

New environmental performance baseline for inland ports.

A benchmark for the European inland port sector.

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ABSTRACT

This paper presents the results of a collaborative programme of action between the European Federation of Inland Ports (EFIP) and the EC PORTOPIA research project to assist EU inland ports to enhance further their environmental performance. In order to achieve this goal, an environmental survey was specifically designed to reflect the operational and geographical circumstances of inland ports and to help to accelerate the culture of the reporting of environmental performance.

The survey was developed to be user-friendly and practicable, and based on established good-practice taking into account the suggestions and advice of EFIP and its members, as well as the experience of the EcoPorts Network. As a result of the survey, an initial baseline of environmental performance for the EU inland port sector was established.

A total of 27 port authorities participated in the survey, representing a range of port profiles in terms of size, commercial profile and geography. All response details were treated in strict confidence and the benchmark performance was reported as a European average. Results show that approximately 70% of the respondent ports declare that they have the major components of an Environmental Management System (EMS) actively in place (e.g. policy, inventory of legislation). An environmental index (1-10) has been calculated reflecting the performance of the sector in terms of the application of major EMS components. The average index value for the EU inland port sector baseline resulted in 6.

Almost 67% of respondent ports indicated that they conduct environmental monitoring of different aspects, with waste being the most common. The survey results have also delivered the first top-10 ranking of environmental priorities for the EU inland port sector. It is interesting to note that also almost 70% of the inland ports apply initiatives to implement green actions. The outcomes of this paper are likely to be of interest to a wide range of stakeholders and decision-makers.

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Keywords: *Inland Ports, environmental performance, indicators, environmental management, European benchmark*

INTRODUCTION

Inland ports are very diverse in the functions they fulfil, the role that they play in the modal shift and in their size, as recognized by the European Federation of Inland Ports (EFIP) (www.inlandports.eu). The policy of this institution is to foster the use of the inland waterway, which is one of the three most environmentally friendly modes of transport along with rail and maritime transport (EFIP, 2015).

For this reason, EFIP and the European Commission believe that inland ports have a strong potential that requires investment in order to optimize the co-modal transport chain and to contribute to a sustainable transport. EFIP and its members recognize that the development and use of inland waterway infrastructure must be performed taking into consideration European and other environmental legislation. In fact, the EU approach towards inland ports has been already defined in different policies and documents, such as the revised Trans-European Transport Network policy (EC, 2007) and the Combined Transport Directive (EC, 1992). Both highlight the potential of inland waterway transport and combined transport as a more sustainable alternative to pure road transport (EFIP, 2015).

To achieve integration and sustainability of inland ports, EFIP has fostered different environmental initiatives, such as the implementation of Liquefied Natural Gas (LNG) refuelling points and shore-side electricity supply, promoted by the EU-Commission (EFIP, 2015). In addition, different European projects supported by EFIP, such as Connecting Citizen Ports (CCP21, 2010), the DaHaR project (DaHaR, 2011), or the WANDA project (WANDA, 2012) have also been devoted to improve inland ports' performance. The first one aims at encouraging connectivity and sustainable transport among inland ports from Belgium, France, Germany and Switzerland (e.g. port of Paris, Brussels, Basel), whereas DaHaR and WANDA projects have the goal to enhance the sustainability of the inland port transport in the Danube Region.

In this paper, an initiative is presented to promote sustainability and integration of the EU inland port sector through a diagnosis of the environmental performance of the member ports. This initiative, conducted within the framework of the EC PORTOPIA project (www.portopia.eu) and with the supervision and collaboration of EFIP, took the form of an environmental survey dedicated to inland ports. The scientific basis for the development of the survey as well as the validation process and the gathered outcomes are presented in the current document.

INLAND PORTS AND ENVIRONMENT

Inland port definition

The research pathway took into account the definition of the concept of inland port in order to target the main actors, limit the scope, and to develop a suitable approach for this particular type of ports. However, there are few comprehensive and recognized definitions in the literature. In fact, inland ports are generally included in a broader term called *Inland node* that could be defined in general terms as "An inland location where a trade activity is conducted,

regardless its scale” (Rodrigue, 2015). Although the breadth of the definition of this type of nodes, all of them gather the following three characteristics (Rodrigue & Nottebom, 2013):

- Existence of an intermodal terminal (e.g. truck, rail, barge).
- Connection with a port terminal through rail, barge or truck services, often through a high capacity corridor.
- Existence of logistical activities that support and organize the freight transited, often collocated with the intermodal terminal.

When focusing on inland ports, one general and accepted definition is the one of Rodrigue & Nottebom (2013): “A rail or a barge terminal that is linked to a maritime terminal with regular inland transport services”. According to this definition, an inland port has a level of integration with the maritime terminal and supports a more efficient access to the inland market both for inbound and outbound traffic. This implies an array of related logistical activities linked with the terminal, such as distribution centers, depots for containers and chassis, warehouses and logistical service providers.

However, the inland port definition is still very broad and can have different interpretations. Therefore, for this study the aforementioned definition has been adapted to: “An Inland port is a strategic multimodal node that includes at least a ship or barge terminal with connection with other ports (maritime terminal or inland port) before reaching the oceanic or sea trade”. It is important to highlight that the present definition has been validated by EFIP, which has collaborated and contributed with its knowledge, advice and experience throughout the study.

EFIP environmental initiatives

As previously stated, one of the main purposes of EFIP is to foster sustainability among its port members. This statement is clearly recognizable in its annual reports, policies and newsletters. The message is reinforced by EFIP’s logo that combines the elements of rail, road and barge traffic, signifying the multimodal nature of inland ports’ activities. In addition, the blue and green colours reflect the sector’s strong link with the water as well as its commitment to contribute to an environmentally sustainable transport system (EFIP, 2014).

In fact, EFIP is devoted to promote a greener inland waterway transport sector in order to maintain its proactive profile in terms of overall environmental performance. Therefore, EFIP supports policies aimed at further reducing emissions from inland waterway transport, pointing out that the special economic circumstances of the sector should be taken into account. Thus, on this basis, it recommends that strict emission standards should be accompanied by meaningful financial support measures, in particular for the retro-fitting of the existing fleet (EFIP, 2015).

Another evidence of EFIP’s commitment to the environment is that its members are currently actively working on the provision of alternative fuels, such as LNG and shore side electricity. A good example of that is the LNG Masterplan for Rhine-Main-Danube (Seitz, 2013) which has the objective of facilitating the implementation of LNG as fuel in inland navigation.

Port Straubing (Germany) provides another example of EFIP inland ports’ best practice which is the existence of three different companies that supply biomass to produce biofuel (biodiesel), achieving an Eco-friendly inland navigation (Kluge, 2012). The success of this type of facilities depends on the natural resources of the inland port surrounding area. Focusing on this point,

due to the abundance of forests and agricultural areas of the Danube riparian States (e.g. Germany, Ukraine, and Romania), the approach of the Port Straubing could be implemented in other inland ports. In fact, the potential benefits of introducing bio-based chemicals as a raw materials instead of the conventional fuels (petroleum-based chemicals) were mentioned by Mr. Kluge, Managing Director of the Federal Association of German Inland ports (Kluge, 2012).

Another example is the Magdeburg Port (Germany), which uses eolic energy as an alternative resource, providing enough energy to reduce the diesel consumption and achieving an important decrease on the emissions of contaminant compounds (CO₂, NO₂, SO₂, etc.) and noise (Kluge, 2012).

Finally, as already introduced, EFIP has been involved in several European projects aimed at performing a sustainable management among inland ports (e.g. DaHaR, WANDA). The most recent one is the ongoing PORTOPIA, in which EFIP has strongly collaborated and acted as an external advisor offering its experience and influence within the EU inland port sector.

The PORTOPIA project's purpose regarding inland ports is to select a list of Key Performance Indicators (KPI) according to the EU inland ports needs and characteristics, and integrate them into the project database (ports observatory dataset). In order to gather data on different Environmental Performance Indicators (EPIs), an environmental survey tailored for inland ports was developed. It takes into account their special needs and characteristics in terms of functionalities and dedicated resources. The survey development, validation and results are the main strengths of the present study and have been described in detail in the following sections.

METHODOLOGY

To develop the environmental survey for inland ports, a background literature and a web-based search on environmental indicators used in inland ports was conducted. The results demonstrated that there is a lack of data on specific EPIs for this particular type of port. It may be suggested that the reason lies in the fact that inland ports either do not generally present a systematic register of EPIs or it is not publicly available.

For this reason, the research on environmental indicators was extended including other sources such as the EPIs included in the Global Reporting Initiative (GRI, 2006) or the EPIs used in the seaport sector. Apart from this, different environmental initiatives observed in inland ports such as the ones mentioned before (i.e. biomass production, LNG bunkering) were also taken into account. Another source of EPIs considered was the European Sea Ports Organization (ESPO) environmental questionnaire, a survey circulated every four years among ESPO ports where the top 10 environmental issues are ranked by priority (ESPO, 2013) and may provide information on potential EPIs.

For the EPIs used in the seaport sector, different projects focused on port environmental management that had identified several EPIs were reviewed. This is the case of EcoPorts project (Darbra et al., 2004), PEARL project (Darbra et al. 2009), PPRISM project (Puig et al., 2014) as well as the ongoing PORTOPIA project. The first one, EcoPorts (2002-2005), developed a tool with a list of 125 EPIs assisting ports in reporting their environmental performance according to their needs (Darbra et al, 2004). In addition, in this project another useful tool to identify environmental indicators was developed: the Self-Diagnosis Method (SDM) (Darbra et

al., 2004). It is a general questionnaire that aims at providing an overview of the situation to the respondent ports regarding mainly environmental issues.

The second one, the PEARL project (2006-2008), had the objective to research and improve the understanding of which aspects need to be monitored by European ports (Darbra et al., 2009). A top ten ranking of the port's environmental monitoring needs was developed (e.g. marine related issues, water quality) providing an overview of the most required environmental indicators.

The third one, PPRISM project (2010-2011), had the goal of establishing a culture of performance measurement in European ports (Puig et al., 2014). In this project, research on environmental indicators was conducted classifying them in three categories: management, operational (related to the operations conducted in the ports such as carbon footprint or water consumption) and condition indicators (specific for each port such as air, water and sediment quality).

Finally, the PORTOPIA (2013-2017) project main goal is to create an online database accessible to all the ports in order to facilitate the reporting and benchmarking. The established environmental categories of the PORTOPIA database are the following ones: (A) Environmental management, (B) Environmental monitoring, (C) Top 10 Environmental priorities and (D) Services to shipping. All in all, this wide amalgam of information and sources of indicators was considered sufficiently solid and scientifically robust to be used as a background for the development of the environmental survey for inland ports.

Survey development

Although different sources related to seaports were taken into account, it is important to note that the situation in inland ports is slightly different to the one in seaports and it has its own characteristics. It may be suggested that the culture of monitoring and reporting in inland ports may be relatively restricted compared with seaports due to their special circumstances in terms of dedicated resources such as personnel, technology and funding. There are circumstances where an inland port may currently face a greater challenge in terms of the actual implementation of a programme of monitoring and reporting.

The main goal of the present study was to develop an approach to raise awareness of inland ports to the potential benefits of implementing and operating a culture of environmental monitoring and reporting through a recognized EMS programme.

For this reason, instead of requesting a detailed list of environmental EPIs, it was considered more reasonable to develop a general environmental survey in order to have an overview of the current situation of the environmental performance of inland ports. The survey was developed taking into account the sources of EPIs already introduced but following mainly the approach of the established EcoPorts' Self-Diagnosis Method (SDM) combined with the categories identified by the PORTOPIA project. The SDM approach, together with the EcoPorts network, have encouraged seaports towards their current, well-recognized culture of environmental management and reporting. Therefore, the proposed approach was considered to be appropriate in order to enhance inland port's reporting culture.

In order to persuade the inland ports to share information related to their performance, inland ports characteristics and particularities were taken into account. To do so, the environmental survey was based on the following set of criteria, validated by sector professionals and EFIP:

- **REALISTIC:** the proposed questions or indicators were accurately defined according to the characteristics and the real needs of the inland ports.
- **FEASIBLE:** taking into account the current situation of inland ports, the answers of the proposed questionnaire were designed so that they involve few resources to report on them as well as a reasonable time.
- **UNCOMPLICATED:** linked to the last point, the questions proposed were easily formulated in order to make them understandable. In addition, the questionnaire was launched in a user-friendly format.
- **QUALITATIVE:** it has been observed that inland ports do not normally share figures of their performance with quantitative results. Therefore, it was considered to include qualitative questions in order to get a better feedback from them.
- **ADDED VALUE:** to persuade the inland ports to report the required information, it was necessary to show them the importance of the reporting culture in order to contribute in a positive benchmark that pushes ports into a better performance.

Taking into account the different sources of potential indicators reviewed and the particularities of the inland ports reflected on the set of criteria established, a first version was launched. The survey is composed of a set of 15 qualitative questions divided in 4 categories that are related to any recognized environmental management system: (A) environmental management, (B) environmental monitoring, (C) environmental priorities and (D) green actions. The latest section was included in order to take into account the environmental initiatives carried out by inland ports that were identified during the conducted research. The environmental survey also comprises an introduction to highlight the benefits of the developed approach, and a glossary of terms to clarify any potential term included in the survey that is not clear enough. [The complete survey can be found in appendix I.](#)

Survey validation

In order to validate the first version of the environmental survey, the collaboration of professionals in the sector and inland port authorities was deemed essential. The preliminary survey was circulated among 4 'pilot' inland ports in order to gather feedback according to the complexity, understanding and the format of the aforementioned survey.

The validating ports were the German Association of Inland Ports (BöB), the Port of Strasbourg (France), the Port of Brussels (Belgium) and the Port of Lille (France). Strategic feedback was also provided by EFIP Secretariat.

Useful comments and feedback related mostly to format, definition of terms used, and issues related to 'green' activities were obtained. The draft version was modified accordingly. In the following figure, an example of the last section of the final survey (D) Green actions is presented.

D. Green actions

N°	Questions	YES	NO
13	Does the port apply initiatives to implement green actions? If yes, is any of the following carried out? (Please tick)	<input type="checkbox"/>	<input type="checkbox"/>
	• On-shore power supply	<input type="checkbox"/>	<input type="checkbox"/>
	• Biofuel production for port self-supply or bunkering	<input type="checkbox"/>	<input type="checkbox"/>
	• Liquefied Natural Gas (LNG) bunkering	<input type="checkbox"/>	<input type="checkbox"/>
14	Does the port recognize green ship certificates ¹⁰ ?	<input type="checkbox"/>	<input type="checkbox"/>
15	Does the port applies differentiated fees for implementing green actions? If yes, is any of the following applied? (Please tick)	<input type="checkbox"/>	<input type="checkbox"/>
	• Incentives for companies that treat their waste	<input type="checkbox"/>	<input type="checkbox"/>
	• Incentives to reduce vessel speed according to a virtual arrival ¹¹	<input type="checkbox"/>	<input type="checkbox"/>
	• Discounts for ships using bunker oils with low Sulphur content	<input type="checkbox"/>	<input type="checkbox"/>
	• Discounts for ships using particle filters that reduce emissions of NO _x	<input type="checkbox"/>	<input type="checkbox"/>
	• Incentives for companies using the inland waterway (i.e. ships) for the freight distribution	<input type="checkbox"/>	<input type="checkbox"/>
	• Other: <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>

Figure 1: Green actions section in the environmental survey for inland ports

Survey distribution and collection

Initially, the survey was presented in the Spring EFIP Executive Committee (Trier, April 2015) to its members through an interactive session. Positive feedback was provided not only by individual ports but also by national associations (i.e. French and German). This led to the distribution of the survey among all the EFIP members during May and June of 2015. An online version of the survey is available at <http://1drv.ms/1FQbw1X>.

With the results obtained, it was possible to conduct a statistical assessment, to set-up the baseline of the environmental performance of the EU inland port sector, and to draw some preliminary conclusions. A total of 27 surveys were completed and the geographical origin of the respondent inland ports sample is as follows: Austria (1), Belgium (5), Croatia (1), France (8), Germany (6), Netherlands (2), Romania (1), Slovakia (1), Spain (1) and Switzerland (1).

RESULTS

The results section consists of the assessment of the set of EPIs included in the survey which can be linked to the main sections of any Environmental Management System. The results are presented according to the 4 categories defined in the environmental survey: environmental priorities, environmental management, environmental monitoring and green actions.

The present results establish not only the benchmark of the environmental performance of the EU inland ports, but also identify the strengths and potential concerns of the resultant values. In addition, these outcomes establish the basis for the benchmarking of future trends in order to demonstrate the progress of the EU inland sector. This is considered to be strongly beneficial for decision makers and port sector stakeholders.

Top 10 ranking of environmental priorities

One of the main outcomes of the present study is the establishment of the top-10 environmental priority issues for the EU inland port sector. This is the first time that such a ranking has been produced and therefore it sets the baseline of the environmental priorities for the EU inland port sector. This priority ranking of environmental issues can be particularly useful to the Federation and its members in terms of: i) Identifying key issues of international concern, ii) Assisting in the selection of major topics for conferences, workshops or training sessions, iii) Demonstrating trends over time as the priority of issues change with legislation, incidents or other catalysts that influence their perceived status and significance, and iv) Focusing resources for significant areas of research.

In the following table, the top-10 environmental priorities for inland ports are presented. They are compared with the top-10 ranking of sea ports environmental priorities obtained by ESPO in the last update of its environmental questionnaire (ESPO, 2013). This comparison is done in order to identify the similarities and differences between the respective sectors. Those priorities that are not common have been highlighted in orange.

Table 1. - Top-10 environmental priorities rankings of the European inland port and seaport sectors.

	Inland Ports EFIP (2015)	Sea Ports ESPO (2013)
1	Relationship with local community	Air Quality
2	Air Quality	Garbage/port waste
3	Water Quality	Energy consumption
4	Port expansion (land related)	Noise
5	Garbage/Port waste	Ship waste
6	Soil contamination	Relationship with local community
7	Hazardous cargo	Dredging: operations
8	Noise	Dust
9	Energy Consumption	Port expansion (land related)
10	Ship waste	Water quality

As mentioned in the introductory section of the results, responses of 27 inland ports were used in order to define the Top-10 environmental priorities ranking presented above. The ranking for the seaport sector was built on a basis of more than 70 respondent ports. Even if the number of ports is substantially different, and this makes difficult to come out with solid and statistically consistent statements, some interesting observations may be made.

On one hand, it has been observed that air quality is placed in high positions of the Top-10 environmental priorities ranking for both sectors. This reflects the significance of this aspect due to its direct relation with the health of people working or living around ports and trans-boundary nature of the components that make up the sum-total characteristics of the aspect. It is also in line with the international and European policy agenda, through the ongoing review of the EU Air Quality policy (Puig et al., 2015a).

On the other hand, it may be observed from the table above that 80% of the issues identified for both sectors are coincident although not all of them are in the same ranking position. It may suggest that the EU inland port and seaport sectors are facing equivalent environmental challenges since both sectors are working under the same environmental standards (i.e. EU directives).

Apart from this, it may be suggested that the variation on the position placed by both sectors in the different environmental priorities is related to their different size and activity volume. Although it is well-known that inland ports may be different among them, in general terms they tend to have smaller dimensions than seaports. For this reason, it may be pointed out that energy consumption and noise place a higher ranking for seaports than for inland ports, which activity is not as high as seaports and therefore they have a minor consumption of resources as well as lower noise emissions. In the same line, since ships handled in seaports are normally more in quantity and larger in size than the ones navigating through the inland waterways, the waste produced by these ships is more relevant for seaports than for inland ports.

As a consequence of the high percentages of coincidences in the Top-10 rankings compared, it is perhaps possible that a potential collaboration between inland and seaports is feasible and may provide strong benefits to the commerce corridors. In order to achieve this goal, an approach similar to EcoPorts network, in which ports have been helping one to each other and exchanging information among them for the last 20 years, could be adopted.

Management

This section presents the results of the EPIs included in the survey category (A) environmental management. As it can be seen in table 2, two columns are presented, one with the positive percentage of responses and one with the negative percentage.

Table 2. - Results of environmental management performance of EU inland ports.

Nº	Questions	YES	NO
1	Does the port have an Environmental Management System (EMS)?	25.9%	74.1%
2	Does the port have an Environmental Policy?	74.1%	25.9%
3	Does the port have an inventory of relevant environmental legislation?	63.0%	37.0%
4	Does the port have an inventory of Significant Environmental Aspects for the port area?	63.0%	37.0%
5	Does the port have a proper definition of objectives and targets for environmental improvement?	66.7%	33.3%
6	Does the port promote environmental awareness and training among employees?	81.5%	18.5%
7	Does the port have a designated responsible person for managing environmental issues?	81.5%	18.5%
8	Does the port publish a publicly available environmental report?	33.3%	66.7%
9	Does the port have a specific budget for environmental management?	48.1%	51.9%
10	Does the port have an emergency and contingency plan?	66.7%	33.3%

As a general result it has been observed that the majority of the respondent inland ports have positively fulfilled most of the environmental management questions included in the survey, which are linked to any recognized Environmental Management System. In particular, around 70% of the ports stated that they have the major components of an EMS (e.g. policy, inventory of legislation) actively in place proving that the environmental management is actually taken into account among the participant inland ports.

Significantly, it can be observed that 81.5% of ports promote environmental awareness and training among employees and have designated a person for managing environmental issues. Other important specific aspects to highlight are that 74.1% of the ports have an

environmental policy and 66.7% define properly its environmental objectives and targets and have an emergency and contingency plan.

In addition, on the basis of the criteria shown in the footer below, an Environmental Management Index¹ (EMI) has been also calculated (1-10) that reflects the relative significance of each of the EMS components included in the environmental management survey category. **The specific weighting of each element was stipulated by experts with proven experience on environmental management of ports.** The average EMI obtained for the EU inland port sector baseline is 6.

Monitoring

The main outcome of this section is that 51.9% of the participant inland ports have an environmental monitoring program. In addition, there are some ports that even if they have not implemented yet an environmental monitoring programme, they are already monitoring several parameters. This is due to the fact that these parameters are controlled by either the government or the port operators (companies) and reported to the port authorities.

As a consequence, it can be stated that almost 70% out of the total sample of the ports that answered the survey are conducting a certain degree of monitoring. Regarding the parameters monitored, the distribution observed is the presented below.

Table 3. – Results of environmental monitoring indicators of EU inland ports.

Indicator	YES	NO
Does the port have an environmental monitoring program?	51.9%	48.1%
Which of the following issues are monitored?		
· Waste	59.3%	40.7%
· Energy consumption	44.4%	55.6%
· Water quality	44.4%	55.6%
· Noise	40.7%	59.3%
· Air quality	37.0%	63.0%
· Water consumption	37.0%	63.0%
· Sediment quality	29.6%	70.4%
· Biodiversity	25.9%	74.1%
· Soil quality	25.9%	74.1%
· Carbon Footprint	25.9%	74.1%

Although the table above has been built on a basis of 27 responses, it can be noticed that the parameter with a higher percentage of monitoring is waste (59.3%), outstanding from the rest.

Green actions

The outcomes of the environmental indicators included in the survey category (D) green actions are presented in the following table:

¹The Environmental Management Index (EMI) is calculated through a weighting of the different questions on management. Each question is multiplied by a weight factor as it can be seen in the following equation: $EMI = (1) * 1.75 + (2) * 1.5 + (3) * 1.25 + (4) * 1.25 + (5) * 1 + (6) * 0.75 + (7) * 0.75 + (8) * 0.5 + (9) * 0.5 + (10) * 0.75$. The value of the number in brackets (e.g. (1)) will be 1 (if the port has the element) or 0 (if the port does not have the element). The maximum value of the index is 10 and the minimum is 0.

Table 4. – Results of the green actions performance of EU inland ports.

Indicator	YES	NO
Does the port apply initiatives to implement green actions?	66.7%	33.3%
If yes, is any of the following carried out?		
· Liquefied Natural Gas (LNG) bunkering	55.6%	44.4%
· On-shore power supply	50.0%	50.0%
· Biofuel production for port self-supply or bunkering	22.2%	77.8%
· Not specified (i.e. ports have replied positively to this question but they do not detail which actions are they taking).	22.2%	77.8%
Does the port recognize green ship certificates?	22.2%	77.8%
Does the port applies differentiated fees for implementing green actions?	48.1%	51.9%
If yes, is any of the following applied?		
· Incentives for companies using the inland waterway (i.e. ships) for the freight distribution	53.8%	46.2%
· Discounts for ships using bunker oils with low Sulphur content	30.8%	69.2%
· Incentives for companies that treat their waste	23.1%	76.9%
· Discounts for ships using particle filters that reduce emissions of NOx	23.1%	76.9%
· Incentives to reduce vessel speed according to a virtual arrival	0%	100%
Not specified (i.e. ports have replied positively to this question but they do not provide information on which fees are they applying)	23.1%	76.9%

As can be seen in the previous table, 66.7% of the inland ports apply initiatives to implement green actions, being LNG bunkering the most implemented one (55.6%), followed by the use of on-shore power supply (50%).

Almost 50% of the respondent inland ports apply differentiated fees for implementing green actions, being the incentives for companies using the inland waterway the most common one (53.8%). This may suggest that inland port authorities are devoted to foster the use of the inland waterway among their port operators (companies) in order to perform a sustainable freight distribution.

Survey feedback

This study was possible due to the collaboration of 27 inland ports and EFIP. To acknowledge their contribution and in order to provide them with a proper feedback, the following actions were conducted:

- ✓ The respondent ports received an individual summary report of the results and conclusions extracted from the environmental survey. The individual figures were treated under strict confidentiality.
- ✓ The EU inland ports were provided with the first environmental performance baseline. This allowed inland ports not only to compare their individual results with the EU benchmark itself, but also to set a milestone for assessing their evolution of their environmental performance and trends over the time.
- ✓ They were provided not only with a first overview (individual and sectoral) of its environmental performance but also with information on future actions for further improvement.
- ✓ The respondent ports may be rewarded with a recognition in PORTOPIA website for their participation in the project through the fulfilling of environmental survey for inland ports.

All in all, it is expected that the outcomes obtained through this study may be substantially beneficial not only for the individual respondent but also for the overall EU inland ports, since it has been possible to set a potential baseline for benchmark within the sector.

THE WAY FORWARD

The present study provided an overview of the current situation of the EU inland port sector regarding environmental performance. As stated, inland ports can demonstrate strong commitment to their environmental liabilities and responsibilities as witnessed by implementation of key elements of recognized Environmental Management Systems. However, there still exist some environmental challenges to be faced in order to disseminate and develop the concepts of environmental management and reporting culture. In addition, environmental management and performance are issues that may be always reviewed and continuously enhanced according to the challenges identified, which evolve over the time.

Based on the survey responses, it is likely that the trends of environmental management performance by inland ports will continue to improve as well as the culture of EMS development. As a consequence, monitoring and reporting would become more widely established and executed. In the present section, follow-up links are provided as guidance to assist inland ports in their endeavour toward a positive culture of environmental reporting and management.

As the culture of environmental management and reporting is further developed further, proactive ports will be well-placed to act as mentors and ambassadors for the implementation of good practice through the Federation. Options available to assist EFIP members with the development, implementation and further enhancement of a credible Environmental Management System (EMS) are:

- i) **Tool for the identification and assessment of Environmental Aspects in Ports (TEAP).** The main objective of an EMS is to control the impacts of the significant aspects, that is, the activities, products and services that may be carried out or produced in the port. The TEAP tool (Puig et al, 2015b) is specifically designed to assist ports in identifying these elements. The open source tool, developed by UPC and freely available at www.eports.cat, aims at assisting in the selection of the significant aspects, a compulsory requirement of ISO 14001 or EMAS.
- ii) **EcoPorts Network** (www.ecoport.com) which provides a model for sectoral collaboration. This approach can be defined with the concept and ethic of 'ports-assist-ports' in the free exchange of environmental knowledge and experience which are well-established within ESPO, and finds resonance within EFIP. Member ports have the option of adopting and applying the tools and methodologies developed by ports, for ports within the EcoPorts network. The well-established and widely applied tools are the Self Diagnosis Methodology (SDM) and the Port Environmental Review Standard (PERS), both available at EcoPorts website. For ports outside Europe the EcoPorts network may be contacted through the Foundation ECO-Sustainable Logistic Chain (www.ecoslc.eu).

CONCLUSIONS

One of the outcomes of the present study is that although inland ports are already conducting efforts towards sustainable development and reporting culture there is still room for further improvement. Inland ports normally operate under special circumstances in terms of dedicated resources and, therefore, they may have difficulties to meet the demanding standards required in certified Environmental Management Systems.

For this reason, the environmental survey for inland ports was developed, which is considered to be a realistic approach that delivered a real outcome concerning the environmental situation of the EU inland port sector. In fact, the environmental survey was specifically designed and applied in order to identify the current environmental inland port practices so that port authorities can track, monitor and report their progress in relation to this baseline data. It seems important to highlight that the survey development and criteria were validated taking into consideration the advice, expertise and experience of EFIP and 'pilot' inland ports.

The environmental survey for inland ports was presented in the spring EFIP Executive committee. The participant inland port managers were able to respond the survey in a brief interactive session under the assistance of the PORTOPIA team. Then, the survey was circulated through the EFIP secretariat which contacted its ports members in order to persuade them to provide with feedback. It is important to highlight that national inland ports associations (i.e. French and German) offered their contacts and influence in order to circulate the survey among their port members. This illustrates the benefits that may be achieved through a pro-active and collaborative approach between port organizations and its members in order to work to put policy into practice.

Once the results of the survey were collected, the statistical treatment of the results was conducted in order to draw potential conclusions. Although it may be suggested that a higher number of completed surveys is required in order to further substantiate major findings, EFIP and its members can already demonstrate a culture of environmental management and reporting practice with several instances of good examples already in place. The positive responses to participation and input by EFIP and its members may be considered as a measure of the interest and commitment of the port professionals in their endeavors concerning compliance with environmental legislation and the implementation of policy. In addition, this survey has established a baseline from which future trends and progress of the inland port sector may be tracked, and longer-term benchmark performance be assessed.

Finally, it is suggested that the results of the survey demonstrate the mutual benefits of collaborative research between academia and the professional port bodies. In this example, the EC PORTOPIA project has gained data and insight on Environmental Performance Indicators for inland ports. The ports themselves, through their federation EFIP, have taken the opportunity to establish a baseline from which progress and trends of the environmental performance may be monitored and revised accordingly. Most significantly, it may be argued that they also strengthens the port sector's declared policy of competence to comply with legislation on the basis of voluntary, self-regulation.

ACKNOWLEDGEMENTS

The authors acknowledge with grateful thanks the cooperation and input from EFIP Secretariat and its member port authorities, as well as the French and German Inland Port Associations,

without their help and efforts it would not have been possible to gather such results. This collaboration with the EC PORTOPIA Project provided a credible source of knowledge and experience upon which the baseline and performance measures were established.

REFERENCES

CCP21, 2010. Connecting Citizen Ports 21, brochure. [Online]. Available at: <http://www.citizenports.eu/wp-content/uploads/2014/03/Download-the-CCP21-brochure.pdf> (accessed 26.09.14).

DaHAR, 2011. Danube Inland Harbour Development, brochure. [Online]. Available at: http://www.romanian-ports.ro/DAHAR/Dahar_English_Brossura_2014_APDM.pdf (accessed 26.09.14).

Darbra, R.M., Ronza, A., Casal, J., Stojanovic, T.A., Wooldridge, C., 2004. The Self Diagnosis Method: A new methodology to assess environmental management in sea ports. *Marine Pollution Bulletin* 48 (5–6), 420–428.

Darbra, R.M., Pittam, N., Royston, K.A., Darbra, J. P., Journee, H., 2009. Survey on Environmental Monitoring Requirements of European Ports. *Journal of Environmental Management* 90, 1396–1403.

EC (European Commission), 1992. Council Directive 92/106/EEC of 7 December 1992 on the establishment of common rules for certain types of combined transport of goods between Member States. Official Journal of the European Communities. Belgium: Brussels.

EC (European Commission), 2007. Trans-European transport network. Report from the commission to the council, the European parliament, the European economic and social committee and the committee of the regions. Belgium: Brussels.

EFIP (European Federation of Inland Ports), 2014. EFIP ANNUAL REPORT. Foreword. European Federation of Inland Ports – EFIP. Belgium: Brussels.

EFIP (European Federation of Inland Ports), 2015. European Federation of Inland Ports, website. [Online]. Available at: <http://www.inlandports.eu/> (accessed 3.08.15).

ESPO (European Sea Ports Organisation), 2013. ESPO Port Performance Dashboard. [Online]. Available at: http://www.espo.be/images/stories/Publications/studies_reports_surveys/espo_dashboard_2013%20final.pdf (accessed 7.09.15).

GRI (Global Reporting Initiative), 2006. G3 Sustainability Reporting Guidelines. Version 3.0. The Netherlands: Amsterdam

Kluge, B., 2012. Green Logistics in Inland Ports. Federal Association of German Inland Ports. Powerpou. 2nd German-Chinese Conference on the implementation of the Action Plan Green Logistics. Berlin, September 2012.

Puig, M., Wooldridge, C., Darbra, R.M., 2014. Identification and selection of Environmental Performance Indicators for sustainable port development. *Marine Pollution Bulletin* 81 (1), 124–130.

Puig, M., Wooldridge, C., Michail, A., Darbra, R.M., 2015a. Current status and trends of the environmental performance in European ports. *Environmental Science & Policy* 48, 57–66.

Puig, M.; Wooldridge, C.; Casal, J.; Darbra, R.M., 2015b. Tool for the identification and assessment of Environmental Aspects in Ports (TEAP). *Ocean and coastal management* 113, 8 – 17.

Rodrigue, J.P., 2015. The geography of transport system. Some terms used to define inland nodes. [Online]. Available at: https://people.hofstra.edu/geotrans/eng/ch4en/appl4en/table_definitionsinlandports.html (accessed 9.09.15).

Rodrigue, J.P. and Nettebom, T., 2013. The Geography of Transport Systems, Chapter 4, application4, Inland ports / Dry ports.

Seitz, M., 2013. LNG Master plan for Rhine/Meuse-Main-Danube, 2012-EU-18067-S. Session TEN-T Innovations and New Technologies. Tallinn, October 2013.

WANDA (Waste management for inland navigation on the Danube), 2012. WANDA project. Jointly for our common future. Brochure. [Online]. Available at: http://www.wandaproject.eu/fileadmin/content/Downloads/Folder/EN_WANDAFolder.pdf (accessed 17.07.15).

APPENDIX I



Environmental Survey for inland ports



Introduction

As agreed with EFIP Secretariat, this document is an invitation to members of the European federation of Inland Ports to make a direct contribution to the aims and objectives of the E.C. Project PORTOPIA (www.portopia.eu). This project aims at creating an integrated database of relevant information for the purpose of enhancing further the sustainability and competitiveness of the European port sector in which inland ports, represented by EFIP (www.inlandports.eu/), play a key role. The Survey methodology was developed and evaluated in partnership with EFIP representative ports.

As stated by EFIP, the importance of Inland Ports as strategic intermodal nodal points in the transport and logistic chain is widely recognized, as well as the good local knowledge that inland port managers have of their own port area (i.e. functional organization of their tenants and operators). However, it may be suggested that they often have to operate under special circumstances in terms of dedicated resources.

This survey provides a user-friendly mechanism for Inland Ports to contribute directly to the PORTOPIA project by identifying meaningful environmental performance data. It is composed of a set of Yes/No answers that focus on four main environmental categories: i) Management, ii) Monitoring, iii) Priority issues, and iv) Green initiatives. These topics are generic and included in the components of any effective Environmental Management System (EMS). It may be suggested that participation in the survey by individual Inland Port Authorities is a useful exercise because the time spent completing the survey (estimated 20 minutes) is invested in developing the port's EMS.

In return, each respondent port will receive a summary of its results as well as feed-back and follow-up links. *It should be noted that all responses will be treated as being strictly confidential and anonymous – no individual results will be made publicly available. This sort of agreement has been in place with ESPO for fifteen years in the case of seaports (i.e. ECOPORTS tools).*

For on-line or telephone assistance with completion of the survey, please feel welcome to contact:

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THANK YOU FOR YOUR COOPERATION

Final Survey



Environmental Survey for inland ports



Name of Port: Country:
 Contact Name: Contact e-mail address:

A. Environmental management

	Topics	YES	NO
1	Does the port have an Environmental Management System¹ (EMS)? If yes, indicate type: <ul style="list-style-type: none"> • ISO 14001 • EMAS • PERS 	<input type="checkbox"/>	<input type="checkbox"/>
2	Does the port have an Environmental Policy² ?	<input type="checkbox"/>	<input type="checkbox"/>
3	Does the port have an inventory of relevant environmental legislation ?	<input type="checkbox"/>	<input type="checkbox"/>
4	Does the port have an inventory of Significant Environmental Aspects³ for the port area?	<input type="checkbox"/>	<input type="checkbox"/>
5	Does the port have a proper definition of objectives and targets⁴ for environmental improvement?	<input type="checkbox"/>	<input type="checkbox"/>
6	Does the port promote environmental awareness and training among employees?	<input type="checkbox"/>	<input type="checkbox"/>
7	Does the port have a designated responsible person for managing environmental issues ?	<input type="checkbox"/>	<input type="checkbox"/>
8	Does the port publish a publicly available environmental report⁵ ?	<input type="checkbox"/>	<input type="checkbox"/>
9	Does the port have a specific budget for environmental management ?	<input type="checkbox"/>	<input type="checkbox"/>
10	Does the port have an emergency and contingency plan⁶ ?	<input type="checkbox"/>	<input type="checkbox"/>
Comments:			

B. Environmental monitoring⁷

	Questions	YES	NO
11	<i>Does the port have an environmental monitoring program?</i>	<input type="checkbox"/>	<input type="checkbox"/>
	<i>If yes, please could you indicate which of the following issues are included?</i>		
	• Air quality	<input type="checkbox"/>	<input type="checkbox"/>
	• Water quality	<input type="checkbox"/>	<input type="checkbox"/>
	• Soil quality	<input type="checkbox"/>	<input type="checkbox"/>
	• Sediment quality	<input type="checkbox"/>	<input type="checkbox"/>
	• Noise	<input type="checkbox"/>	<input type="checkbox"/>
	• Energy consumption	<input type="checkbox"/>	<input type="checkbox"/>
	• Water consumption	<input type="checkbox"/>	<input type="checkbox"/>
	• Carbon Footprint ⁸	<input type="checkbox"/>	<input type="checkbox"/>
	• Waste	<input type="checkbox"/>	<input type="checkbox"/>
	• Biodiversity	<input type="checkbox"/>	<input type="checkbox"/>
	• Other: <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>

C. Top 10 Environmental priorities

12. From the following list, please rank the Top 10 issues that you consider a priority for your port (where 1 is the most important and 10 the less):

Issue	Rank
Air quality	
Dust	
Odours	
Cargo Spillage (handling)	
Light pollution	
Conservation areas	
Energy Consumption	
Noise	
Water quality	
Antifouling paints	
Ship discharges to water ⁹	
Bunkering	
Dredging: operations	
Dredging: disposal	
Sediment contamination	
Soil contamination	
Garbage/ Port waste	
Ship waste	
Port expansion (land related)	
Port expansion (water related)	
Hazardous cargo (handling/storage)	
Climate change	
Relationship with local community	
Other: <input type="text"/>	

D. Green actions

N°	Questions	YES	NO
13	Does the port apply initiatives to implement green actions? <i>If yes, is any of the following carried out?(Please tick)</i>	<input type="checkbox"/>	<input type="checkbox"/>
	• <i>On-shore power supply</i>	<input type="checkbox"/>	<input type="checkbox"/>
	• <i>Biofuel production for port self-supply or bunkering</i>	<input type="checkbox"/>	<input type="checkbox"/>
	• <i>Liquefied Natural Gas (LNG) bunkering</i>	<input type="checkbox"/>	<input type="checkbox"/>
14	Does the port recognize green ship certificates¹⁰?	<input type="checkbox"/>	<input type="checkbox"/>
15	Does the port applies differentiated fees for implementing green actions? <i>If yes, is any of the following applied?(Please tick)</i>	<input type="checkbox"/>	<input type="checkbox"/>
	• <i>Incentives for companies that treat their waste</i>	<input type="checkbox"/>	<input type="checkbox"/>
	• <i>Incentives to reduce vessel speed according to a virtual arrival¹¹</i>	<input type="checkbox"/>	<input type="checkbox"/>
	• <i>Discounts for ships using bunker oils with low Sulphur content</i>	<input type="checkbox"/>	<input type="checkbox"/>
	• <i>Discounts for ships using particle filters that reduce emissions of NO_x</i>	<input type="checkbox"/>	<input type="checkbox"/>
	• <i>Incentives for companies using the inland waterway (i.e.ships) for the freight distribution</i>	<input type="checkbox"/>	<input type="checkbox"/>
	• <i>Other:</i> <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>

Glossary of terms

¹**Environmental Management System (EMS):** Part of the overall management system used to develop and implement its environmental policy, and manage its environmental aspects (ISO 14001, 2004). In the port sector, the main standards to achieve an EMS are the ISO 14001, EMAS and PERS.

²**Environmental Policy:** Overall intentions and direction of an organisation, related to its environmental performance as formally expressed by top management. The environmental policy provides a framework for action and for setting of environmental objectives and environmental targets (ISO 14001, 2004).

³**Significant Environmental Aspect (SEA):** An environmental aspect is an element of an organisation's activities, products or services that can interact with the environment. A Significant Environmental Aspect is an aspect that has or can have a significant environmental impact (ISO 14001, 2004). An example of SEA may be the emissions of combustion gases or the discharges of wastewaters.

⁴**Environmental objective and target:** An objective is an overall environmental goal, consistent with the environmental policy, that an organisation sets itself to achieve (ISO 14001, 2004). An environmental target is a detailed performance requirement, applicable to the organisation or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives (ISO 14001, 2004). For instance, an objective could be 'reduction of gas emissions to legal limits', and a target 'to reduce the global gas emission by 10% by 2015'.

⁵**Environmental report:** An environmental report provides information about the environmental activities, achievements and results that a Port Authority has carried out throughout the preceding year.

⁶**Emergency and contingency plan:** It is a document that aims at preparing an organization to respond well to an emergency situation (e.g. fire, explosion, toxic release, etc.).

⁷**Environmental monitoring:** Activity involving repeated observation, according to a pre-determined schedule, of one or more elements of the environment, to detect their characteristics (status and trends) (ISO 14001, 2004). As example, measuring the concentration of pollutants released to the air (e.g. NO_x, SO_x, CO, etc.)

⁸**Carbon Footprint:** It is a measure of the total amount of greenhouse gas (GHG) emissions that is directly and indirectly caused by an activity. A Carbon Footprint accounts for all six Kyoto GHG emissions: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆) (Carbon Trust, 2010).

⁹**Ship discharges to water:** Possible water discharges from ships are bilge water (water collected in the bilge of the ship and that may contain oils and hydrocarbons), ballast water (water used to give stability to a vessel and that may contain invasive aquatic species), sewage, chemical substances, lubricants, fuels, oily wastes and garbage.

¹⁰**Green Certificates:** it is a proof that the port is conducting environmental initiatives according to standards such as: Environmental Ship Index (ESI); Clean Ship Initiative (CSI); Energy, efficiency design (EED); ESPO Green Award, etc.

¹¹**Virtual arrival:** A process that involves an agreement to reduce a vessel's speed on voyage to meet a Required Time of Arrival when there is a known delay at the discharge port.

References

Carbon Trust. 2010. Carbon Footprinting. The next step to reduce your emissions. London: The Carbon Trust.

ISO (International Organisation for Standardisation), 2004. ISO 14001:2004 Environmental management systems - Requirements with guidance for use.