initiative, refer to textbox chapter 5.3.4).

4.6 Port Authorities as Regulators and Enforcing Agents

Environmental issues may be addressed through port regulations, which can be issued by the harbour master, the port authority, or the municipality in which the port is located.

Whereas the police role of the harbour master primarily focussed on navigation, safety and security, it now addresses environmental issues as well, with respect to own regulations but, if agreed with the public authorities, also with respect to enforcement of other national or international regulations.

4.7 Port Authorities as Developers and Managers of Infrastructure

Developing infrastructure can have severe environmental impacts when not dealt with properly, but it can also provide opportunity to reduce environmental impact and *enable* favorable developments, by providing technical solutions (working with nature) or by facilitating less polluting activities (e.g. for cargo transportation).

4.8 Port Authorities as Operators

While port authorities develop own activities as operators (of terminals, of dredging services, of tug/towing services or of other services), added value can be created by setting the trend, by providing good *examples*, and by offering solutions that cannot always be found on the regular market.

4.9 Port Authorities as Central Points of Knowledge on Ports and Environment.

Creating a knowledge base on the status of environment, and the activities impacting the environment and solutions to deal with environmental challenges, and sharing it, can significantly contribute to the environmental debate and policy development in and around the port. Port authorities can facilitate and encourage cooperation with specialized knowledge institutes and universities for this, if viable creating an integrated database for data storage and information exchange.

4.10 Port Authorities as Drivers for Innovation

Port authorities are ideally placed to act as facilitators to raise the environmental profile of their ports. Ports can stimulate new developments through technical, financial and process support, together with partners in and around the port.

4.11 Port Authorities as Partner in the Community

Port authorities can facilitate the exchange of concerns and ideas between the companies in the port and the surrounding communities (e.g. organization of community platforms, by taking up a role in environmental complaints desk).

Ports are nodal points of knowledge on ports industry and sustainability measures environment. And ports can use there global network and knowledge amongst other ports and operators. Address environmental or sustainability issues by promoting the use of protocols from international conventions. And as such influence supply chains and inspire ports and industries elsewhere.

Port authorities can also serve as an example to the community by paying attention to the various aspects of sustainability in their own operations such as making use of:

- Sustainable materials and techniques in own materials;
- Infrastructure and services such as building offices according to the passive house concept;
- Using LED technology for lighting public areas;
- Using alternative energy sources for vehicles and vessels;
- Etc.

5 Environmental and Sustainability Issues in Ports and Related Logistic Chains

The following environmental- and sustainability issues play important roles in the operations of the ports and their related logistic chains:

1. Land and water areas uses;
2. Modalities and connectivity;
3. Air quality;
4. Surface water and sediment quality;
5. Soil and groundwater quality;
6. Dredging impacts;
7. Sound impacts;
8. Energy and climate change mitigation;
9. Climate adaptation;
10. Habitat and species health;
11. Landscape management and quality of life;
12. Ship Related Waste Management;
13. Sustainable Resources Management.

In the paragraphs below, each of the above issues is described in more detail each time using the same sub-division:

- Challenges: describes the most common challenges that are faced by ports when dealing with the issue;
- Issues: describes which issues need to be addressed;
- Perspective of Port Authority: suggests what the perspective of the port could be when searching for sustainable solutions to solve the challenges and issues;
- Response Options: lists possible sustainable response options for a port from a management driven point of view and what the available technologies and resources are that can be used to solve the issue;

Best case practices from other ports are provided throughout the text.

5.1 Land and Water Area Uses

5.1.1 Challenges

Developing sound land and water area use is the first step towards becoming a Green Port. This is both for new port developments (Greenfields) and upgrading existing developments (Greyfields). Land and water areas are usually limited available on most ports and claimed by several functions.

The first challenge is to determine if the chosen location allows for a viable long term operability of the port when considering the overall social (workforce, hinterland), ecological (nature areas) and environmental (sedimentation/erosion, wave/flooding, river discharges etc) situation.

It is important to make a long term plan in which land and water areas are assigned to the different functions in the port in such a way that the port operations work effectively, (hinterland) transport modes are enhanced, the natural environment can flourish and the people enjoy the area.

A second challenge is to assign the different areas in such a way that natural process are maintained or even enhanced which often means a flexible boundary between land and water

areas. Flexibility is needed in terms of easy change of function of the area as well as gradual development in time and space.

For some ports, the interaction between port and city is an important aspect. Here the challenge is even larger as the area should not only be enjoyable for working, but also for living. Other functions as education, health and recreation need to be incorporated in the area planning. A sustainable port needs to strengthen its links with the city in order to bridge the interests of the local community. The planning should be seen as an opportunity to strengthen City-Port relations.

Master Planning is the main tool used to assign identified needs in a rational way to the available areas. A complete market study, including assessments of long term market trends and expected developments, is the starting point. The Master Plan (Strategic Plan) indicates the direction in which the port can further be developed. It should provide for an economic development geared to the other functions that can be present in or around the port area, such as living, recreation, landscape, nature, etc. It aims for a smart balance that combines overall spatial claims of different users (stakeholders) and functions. It is therefore important that it maintains a certain flexibility in order to respond to changes in trade, ships and technology.

The results of a good plan should be seen in an improvement of the effectiveness of the whole port by means of a better use of the available resources, reduction of bottlenecks, reduced land use conflicts and improvement of the quality of the hinterland connections, among other benefits.

By means of drafting a sound port development strategy, enough space could be reserved and improvements on the existing situation and uses could be reached. Also, by means of upgrading hinterland connections, new developments will be better accommodated.

The plan can be the main instrument for the identification and protection of nature areas within the port boundaries.

5.1.2 Issues

- Manage port and tenants wishes and demands for land and water areas;
- Interaction between operational needs and recreational (public space) & nature (habitat conservation) needs;
- The need to separate conflicting land uses and buffer port operations from sensitive community (or environmental) uses;
- Port and city interactions concerning jobs, quality of life, space and infrastructure (social);
- Future claims for renewable energy (solar, wind and ocean energies). Combine the related provisions for future means with the present needs (e.g. like pipelines) and their relation to nature (in a wider framework);
- Lagging connectivity due to different owner (government);
- Allocation of spaces occupied by activities unrelated to the port industry;
- Make provisions for upcoming influences of climate change (WwN philosophy);
- Very long life cycle of the infrastructures, faced with quick technological and market changes.

5.1.3 Perspective of the Port Authority

- As area manager (or director):
    - Develop a Port Master Plan for the coming 20 to 40 years;
    - Define and justify the right to operate and develop an agreement with key stakeholders;

  - Steer and guide all actors and stakeholders starting from one common vision for the entire port area;
  - Conclude cooperation agreements with other authorities, centres of knowledge, interest groups, inland ports and other seaports among others;
  - Invest in (inland navigation) terminals that are located outside the seaport area in order to set up a network of seaport-supporting activities, thus contributing to a more efficient use of the sites located in the port area;
  - Coordinate strategies with ports that serve the same hinterland and/or industrial sectors (maintain healthy/reasonable inter-port competition);
  - Draft flexible port development strategy;
  - Connect and manage / integrate other spatial demands and plans;
  - Combine functional users of space, search for win-win situations;
  - Think on a long term basis and introduce sustainable development as a main driver for a sound economic growth strategy.
- As estate owner: set concessions strategies to encourage business opportunities with sustainability background;
- As regulator: set planning guidance for future developments considering risks related to environmental hazards;
- As developer of infrastructure:
  - Be consistent with the spirit of the plan;
  - Increase space productivity e.g. by clustering activities, realise and/or stimulate collective facilities, tackle brown field areas in order to make the unused sites available again for economic activity;
- As a partner of the community: harmonize with the city and/or region development plans, with respect for each other's boundaries and possibilities.

5.1.4 Response Options

Management Driven

- Stakeholder participation: many stakeholders have their own views, interests and ideas on the use of the land and water areas. They can be formulated as general principles, strategies and guidelines and be adopted, depending on the nature of each area, as specific measures for the environment protection and management. Participation of stakeholders at specific stages of the planning process will avoid disruptions and misunderstandings;

Rotterdam Port Vision 2030

Two main ambitions:

1. In 2030 Rotterdam is Europe's most important port and industrial complex. It is a powerful combination of the Global Hub and Europe's Industrial Cluster, both of which lead the field in terms of efficiency and sustainability.
2. In 2030, the Port of Rotterdam is a link in logistics chains with the lowest ecological footprint per ton-kilometre in the world.

The Rotterdam Port Authority, the port administrator, has evolved from an administrative, reactive landlord port to become a participatory and proactive regional developer. Where the focus used to be on commercial contracts, the management focus is now on the phenomenon 'license to operate and grow'. This is the support from the surrounding community, and the freedom this support gives the port to be able to operate and grow.

This governing mechanism, combined with the company's ambition to also be the most efficient and smartest port in this part of Europe, defines the type of client the Port Authority would like to attract. These must be frontrunners – companies that lead the way in terms of sustainability.

The port administrator gives ships that are more environmentally friendly than the law stipulates a discount on port dues and companies must compete in terms of sustainability, whether involved in land allocation, construction or infrastructure maintenance. In each case, companies go further than the law requires

- Authorities also integrate other aspects in their strategies such as regional and local planning, culture, environment, industry, society, tourism and economics, as well as any policies that may have a direct or indirect impact on it. Ports should be aware of this while preparing and implementing their planning;

Puerto Madero, Buenos Aires, Argentina

Puerto Madero, officially opened in 1889, was the first big port infrastructure built at Buenos Aires. Rapidly it becomes one of the busiest South American harbours and consequently the port was extended. The most modern facilities at Puerto Nuevo become more attractive for the maritime traffic than this older infrastructure, which was placed very close to the city centre.

In 1989 it was decided to rescue this abandoned old port area, full of outstanding examples of 19th Century industrial architecture, by integrating it with the city. The project for the retrieval of 170 hectares for dwellings and public spaces was almost completed in 10 years, becoming one of the main tourist attractions of the city for the 21st Century and being considered an outstanding example of city – port integration. More information could be found at http://www.puertomadero.com

- Adopt Working with Nature (WwN) philosophy that is advocated through PIANC, in

which the perspective of the natural system is promoted to be leading the technical design (www.pianc.org/workingwithnature.php).

> **Working with Nature** is a PIANC initiative which calls for an important shift in thinking in our approach to navigation development projects to help deliver mutually beneficial, 'win-win' solutions. It promotes a proactive, integrated philosophy which:
> - Focuses on achieving the project objectives in an ecosystem context rather than assessing the consequences of a predefined project design; and
> - Focuses on identifying win-win solutions rather than simply minimising ecological harm.
>
> Project objectives are considered firstly from the perspective of the natural system rather than from the perspective of technical design. However, **Working with Nature** does not mean that we no longer achieve our development objectives: rather it ensures that these objectives are satisfied in a way which maximises opportunities and – importantly – reduces frustrations, delays and associated extra costs.

- Focus on communication: reporting on the progress of the planning process at specific stages as well as a public consultation of the final draft could be a way to guarantee the harmonization of the future actions regarding the community interests;
- Continually reassess issues (critical but pro-active approach) and periodically update the Master Plan. Anchor the process with stakeholder involvement.

Available Technologies and Resources:

- GIS-based spatial and environmental planning/mapping programs (MAPINFO / Maptable);
- Land-value calculators including valuation of nature (for spatial/business plans);
- Check-lists covering the broad sustainable framework for a port could be used to guarantee that most issues have been covered during the planning phase. Appraisal tools could be used in that sense, doing the theoretical exercise by applying the methodology on the paper for the different options in order to help making the selection;
- 'Serious Gaming' options to involve stakeholders/clients more easily in a 'lighter' way.

5.2 Modalities and Connectivity

5.2.1 Challenges

The expected future growth in world trade will lead to growth in global sea transport. More cargo will be handled in seaports. To be able to cope with this growth on the marine side, the quality and capacity of the hinterland transport system should be high. The challenge is to accommodate this increased transport volume while minimizing or eliminating the environmental footprint of the transport. This challenge includes optimizing the hinterland transport systems, transferring cargo efficiently, using several hinterland transport modalities and reducing external traffic impacts.

5.2.2 Issues

- Developing hinterland transport strategy including models for alternative shuttle services;
- Modal shift from road to rail, water and pipeline, i.e. to the most sustainable modes of transport;
- Need to allocate future transport corridors and protect those defined from inappropriate development;
- Traffic management;

- Integration of Port Community Systems, sharing information of the public and private sector;
- Safety and incident management; anticipating disruptions in water level (inland navigation), accidents and hazerdous cargo;
- Gateway development, such as Authorized Economic Operator System (AEO) that allows clearance of cargo in the final (inland) port of delivery;
- RFID and ICT in logistics;
- Innovation in transport modes based on sustainable energy sources.

5.2.3 Perspective of the Port Authority

- As area managers: Strategic planning on hinterland transport and associated transport corridors. Encourage construction and operation of sustainable transport logistics infrastructure;
- As estate owners: Concession/lease agreements;
- As managers of infrastructures: develop and facilitate several hinterland transport modalities and connections to national and international rail and barge networks;
- As facilitator in the logistic chain: coordination of waterborne traffic, management of nautical access, management of road and rail traffic in and to the port area;
- As operators: Supporting trends in hinterland modal shift;
- As central points of knowledge: promote innovation on transport modalities;
- Port authorities as part of a local and global community.

5.2.4 Response Options

Port Authorities mostly do not have responsibility or authority over the hinterland transport. Outside the port boundaries, traffic management is mostly a government responsibility, and the organization of hinterland transport is done by private parties, like cargo owners, shippers, freight forwarders, railway- and barge operators, terminal operators and stevedoring companies. Still, Port Authorities may have instruments to influence hinterland transport (e.g. the modal splits).

The most important drivers of hinterland transport are the accessibility of the final destination, reliability, speed and the cost of transport. The available options for hinterland transport are formed by availability of infrastructure to final destination, while the choice for usage of available infrastructure is made by costs of transport (cost of fuel/energy, costs of usage of infrastructure, time related costs). The following response options are often available for Port Authorities to influence modalities and connectivity.

<u>Management Driven:</u>

1. *Strategic Planning of hinterland transport*
   Within the Port Strategic Plan, define long term targets for the hinterland transport. These targets can depend on the hinterland destinations, commodities handled in the port and available transport networks (water, rail, road). In addition, define the role of the Port Authority (coordinator, promoter or facilitator) in the intermodal transport chain. For example, the port can choose to be proactive in development of inland (dry) ports or participate in dedicated infrastructure to inland (dry) ports.
   The Strategic Port Plan is the instrument to discuss the long term development of the port and cooperate with the other public authorities and stakeholders to integrate the long term investment in regional and national infrastructure to accommodate the growth in transport. Furthermore, it gives the opportunity to discuss the “soft” infrastructure for the transport; i.e. cost of infrastructure usage, taxation of energy sources and/or regulating use of infrastructure (transport of hazardous cargo);
2. *Developing dry ports or dedicated infrastructure*:

Based on the objectives set in the strategic plan, the Port Authority can develop infrastructure for different modalities. Within the port boundaries, the infrastructure is often financed and developed by the Port Authorities, but outside the port boundaries, the Port Authority can also participate in development of dedicated infrastructure or partner/invest in inland (dry) ports in order to facilitate different modalities and increase the connectivity of the port.

Walvisbay Port, Namibia
An example is the participation of the Port of Walvis Bay, Nambia in the public authority for the development of cargo corridors to Angola, South Africa and Malawi, DRO.

3. *Integrated Port Community System*:
   A major aspect in the organization of the hinterland transport is an adequate information system on the different cargo flows through the port. Developing different shuttle models for intermodal transport depends on concentrating cargo flows over part of the transport cargo. Concentration of cargo flows will reduce the costs of transportation, and therefore, it may be beneficial to use multiple modalities in the hinterland transport. However, adequate information on location and status of cargo is essential to combine cargo flows and to inform stevedoring companies on expected arrival times. Reliability in transport times is a key parameter in cargo transport.
   Most Port Authorities as well as most terminal operators do have port information systems. Integration of these systems is necessary in order to manage and organize the entire transport chain from origin to destination. Regional or global standards for Cargo Information Systems can help in organizing this in a robust manner (e.g. Portbase in the Ports of Amsterdam and Rotterdam, APCS in Port of Antwerp and the port community systems of Barcelona, Bremen, or Hamburg www.epcsa.eu).
4. *Demanding modal splits in concession/lease contracts*:
   In awarding concessions to terminal operators, it may be possible for the Port Authorities to demand certain modal splits for hinterland transport, especially concerning containers. This can be based on certain maximum tonnage to be transported by road or based on maximum percentage of throughput to modalities which are less favourable (reduced road transport and promote water or rail transport). In this way, terminal operators are pushed (or promoted) to manage their terminal with different incentives. The attracted cargo can be better suited for local waterborne hinterland transport, or the terminal operators are promoted to partner with inland ports and develop different shuttle systems. Also, the infrastructure of the terminal can be developed in such a way that water and rail transport have increased capacities. This is a particularly valuable instrument for new terminals, but by promoting these aspects for existing terminals and discussing them with terminal operators, a shift in modal transport can also be achieved in existing terminals.
   Concerning bulk cargos, port authorities should focus on providing areas that can be developed into (dedicated) rail and/or barge terminals to transport the large volumes of bulk to the hinterland.
5. *Promote water transport options for the links with the hinterland*
   An inland waterways transport is an option for ports located close to the mouth of a navigable river or a channel network. Coastal and Short Sea Shipping are always possible, but require to be integrated into the logistical chain and achieve the same levels of efficiency than other modes of transport to become a reliable competitor. The port can facilitate these services by assigning appropriate spaces and berthing facilities. Where possible ensure sustainable maintenance practices e.g. in case of maintenance dredging search for environmentally friendly dredging and reuse of sediments within the system.

Available Technologies and Resources

- Port Strategy Planning, several models are available such as Bird 1973 and Port of Amsterdam and TU Delft, 2012
- Traffic management: Optimization of traffic flows by providing dynamic traffic

information:
- Peak shaving in road traffic by rewarding passengers not travelling on peak hours
- Minimizing traffic during major reconstruction works
- Accommodating workers at the construction site (Hotel@work)

5.3 Air Quality

5.3.1 Challenges

The challenge is to accommodate port operations and port development that meet the short- and long term goals and ambitions related to air quality as perceived by owners, users and stakeholders of the port.

The ambition should be to make further development of the port operations possible without decreasing (better by improving) the air quality in the area. All users of the port should be challenged to work on this ambition and it requires effective operation of port traffic, terminal operations, hinterland transport and transport of employees to the different terminals.

5.3.2 Issues

- Limited and/or diminishing environmental allowances with regard to emissions (NOx, SOx, Black Carbon, PM);
- Perception of communities (health);
- Impact on nearby affected habitats (by atmospheric deposition);
- Synergic opportunities (logistic + industrial chain);
- Accommodate development while improving environmental quality;
- Vapour recovery systems for oil- and gas transhipment.

5.3.3 Perspective of the Port Authority

- Need for clear definition to maximize environmental quality in consultation with stakeholders (vision and management);
- Determine the level of influence the port authority has in each zone of the port area. Identify the legal vs. rational influences concerning geographical, environmental, logistic chains, infrastructure, etc.;
- Anticipate future laws and legislation, invest in future, attract front runners;
- Consider differentiated approach on air quality strategies for new and rehabilitation works;
- Inclusion of performance targets in leases.

5.3.4 Response options

Management driven

- *Contract requirements & lease agreements*
  In this respect, the Port Authority (the landlord) can direct the port community towards sustainable attitudes and behaviours such as monitoring and improving air quality. For instance, in each terminal concession or lease agreement process, the Terms of Conditions could be drawn in order to make preference for the more sustainable offers presented. Also, a strict control could be imposed on the concessionaires to monitor how they are performing in terms of sustainability practices regarding each of their own terms and the applicable updated legislation.

Innovative Contract Terminal Operations, Rotterdam Port, The Netherlands
The new clients for the new port area Maasvlakte 2 in the Port of Rotterdam went through an international public bidding procedure to select the terminal operators for the new port area. The slogan for the international bidding procedure was to 'create your own future'. The tenders submitted were assessed not only for direct commercial value to the Port Authority, but also for 20 % on sustainability, such as the way in which they addressed spatial, energy, emissions and hinterland transport issues. The result was a concession for the construction of the first container terminal at Maasvlakte 2, an investment of almost one billion euros, for a global player in the international container terminal business. From the very beginning, the company created a distinct profile for itself with a slogan that said it was going to build the most sustainable terminal in the world in Rotterdam – a win-win situation for the port. And, it was true to its word. The sustainability requirements have been translated into contractual conditions, which are also subject to monitoring. The following focus areas illustrate what is being built:

- Major focus on automation and efficiency; new generation AGVs
- Maximize use of green energy
- Energy recovery from container cranes
- Energy-neutral buildings (underground thermal energy storage)
- Ultimately < 35 % road transport to hinterland

None of these were yet legal requirements, so this is quite clearly a frontrunner company, as the Port Authority calls it. Ref: www.maasvlakte2.com .

- Encourage responsible behaviour of tenants

Clean Trucks and Vessel Speed Reduction Programs, Port of Los Angeles, USA
In partnership with the Port of Long Beach, shipping terminal operators, trucking companies and manufacturers, truck drivers, other industry stakeholders, and regulatory agencies, the Port of Los Angeles started a progressive ban on polluting trucks that were allowed to enter the port. Since January 2012, only trucks meeting the 2007 Federal Clean Truck Emissions Standards were allowed to enter the Port. When the program was fully implemented in 2012, port truck emissions were reduced by more than 80 percent (http://www.portoflosangeles.org/CTP/idx_ctp.asp).

In addition, the Ports of Los Angeles and Long Beach have implemented the Vessel Speed Reduction Incentive Program (VSRIP). This voluntary program rewards vessels that slow down to 12 knots or less within 20 or 40 nm of the entrance of the harbour with dockage rate reduction. The VSRIP reduces both primary pollutant and greenhouse gas emissions. At the end of 2011, over 90 percent of vessels were compliant at 20 nm and over 70 percent were compliant at 40 nm.
(http://www.cleanairactionplan.org/programs/vessels/vsr.asp)

- Encourage and reward innovations and (technologies) e.g., by offering discounts or bonuses;
- Operational phase: install monitoring stations (including a reference station for background values) and draft an action response plan based on a series of intervention levels.

Available Technologies and Resources

- Create physical barriers that stop or reduce further dispersion of air pollutants (dust) – contained spaces, control technologies, trees lining, specially designed barriers that bind pollutants, etc.

Enclosed facilities for the storage of coal at Spanish Ports
Complains from the community about open storage coal facilities placed close to cities has been solved in these two cases:

- The "Medusa" (jellyfish) terminal in the port of A Coruña has reduced the impact of port coal unloading operations on air quality by 90%. The facility is owned by Union Fenosa Generation (the owner of a power generation plant linked by rail to the port) and consists of a dome-shaped spherical, 110 m in diameter and 35 meters high, with capacity for 100,000 m³ of coal. Filling of the storage is done through a rotational stacker boom.
- The Mineral Bulk Terminal of the Port of Santander has a enclosed building for the storage of coal, with a surface area of 75,000 m² and a capacity of 412,540 m³. All conveyor belts are full closed. Vessels are unloaded by means of grabs discharging on ecological hoppers.

- Use of treatment mechanisms for external storage of bulk products to minimize dispersion of particulars (e.g. water sprays, covers, binding agents);
- WPCI initiatives such as Onshore Power Supply / cold ironing;
- Retrofitting, examples are (elaborate on examples):
    - Amsterdam Sustainability Fund
    - Port of Los Angeles Technology Advancement Programme
    - Dutch Inland Navigation Engine Refitting

- Port initiated financial programs involving the differentiation of port dues aimed at reducing emissions;

Environmental Shipping Index
The Environmental Ship Index is an initiative taken by the ports to distinguish between maritime ships in terms of their environmental performance. Its aim is to be able to provide incentives by rewarding good performance. Developing such an instrument together creates a greater support base and implementing it together the greatest effect. Using the index, ships that emit fewer air pollutants than the legal limit receive points. A ship receives zero points for emissions that exactly meet the legal requirements and 100 points for zero emissions and if CO2 emissions are also monitored. The ESI is a voluntary system, web-based, free of charge and international. Ships can register by internet, by filling in some details from their engine certificates as well as the amount and sulphur content of the bunkered fuels.

The ESI was introduced on 1 January 2011 and there has been much interest in the voluntary system, both from ships and ports. The number of ships registered increased quickly from 100 to over 500. The scores of the registered ships vary between 0 and 40 points, but a ship using LNG as engine fuel can easily score over 60 points.

As of 1 January 2012, eleven ports are using the system as a reward instrument, including Antwerp, Rotterdam, Ghent and Hamburg. And in 2012 the first ports outside Europe: Los Angeles New York and Ashdod joined the initiative.

- Green Award: certifies ships that are extra clean and extra safe. Ships with a Green Award certificate reap various financial and non-financial benefits. By rewarding high safety and environmental standards in shipping, Green Award makes above standard ship operation economically more attractive.
  The Green Award certification scheme is open to oil tankers, chemical tankers and dry bulk carriers from 20.000 DWT and upwards, LNG carriers and inland navigation vessels. The Green Award procedure is carried out by the Bureau Green Award, the executive body of the independent non-profit Green Award Foundation. The certification procedure consists of an office audit and an audit of each individual ship applying for certification. Amongst many others, the assessment focuses on crew, operational,

environmental and managerial elements.
At ports in Belgium (Ghent), Canada, Latvia, Lithuania, the Netherlands, Oman, New Zealand, Portugal and South Africa, the Green Award vessels receive a considerable reduction on port dues. Private companies also appreciate the extra quality which Green Award guarantees. Several incentive providers, government institutions as well as private companies, grant savings to a vessel with a Green Award certificate, which subject to annual verification, is valid for three years.

5.4 Surface Water and Sediment Quality

5.4.1 Challenges

The Green Port goals related to water are to support the attainment of beneficial uses of the harbour's water and, furthermore, to prevent port operations from degrading the surrounding water quality or even take measures to improve the water quality in the port to achieve defined standards. The challenge should be to achieve the water quality in the port which is suited for marine live and has potential for ecological habitats to be developed in the port area.

5.4.2 Issues

- Contaminant inputs (sediment and water) from upstream in watershed, storm water runoff and litter, and the port's lack of direct control in upstream jurisdictions;
- Prevention of water quality impairments as a result of port activities in relation to the availability of Port Authority Resources that can observe/monitor port activities and ensure environmentally responsible behaviour (see also MARPOL):
    - Port waterside (vessel discharges, vessel maintenance, dry waste);
    - Port landside (Tenant operations such as containers, terminals, boat yards, power generation, water treatment plants, dry waste, spills);
- Contaminated sediment including historically contaminated hot spots and re-suspension of these areas, leaching of contaminants into the ground(water);
- Chemical- and Oil spill prevention and response;
- Water extractions leading to changes in hydraulics and quality (salinity):
    - Daily routine use in operations;
    - Intense water use, e.g. for cooling functions, dust control;
    - Small extractions such as water needed for fire fighting, irrigation, dust control;
- Multiple jurisdictions / regulations from port policies, local community agreements, state and international shipping can complicate / frustrate operations.

5.4.3 Perspective of the Port Authority

- Port as Area Manager responsible for planning water supply (quality) and use and sediment quantity and quality entering port through sea and rivers (if any);
- Port as developer/manager of infrastructure controlling and/or treating land-side and water-side water discharges (including sediment content and quality) such as storm water treatment and ballast treatment;
- Port as enforcer setting local port regulation/tariffs and making sure that rules & regulations are followed via monitoring;
- Port as partner in community reaching out to tenants and communities in the influence zone of the port, providing integrated CSR plans and strategies. Strong link with enforcement ensuing a trusted port through regular audits of operators, identifying and correcting potential regulatory violations;
- Port as outreach and educator of users and operators providing information on rules and regulations, mitigation measures and listing clear requirements that assist in understanding the issues concerning water and sediment quality;
- Port as central point of knowledge safeguarding lessons learned identified during

design, construction and operations via monitoring programmes that demonstrate how implemented measures would ensure that the water and sediment quality improves;
- Port as facilitators of innovation stimulating and rewarding new ideas and technologies leading to overall technology advancement;
- Leading by example.

5.4.4 Response Options

Management Driven

- Tenant outreach and education - make clear to all users what the requirements are with respect to sediment- and water quality, anticipate questions that tenants and shippers (who operate under different regulatory frameworks in many ports) may have regarding acting environmentally responsible:
    - Guidance documents (lists what can and cannot be done);
    - Providing tenants available resources to comply with regulations;
- Drafting a Water Resources Action Plan (WRAP) and associated documents such as: Vessel Discharge Rules and Regulations, Clean Marina Program Guidebook, Sediment Management Guidance [roadmap for dredging project, i.e. testing, permitting, placement options, BMPs] & Design Guidance Manual [structural storm water controls]. Lease contracts with terminal operators can be based on the WRAP (e.g, Port of Los Angeles, USA);
- Consider estuarine or river basins approaches when dealing with sediment and water quality. Collaborate with all stakeholders within the basin to ensure that sources of pollution (industry, agriculture, settlements, etc) are removed by incorporating mitigation measures such as building and upgrading treatment facilities, containment basins, adopting plant processes, etc.

Rhine Source Control Program, Port of Rotterdam Authority, The Netherlands

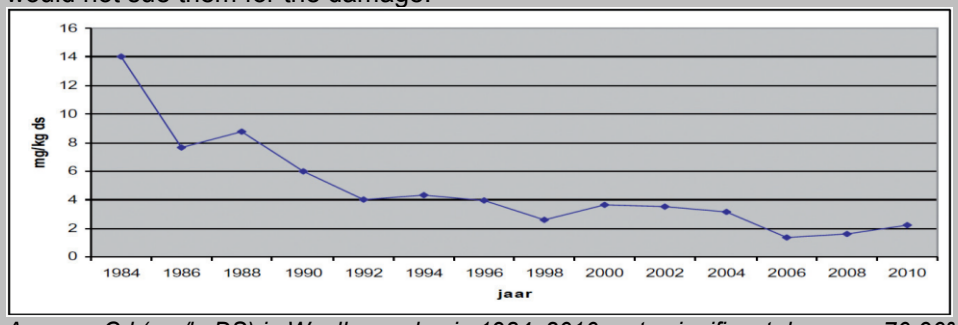
The port of Rotterdam lies in the Rhine estuary, an important strategic position as it provides direct access to the hinterland over water. In the past, this water carried waste and contaminated sediment from the catchment area to Rotterdam. The deep harbour basins in the port ensured that part of this sediment and waste sunk into these basins and constant dredging was needed to maintain their depth.

At the end of the 1970s, the result was an increasing environmental problem. There was nowhere to dispose the contaminated dredged material from the port. A plan was made to store the contaminated sediment responsibly in a large facility near the Maasvlakte, the Slufter, which would provide storage for at least 15 years. However, at the same time a mindset change and a course was set for a clean Rhine and polluted tributaries such as the Ruhr. With the support of environmental organisations, a monitoring campaign was setup along the Rhine and identified every main sources of discharge, although not all listed companies were happy about this. The companies responsible for the main sources of discharge were approached and had the choice:

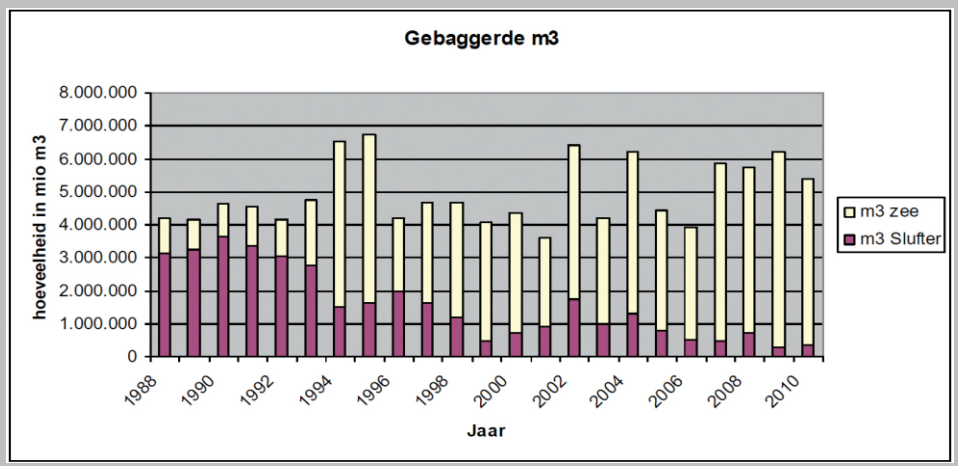
(i) Either reduce discharges by 70 to 90 % within 15 years, which was the level required for clean sediment, or

(ii) (ii) The port would publish the fact that they were major polluters of the Rhine and therefore the North Sea and the Wadden Sea, and face legal procedures to recover the damages.

The main polluters were the large steel, chemical and pharmaceutical companies along the Rhine in Germany, France and Switzerland. It seemed to be an impossible task and was at time not supported by the national governments who thought it was none of the business of the port. But the initiative proved to be very successful. Agreements were reached with all the major companies and in these agreements, the companies guaranteed that they would reduce their discharges by between 70 and 90 %. In return the Port of Rotterdam Authority would not sue them for the damage.



Average Cd (mg/kgDS) in Waalhaven basin 1984–2010, note significant decrease 70-90%.



90% decrease in sediment deposited in the Slufter (purple) vs sediment deposited in sea (white)

-

Available Technologies and Resources

- Facilitate and encourage (innovative) technologies used to mitigate inflow of

contaminated sediments and water into or from the port area. This can be done through measures such as:

- Interception of water run-off and storm water treatment plants specific for ports areas;
- Artificially controlling (heightening or lowering) ground water tables and designing drainage trenches that allow for discharge of contaminated water;
- Designing sediment traps to capture contaminated sediment;
- o Ecological optimization of port infrastructure (such as artificial reefs of old quay wall structures or Wetlands of clean dredge material);
- Plan and design storm water catchment basins that can collect large volumes of water potentially containing pollutants which can be used in the port operations after it has been treated and cleaned;

Rain water treatment and reutilization at the Port of Avilés, Spain
The storm water system of the new right bank terminal development, delivered by the end of 2011, was designed in order to treat all the raining water and reutilizing part of it. The works included interceptors with separation devices and conductions to cisterns allowing the use of the recycled water for irrigation and other uses compatible with non-drinking water quality within the perimeter of the terminal. Location of each of those elements was studied in order not to disrupt operations. More information could be found at http://www.puertoaviles.es

- Set up an integrated monitoring system based on intervention and/or warning levels that monitor the water and sediment quality in and around the port area. Ensure adequate measures and equipment is in place to intervene when certain levels have been reached or superseded;
- Develop and gather information (best practices) through specialized knowledge platforms where researchers and scientists meet with involved stakeholders. Incorporate and use knowledge developed in these settings to update and create legislation and requirements on sediment and water quality.

SedNet
SedNet is a European network aimed at incorporating sediment issues and knowledge into European strategies to support the achievement of a good environmental status and to develop new tools for sediment management.
The focus is on all sediment quality and quantity issues on a river basin scale (including port areas), ranging from freshwater to estuarine and marine sediments.
SedNet brings together experts from science, administration and industry. It interacts with the various networks in Europe that operate at a national or international level or that focus on specific fields (such as science, policy making, sediment management, industry, education), www.sednet.org.

5.5 Soil and Groundwater Quality

5.5.1 Challenges

- To enhance development without compromising or (further) deteriorating soil and groundwater quality;
- To facilitate further economic developments by managing historic legacies of soil and groundwater pollution in such a way that environmental, health and safety risks are controlled.

5.5.2 Issues

- Contaminants in soil and groundwater potentially posing environmental, health or safety risks or potentially hampering future developments;
- Lack of detailed baseline data on contamination levels to identify parties responsible for remediation of further soil and ground water quality deterioration;

- To avoid that costs and impacts caused by particular parties are borne by whole (port) communities;
- Management of historic groundwater pollution, in some cases originating from mixed plumes: multiple sources, multiple contaminants and multiple liable parties;
- Prevent uncontrolled reuse of contaminated excavated soil that can lead to spreading of contamination.

5.5.3 Perspective of Port Authority

- As estate owner: to keep the value of the property, to advise lessees of existing contamination levels and the need to avoid deterioration of soil quality and spreading of contaminated soil;
- As regulator: development without environmental, health and safety risks;
- As enforcer of national and international regulations: it is in the interest of the port authority as estate owner and of future land concessionaires to ensure that land users comply with regulations regarding prevention of soil and groundwater contamination and soil characterisation. This also creates a level playing field in the port.

5.5.4 Response options

<u>Management driven</u>

- Clauses in concession agreements stating that the land must be returned in the same state as start of lease. All pollution must be removed or a damage restitution must be paid;
- Identify sources and draft Source Control Programmes to stop and/or mitigate pollution;
- Draft regulations and reserve port capacity (enforcers) to ensure enforcement of these regulations. Consider a system of reduction bonuses and/or penalties;
- Clear and continuous reporting of monitoring results.

<u>Available Technologies and resources</u>

- Site characterisation guidance, determine historic locations of contaminants and (potential) sources of contaminants using latest technology;
- Prevention of soil and groundwater contamination:
    - Infrastructural and technical measures such as sealed floors, containment, automatic valves and high level alarms, leak detection systems;
    - Working procedures/regulations for fuelling of equipment and other activities involving transfer of hazardous liquids.

Container spillages basins on terminals
Specially designated facilities are designed where boxes loosing contaminated liquids can be placed temporarily. Container's spillages could be due to damages on the packaging or accidents during handling. Those areas are basically low deep pools with a connection to a buried tank from where the liquid will be pumped to trucks for being transported to final disposal. The contaminant areas/tanks are built in waterproof reinforced concrete over a polyethylene synthetic rubber membrane chosen according to the type of liquids foreseen and placed according to strict specifications.

- Mega site approaches and redevelopment of industrial areas, which combines the management of historic groundwater pollution for larger port areas (integrated approach with a combination of e.g. selective removal of sources of contamination, (forced) natural attenuation, 'smart' monitoring and selective plume remediation).
- Risk based approach of contaminated groundwater, based on dominant receptors (monitoring, modelling etc.)

5.6 Dredging Impacts

5.6.1 Challenges

The Green Port goals related to sustainable dredging are primarily to keep the port's nautical access open, clean and safe. Further, the goals include: 1) managing dredging activities in concert with maintaining and improving environmental quality and 2) managing dredged material according to the philosophy of prevent (quantity and quality), reuse (with or without pre-treatment) and placement.

5.6.2 Issues

- Capital and (periodic) maintenance dredging and financing;
- Alignment of port, local, regional, national and international regulations associated with dredging;
- Perceptions of stakeholders especially in relatively undisturbed regions;
- Management of contaminated sediment from dredging and/or capping;
- Identifying disposal/placement/beneficial use options in or within proximity to port;
- Understanding hydraulic and morphological system of the port area to optimize dredging programmes and minimize further impact on the environment;
- Effective mitigation measures for minimizing potential impacts of emissions from dredging equipment including turbidity management.

5.6.3 Perspective of the Port Authority

- Ports as Area Manager: determine navigational need for depth and maintenance:
    - Organize vessel traffic and navigation;
    - Prevent pollution of water/sediments;
- Port as Developers and Manager of Infrastructure:
    - Define integrated environmental, technical, economic and safety objectives and relevant stakeholders (CSR) when considering new infrastructure and related capital dredging (reuse of sediments);
    - Coordinating with other agencies and entities with similar goals (i.e., USACE/PA partnerships) for capital dredging design and reuse of sediment;
    - Find synergies in periodic maintenance dredging and capital development needs;
- Port as Central Point of Knowledge & as Facilitators of Innovation: Understand water and sedimentation system (quantity and quality) with assistance from partners (universities, research institutions) with the aim to minimize maintenance dredging needs and/or develop sustainable programmes for re-use of dredged material within the hydraulic and morphological system, e.g. development of estuarine nature from mud-flats/marshlands to barrier islands;
- Port as Partner in Community:
    - Communicate ongoing and planned dredging activities;
    - Prevent and/or mitigate impacts to surrounding community;
    - Create information centres and site visits to inform and educate communities about the maintenance and capital dredging projects and invite community to participate.

5.6.4 Response Options

<u>Management Driven</u>

- Draft a sustainable Port Dredged Material Management Plan providing guidance for how material should be removed and where it can be placed or beneficially re-used;

Ports of Bremen and Bremerhaven, Germany
As estuary-ports the Ports or Bremen and Bremerhaven had special problems with sedimentation in harbour basins. In connection with contaminated sediments a total review of practices took place and a sustainable water-depth-management has been developed. It was described as best-practice-example for the PERS-certification in 2011 in the environmental report 2010: http://www.bremenports.de/en/greenports/shaping-the-future/pers-sets-high-standards.

- Invest in integrated Environmental Impact Assessments identifying potential impacts of dredging operations and listing best-practice mitigation requirements tailor-made for the project and defined in close cooperation with executing parties. Use receptor-based approach based on a thorough understanding of the social, ecological, hydraulic and morphological system;
- Implement realistic dredge permit conditions and best management practices (BMP) aimed to prevent/minimize impacts from dredging. Update regularly on the basis of lessons learned and feedback sessions;
- Monitoring dredging activities to test and demonstrate BMP effectiveness;
- Set-up a strong communication programme including stakeholder involvement to explain and create support for the dredging activities;
- Refer to existing dredge management documentation and initiatives:
    - PIANC EnviCom has published and is working on several reports about dredging and port construction in environmentally sensitive areas like coral reefs, vegetation, animals/wildlife providing information on best environmental practice and risk management issues, http://www.pianc.org/;
    - Central Dredging Association (CEDA) information and position papers on environmental aspects of dredging, climate change, dredged material as resource, etc http://www.dredging.org/content.asp?page=110 .
    - Tidal River Development (TIDE) organizing pilot projects and comparing, assesses and planning mitigation and compensation measures such as sediment traps, new dredging methods, restoration of river shores. In addition, TIDE jointly develops new, solution-oriented mitigation methods. http://tide-project.eu/index.php5?node_id=Downloads;83&lang_id=1
    - Building with Nature: The research programme carries out pilot projects aimed to utilize natural processes and provide opportunities for nature while realising hydraulic infrastructure. Projects involving minimization, alternatives and sustainable re-use of dredging. http://www.ecoshape.nl/
    - US Army Corps of Engineers (USACE) publications on Engineering with Nature, Dredging and Dredged Material Disposal, Beneficial Uses of Dredged Material, Confined Disposal of Dredged Material: http://el.erdc.usace.army.mil/dots/budm/budm.cfm
    - International Association of Dredging Contractors (IADC) fact sheets on sustainable dredging techniques, mitigation measures and management, etc. http://www.iadc-dredging.com/84/dredging/facts-about/

Available Technologies and Resources (see also list of initiatives above):

- Prevent/ reduce sedimentation and thus dredging needs, examples:
    - Design harbour basins based on hydraulic models minimizing inflow of sediments e.g. via current deflector walls as successfully implemented in the Ports of Hamburg and Antwerp;
    - Implement overall sediment management reduction plans that include optimized dredging campaigns and sediment trapping basins;
    - Flattening out of high spots in a berth by dragging the sediment into a flatter

surface or deeper area instead of dredging;
    - Organize tests to determine actual nautical depth in ports that have fluid mud. Allow hulls to go through muddy waters and determine what density level enough impedes movement of ships. Update maintenance dredging levels to allow for these density levels (e.g. 1200kg/m3);
- Implement and develop technologies to beneficially reuse material with or without pre-treatment:
    - *Engineered uses:* beach nourishment, berm creation, capping, port and land creation, land improvement/heightening, replacement fill- and shore protection e.g. beach nourishment in the Columbia River Dredging (Pacific Northwest, USA) and placement of material not suitable for open water placement at the OENJ Former Bayonne Landfill (New Jersey, USA);
    - *Agricultural & Product uses:* aquaculture, construction materials, decorative landscape products and topsoil. Example: The Maritime port of Singapore (MPA) partnered with a local technology company to develop an award winning technology to safely treat contaminated dredged materials and industrial waste, and convert them into environmentally safe construction and reclamation materials. This reduces or eliminates disposal and potential pollution issues arising from dredging and disposal of maritime related wastes such as oil sludge and copper slag. The Port of Antwerp has constructed the AMORAS project (Antwerp Mechanical Dewatering, Recycling and Application of Sludge), a sustainable solution for the storage and processing of maintenance dredging material from the Port of Antwerp;
    - *Environmental enhancement* - fish and wildlife habitats, fisheries improvement and wetland restoration. Examples are the building of the sanctuary Poplar Island (Maryland, USA) by Port of Baltimore and USACE, the Elders West Marsh Island in Jamaica Bay (New York & New Jersey, USA) constructed by Port Authority of New York and New Jersey and the USACE New York District;

Disposal strategy during the enlargement of the navigation channel in the Western Scheldt estuary

In 2009 capital dredging works were performed in the navigation channel of the Western Scheldt estuary in order for the Port of Antwerp to be able to welcome ships with a tide independent draft of 13,10m. An amount of 7,7Mm³ of sediments (mainly sandy material) had to be dredged for this project.

A team of international experts commissioned by the Port of Antwerp investigated the possibilities for this project. They proposed a new disposal strategy where the dredged material would be used to induce positive eco-morphological evolutions rather than just getting rid of it. In their proposal the dredged material could be used to extent existing sandbars, creating intertidal and shallow water area and in the meantime improving the abiotic conditions in existing intertidal areas (i.e. reducing the dynamics locally). After an extensive feasibility research (2002-2003) and two in situ disposal tests with detailed monitoring at the sandbar of Walsoorden (2004-2008), it was concluded that this strategy can be executed with success.

During the Environmental Impact Assessment of the enlargement of the navigation channel, one of the alternatives investigated involved this alternative disposal strategy at four different locations in the Western Scheldt (among which the sandbar of Walsoorden). All of the capital dredging works would be disposed along sandbars, even a part of the maintenance dredging works during the first years as well. It was concluded form this assessment that possible negative effects of the project were mitigated by this strategy, even in the end having an important positive effect on the ecology of the entire Western Scheldt.

In 2009 the capital dredging works were executed, involving the use of a pontoon with a diffuser head to dispose the material very quietly and accurately on the estuarine bed. Since then high resolution ecological and morphological monitoring has been executed. From morphological viewpoint, the project is a big success as the disposed sediments remain stable. Thus the abiotic circumstances are created to improve the ecology of the Western Scheldt estuary. During the next years the ecological monitoring will reveal whether the biotics will follow as well.

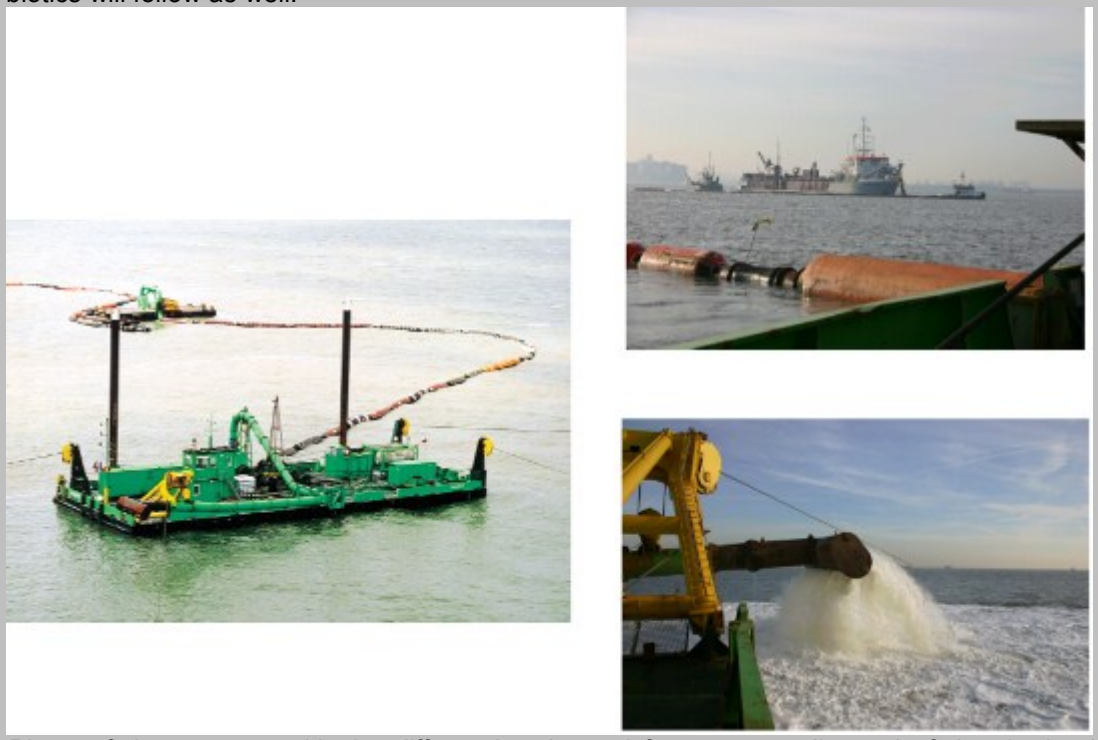


Photo of the pontoon with the diffuser head, used for accurate disposal of the dredged material. Photo right top: hopper dredger connected to the floating pipeline.

- Promote/stimulate and award Emission Control Technologies (also refer to chapter on Air)

- Diesel retrofit technologies such as Diesel Oxidation Catalysts (DOC), Diesel Particulate Filters (DPF) or Selective Catalytic Reduction (SCR);
- Alternative Power/Fuel-based technologies with cleaner engines;
- Engine and Equipment Strategies relating to vessel or equipment repowering, replacing older/higher-emitting engines with cleaner engines;
- Investigate potential for use of green valves for hopper dredges which concentrate sediment overflows when released back into the water (turbidity control);
- Fish bubble curtains along harbour entrances to keep fish out of the dredging area and therefore less impacted by both sediment and noise, e.g. as used in the Pacific Northwest USA.

5.7 Sound/Noise Impacts

5.7.1 Challenges

Port activities and related transport produce sound that can be perceived as a serious environmental nuisance. This can be above- or underwater sound. Sound may not only reduce the quality of life, but may also provide a health hazard and may have ecological impacts. The control of sound is a vital component of the integration of port planning into the local community. Often permanent or long term sound related to cargo handling, road and rail transport bring in more complaints than temporary construction and dredging sound.

Generally the Environmental Impact Assessment for above- and underwater sound requires contours, indicating noise levels, around the source of sound. These need to be correlated to potential receptors to determine impacts, if any. Careful study needs to be executed to determine which frequencies, levels, intervals, build-ups etc impact the receptors before mitigation measures are determined to ensure that they are effective.

In the marine environment anthropogenic (or “human-generated”) underwater sound levels are increasing and receive more attention in recent years. A growing body of scientific research confirms anthropogenic sound may induce adverse effects upon marine mammals and fish. Sources of anthropogenic marine sound related to ports include construction, shipping- and temporary dredging activities. CEDA has produced a paper on Underwater sound in and around port areas:

CEDA paper on Underwater Sound related to Dredging

Results of the expert research committee showed that compared to other activities generating underwater sound, dredging is within the lower range of emitted sound level pressures. While it is clear that dredging sound has the potential to affect the behaviour of aquatic life in some cases, injury in most scenarios should not be a concern, or should be preventable. Research proved that it is very unlikely that dredging-induced sounds lead to any population level consequences, although harm to individuals should not be overlooked.

The paper recommends to increase knowledge about the effects of underwater sounds on aquatic life (if possible before project starts), stressing that a lack of knowledge should not lead to unjustified restrictions and measures. The development of a standardised monitoring protocol for underwater sound is necessary to facilitate evaluations of reasonable and appropriate management practices in projects. Field investigations, or under more controlled conditions in the lab, of the effects on marine mammals and fish should be undertaken.

http://www.dredging.org/content.asp?page=110

NoMEPorts Good Practice Guide on Port Area Noise Mapping and management
The LIFE co-funded NoMEPorts project was based on the concept of shared knowledge on noise issues with the aim of creating a level playing field between European Ports in terms of implementation of the Environmental Noise Directive. The developed Good Practice Guide on Port Area Noise Mapping and Management has been compiled as a synthesis and user-friendly interpretation of the EU Environmental Noise Directive. It includes a summary of the management response options for the effective implementation of the Directive's provisions with a focus on port areas.
The topic of noise management itself is addressed through considerations of analysis of noise maps, the options available for noise reduction, and the development of action plans for current activities and future development. Guidance is given on effective methods for dissemination to, and involvement of, the public in terms of dealing with noise issues. The Guide concludes with a perspective on evaluation of action plans and their implementation.
The good practice guide and the optimised management system facilitate the identification of potential noise sources and the effective determination of hot spots, thus increasing the efficiency of the noise mapping and reducing associated costs. Noise management enables the assessment of future development scenarios and the prediction of associated noise annoyance. In such a way, development plans can be re-considered and actions can be taken at an early stage to mitigate the predicted noise impact.
http://www.ecoports.com/templates/frontend/blue/images/pdf/good_practice_guide.pdf

5.7.2 Issues
- Transportation induced sound: road, rail, water in and outside of port area;
- Industrial sound related to production processes;
- Construction activities (temporary sound).

5.7.3 Perspective of the Port Authority
The main recommendations for port design related to the reduction of nuisance by sound are:
- The lay-out of the port. Zoning of the port with different permitted noise levels for the various zones. Noisy industry can be moved to areas with a higher permitted noise level. This is good for both the industry, which can develop more activities in the new area, as well as for the urban area, which has less nuisance of sound;
- The distance between noisy activities and urban areas should be far enough (for instance greater than 500 meters);
- Where effective, consider the construction of noise barriers (concrete, trees, earthen walls, etc);
- Restrictions on the industrial equipment sound.

5.7.4 Response options (implementation)
Management driven
- Develop acceptable sound contours in and around the port based on measurements taken during different seasons / meteorological conditions;
- Work with sound budgets with the different users;
- Zoning of activities by planning noisy activities away from potential receptors;
- Environmental Management Plans for in-water construction (e.g. pile driving).

Available Technologies and Resources
- Develop, test and implement sound prediction models and relate them to monitoring systems and intervention levels;
- Consider alternatives within the port area such as silent asphalt, linking activities to meteorological conditions (wind direction), silent tyres, electric cars, etc;
- Stimulate and implement noise reduction technology;
- Piling during port construction and piling: slow start to give species a change to escape from the project site.

5.8 Energy and Climate Change Mitigation

5.8.1 Challenges

Greenhouse gas (GHG) pollutants such as carbon dioxide (CO_2) are linked to global warming. CO_2 is generated through the combustion of fossil fuels, and at the time of the report, the maritime industry is responsible for approximately 3 percent of worldwide CO_2 emissions (reference?). Because of this, IMO is searching for ways to set up an emissions trading scheme for the shipping sector.

To reduce GHG emissions, and reduce the dependency on fossil fuels, a non-renewable and finite limited resource, Port sources such as ships, trucks, trains, cargo handling equipment, and harbour craft must transition from diesel fuels to a renewable energy source. Improving operational efficiencies can also significantly reduce GHG emissions.
Shifting to cleaner, yet not entirely emission-free fuels such as LNG can furthermore facilitate the transition towards lower CO2 levels. Another PIANC workgroup focuses on renewable energy in maritime ports and will fully develop the issues related to developing cleaner energy systems as briefly outlined in this report.

5.8.2 Issues

- Reduce CO_2 and other greenhouse gas emissions from port operations and related navigation and hinterland transport;
- Reduce energy consumption and energy costs through increase of efficiency and modernizing (industrial) processes. Search for opportunities to link activities e.g. through the logistics chain of sequential production activities and/or stimulating use of energy created by one company (e.g. heat from power plants) to be used by secondary users; for example such as LNG re-heating after storage at extremely low temperatures;
- Cost-effectiveness of renewable energy sources and the role of subsidies;
- Develop long-term, dependable, renewable energy sources: In order to achieve security of supply from intermittent sources such as solar and wind, it is necessary to try and develop smarter grid networks that off-set variability in renewable energy production with buffers such as energy storage (batteries, pumped-hydro etc.); and by utilizing flexibility in energy demand (e.g. cooling warehouses) of some of the Port's customers. So-called demand-response opportunities have a value in the energy-supply chain that is currently under-estimated;
- Stimulate use of LNG in shipping (sea and inland) and port operations through provision of bunkering facilities.

5.8.3 Perspective of the Port Authority

- As a facilitator of the logistics chain - implement cleaner and more efficient facility operations based on improved technology;
- As a facilitator of innovation - reduce energy dependence by developing and using renewable energy sources within the port boundary;
- As a partner with the community – reduce pollutants that could cause harm to people and other living things worldwide.
- As an operator – give a good example concerning own infrastructure and equipment (e.g. use alternative (renewable) energy sources in boats, vehicles and buildings, pay attention to reduction of energy consumption of boats, vehicles, buildings, etc)
- Showcase: reduce and / or compensate CO2-footprint resulting from your own operations.

Selective light control system port areas, Port of HaminaKotka, Finland
Port of Kotka Ltd, currently Port of HaminaKotka Ltd, area lighting is implemented mainly by 40-meter high lighting masts. A lighting control system ensures that the full lighting is not switched on unnecessarily.
In every lighting mast there are 9-24 lights. All lights are connected in three groups, so every lighting mast can control in three parts. Those parts (lights) are situated symmetric in the mast.
In the basic lighting situation, lighting mast runs only for 1/3 lamps. In the task lighting situation, all the lights are in operation. The lighting control system takes into account that the lamps wear (un)evenly. The system recycles the basic lighting lamps, in other words, every time the default lighting will begin to operate in different lamps. BAS (building automation system) change the default part (1/3) in every day. This means that the lamps will wear evenly, and it increases the maintenance time.
The building automation system (BAS) controls lighting using light sensor, set time and mobile phone.
When the basic lighting is on, you can order more light by using the mobile phone. You can send a SMS message to the automation system and this SMS order put the lights on in full mode in a certain area. Lighting areas, for example in Mussalo harbor, are 23 pcs. In the SMS message you can choice the area, where you want more light. You can also close the lights off, if you wish, in the same system with mobile phone.
BAS system measure how long time each lights has been used. This system will provide data the need for maintenance and faults.

5.8.4 Response Options

Management Driven

- Greenhouse gas emissions inventory and setting goals – The first step in controlling emissions is to know what the emission sources are; then goals to reduce emissions can be developed. As an example, the Ports of Auckland (New Zealand) & Brisbane (Australia) have prepared a GHG inventory and the Port of Rotterdam has a GHG reduction goal of 50% by 2025;
- Energy conservation measures – a low-cost way to reduce emissions is to implement measures that encourage conservation (operational efficiencies);
- Improving efficiency within the logistics chain – streamlining the number of container moves, truck traffic, and rail and inland navigation access will decrease CO_2 emissions;
- World Ports Climate Initiative (WPCI) – all ports are encouraged to join this IAPH initiative, a group of ports working together on projects that reduce GHG emissions;
- Energy Management Plan – documents GHG emission sources and sinks, outlines efficiency measures, and makes commitments to renewable energy and/or smart grid connections;
- Controlled (sectional) warehouse heating, cooling and lighting (shuts down when area is not in direct use), etc. such as in the fruit warehouses in the Port of Antwerp

Sustainability and Innovation Fund Port of Amsterdam, The Netherlands
A sustainable development of the port region is of strategic importance for the Amsterdam Port Authority. This can only be achieved in close cooperation with local and regional companies. The fund gives a grant for feasibility studies and for pilot projects. From the start in 2009 until 2012 a total of € 4 million has been granted to companies in the port region for development of innovative sustainable projects. These projects mainly focussed on development of sustainable energy sources, energy reduction and reduction of CO2 – emissions in the port area. November 2012 an evaluation has been made of this fund and the results over the last years (2009 – 2012). Based on this evaluation it has been decided to continue the fund.

Some examples of feasibility projects are:
- Use of compromised bio gas as fuel for trucks used for city distribution of cargo.
- Research for bio mass incineration plant for steam delivery to a ethanol factory.
- Effective use of residual heath by the production of asphalt.
- Realisation of a tank station for bio gas for trucks for collection of household waste.

Some examples of pilot projects are:
- Production of fertilizer by using residual products to close the phosphate production circle.
- Development of a crane system for use of regenerative energy during braking of the crane lifting system.
- Innovative system for reduction of evaporation during loading and unloading of oil products.
- Demonstration installation for energy production of waste products in agri bulk.
- Development project for use of recycled consumer oils and fats in production of bio fuels.
- Use of chute for development of heat and steam.
- Use of LED lighting on terminal.
- Development of a crowd funding program for use of solar energy cells on roofs of warehouses in the port area.

Available Technologies and Resources

- WPCI Greenhouse Gas Toolbox – contains various actions that Ports can implement to reduce GHG emissions: http://wpci.iaphworldports.org/iaphtoolbox/index.html;
- Technologies in the toolbox include onshore power supply, vessel speed reduction, and conversion of port equipment to electric power with regeneration;
- WPCI Carbon Footprinting Guide for Ports – a resource guide that any Port can use to estimate their carbon footprint: http://wpci.iaphworldports.org/data/docs/carbon-footprinting/PV_DRAFT_WPCI_Carbon_Footprinting_Guidance_Doc-June-30-2010_scg.pdf;
- WPCI Carbon Calculators – free online calculators that can be used to estimate facility (Scope 1 and 2) or tenant/maritime (Scope 3) emissions: http://wpci.iaphworldports.org/carbon-footprinting/
- On-Port Renewable Energy
    - Wind Power – The Port of Antwerp has installed off-shore wind power;
    - Wave Power – Test projects are underway in a.o. Scottish waters (European Marine Energy Centre (EMEC) in Orkney;
    - Solar Power – The Port of Los Angeles installed over 1 MW of solar power on the roof of its cruise terminal

- Carry out studies to determine combinations of renewable energies need to be examined to determine which is most effective for each port and local environment.

Study on Implementation of Renewable Energy Sources in Port of Pointe Noire, Republic of the Congo
During planning of the rehabilitation works and extension of the existing facilities in the Port of Pointe Noire, an investigation was carried out if and how renewable energy sources could be implemented and integrated into the port facilities to reduce carbon dioxide emission in a tropical climate under consideration of site specific constraints.
Site specific constraints that were considered:
- Environmental conditions (temperature, wind speeds, currents, wave heights, geothermal gradient)
- Investment costs for renewable energy power plants
- Availability of construction materials for renewable energy power plants
- Availability of renewable energy sources (e.g. wood pellets, bio fuel, wind speed, radiation, etc.)
- Local capability to maintain renewable energy power plants

The current power supply is 10.30 MW per day supplied via a 20 kv power line, whereas the current power demand is 15.00 MW per day.
The following renewable energy sources were investigated: Wind, Geothermal Energy
Hydropower, Solar Power and Bio Mass. The last two sources appeared to be viable.

- The Port of Hamburg organized the design the 3.5M TEU Central Terminal Steinwerder (CTS) using a CO_2 neutral terminal as the basis of the design. The aim was to develop a fully functional container terminal while maximising sustainability, using environmentally friendly equipment and creating public access for recreation with added educational value regarding the environmental as well as the technical features of the development. Some examples of measures taken are:
  - Generation of electricity from renewable energy sources;
  - Introduction of a Waterwall on the East side of the terminal area;
  - Maximised use of recycled material;
  - Container handling equipment electrically powered where possible;
  - Containers distributed by train and feeder ships only.

- Finally, the PIANC Climate Change Taskgroup published mitigation documents for Maritime and Inland Navigation on http://www.pianc.org/climatechange.php.

5.9 Climate Adaptation

5.9.1 Challenges

Ports must prepare for sea level rise, including increased storm surges, due to climate change. Sea level rise has already impacted port operations in some areas of the world. In 2007, the Intergovernmental Panel on Climate Change (IPCC) projected that during the 21st century, sea level will rise another 18 to 59 cm. A 2012 Massachusetts Institute of Technology (MIT) study on storm surge floods accompanied with high speed swirling winds (cyclone, tornado etc) indicates that due to climatic changes including sea level rise, flooding currently designated as 100-year floods in the future may be seen as frequently as every 3 to 20 years, for example in the New York area.

5.9.2 Issues

- Increased flooding and damage to facilities e.g. as a result of new/increasing occurrences or of extreme weather such as cyclones;
- Uncertainty of future regional impacts versus the decision to make costly infrastructure improvements;
- Sea level rise may change global navigational routing, such as the opening of Arctic navigation routes;
- Sea level rise also causes changes on coastal morphology and higher wave heights above the port limits leading to overtopping;
- Intense rainfall and higher wind speeds leading to more downtime for cargo handling equipment, ship delays etc;
- Increased salination;
- Water shortages in some regions, water excess in others.

5.9.3 Perspective of the Port Authority

- As area managers – long-term planning and designs for new infrastructure should consider the impacts of climate change;
- As developers and managers of infrastructure – the port has a responsibility to protect their properties from climate change impacts, especially in the case when ports form part of the local or regional flood protection schemes;
- Need to ensure land transport corridors to the port are developed taking into account climate change impacts.

5.9.4 Response Options

Management Driven

- Assess facilities, identify the vulnerabilities and proactively reinforce. International Finance Corporation performed a case study at the Port Muelles el Bosque (Cartagena, Columbia) to assess the facility's sensitivity to climate change. As a result, the port made investments to reinforce its most vulnerable infrastructure: http://www-wds.worldbank.org/servlet/main?menuPK=64187510&pagePK=64193027&piPK=64187937&theSitePK=523679&entityID=000386194_20110621014319

Available Technologies and Resources

- Modeling – Rand Corporation developed a Robust Decision Making (RDM) Model that informs infrastructure investment given the uncertainty of the rate of sea level rise and the increase in storm surges. This model balances cost considerations with expected life of the infrastructure and various climate change predictions. A case study was prepared for the Port of Los Angeles, but could be adapted to other ports: http://www.energy.ca.gov/2012publications/CEC-500-2012-056/CEC-500-2012-056.pdf;
- Natural defences: create oyster reefs that grow with sea level rise and protect shorelines and ports from high waves and erosion

(http://www.scapestudio.com/projects/oyster-tecture/)
- Protecting – The Italian Ministry of Infrastructure and Venice Water Authority constructed the Venice Lido Barrier, which keeps the Venice Lagoon at a lower water levels (while allowing ships to pass through) in response to higher sea levels: http://www.smit.com/sitefactor/public/downloads/pdf/Marine%20Projects/Venice%20flood%20barrier.pdf;
- PIANC has published the following adaptation documents:
    - Maritime Navigation Adaptation discusses ocean effects including sea level change, wind conditions, wave action, storm events, and ice conditions: http://www.pianc.org/ptgmaradaptation.php;
    - Inland Navigation Adaptation discusses inland navigation concerns such as precipitation and snow melt, water temperature, floods, droughts, and river morphology: http://www.pianc.org/ptgadaptation.php;
    - UN published May 2012 the book the Maritime Transport and Climate Change Challenge: http://www.routledge.com/books/details/9781849712385/.

5.10 Habitat and Species Management Health

5.10.1 Challenges

Ports and their (maritime) accesses are often located in or near valuable natural habitats, in certain cases designated as protected areas. Approaches are to be defined and implemented whereby port and nature/habitat development can go hand in hand and mutually strengthen each other as much as possible.

Instead of first developing a project and then dealing with nature protection issues, projects to be developed should start from a good understanding of natural systems, based on an approach of Working with Nature. Working with Nature considers the project objectives firstly from the perspective of the natural system rather than from the perspective of technical design. However, Working with Nature does not mean that we no longer achieve our development objectives: rather it ensures that these objectives are satisfied in a way which maximizes opportunities and – importantly – reduces frustrations, delays and associated extra costs. This philosophy is also advocated by the Building with Nature Research Progamme (www.ecoshape.nl) in which (large-scale) pilot projects are carried out testing innovative principles that integrate nature with (marine) infrastructure in the field. Based on the lessons learned, the programme has developed a Guideline for the design of such integrated projects.

In essence, adopting the Working with Nature philosophy means doing things in a different order and contribute to the regional level of biodiversity. Instead of developing a design and then assessing its environmental impacts – an approach which inevitably revolves around damage limitation and is ultimately not sustainable – Working with Nature advocates the following steps:

1. Establish project needs and objectives;
2. Understand the environment;
3. Make meaningful use of stakeholder engagement; identify win-win options;
4. Prepare project proposals/design that equally / simultaneously benefit navigation and nature.

5.10.2 Issues

- Identify opportunities for establishing temporary nature, e.g. on new areas where development is planned in the future;
- Application of eco-structures instead of concrete or steel structures that allow for

development of ecological systems e.g. aquaculture;
- Integrate habitat creation in port master and development plans;
- Buffers for sensitive environmental resources;
- Land Use plans that reserve/confirm areas for conservation;
- Dredging strategies based on ecological situation, e.g. no dredging in breeding seasons;
- Control and stop invasive species via navigation, road and rail;
- Ensure that the port authorities and services have emergency and disaster management plans ready and that they are practiced in carrying out the pre-described measures. The aim is to minimize impacts of disasters as quickly as possible.

5.10.3 Perspective of the Port

Ports can address nature protection issues through their role:

- As area manager → strategic planning of ecological corridors e.g. creating (temporarily) stepping stones;
- As estate owner → ecological management of strategic areas;
- As developer of infrastructure → incorporate eco-structures in new developments;
- As centre of knowledge → support monitoring and research in development of habitats in port areas.

'Natuurpunt' manages more nature at the Moervaart canal
Since September 2008, by order of Ghent Port Company, the NGO "Natuurpunt" has been managing an area of 2.1 hectares large. This area was extended by one third at the end of June 2011 up to 2.8 hectares.
'Natuurpunt' can carry out nature management works in these areas. This management consists of mowing the bank vegetation, strengthening the reed land and maintaining the strip of wood in the silted up part of the river. Moreover, 'Natuurpunt' can also perform scientific research there, organize scientific and/or educational excursions, install informative signs and carry out supervision. 'Natuurpunt' can equally recommend the area for acknowledgement as a nature reserve to the Flemish government. The use of 'Natuurpunt''s know-how in the field of nature management will not only enhance the nature value of this area but will also strengthen its recreational value for walkers, anglers and nature lovers among others.

5.10.4 Response Options

Management driven

- **Strategic planning** is an important instrument to assure that nature and port development can go hand in hand.
    - A good planning process with solid and early stakeholder involvement is crucial in order to assure that strategic plans are being implemented;
    - Furthermore, a solid legal nature protection framework with clear ecological objectives in place, providing certainty towards port development and towards nature development, is crucial. Uncertainty can lead to situations whereby port developments are seriously delayed or even made impossible;
    - Clear ecological objectives are essential and provide a basis from which port developments in and around valuable nature protection areas can be realized. A clear framework in which objectives are to be realized is also desirable, e.g. in order to avoid any particular emergence of a particular species or habitat creates problems that cannot or are very hard to overcome;
    - In Europe, the European Commission has drafted a Guidance on the implementation of the EU nature legislation in estuaries and coastal zones (January 2011);
    - PIANC adopted the Working with Nature guidelines that can be integrated in the strategic planning of a port area (www.pianc.org/workingwithnature.php).
- **In development of new port areas** the Port Authorities can be active in creating so-

called eco-structures in the port to create habitats for fish or other aquatic species.

- With the general improvement of sediment and water quality, the authority can now focus on its ecological potential as a hub and stepping stone for aquatic species. Examples are artificial reefs, water chambers within quay structures or reef blocks as part of extension schemes and even the development of new coral reefs (www.ecoshape.nl);
- Also, ports are or can be a valuable habitat or can, to a certain extent, be used to create valuable habitats. If functioning well ecologically, ports offer more possibilities for aquaculture and fisheries, since they may be designed as hatchery as well;
- The Port of Antwerp used an innovative approach for development of a port in protected area that was based on conservation objectives. The development was drafted in close cooperation with nature protection administration and nature protection NGO´s;

Development of Nature areas Port of Antwerp

The Port of Antwerp is developing in and around its port area valuable and European protected nature protection areas. This is possible by a proactive approach which is based on conservation objectives. Together with all stakeholders (including nature protection administration, nature protection NGO´s), the good status of conservation to be achieved in the area was defined. Based upon these objectives, a port area nature development plan was drawn up with the direct involvement of NGO's assuring that the conservation objectives that were set would be achieved, and allowing thus port development in and around part of the protected area.

Through integrated planning and pro-active approach, based on dialogue, co-operation and active participation of all stake- and shareholders thus:

- Favourable state of conservation of SPA will be restored or maintained in network of nature areas around the port area.
- Favourable state of conservation of protected species will be restored or maintained in network of ecological structure within the port area.
- Further development and exploitation of the port and industry will be possible without significant impact on favourable state of conservation.

At present more than 1000 ha of nature protection area has been developed around the port and ca. 500 ha within the port.

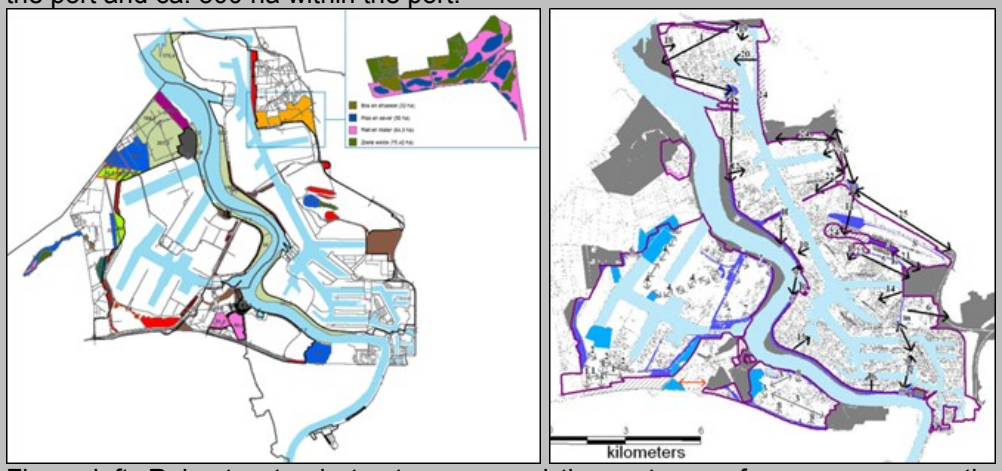


Figure left: Robust natural structures around the port area, focus on conservation objectives

Figure right: Network of Ecological Infrastructure, focus on species conservation

- The EU has published Guidelines on the implementation of the Birds and Habitats Directives in estuaries and coastal zones with particular attention to port development and dredging (2011). Furthermore, the EU has drafted a report on Sustainable inland waterway development and management in the context of the EU Habitats and Birds (2012) http://europa.eu/index_en.htm;

- The Port Authorities have general areas which are reserved for future port extension. The **management of these areas** can easily be done in an ecological manner. One of the items to be discussed is the consequences when important species are settling in these areas. Of course it is of importance that settlement of good species will not endanger the possible future development of these areas for port activities. The concept of temporary protection is presently explored for its ecological potential and legal possibilities in the Netherlands. The ecological potential is significant, since natural habitats suitable for pioneering species are lacking. (See e.g. www.stroming.nl/pdf/guide_tempnature.pdf).

Sheep handle ecological management at Kluizendok
Alongside the Kluizendok in Ghent port, in the winter hundreds of sheep were grazing. The sheep took care of the ecological management of the sites that still have to be further developed. For this form of ecological management Ghent Port Company and the Flemish Maritime Access Agency -both owner and manager of the land- made an agreement with with Natuurpunt ("nature point") and the Flemish Nature and Woods Agency.
Already in 2010 grass was sown in order to prevent sand from flying up. In the past few months, also all bushes and trees that had started growing there by themselves were removed. In order to further manage these sites in a sustainable way, sheep were brought into action. Under the care of a shepherd the sheep were grazing on an area of 300 hectares (http://en.havengent.be/nieuwsdetail.aspx?id=1729).

Ports of Bremen and Bremerhaven, Germany
The container terminal in Bremerhaven had further extensions in the years 1991-2008. The container-quay and the operating area was more than doubled up to ~ 5 km length and more than 330 ha.
For these impacts adjacent to NATURA 2000-sites and the UNESCO-site "Wattenmeer" large compensation sites have been created and are now part of the ecologic port infrastructure. The development and its innovative elements have been described in connection with a best-practice-example for the PERS-certification in 2011.
(http://www.bremenports.de/en/greenports/shaping-the-future/pers-sets-high-standards)

Available Technologies and Resources

- A typical challenge that requires technological solutions is the creation and maintenance of maritime access in valuable estuarine or maritime ecosystems. Creation or maintenance of maritime access should start from a good understanding of the system in which it is created and should as much as possible make use of the system itself and can in some cases even contribute to the well-functioning of the system;
- An example of a port expansion project in sensitive environment is the Port of Botany extension for Sydney ports: (http://www.sydneyports.com.au/__data/assets/pdf_file/0010/3610/PEHEP_Report_ExecSummary.pdf)
- Design new harbour basins and port areas taking ecosystems into account e.g. ensure presence of salt/fresh gradients for fish migration, fish ladders in case of locks and

sluices, use intertidal flats / mangroves / reefs as natural protection against incoming waves, create local sanctuaries for birds and fish in and around port areas, etc. Ensure that designated areas and projects are interconnected and not solitary initiatives.

5.11 Landscape Management and Quality of Life

5.11.1 Challenges

Landscape is an area whose character is the result of the action and interaction of natural and/or human factors and it is a key issue in individual's social well-being and people's quality of life.

Green Ports should look to minimize the impact on the existing landscape. On current infrastructures and activities, this philosophy is needed to appraise the visual impact of landscapes and to correct what is wrong. For new facilities, the design should take advantage of existing topography and vegetation, and prefer low profile infrastructure and equipment, if technically feasible and if the overall facility footprint is not significantly increased.

5.11.2 Issues

Port's infrastructures and equipments that generally could produce greater visual impact are:

- Earthworks: their visual impact could be important and produce effects on the natural character of the coastal environment. They could also imply disturbance of the soil or vegetation removal, primarily for land stability reasons;
- Quarries used for the production of construction materials should require restoration, even if they are quite far from the port location;
- Silos and other huge storage facilities: tall buildings should not create a barrier which obstructs the view of the sea from the city or local communities;
- Open air storage of minerals should be carefully studied, not only they could produce a large visual impact, but also the wind could spread particles. In the latter case, high barriers could solve the problem but increase the negative visual effect on the landscape;
- Cranes and large cargo handling equipment: while increasing in number and becoming larger every time, neighbouring communities complaints on cranes blocking their views have also risen. Noise barriers should also be designed considering their potential visual impact;
- Night Lighting: within the port area, there should be minimal illumination into the sky as well as into adjacent viewpoints, in order to maintain the night time setting. Also, flares associated with the venting of gas by–product or other industrial process should be considered.

5.11.3 Perspective of the Port Authority

- As estate owner: include on tenders/leases the landscaping regulations for new concessioners/tenants;
- As regulator: set own norms but be aware of local and regional landscape policies; even if they do not apply to the port area, it is important to harmonize criteria;
- As developer of infrastructure: include landscaping among the studies to be performed for each new project;
- As a partner of the community: strengthen the links with the city in order to consider views from the community side;
- As centre of knowledge: become a reference on industrial landscaping for the community.

The ESPO Award on Societal Integration of Ports
The award was established in 2009 to promote innovative projects of port authorities that improve societal integration of ports, especially with the city or wider community in which they are located. In this way, the Award wants to stimulate the sustainable development of European ports and their cities. Many of the projects presented during the different editions include many cases with landscape components that become referential outgoing examples for this matter. Brochures for each edition show a brief on each project submitted, and they could be downloaded from http://www.espo.be

5.11.4 Response Options

The best response consists of an integrated landscaping strategy captured in an action plan. The initial stage should be a diagnosis, with a Visual Impact Assessment as the main component of it.

The Visual Impact Assessments should be developed within the port boundaries, and in some cases beyond them, for existing and new facilities (follow and/or adapt methodologies proposed for infrastructure projects in general as those mentioned in references 1 and 2).

The objectives of a visual impact assessment study usually include:

- Description of the existing landscape;
- Identification of potential visual impacts associated with project and operation;
- Proposal of design responses; and
- Reduction, mitigation and management measures and assessment of residual impacts on landscape.

Visual impact results from the combination of visual modification (contrast between the development and the existing visual environment) and visual sensitivity (a measure of how critically a change to the existing landscape will be viewed from various use areas).

Appraisal for new facilities should be done for two stages: construction and operations. Usually they are quite different: the construction stage is temporary while the operations are on long term basis.

Once completed the diagnosis, a holistic landscape strategy could be formulated through a plan, including the proposed mitigation actions. The port should take the decision to adopt the more convenient option based on a case-by-case analysis. Mitigation actions fall under one of the following strategies: avoidance, reduction, remediation and compensation. Examples of mitigation measures are:

- Sensitive location and siting;
- Site layout;
- Choice of site level;
- Appropriate form, materials and design of built structures;
- Lighting;
- Ground modelling;
- Planting;
- Use of colour schemes, camouflage or disguise.

As landscape is often a sensitive issue in the relations of the port with the community, a consultation process will be useful to achieve consensus and support in implementing the measures proposed.

Available Technologies and Resources

- Visual simulations are tools used to predict how a new infrastructure or equipment is likely to appear. Simulations from different public viewpoints, shown on scheme plans, could be prepared. High resolution digital photographs could be taken from each of the viewpoints and their GPS locations recorded. Then, the proposed works should be placed at each specified location. The visualization process involves adding computer generated models of the new construction (including the equipment) in the photos of existing areas. Also a 3D model of the site at the existing stage could be generated. The proposed works could then be rendered in the photographs. Analysis may include changes of the positions of the moving equipment as well as different colour schemes that can be applied to them. These types of tools can be very valuable resources to help educate everyone involved with a new project, from port commissioners to the local community, about the potential aesthetic impact of a new facility.
- The following mitigation measures could be applied specifically at ports:
    - Colour: port facilities could be back dropped by land in views from the primary sensitive viewing locations. In such cases, buildings should be of a colour that is visually compatible with the surrounding landscape. Where appropriate, structures located within the setting of the ocean, such as the quay handling equipment should be coloured such that they appear recessive in views;
    - Visual Screening: community views may be dealt with via visual screening. Visual screening is most effective when employed at the site perimeter. Given the security requirement for views along the perimeter fence to be maintained, any amelioration treatment must be offset away from the fence to maintain a clear visual corridor;
    - Screen Planting: is the most effective manner to provide amelioration up to significant heights – 10 to 15 metres. This will provide screening of the majority of features on the site. Taller elements, such as tanks and stacks will be dependent on material colour selection to reduce their visual impact;
    - Earth Mounding or Bunding: is an effective short term amelioration measure, as it blocks views immediately upon completion. The raw, earth-coloured appearance of mounding is very quickly replaced by the green of germinating cover plants, particularly in tropical locations.

Landscaping for Dry Dock No. 10 in Marseille, France
The dry dock No. 10 was built between 1972 and 1976. It is one of the greatest works of its kind in the world, able to accommodate vessels of up to 800,000 tons. During its design the impact of this huge work on the landscape was mitigated by means of a pioneer study, for this kind of works, for the colours that were used for painting the superstructures. The study started by drawing up a gradational inventory of the coloured perceptions derived from the various site constituents, and inferring preferential relationships. The authors took into account that a painter as famous as Cezanne had been inspired by the mobility of the Mediterranean landscape.

Landscaping of buffer zones in the Ghent Canal Zone
The Regional Zoning Implementation Programme "Delineation of Ghent Seaport Area - Layout R4-East and R4-West" provides for 16 "buffer zones". These are mostly undeveloped areas that act as buffers between the industrial activities and the surrounding villages.
In 2004 the Flemish government charged the Vlaamse Landmaatschappij (VLM: Flemish Land Company) with the task of organizing the land 'Ghent Canal Zone – Coupling Areas'. These arrangement plans indicate where, when, by whom and how the realization of the buffering and landscaping development in the coupling area will be done. In their execution all stakeholders are involved, on the one hand by their representation in a 'plan advisory group' and on the other hand because each design of arrangement plan is also subjected to an advice by the province and municipalities involved that can organize a public investigation.
Depending on their location the coupling areas are arranged as parkland, woodland or farmland and also bycicle routes are integrated in order to create safe bicycle links through the port are.


References for Landscape

1. Guidelines for Landscape and Visual Impact Assessment (2002), Landscape Institute with the Institute of Environmental Management and Assessment, London and New York, Spon Press
2. The Visual Management System (VMS) developed by the US Forestry Service – see also: Bacon, Warren R. (1979): "The visual management system of the Forest Service, USDA" Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, In-cline Village, Nevada.
3. Maguelonne Déjeant-Pons (2006): "The European Landscape Convention" (on line) Paper Presented at the Forum UNESCO University and Heritage 10th International Seminar "Cultural Landscapes in the 21st Century" Newcastle-upon-Tyne, 11-16 April 2005.
4. International Finance Corporation (IFC) – World Bank Group: "Environmental, Health and Safety Guidelines for Onshore Oil and Gas Development" (2007).

5.12 Ship Related Waste Management

5.12.1 Challenges

- Ensuring maximum delivery of ship-generated waste and cargo residues through availability of adequate port reception facilities (compliance with legislative requirements) and the establishment of (financial) incentive schemes in order to avoid waste being discharged at sea
- Ensuring environmentally sound downstream waste processing through application of IT-based monitoring schemes

5.12.2 Issues

The protection of the marine environment can be enhanced by eliminating discharges into the sea of ship-generated waste and cargo residues. This can be achieved by improving the availability and use of reception facilities.

Adequate port reception facilities should meet the needs of the port users, without causing undue delay to the ships using them. Port reception facilities can be fixed, floating or mobile, and should be adapted to collect the different types of ship-generated waste and/or cargo residues.

- Delivery of ship-generated waste:
  - MARPOL Annex I (bilges, sludge, waste oil)
  - MARPOL Annex IV (sewage)
  - MARPOL Annex V (garbage)
  - MARPOL Annex VI (waste from scrubbers, ozone depleting substances)
- Delivery of cargo residues/wash waters:
  - MARPOL Annex I (oily slops)
  - MARPOL Annex II (hazardous/non-hazardous, prewash)
  - MARPOL Annex V
- Delivery of waste from inland navigation:
  - oily wastes
  - wash waters and cargo residues
  - household waste

5.12.3 Perspective of the Port Authority

Port authorities hold a key position regarding the delivery of ship-generated waste, taking into account the different perspectives of a port:

- As an administrator;
- As a regulator/enforcing agent;
- As estate owner.

5.12.4 Response Options

<u>Management Driven</u>

- Port waste management plan: adequacy of reception facilities can be improved by up-to-date port waste management plans;
- Spatial requirements;
- Delivery incentive schemes: cost recovery systems should provide financial incentives for ships not to discharge at sea. These systems preferably reflect the “polluter pays” principle, taking into account the costs for using port reception facilities, including the treatment and disposal of the waste. Several systems are already applied in ports:
  - Indirect systems;
  - Direct systems;
  - Combined systems;
- Data collection and monitoring;
- Enforcement.

<u>Available Technologies and Resources</u>

- Development of port reception facilities (incl. types: mobile, fixed, floating);
- Adequacy issue assessment of:
  - Delivered volumes
  - Volumes to be expected
  - Types and amount of traffic (seagoing vessels as well as inland navigation)
  - Capacity of port reception facility (incl. treatment and storage)
- Waste handling characteristics (incl. equipment and storage);

- Types of cargo handled in port;
- Design of port reception facility;
- Information and monitoring systems.

References
- Port of Antwerp information and monitoring system (WASDIS/WASCOL): data collection and monitoring from advance waste notification to collection of waste by port reception facility;
- ISO Standard (ISO 16304): Ships and marine technology – Marine environment protection - Arrangement and management of port waste reception facilities.

5.13 Sustainable Resource Management

5.13.1 Challenges
Material resources are scarce and should be dealt with carefully:
- Within ports, significant material flows are generated, by economic activities or by infrastructural developments on land or in water. By closing material loops, significant waste flows can be avoided;
- In a broader perspective, i.e. beyond the port area, resource management needs a logistic component. Ports can facilitate resource management, and thus contribute to the development of a greener industry.

5.13.2 Perspective of the Port Authority
- Facilitator or key player in the logistic chain;
- Developer and manager of infrastructure;
- Facilitator of innovation.

5.13.3 Issues
Closing material loops requires cooperation between companies to detect (waste) material streams they can exchange. Therefore companies must have some kind of forum to exchange information, experiences and good practice examples.

Recycled material
In some cases, municipal ordinances drive Ports to achieve various levels of recovery of recycled materials. However, many ports already have well established in-house recycling programs and also participate with local community agencies to maximize their recycling efforts.

Ports can also include reduce-recycle-reuse policies as part of an Environmental Management System (EMS) and sustainability program. Waste minimization and recycling programs include measurable goals, objectives, monitoring requirements, and reporting schedules to track progress and to identify areas of improvement.

Recycling of construction material is an accepted practice. Construction and demolition projects, generally large in scale, provide excellent opportunities for cost effective recovery of large quantities of construction debris including metal, wood, concrete, and asphalt.

5.13.4 Response Options
Management Driven
- Provide forums for companies to exchange information on closing material loops: support cooperation between companies both inside and outside the port;

- Collect and disperse practical information on cooperation and material exchange;
- Incentives (deduction of concession charges) to encourage sustainable resource management;
- Obligatory minimum levels of material reuse for new companies, i.e. in newly developed industrial zones;
- Park management.

Available Technologies and Resources

- Close the gap/umicore project with WEEE
- Material management of dredged materials.

6 Institutional and Social Aspects (Port Governance)

6.1 Governance at all Levels

Governance, the process of decision-making and the process by which decisions are implemented, can be considered in several contexts such as: corporate, international, national and local. The analysis of governance focuses on the formal and informal actors involved in it and the formal and informal structures that have been set in place to arrive at and implement the decision.

Government (at different levels) is one of the actors in governance. Other actors involved in governance vary depending on the context considered and they may include:

- Media;
- Lobbyists;
- Multi-national corporations;
- NGOs;
- Finance institutions;
- Political parties;
- Public;
- Communities;
- Industry Groups;
- etc.

All of them may play a role in decision-making or in influencing the decision-making process.

Good governance means competent management of the resources and affairs in a manner that is open, transparent, accountable, equitable and responsive to people's needs (including the views of minorities and of the most vulnerable). Other key characteristics of good governance are: being effective, being efficient, and following regulations to ensure that corruption is minimized. In a broader sense, it means being responsive to the present and future needs of society.

Ports of Bremen and Bremerhaven, Germany
Companies of the maritime business of the Federal State of Bremen introduced under the label "VIA BREMEN" a working group/network for sustainability and carbon-footprinting. The port manager "Bremen Ports" is a central driver for cooperation and innovation.

6.2 Legal Framework

The relation between ports and the regulatory framework is not uniform worldwide: in some regions, ports tend to regulate themselves as much as possible (e.g. the Hanseatic ports in Europe), while in other regions, ports rather rely on a strong national legal framework.

In any case, in the Green Port concept, port authorities are proactive orchestrators which, ahead of legislation and based on stakeholder values, determine their future strategies and create the needed conditions for the license to operator and grow. They invest in creating values that meet the demands of the future. In that case the (future) legal framework should at least recognise those needs and support these developments with appropriate legislation and regulations.

Developing initiatives ahead of the regulations is the best way to have regulations in place which would be functioning from operational and societal perspectives and to avoid a cascade of sub-optimal regulations.

At the same time, it is also of great importance that port authorities adhere to existing national and supranational legislation, working together with public authorities when there is a necessity to develop this legislation in more detail. Especially when concerning nature protection and ecosystem developments, effects of measures taken are only visible in the longer term (>3-5 years). This calls for a stable legislation that, once implemented can be fine tuned or corrected but not changed repeatedly. Port authorities can cooperate with public authorities to ensure that the existing legislation is developed and stabilized to allow for long term sustainable implementation. Evaluation of the legislation can take place when monitoring results are available after several years.

6.3 CSR and Stakeholder participation

The corporate social responsibility (CSR) is (following the European Commission definition) the practical way companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis. This concept considers that businesses have responsibilities that go beyond satisfying the needs of their shareholders and customers while staying within the law.

The CSR is related to the broad concept of sustainability that considers the Triple Bottom Line. Within this framework, port businesses should consider their responsibilities to suppliers and workers along with the global logistical chains in which they are integrated, to those people who are not directly related to their activities but are impacted by them, and to future generations of stakeholders. Port authorities have the opportunity to encourage companies within the port areas to produce yearly CSR reports and stimulate sustainable awareness and -operations.

Stakeholders, according to the CSR definition, are the main receptors of the companies' actions towards them. Stakeholders are any individual or social group having interest or being affected by the activities of the company. In the case of port companies, they could be classified into:

- Internal stakeholders: managers, employees, board members and shareholders of the company.
- Market players: stevedoring companies, inland transport operators, shipping lines and agents, freight forwarders, logistic service providers, tugs, pilots, port industries, shippers, cargo surveyors.
- Public policy makers: local, regional, national and supranational.
- Community groups: local inhabitants, consumers, tax payers, environmental groups, the press.

Clearly, there is a need for each port to identify, understand properly and create positive relationships with its relevant stakeholders. This can be done e.g. through cooperation between port authorities and stakeholders concerning input for the CSR reports. In the case of large scale development projects, joint CSR reports can be made specifically for the project during the duration of the project.

6.4 Stakeholders

This chapter provides a list of main stakeholders typically involved in port development and operations, describing their responsibilities and the opportunities they have to promote sustainable development. In all cases, stakeholder interactions are necessary with regards to a successful implementation of the Greenport concept.

6.4.1 Public Authorities

Public Authorities comprise those at national, regional or local level, including the city. They are ruled by their own laws and regulations covering most activities of citizens and companies

operating within the boundaries of their jurisdictions. In some cases, they are shareholders / part owners of the port authorities. They are responsible for making public policies at all levels: local, regional, national and supranational.

The national authorities are members of international organization and have subscribed many conventions that became part of their national legislation. In some cases, the national authorities are the local enforcement authority of the international conventions, for instance the IMO conventions.

Ports are subject to general legislation, but if they are publicly owned, they are, in some way, integrated on the Public Administration. In any case, the relations between the port and the local authorities have their main component in common sustainable issues. Cooperation and mutual understanding are key factors to achieve the best results in this field.

6.4.2 Port Authorities

Port authorities have been designated to manage the port. They are involved in the day to day management as well as on the mid and long term planning. The success in becoming a green port and keeping the impetus depends to a great extent on their conviction and skills.

The port is organized in a way that some staff is responsible for the sustainable performance of the organization. But, a truly Green Port should have its whole staff committed to following this philosophy at each level and for all activities.

Finally, the port managers as individuals should not forget that they are also part of the community where they live.

6.4.3 Technical Experts

Technical Experts play a fundamental role in developing sustainable and environmentally friendly ports. In most cases, the planning authority concerned with the port development has hired external support for certain required expertise relevant for planning and design. Therefore, the aim of this guideline is to facilitate the Technical Experts services as related to incorporation of sustainable design principles into port development projects. Hence, Technical Experts will be used to strengthen port projects through improvements in aspects relating to environment including socio-cultural issues, operational aspects, land-side and water side impacts as well as pollutant control.

For the concept of a sustainable port, Technical Experts must integrate environmental issues into the whole process of port development with focus on: energy saving, resource conservation and sustainable port layout planning. This will require a change of the design principles from a purely technical approach to a holistic approach with focus on social, economic and environmental issues.

6.4.4 Contractors

Contractors working for ports are involved in large projects such as new facilities/infrastructure or in smaller projects including maintenance. The size and characteristics of the projects require different kinds of contractors to be hired by the port. Local firms usually are preferred for the smaller jobs, while larger national or international firms are preferred for the bigger contracts.

The works on the port areas are quasi permanent, and big projects could last many years. For that reason, the behaviour of the contractors working in the port area is of main concern for the Port and the surrounding community. A typical example are complaints due to additional traffic generated around the works, with a lot of heavy vehicles producing noise, vibrations,

emissions, congestion on roads, potential accidents, etc.

Any sustainable work done in the port environment requires special skills and when the work is performed by contractors without adequate experience it often leads to negative experiences and publicity. However, it is equally important that the Port Authority work closely with Contractors also demonstrating a commitment to sustainability. Contractors performing work on the ports must have proven and verifiable references to determine their:

- Working knowledge of the marine environment;
- Provision of adequate means to work in this environment;
- Sustainable policies strictly enforced in their work (employment, health and safety, waste treatment, energy saving, etc ...) adapted to this environment.

The port should ensure that similar criteria applies towards all the subcontractors.

6.4.5 Financiers

The financial institutions provide capital to make the necessary investments to develop the port. Financiers could be international organizations with a global activity (World Bank), regional (IDB, AFDB, ADB, EBRD, etc.), national or private. Most of the recognized institutions presently have their own codes linking their lending policies to sustainability criteria.

Prior to any operation, the fund managers should conduct environment and social risk assessments on prospective investments and monitor environment and social Action Plans designed to improve the environmental and social soundness of the investment.

6.4.6 Shipping Companies

Shipping Companies could be seen as the first in the order port customers. As owners and operators of the ships that will use the port facilities, their new requirements usually are at the very beginning of any new port facility planned. The trends on new ship construction (in particular their size) and innovative technologies represent frequent challenges for the port.

Ships' productivity is linked to efficient port services and Shipping Companies are always pushing for efficient operations. They are also integrated in the logistical chain, and thereby involved in related businesses thus allowing for further expansion of sustainable working methods.

6.4.7 Shippers

Shippers of cargo have more and more interest to have their cargo transported in a sustainable way. This is a result of demands made by their ultimate customers and passed down the cargo transport chain – the consumers. For instance a number of shippers have joined forces together with some carriers in the clean cargo working group with the objective to better understand and to assess the footprint of transport of goods. Indeed, logistic supply chains, in which ports are nodal points, can have by themselves relevant social, economic and ecologic impacts. At present, sustainability performance of logistic supply chain is not yet frequently reported in sustainability reports of shippers, and if it is done, it is done in a very quantitative way.

Reporting about the sustainability performance of logistic supply chains could contribute to a more objective and targeted measurement of sustainability performance of ports and could eventually contribute to the sustainability performance of shippers and their goods.

6.4.8 NGO's

Non-governmental organizations (NGOs) are legally constituted organizations that operate independently from any form of government and they are neither conventional for-profit

businesses nor branches of political parties.

NGOs are typically value-based organizations which depend, in whole or in part, on charitable donations and voluntary service. Some are organized around specific issues, such as human rights, environment or health, and many of them have become increasingly professional over the last two decades.

NGOs could be classified into:
- Community-based organizations (CBOs) - which serve a specific population in a narrow geographic area;
- National organizations - which operate in individual developing countries, and;
- International organizations - which are typically headquartered in developed countries and carry out operations in more than one developing country.

NGOs have become major players in the field of international development. Institutions like the World Bank (WB) began to dialogue with NGOs in the 1970s on environmental concerns. After three decades of interaction, the WB learned that the participation of NGOs in government development projects and programs can enhance their operational performance by contributing local knowledge, providing technical expertise, leveraging social capital, and bringing innovative ideas and solutions, as well as participatory approaches, to solving local problems.

Throughout the 1970s and 1980s, most examples of WB-NGO collaboration involved international NGOs. In recent years, however, this trend has been reversed; an increasing number of projects involve community based organizations.

6.4.9 Others

As mentioned, port's stakeholders are numerous and various. Among those not mentioned previously, there are:
- Labour union sections (port employees, portworkers / stevedores, seafarers, etc.);
- Business firms working on and around the port (stevedoring companies, inland transport operators, shipping agents, freight forwarders, logistic service providers, tugs, pilots, port industries, cargo surveyors);
- The local community, fishermen, yacht clubs, the media, etc.
- Hinterland transporters (lorry drivers and companies, train companies, river barges).

Each of them has their own interests and could be affected by the port activities.

6.5 Reporting

With the framework of corporate social responsible policy, some ports are reporting about a number of indicators that cover economic, social and environmental issues. The cornerstone of CSR reporting is the interaction with different stakeholders. Through identification of and reporting about relevant (environmental) issues, a basis is provided for new initiatives contributing to the license to operate, basis for development and operations at each and every port.

Integrated Port Community CSR (Port of Antwerp)
In the frame of the efforts to enhance the active involvement of the Antwerp Port community in improving the overall sustainability performance of the port, the public sector (port authorities) and the private sector, represented by Alfaport Antwerp, have drawn up a first sustainability report for the port of Antwerp. It was the first sustainability report for a port area worked out jointly by private and public sectors.

The report was worked out in accordance with the GRI standards. The stakeholders were involved intensively during the whole process. Representatives of companies and industry, trade unions, local governments, NGO's, agricultural organizations, transport sectors and institutes involved in educational programs participated actively in discussions regarding the topics that should be included but they were also involved in the evaluation of the text proposals. From the discussions it became clear that the GRI guidelines do not always cover the reporting needs that emerged and that there is a need for a sector supplement on ports.

The outcome of the stakeholders process and the selection of indicators resulted in an integration of sustainability indicators for people, planet and profit more or less linked to the route followed by goods that enter the port of Antwerp. The report was presented by the port community in 2012, rather than by the port authority and integrates ca. 40 (environmental, social and economic) indicators http://www.sustainableportofantwerp.com/en/catalog_overview/109. The report was published next to the port authority´s own yearly (sustainability) report.

Some countries are promoting the obligation to report regularly on their sustainable performance. In Spain, the Ports Act (enacted in August 2010) makes a clear commitment to sustainability. The new Act requires each Port Authority to prepare an annual report on sustainability. Puertos del Estado, the entity in charge of harmonizing all Spanish ports of general interest, has published, in collaboration with the Port Authorities of Coruna and Valencia, a "Guide for the preparation of sustainability reports in the Spanish port system" that allows for communicating the results of environmental performance to economic and social system members. The guide uses GRI as it mains reference.

The Global Reporting Initiative (GRI) is a network-based organization that produces a comprehensive sustainability reporting framework that is widely used around the world. This Reporting Framework is based on the principles and Performance Indicators that organizations can use to measure and report their economic, environmental, and social performance. Its cornerstone is the Sustainability Reporting Guidelines. The third version of the Guidelines – known as the G3 Guidelines - was published in 2006, and is a free public good. GRI started with the development of a thoroughly revised version, the G4 guidelines. Next to these general guidelines on sustainability reporting, a number of sectoral guidelines are available (e.g. for airports).

Ports that are making a sustainability reports include: Port of Amsterdam (Netherlands), Port of La Coruna (Spain), Port of Sines (Portugal), Port Metro Vancouver, Port of Rotterdam, Port of Antwerp, Port of Los Angeles, Port of Auckland and Port of Sydney. Some of the reports are focusing on the activities of the whole port; some are focusing on the activities of the port authorities. Some are drawn up by port authorities; some are drawn up by port communities.

From these reports, it can be seen that

- There are a number of port specific elements that are not included in general (GRI) guidelines;

- There is potential to increase the number and quality of sustainability reports;
- There is potential to create more uniformity, at least as far as process is concerned.

A sector supplement to the GRI guidelines on sustainability reporting for ports would therefore be useful.

6.6 Environmental Management Systems and Certification

Certification refers to the confirmation of certain characteristics of the organization, in our case a port. This confirmation is usually provided by some form of external review, evaluation, assessment, or audit.

With the advent of the International Standards Organization (ISO) and the promulgation of ISO9001 (Quality Management System), ISO14001 (Environmental Management System) and ISO26000 (Social Sustainability), international ports were early adopters of a systematic approach to port operations and development certifications.

There is significant implementation of environmental management systems (EMS) or a facsimile thereof at seaports worldwide. The majority of seaports that utilize EMS limit the systems to specific properties, operations, or programs. This approach is commonly referred to as a "fence line EMS." While EMS implementation is becoming more common at seaports in the U.S., full ISO14001 certification can be a time consuming and costly endeavor that only a few seaports have completed (e.g. the Port of Brisbane). However, many seaports are "self-declared" (i.e. self monitored) and continue to find great benefit in improved operational efficiencies, improved environmental compliance and stewardship, and cost savings. In the U.S., the American Association of Port Authorities has sponsored an EMS program for over 25 port authorities to help realize these benefits.

Adoption of a 3rd party audited EMS can have significant benefits, not only in terms of identification and management of environmental risk, but also in terms of regulator confidence. In some cases, regulators may have greater confidence that development approval conditions will be complied with given the systematic approach incorporated in the port's EMS.

In Europe, with the full support of ESPO, the concept of port environmental management has developed markedly during the last 15 years. The progress was driven by mutual collaboration between the port sector, research institutions and specialist organisations. The framework for this mutual collaboration was developed through joint activities instigated and funded by primary port partners and part-funded by EC Research and Development Programmes. The cooperation between port professionals, academic researchers and specialist organisations has proved to be a potent mix in terms of delivering a functional framework of cost-effective solutions developed to implement policies and produce continuous improvement of the port environment.

A systematic approach to environmental management enables the continuous identification of an individual port's priorities while introduces a functional organisational structure that sets respective targets, implements measures, monitors impact, evaluates, reviews and takes corrective actions when and where necessary. In this way ports can achieve and demonstrate continuous environmental improvement. The ESPO / EcoPorts tools and methodologies provide a proven overarching framework that assists ports in their environmental management (www.ecoports.com).

The Self Diagnosis Method (SDM) is a well established methodology for identifying environmental risk and establishing priorities for action and compliance. SDM is a concise checklist against which port managers can self assess the environmental management

programme of the port in relation to the performance of both the sector and international standards.

Over the last 10 years, the Port Environmental Review System (PERS) has firmly established its reputation as the only port-sector specific environmental management standard. PERS stems from work carried out by the ports themselves and it is specifically designed to assist port authorities with the functional organisation necessary to deliver the goals of sustainable development. The overriding ports element is especially important. There is plenty of advice available on general environmental topics but the highly specialised nature of the environmental challenges in the port area that port authorities face, means that a "custom made" approach is absolutely vital. While incorporating the main generic requirements of recognised environmental management standards (e.g. ISO 14001), PERS is adapted to deliver effective port environmental management and its implementation can be independently certified by Lloyd's Register. Furthermore, the scheme effectively builds upon the policy recommendations of ESPO and gives ports clear objectives at which to aim.

Ports of Bremen and Bremerhaven, Germany
The environmental management of the Ports of Bremen and Bremerhaven has been certified after the PERS-standard in 2011. Central elements and information about the environmental management in the ports are open to the public by the environmental report 2010 on the greenports-internet-portal. The port manager "bremenports" is in contact with other ports (national & international) to help them introducing green-port-elements and is a competent partner for the public.

Several seaports were also certified by the European Union´s Eco-Management and Audit Scheme (EMAS). This is a voluntary instrument which acknowledges organizations that improve their environmental performances on a continuous basis. EMAS differs from ISO14001, not only by its governmental-legal origin, but also by its more stringent requirements.

Portcompliance (www.portcompliance.org) is a USA port sector tool developed in partnership between the National Center for Manufacturing Sciences (NCMS) and Environmental Protection Agency (EPA) Region 2 with the support and assistance from the Port Compliance Assistance Focus Group consisting of industry, federal, and state regulatory agencies.

This tool emphases environmental, land-based, regulatory issues facing port tenants and authorities. Included are common port operations cross referenced with regulatory requirements; audit program incentive opportunities; enforcement case studies and updates; inspector checklists. To demonstrate the beyond compliance arena guidance on environmental management systems, diesel retrofit and other good practices and community outreach initiatives are included.

6.7 Environmental Permits

Although the philosophy of a greenport is to operate beyond legislation based on a long term strategic plan also the port is subject to existing regulation which includes the compliance to environmental permits.

Around the world permitting procedures are different in their appearance, but ports could together with the permitting authorities pro-actively promote that the permitting instrument is transparant and includes stakeholder involvement and that the instrument is used to ensure:

1. Integrated assessment of port activities
2. Integrated monitoring and evaluation of port activities.

And it should be realized that in a many situations transparant agreements with operators or

listing of requirements in contracts can be upfront or instead of the permitting procedures very effective.

Some countries use or are developing umbrella permits for port areas. The opportunity of such a permit is that it can anticipate on managing the activities within a certain or a reducing environmental space. And it will also enable the area manager, e.g. the landlord port authority and the permitter to look at the area in an integrated way and assess the activities in a holistic way. It could be an effective instrument in the lease and contracting processes with regard to the clients and operators in the port. It however should not interfere with the responsibilities of the port authority and the responsibilities of the individual users of the port area. But when used well it can be a welcome instrument for the landlord port manager to ensure long term sustainability and improve the transparency of the footprint of all the industrial and terminal related activities the port area, including the footprint of its related transport processes, when supported by integrating monitoring and evaluation processes.

6.8 References for Institutional and Social Aspects

UNESCAP www.unescap.org/pdd/prs/ProjectActivities/Ongoing/gg/governance.asp
GRI www.globalreporting.org
UNEP www.unep.org
ESPO www.espo.be
ECOPORTS www.ecoports.com

7 Conclusions and Recommendations

Conclusions:

1. In a sustainable port, the role of Port Authorities changes from re-active landlord to pro-active partner in the development of the region and of the logistic chain.

2. Co-operation with all stakeholders is essential in any port development and operations;

3. Port activities are increasingly governed by limited and decreasing environmental space and resources. A Sustainable Port develops in harmony with its environment.

4. Sustainable ports follow a new growth paradigm that is truly sustainable with green growth as an economic driver.

5. There are numerous technological and societal developments to be taken up by ports to facilitate the transition towards green growth;

6. Ports are in a unique and privileged position in the global logistic chain to capture and evolve their roles to initiate and consolidate the needed change, for their own benefit and the prosperity of the region that it serves.

7. As port development takes place over a longer time perspective, sustainable port development is based on a long term proactive vision irrespective of actual regulations.

Recommendations

Sustainable Ports use their roles to a maximum to accommodate the transition to green growth for their own benefit and the prosperity of the region they serve:

Area manager
- Stakeholder values should be included in the strategic planning, in a way that provides leadership, so that the area can create more value than just the traditional commercial value of the primary port functionalities.
- Sustainability should be the primary focus in the port master planning.
- Master planning should fit into a larger picture of integrated area planning which serves the connectivity, the liveability and the biodiversity.
- Use scarce land resources efficiently and create bufferzones, landscape, aesthetic areas and added value in developments.

Estate owner
- Include sustainability in selection/location of tenants and in lease contracts;
- Organise sustainable estate management that adds value by providing accompanying services and infrastructures. (e.g. local smart grids, combined waste (water) treatment, renewable energy services, public transport, facilitating cradle to cradle concepts…);

Manager in the logistic chain
- Facilitate and promote adequate (multimodal) infrastructure, within the port boundaries and towards the hinterland and the inter port connectivity.
- Facilitate and promote ICT infrastructure and data exchange in order to organise the efficient and effective transport and distribution of the cargo flows.
- Develop tools to change behaviour of the users of transport infrastructure towards a

more sustainable and better use of existing infrastructures.
- Coordinate and co-operate with other nodal points in the logistic chain in order to realize the most sustainable logistics to and from the (shared) hinterland and in door-to-door logistics.

Administrators
- Include price mechanisms in lease and use of the port and its infrastructure towards more sustainable development and use. E.g. differentiated port dues and lease prices.

Regulators and enforcing agents
- Cooperate with other regulatory and enforcing agents in order to achieve objectives (e.g. environmental zoning)
- Include sustainability considerations in the port by-laws (e.g. bunkering, power supply, waste, oil spills,..).

Developers and managers of infrastructure
- Sustainability in development and management of infrastructure (e.g. when contracting and procuring) and develop and use criteria with regard to:
    - Land-use
    - Energy use
    - Emissions to air, water and soil
    - Connectivity
    - Lifecycle impacts and lifecycle costs and benefits
    - Effects on and contribution to biodiversity (cfr. working with nature)

Port operators
- Set an example to port users in activities run by the port authority.

Central points for knowledge
- Create a knowledge base on environment, asset-management, energy, traffic flows,…
- Facilitate and mediate in knowledge transfer aiming for sustainable development
- Develop strategic alliances with public authorities with regard to collection of data and reporting.

Facilitators of innovation
- Create space for innovation(physical, regulatory and creative)
- Co-finance with other partners initiatives for innovation
- Stimulate cross-sectoral learning and innovation
- Promote awards, seed funding, crowd sourcing and public panels
- Develop strategic alliances between (higher) education and research organisations and the port community.

Partner in community
- Create community platforms and public peer teams to stimulate dialogue and transparency with regard to sustainable port development and operation
- Set the tone in transparency

Port authority as economic developer
- Ports are responsible for a sustainable economic development of their area and thus develop commercial activities. The provision of good environmental services towards shipping lines can make the difference when these are making choices between ports. Offering a green component in a green logistic chain can be an added value for instance when choices are made for fairtrade products. Or a clear and strong permitting

and inspection framework can be an added value for shippers who want to avoid that there goods are ending up in places (associated) with environmental problems.

Recommendation chapter 5

- Knowledge:
  Continuous learning and sharing of information of knowledge and experiences. Organise and disclose the knowledge network in order to improve.
- Innovation:
  Joining forces amongst ports is crucial to deal with the challenges and be effectively innovative.

Recommendations chapter 6

- Knowledge:
  Ports should be pro-active in development of tools together with the governing authorities and the users to monitor the relevant parameters that play a role in the transition towards a sustainable port.
- Community:
  Together with the authorities and the stakeholders they should develop a framework for reporting and evaluation (also for operation).
- Community:
  Use ISO and GRI standards.

(what is done for environment is not any different than what is done traditionally done)