ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΕΙΡΑΙΩΣ

ΤΜΗΜΑ ΝΑΥΤΙΛΙΑΚΩΝ ΣΠΟΥΔΩΝ

ΠΡΟΓΡΑΜΜΑ ΜΕΤΑΠΤΥΧΙΑΚΩΝ ΣΠΟΥΔΩΝ : MSc. IN SHIPPING MANAGEMENT

GREEN PORTS: THE CASE OF GREEK PORTS

Visvardis Georgios

Διπλωματική Εργασία
που υποβλήθηκε στο Τμήμα Ναυτιλιακών Σπουδών
του Πανεπιστημίου Πειραιώς ως μέρος των
απαιτήσεων για την απόκτηση του Μεταπτυχιακού
Διπλώματος Ειδίκευσης στην Ναυτιλιακή
Διοικητική

Πειραιάς

Σεπτέμβριος 2019

Δήλωση αυθεντικότητας / ζητήματα Copyright:

«Το άτομο το οποίο εκπονεί την Διπλωματική Εργασία φέρει ολόκληρη την ευθύνη προσδιορισμού της δίκαιης χρήσης του υλικού, η οποία ορίζεται στην βάση των εξής παραγόντων: του σκοπού και χαρακτήρα της χρήσης (εμπορικός, μη κερδοσκοπικός ή εκπαιδευτικός), της φύσης του υλικού, που χρησιμοποιεί (τμήμα του κειμένου, πίνακες, σχήματα, εικόνες ή χάρτες), του ποσοστού και της σημαντικότητας του τμήματος, που χρησιμοποιεί σε σχέση με το όλο κείμενο υπό Copyright, και των πιθανών συνεπειών της χρήσης αυτής στην αγορά ή στη γενικότερη αξία του υπό Copyright κειμένου».

Η ΤΡΙΜΕΛΗΣ ΕΞΕΤΑΣΤΙΚΗ ΕΠΙΤΡΟΠΗ

«Η παρούσα Διπλωματική Εργασία εγκρίθηκε ομόφωνα από την Τριμελή Εξεταστική Επιτροπή που ορίσθηκε από τη ΓΣΕΣ του Τμήματος Ναυτιλιακών Σπουδών Πανεπιστημίου Πειραιώς σύμφωνα με τον Κανονισμό Λειτουργίας του Προγράμματος Μεταπτυχιακών Σπουδών στην Ναυτιλιακή Διοικητική.
Τα μέλη της Επιτροπής ήταν:

- Μαρία-Πούλια Μποϊλέ (Επιβλέπων)
- Χλωμούδης Κωνσταντίνος
- Παρδάλη Αγγελική

Η έγκριση της Διπλωματική Εργασίας από το Τμήμα Ναυτιλιακών Σπουδών του Πανεπιστημίου Πειραιώς δεν υποδηλώνει αποδοχή των γνωμών του συγγραφέα.»

ΕΥΧΑΡΙΣΤΙΕΣ

Ευχαριστώ πάρα πολύ την
Κα Μποϊλέ για την πολύτιμη βοήθεια
και την αμέριστη συμπαράστασή της
στην εκπόνηση αυτής της εργασίας.

ΑΦΙΕΡΩΣΕΙΣ

Στη σύζυγό μου και
στήριγμά μου **Φρύνη**,
στην αδερφή μου **Ιωάννα**,
στους γονείς μου
Αγγελική και **Ηλία**
και στους συναδέλφους μου
στην **COSCO Shipping Lines (Greece)**
για την αμέριστη συμπαράστασή τους.

ΠΕΡΙΛΗΨΗ

Αυτή η εργασία εξετάζει εάν οι ελληνικοί λιμένες είναι πράσινοι και ποιες ενέργειες μπορούν να γίνουν προς αυτή την κατεύθυνση. Συγκεκριμένα, προβάλλονται τα χαρακτηριστικά των ελληνικών λιμένων, αναλύονται οι όροι «πράσινο λιμάνι» και «βιώσιμη ανάπτυξη» και αναλύονται οι περιβαλλοντικοί αντίκτυποι της απόδοσής τους. Θα ορίσουμε τον όρο «πράσινοι λιμένες» και θα παρουσιάσουμε τις προϋποθέσεις που ορίζονται από τον ΙΜΟ ως διεθνής οργανισμός και την διεθνή σύμβαση για την πρόληψη της ρύπανσης από πλοία MARPOL, για την πρόληψη της ρύπανσης του περιβάλλοντος.

Στη συνέχεια, θα εξετάσουμε την τρέχουσα κατάσταση των ελληνικών λιμένων και το επίπεδο εφαρμογής της πράσινης πολιτικής. Ειδικότερα, έχοντας προβεί σε μια μικρή ιστορική αναδρομή των λιμένων του Πειραιά και της Θεσσαλονίκης, θα παρουσιάσουμε τις δράσεις που έχουν αναληφθεί από αυτούς τους λιμένες προκειμένου να συμμορφώνονται με τους διεθνείς κανονισμούς, αλλά και πέρα από αυτές, σύμφωνα με άλλες ενδιαφέρουσες πράσινες εφαρμογές από άλλα ελληνικά λιμάνια. Θα παρουσιάσουμε παραδείγματα άλλων «πράσινων λιμένων» και του τρόπου λειτουργίας τους. Λαμβάνοντας υπόψη αυτά τα παραδείγματα, θα γίνουν προτάσεις για την υιοθέτηση σχετικών δράσεων από λιμάνια. Συμπερασματικά, θα εξετάσουμε αν απαντήθηκε η αρχική ερώτηση.

ABSTRACT

This thesis examines whether Greek ports are green and what actions can be taken in this direction. More specifically, the characteristics of Greek ports are presented, the terms "green port" and "sustainable development" are analyzed, and the environmental impact of their performance is analyzed. We will define the term ‘green ports’ and we will present the prerequisites settled by IMO as international organization and International Convention for the Prevention of Pollution from Ships MARPOL for prevention of environmental pollution.

Subsequently, we will examine the current situation of Greek ports and the level of green policy implementation. In particular, having made a small historical recursion of ports of Piraeus and Thessaloniki, we will present the actions that have been undertaken by these ports in order to comply with international regulations, as well as green actions undertaken from other Greek ports.

We will present examples of ‘green ports’ and how they operate. Taking under consideration these examples, we will draft proposals for ‘greening’ of Greek ports. As a conclusion, we will examine if the original question was answered

CONTENTS

List of Figures

List of Tables

INTRODUCTION

As the effects of climate change become more visible, concerns about saving the environment and the planet are rising and escalating dangerously. The steady increase in population, coupled with the increase in consumer goods and the continued effort to improve living standards, has led to a steep rise in the amount of energy consumed annually worldwide. At the same time, the increase in oil production and the increase in demand for electricity has inevitably taken place in recent years. At the same time, the limited use of renewable energy sources, despite the extensive measures taken and the environmental protection programs developed, have led to widespread emission of pollutants, completely degrading and destroying the environment and ecosystems.

By focusing on sustainable development as their primary goal, all productive sectors are considering the method that will help them achieve this result. That is why we are seeing new terms added to the international dictionary such as green housing, hybrid transport and renewable energy. Shipping, being sensitive to environmental issues as a human factor, gives its own answer to the new need that is created, and that is green ports.

Sustainable development is the overriding purpose of the green harbor. Under this treaty, a green port is taking action that has a positive impact on economic prosperity, environmental quality and social responsibility. It therefore adopts actions in this direction and more specifically actions aimed at protecting the neighboring community from environmentally harmful port operations, promoting the port as a leader in protecting the environment, shifting to sustainability, and training such programs the community as well as workers on environmental issues and the promotion of the use of innovative technologies for the immediate reduction of environmental pollutants. Green Harbor is interested in enforcing policies that promote the protection of sustainability and the environment, but it is also concerned about the economic performance of these policies.

In a port the sources of environmental pollutants are many and are not necessarily recognizable to the naked eye. One such example is the docking boats, which in addition to their carbon dioxide emissions from the operation of their engines can often pollute the marine environment due to the ballast they carry and their antifouling. We thus, come to the conclusion that the environment is burdened by a port in four dimensions, water, air, noise and soil.

The purpose of this Thesis is to examine the existence of green ports in the Greek territory. For this purpose, we will proceed with the process of examining the two main Greek ports, Piraeus and Thessaloniki, in order to determine whether they had taken actions and adopted procedures that would characterize them as green. Following the definition of the term green ports, a complete analysis of the current situation of the ports of Piraeus and Thessaloniki will be made.

Assessing how green the Greek ports are today and, in our attempt, to paint a clearer picture, we will present three examples of green ports abroad, located on different continents and more specifically in America and Australia.

For this reason, the sustainable development of a port's natural resources includes actions on the materials used within it, on how to manage waste as well as on water resources, on energy consumption and on transport. Analyzing the quality of environmental characteristics, a green harbor undertakes actions aimed at better managing their indoor environment, pollutant emissions, water quality, land use and overall environmental management.

Ports that want to achieve sustainable development must cope with a specific environmental policy by quantifying the targets. They thus carry out annual detailed reports on the sustainable development of the port. However, these actions should not neglect basic requirements such as working with local stakeholders, working with established businesses in the region and the local community in general to achieve long-term environmental goals.

2. Research aim

At this stage we should note that we have chosen Piraeus port & Thessaloniki mainly because of the volume of work carried out there and not because they do not apply green policies. So, some of the actions described in the Guide may already be followed by the port of Piraeus and Thessaloniki, but they should be recorded in the Guide in order to present a more comprehensive strategic approach and to create the conditions for monitoring the progress of these practices.

The Guide, prepared by the Piraeus Port Authority management and Thessaloniki Port Authority, accordingly, is characterized by five areas of application, each of which sets specific goals and proposes specific actions per sector. At the same time, there are all the benefits to be gained from these areas, such as the environmental and social benefits, the ease of implementation of the actions and of course their cost-effectiveness. Further, in the foregoing, particular attention is paid to understanding whether the action concerns the design or conversion of building installations, outdoor use, construction activity or operation.

The environmental policy pursued by both port authorities and their managements mainly concerns the materials used for their operations, waste management either by operations or by vessels, water resources management, energy consumption as well as transport.

By analyzing the above features, referring to the use of materials, Piraeus and Thessaloniki Port authorities can promote the use of recyclable materials in their premises, limiting the use of recyclable plastic by replacing it with other certified green materials. The benefits to the environment of implementing such an action are very significant and lead to mathematical precision in reducing waste. They are now easier to apply as more and more green materials are certified. However, because the use of green materials is more costly, the results can take more time to appear.

2.1 Environment policies at Greek ports

It is a fact that in Greece of the crisis in the last decade the green investments in Greek ports are limited, even in only two major ports such as port of Piraeus and Thessaloniki lately. In any case, however, a strategy with quantified goals and results will have to be developed, including a vision for both the port of Piraeus and the rest of the Greek ports with a view to sustainable development. Of course, as stated above there are reduced cost actions that can be implemented immediately.

Green Ports investment financing could be envisaged in the National Strategic Reference Framework as we are very close to a new programming period. In the context of the economic crisis that has plagued our country in recent years, such an evolution would create thousands of new jobs, leading to long-term savings while improving the competitiveness and value of Greek ports.

As the central pillars of Commerce internationally, ports are in need of enormous quantities of energy to cover their enormous volume of operations while polluting the environment. Ports must demonstrate to local, and not only, communities, projects and actions that promote the principles of sustainable development with a particular emphasis on environmental protection, which is now directly linked to economic viability and the development of all kinds of activities.

Following the same path, the Greek ports of Piraeus and Thessaloniki must implement a specific environmental protection policy. At the same time, the sustainable development of Greek ports does not require the waste of financial resources to protect the environment. On the opposite bank, the sustainable development of Greek ports could mark a new era for sound financial management of financial resources, with the primary aim of short- and long-term economic performance, in addition to environmental benefits.

3. GREEN PORTS

In this chapter we present the main Greek ports and their characteristics, we introduce the notion of sustainability in ports and we examine the evolution of the green port concept.

3.1 Definition of the term Green-Port

Increasing environmental awareness raises new challenges for port development. In addition, climate change requires adaptation measures to minimize its impacts, such as rising sea levels and rising water levels from floods. International and national legislation on new ports or extensions to existing ports incorporate these issues and

tend to rely increasingly on stringent regulations to create plans to minimize environmental impact and sustainable business development (WG150 2013). Green Ports are seen as the answer to these challenges. But there is no clear and comprehensive description of what a Green Harbor really is. The basic philosophy of the term is that green growth is the driving force behind any economic growth. While economic activities and environmental protection are usually regarded as two separate and conflicting fields, green growth recognizes that one can complement the other (WG150 2013). A key issue related to green development is transport, which has a serious environmental impact. Ports, as focal points of transport networks, can contribute to green development, as they are along coasts, in estuarine systems or river or canal deltas, which constitute distinct modules of ecosystems that interact with each other, and thus their use in transport affects their structure and function. Therefore, sustainable port strategies should aim at integrated management of all these systems (WG150 2013).

The concept of the Green Port also changes the role of the port authority, as well as the way in which port operations are performed. Key elements of this approach are:

1. Long-term vision that can ensure an acceptable ecological footprint.
2. Transparent involvement of stakeholders and stakeholders in its operational and development strategies.
3. The shift from sustainability as a legal obligation to sustainability as a driving economic force.
4. Active exchange of knowledge with other ports and stakeholders.
5. Continuously striving for innovative processes and technology.

Key issues concerning a Green Harbor are (WG150 2013):

- The quality of the environment (soil, water, air, noise).
- The habitats and integrity of Ecosystems
- Energy efficiency and the transition from fossil fuels to clean and renewable energy sources.
- Materials and waste management.
- Climate change and its adaptations.
- Stakeholder engagement and corporate social responsibility.
- Public-private partnerships with NGOs and the academic environment.

The term "Green Port" or "Sustainable Port" is used for that port which aims at sustainable development, combining management of environmental problems with social and economic development. The main problem in such a port is the balance between environmental impact and economic interest. Its economic and social development should not exceed its capacity as a natural system and should ensure that there are no irreversible environmental changes, taking care of the environment in all its functions and activities (Anastasopoulos et al. 2011).

3.2 Environmental Impact of Modern Harbor Operation

3.2.1 Port Activities and Functions

The activities and functions of the ports differ, as they are mainly determined by the nature of the port (e.g. commercial, passenger, etc.) and the cargo being transported. According to Palantza (2008), they fall into two main categories, as shown below.

Daily operating activities:

1. Providing services to ships (mooring, towing, navigation, tethering, unloading, refueling, repairs and maintenance, waste production and management, etc.).
2. Handling of cargo at dock (transportation, handling and storage cargo).
3. The receipt and distribution of cargo which constitutes the link to the hinterland.
4. The "logistics" functions.
5. The movement of vehicles, trucks and machinery.
6. The movement of trains.
7. Passenger traffic.
8. Attending the public and staying in public areas.
9. The operation of private companies and facilities.
10. The operation of organized parking spaces.
11. The marina functions.
12. The operation of workshops, offices and dockers.
13. The maintenance of green spaces.
14. Outdoor lighting.

Development activities:

1. Construction, maintenance and extension works in the maritime zone (pier, mole, cracker, arm, breaker, etc.).
2. Sea level dredging / deepening operations (e.g. deepening, installation of pipelines etc.).
3. Disposal of dredges at sea or on land.
4. Restoration / remodeling of coastal - land area.
5. Renovation work on buildings and other terrestrial installations (e.g. warehouses, cranes, cranes).
6. Construction of roadways and railways etc.
7. Site construction / operation during the execution of works.

3.2.2 Environmental Problems and Impacts

As mentioned earlier, ports play a pivotal role in national and international transport networks. It is therefore obvious that the indirectly and directly related turnover causes many complex environmental issues. Due to the international need to regulate ecological issues as well as the intense public concern, Port Organizations have to look at the issues that concern them. According to Palantza (2008), environmental issues in ports could be divided into two categories:

- The immediate environmental issues, which are related to the activities and functions of the port itself and which the management directly manages.
- Indirect environmental issues arising from the port's interaction with the urban, commercial and industrial fabric that may surround it, geographical conditions (e.g. rivers, high seas) and private facilities and companies operating in the port area.

The impacts of the port's activities and operations relate to the land and sea area it occupies, as well as to the marine segments within the same bay or adjacent land segments. Its indirect impacts can be extended to a larger area, as other infrastructure projects are needed (e.g. to connect the port to the hinterland), while the economic impacts to the wider port area can, in turn, bring about change or put pressure on land use (Vittis 2004). Although port activity pollution is not the same for each port, because it depends on its particular characteristics, ports still face several common environmental issues.

3.2.3 Atmospheric pollution

International shipping includes a fleet of approximately 100,000 ships, operating at 45,000 ports worldwide and generating 900 million tonnes of CO2, approximately 7% of total CO2 emissions. In addition, emit SOx, NOx and particulate matter, which are highly toxic to health and dangerous to the environment. Ships are the main producers of pollution due to their sulfur-containing fuels. In the last 20 years shipping has produced twice as much greenhouse gas emissions as airplanes (Borriello 2013). Although air pollution is responsible for many human activities (road and rail, industry, etc.), according to ANSA (Agenzia Nazionale Stampa Associata), air pollution from ships is responsible for 6000 deaths / year, as well as for serious environmental disasters, which in some cases are considered fatal (ibid.). In particular, according to Palantzas (2008), air pollution in ports comes from:

- Ship exhaust emissions, as they use ancillary and main engines during mooring, to provide heating, cooling and electricity, as well as for cargo operations (Friedrich et al. 2007)
- Exhaust emissions from vehicles (trucks, private cars) and cargo handling machinery.
- Exhaust emissions from private vessels in the port.
- Exhaust emissions from train engines.
- Exhaust emissions from the heating of buildings, spaces, water

- Emissions of ozone-damaging particulates from the operation of containers - refrigerators and freezers.
- The volatile emissions of petroleum products during loading and unloading.
- Emissions of volatile compounds during refueling of ships, vehicles and port machinery
- Volatile emissions from building paints and during shipbuilding activities.
- Dust emissions during bulk loading and storage and when moving vehicles and trucks
- Emissions of flue gases, suspended particulates and dust during site operation and construction works.
- The emissions of toxic substances during silo insemination
- The emissions of chemicals from the cargo of ships

The main air pollutants are: ozone (O3), carbon monoxide (CO), nitrogen dioxide (NO2), sulfur dioxide (SO2), particulate matter (PM), heavy metals (lead) - Pb, male - As, cadmium - Cd, nickel - Ni), chlorofluorocarbons (CFCs), greenhouse gases (carbon dioxide - CO2, methane - CH4 nitrogen oxides - NOx), polycyclic aromatic hydrogen, (C6H6). The statutory limits for gaseous pollutants are listed in the Annex (Tables 2.6 - 2.14). Air pollutants can cause asthma and other respiratory problems, lung cancer, cardiovascular and neurological diseases, and even premature death (Kura et al. 2014). In addition to human health, they also cause serious problems to natural ecosystems (destruction of forest vegetation and agricultural production, acidification of lakes and rivers, global warming, extreme weather, ice melting, rising sea levels, etc.)

3.2.4 Water Pollution

The quality of a port's water is not only a source of pollution, but it is a synergy of many different sources, such as urban, industrial and craft sewage, rivers and tributaries, atmospheric emissions and water column and transport. of floating pollutants from the sea (Palantzas 2008). Although ports are a serious source of water pollution, there is no detailed information on their effects on water quality such as on-air pollutants (OECD 2013). Discharges of pollutants related to the port's own activities concern (Thpa.gr 2013):

A. Petroleum engine debris
B. Cargo residues, mainly petroleum, from cargo storage / Petroleum Waste.
C. Wastewater (mostly from passenger ships).
D. Ship waste (mostly from passenger ships).
E. Sea dumps
F. Liquid bulk harmful chemicals.
G. Harmful substances in packaging.
H. Hazardous and special waste arising from ship maintenance and repairs, such as paint packages containing hazardous substances, PCBs containing materials, liquid chemicals such as solvents, additives, electrolytes and cleaners, batteries, refrigerants, asbestos materials etc.

It can also be contaminated by:

A. Accidents during loading or unloading, such as an explosion, fire or a ship leak in or near a port
B. From activities related to the mooring, repair and maintenance of ships, as well as refueling.
C. From activities related to handling cargo.
D. From activities related to the maintenance and development of port infrastructure and superstructure, as well as dredging operations.

All these pollutants, as they enter the marine environment, affect water quality causing human health and marine life problems. They create oxidation, accumulate toxins in fish and degrade aquatic life (Kura et al. 2014). In particular, the discharge of ballast19, that is to say, water used to stabilize vessels, is one of the most important sources pollution due to the introduction of aliens or aliens into marine ecosystems and the transmission of harmful aquatic organisms, including microscopic toxins such as dinosaurs and other pathogens, such as the cholera bacterium Vibrio (OECD 2013). Finally, dredging operations20, which are an activity necessary to ensure port accessibility, can contaminate sediments and the surrounding marine environment (OECD 2013). In particular, if there is an increased amount of pollutant loads in the excavated products, then, as long as there is no choice but to dump them into the sea, care must be taken to cover the deposits from other "healthy" materials in order to avoid spillage of the pollutant loads. In addition to dredging for port construction, dredging can be done for other reasons (e.g., rock removal for breakwater construction). In this case they should be removed from sensitive environmental areas and definitely outside the break zone (Vittis 2004). One of the central issues of marine ecosystem pollution is the accumulation of dangerous substances in the food chain (Borriello 2013).

3.2.5 Ground Pollution

Soil pollution is mainly linked to the harbor's land-based activities. There are multiple sources of soil contamination in port areas: oil spills from vehicles and fuel depots, chemical leakage from shipwrecks, SO2, NOx emissions, which cause acid rain and thus acidification. However, the major impact of ports on the ground is corrosion. Because the presence of the port modifies the natural transport of coastal sediments, it causes corrosion. This can produce a degradation of natural systems and harm local biodiversity. Secondly, it may neglect parts of the land that could be used for recreational or productive purposes (OECD 2013).

3.2.6 Waste Pollution

Port activities generate waste, especially at oil terminals, fuel depots and dry cargo piers. Cruise ships play a critical role, which although they represent less than 1% of the world fleet, are responsible for 25% of all waste, consisting of glass, tin, plastic, paper, cardboard, steel containers, kitchen fats, kitchen waste and food waste. Plastics are a very important source of waste, as those released by ships account for almost 80% of all trash found on the shores and seabed in the Mediterranean (OECD 2013). Port waste is divided into categories (Palantzas 2008):

I. Solid non-hazardous waste (urban waste, fabrics, wood, green waste, soil, stones, iron, cargo and cargo packaging waste, catering waste etc.).
II. Wastewater (derived from workers and the public).
III. Alternative waste management (coming from various sites and processes and dealing with packaging and packaging waste from glass, plastic, aluminum, paper etc., end-of-life vehicles and their spare parts, end-of-life vehicles and spare parts, lubricating oils, tires, electrical and electronic equipment).
IV. Hazardous waste (printer inks, sails and barrels impregnated with petroleum or hazardous substances, residues of hazardous cargoes and their packaging, packaging of refrigerants, solvents, greases, cleaners, paints, brake fluid, fertilizers).

Waste and their management policies are one of the ever-increasing problems facing today's societies, as the problem is constantly exacerbated by consumer standards and the increase in packaging materials and toxic substances. But the environmental dimension of the issue is important and includes 45 soil, water, air pollution as well as over-consumption of raw materials and energy.

3.2.7 Noise Pollution

There are various sources of noise from the ports, coming from ships, cranes, trucks, trains, various works as well as shipbuilding activities. In absolute terms of noise emission, the industrial dominates, and the harbor ships represent another important source of noise. Of particular importance is the contribution of ferries and cruise ships to the proximity of downtown passenger terminals (OECD 2013, Palantzas 2008). Harbor noise is a major environmental problem internationally, especially when the port is adjacent to urban areas and 47 is open 24 hours a day. In our country there are no measurements and indications of the noise level coming from the ports, with the exception of the port of Thessaloniki and Piraeus. According to these measurements, the noise level, although elevated within the harbor, is within the statutory limits. High levels of noise near port areas are also affected by road traffic (Palantzas 2008).

Noise limits for ports in our country are defined according to land uses (op):

(a) 70dB (A) for shipbuilding zone (industrial area).

(b) 65dB (A) for segments of the port located far from urban areas (areas where the industrial element is predominant).

(c) 55dB (A) for segments of the port adjacent to urban areas (areas where the industrial and urban element is predominant).

Harbor noise can affect a significant number of townspeople, as well as port workers. This may be an obstacle to future expansion of the port (Kura et al. 2014). In addition to the negative effects on human health, noise contributes to the environmental decline of urban centers and the socio-economic degradation of many areas. A common phenomenon is the escape of residents from urban centers to areas with low noise levels (Palantzas 2008).

3.2.8 Traffic Jam

The presence of a port can leads to traffic congestion in the city, caused by traffic to and from the hinterland. A large proportion of freight traffic between port and inland is done by trucks, which add volume to road traffic and often congestion costs in metropolitan areas, which are already burdened (OECD 2013). Congestion on urban road networks due to increased cargo traffic to the port can, in turn, adversely affect the port. It is generally recognized that the port activities and functions of the transmission network cannot operate separately. The ineffectiveness of one will negatively affect the other, and this is evidence of the interconnectedness of inland and maritime networks (Notteboom & Rodrigue 2008 from OECD 2013). Congestion worsens when there is no independent road network for port activities (Verani 2008).

3.2.9 Social Impacts

The social impacts of the ports are related to their development, which can affect the life of the local community, such as resettlement of communities, disruption of life, the creation of poor neighborhoods, disruption to local physical functions, concern for increased risk of accidents. Also, oil spilled from ships and waste can have an impact on both the recreational activities of residents and the tourism of a coastal area (OECD 2013).

3.2.10 Energy Consumption

The main sources of electricity and fuel consumption in a port can be categorized, according to Palantza (2008) as follows:

1. Indoor and outdoor lighting
2. Production of hot water for use or heating.
3. Operation of electric or gas-powered vehicles and machinery.
4. Refrigeration chambers for the maintenance of sensitive products, refrigerators.
5. Heating and cooling of buildings, facilities.

The problem of energy consumption is one of the major global problems.

3.3 Contemporary Trends and Perspectives on Environmental Management

The pressing need for environmental protection has led many port authorities internationally to incorporate the environmental dimension into their management in a variety of ways. The international and European trend is to design and implement appropriate EMSs from each port, in conjunction with partnerships either at national or continental level, as well as between the public and private sectors, to develop a common environmental policy (Naniopoulos. et al. 2004). Typical examples of

promoting the principles of environmental protection and sustainable development in ports are today various Organizations and Associations such as the International Maritime Organization (IMO), the International Maritime Association PIANC - The World Association for Waterborne Transport Infrastructure, the International Union of Nations. Association of Cities and Ports (IACP), the European Ports Authority (ESPO) and the EcoPorts Network, the Hellenic Ports Association (ELIME) (Palantzas 2008). The American Association of Port Authorities (AARA), which represents 150 major western hemisphere ports (AAPA, 2019), is also moving in this direction. AAPA in co-operation with the relevant state environmental protection agency is co-financing and promoting an ISO 14001 phased research program in its ports. In addition to its regular publications on the environment, it also conducts environmental education and information seminars for each port's management and staff and, in addition, rewards its ports - members that have successful environmental policy and environmental actions (Naniopoulos et al. 2004, Palantzas 2008). The Port Associations of the "Associated British Ports" and the "British Ports Association" of the United Kingdom have established a common environmental policy and are working closely with the relevant ministries. Typical actions are the obligation of ports - their members to implement environmental monitoring systems in the water and have issued a manual on the effective management of waste on board ships.

An example of this is the Spanish Public Agency “Puertos del Estado”, which has developed a program for the progressive integrated management of Spanish ports, as well as a program for the implementation of a water monitoring system in accordance with the requirements of Directive 2000/60 / EC. In our country there has been no centralized organized initiative (YENAP, Port Union) to promote practical or integrated EMS (Palantzas 2008). The Government of Queensland (Australia) has recently passed a law on the sustainable development of its ports (Sustainable Ports Development Bill 2015). Many of Australia's ports are located in sensitive environmental areas and therefore have to comply with specific international environmental conditions. For example, in Queensland several harbors are within or within the boundaries of the Great Barrier Reef World Heritage Area (GBRWHA), in Victoria the port of Hastings borders the Westernport area, protected by the Ramsar Treaty and its harbor canals. Melbourne is located near the Ramsar Treaty area. Sustainable development forms the basis of their management strategies in general and in particular their environmental management (GHD 2013). As for the implementation of integrated EMS, the majority of ports limit their application to specific issues, functions or programs. EMS - Environmental Management System is common in US ports, but full certification with ISO 14001 is only sought by a few ports, as it is considered a time consuming and expensive process. In Europe, with the full support of ESPO, there has been a growing interest in adopting uniform environmental management standards over the last 15 years (WG150 2013).

3.4 International Environmental Management Practices

3.4.1 Air Quality Management and Monitoring

The reduction of air pollution is subject to international regulations. The main international instrument for the emission of ships' pollutants is the "Regulations for

the Prevention of Air Pollution from Ships" (6th Annex to the IMO MARPOL Convention), which were voted in 1997 but first implemented in 2005. International practice involves a combination of approaches to reducing emissions and improving air quality. These approaches depend on factors such as international, national and local regulations, the size and affordability of the port, its operations and operations, and other specific features, making comparisons of pollutants difficult to compare of each port. Sources of pollution generally include ships, cargo management, train engines and trucks. From publicizing data on several ports, it seems that there is no set list of common polluters and each port can have its own ports. However, there are many common practices across the continents, such as (OECD 2013, The International Institute for Sustainable Seaports 2010, Palantzas 2008):

- Monitoring with automatic pollution measuring stations.
- Creation and maintenance of a database on all port-related emissions and their contribution to air quality at local and regional level.
- An economic incentive strategy for ships that respect the port's environmental policy or contribute to reducing their pollutant emissions by using environmentally friendly fuels or by using filters or by reducing their speed when they enter the port.
- Providing prizes.
- Using green practices such as "Cold Ironing", also known as "Shore Connection" or "On Shore Power Supply" or "Alternative Maritime Power Supply" 23 (e.g. Port of Gothenburg in Sweden, Port of Rotterdam in the Netherlands, ports Los Angeles and Long Beach in California, USA).
- Prohibition on Entering Vehicles That Do Not Have the Necessary Pollution Control Certificates (International Air Pollution Prevention Certificate).
- Old truck withdrawal programs (e.g. Ports Los Angeles, Long Beach, Oakland, Vancouver, Houston, Virginia, Charleston) and limit the running time of their engines when in standby mode.
- Use of alternative modes of transport instead of road transport, such as the use of inland and inland railways (such as the Alameda - Alameda Corridor, which connects the ports of Long Beach and Los Angeles with the regional rail network).
- Modernization of gear and means of transport.
- Use of alternative fuels in equipment and vehicles such as hybrid electricity, liquefied natural gas (LNG), propane, biodiesel and low sulfur diesel.
- Replacement of traditional renewable energy sources (e.g. solar, wind).
- Upgrading cargo handling technology (e.g. removal of diesel engines).
- Perform aerosol emitting tasks in enclosed, properly configured spaces.
- Installation of exhaust gas retention filters in the combustion furnaces.
- Use of environmentally friendly paints, resins, adhesives, solvents, etc. in their packaging indicating the absence of lead (Pb) and volatile substances (VOC free).
- Inspections of port users and contractors for compliance with the rules and agreements.

Common practice in many US ports, such as Los Angeles, is the detailed inventory of emissions, which determine their levels in a given region, depending on the source. Some ports adopt systematic monitoring and reporting of results and incorporate these emission inventories into larger port sustainability reports, which include a wide range of environmental impacts, as well as initiatives to mitigate them. The methodologies and main indicators vary, which is why National Agencies such as the US Environmental Protection Agency published guidelines in 2009 to harmonize best practices between ports (OECD 2013). Atmospheric pollution is monitored through a stationary and / or mobile station, in an appropriate position, so that the measurements are representative. The station is accompanied by the appropriate meteorological station instrumentation, which provides data on temperature, humidity, wind direction and speed, hours of sunshine, amount of rainfall, atmospheric pressure (Palantzas 2008). An important initiative to tackle air pollution is the adoption of the Environmental Ship Index (ESI), which is part of the World Port Climate Initiative (WPCI), to reduce emissions. of the greenhouse due to port activities. There are 1439 ships and 18 ports involved. Some of the ports are: Rotterdam, Hamburg, Antwerp, Le Havre, Los Angeles and New York / New Jersey. The database of ships participating in the ESI is managed by the International Association of Ports and Harbors (IAPH) (OECD 2013). Several ports are also in the process of measuring and monitoring greenhouse gases (GHG) and carbon footprint (one of the first ports is Auckland port in Australia, 2008) (The International Institute for Sustainable Seaports 2010). Air quality is a top priority on the environmental and policy agenda and is at the heart of the debate on economic development and port development. The impacts of gaseous pollutants vary widely and have regional and global implications. The European Commission with Directive 2008/50 / EC prioritizes the implementation of ambient air quality legislation. Several Member States have been referred to the European Court of Justice or have already been convicted of violating air quality levels. Emissions of air pollutants from port activities are a high priority for European port authorities, which are called upon to put in place appropriate control mechanisms to manage and reduce the associated pollution. ESPO and the EcoPorts network have compiled a "Green Guide" that contains all the necessary guidelines and specifications for a greener port.

3.4.2 Water Quality Management and Monitoring

Water management concerns both consumption and water quality at the port level. The importance of water consumption may vary from country to country, but it is generally accepted that unnecessary consumption of natural resources is not a viable practice. In addition, water saving is a favorable parameter for the general economic policy of port authorities. At the same time, maintaining good water quality is essential for ecosystems and biodiversity, as various port activities can degrade it (ESPO 2012). Maintaining good ecological quality requires monitoring the pollution and measuring it on the basis of physico-chemical and biological criteria.

A common practice of measuring pollution in ports is through sensors, which inform port authorities in real time to take timely measures to tackle it (Anastasopoulos et al. 2011). Various organisms can be used as indicators to monitor their ecological status to describe the environmental status of marine ecosystems (Wenner 1987 by

Georgiades et al. 2015). Monitoring the impact of pollution on living organisms is called Biomedication24 and was introduced by the authorities in the 1970s. Biofeedback relates to the development of techniques for measuring the concentration of organic and inorganic pollutants in living organism tissues, as well as techniques for assessing and recording biological effects on organisms (NRC 1980, NCMR 1997 by Dalianis 2005).

Water quality management includes protection and improvement programs through the management of pollution-causing activities. At the international level, ballast management is predominant. The main tool for this is Annex IV MARPOL. There are various measures taken by governments or port authorities to limit the rejection process either by regulating where and how it will be done or by limiting its quantity. About thirty US states have established zones where ballast disposal is prohibited. There are also limits to the rate and type of pollution it contains (OECD 2013). The US-based Pacific Ballast Water Working Group, a partnership of West Coast ports, steamship companies, universities and the Coast Guard (The International Institute for Sustainable Seaports 2013), has been set up to manage ballast in the US. Many European and non-European countries have written guidelines on distances and how to dispose of ballast, but not Greece (Palantzas 2008). The Regulations on toxic antifouling materials used to deal with or prevent the accumulation of organic or inorganic sediments, such as the installation of various taxa (eg algae, molluscs, flocks, etc.) on board reefs, constitute another means of improving water quality. Since 2008, the International Convention on the Control of Harmful Anti-Fouling Systems (Ships) has been implemented internationally, with corresponding national legal frameworks (OECD 2013). Wastewater and waste cargo management through appropriate port reception facilities is of particular importance for water quality management. Some ports cooperate with local waste management authorities, such as Sweden's Trelleborg ports and Denmark's Kalundborg ports, which ship the pale water from the piers directly to the municipal sewer system, while other ports have built their ports. sewer unit (Kapellskär, Sweden) (op.). In the US, there is particular concern for rainwater management in collaboration with local authorities, and various practices such as their filtration, oil and water separation, the use of retention ponds, their biological treatment. Vancouver Harbor, USA, has one of the largest rainwater harvesting plants in the world. The Ports of Los Angeles (POLA) and Long Beach (POLB) have been developing a joint Water Resources Action Plan (WRAP) since 2009, using pilot innovative management technologies (The International Institute for Sustainable Seaports). 2013).

In Australia, where due to the dry climate there is a particular problem of water resources, similar techniques have been developed in urban areas (ibid.). In Europe in recent years such interest has begun to grow. An example of standard rainwater management is the port of Venice. After collecting all the rainwater in the harbor, they are transferred to an outdoor treatment plant, where the water is filtered by special filters for particles and pollutants (heavy metals, nutrients, hydrocarbons, etc.). This process removes oil, grease and surface foam and water is restored to the sea (ibid). In Europe the effort to tackle water pollution in ports also includes Programs such as CLEANSHIP, designed to develop common environmental practices in the

Baltic Sea region and include pilot technical solutions for the provision of electricity, gas and sewage to ships during their docking (OECD 2013). Water management is a key priority for both the IMO and the EU. Its importance is emphasized in the Water Framework Directive. More than 50% of European surface waters are not in good ecological status and the objectives of the Framework Directive set for 2015 have not been fully achieved. Within this framework, it is a challenge for ports to prioritize the management of their water within their social responsibility and the continuous improvement of their environmental management programs.

3.4.3 Management of Soil Pollution and Dredging Pollution

Ports must handle any type of contaminated material or source of pollution in their land area, as well as port sediments, in order to prevent pollution being transferred elsewhere. Management practices include (Anastasopoulos et al. 2011):

- ✓ Study on the removal of contaminated material.
- ✓ Monitoring of surface water pollution in the areas adjacent to the port, in order to prevent its entry into the marine environment of the port.
- ✓ Environmental studies prior to any construction or dredging or pre-construction work to identify any hazardous waste and to manage it accordingly.

The way dredging is done is dictated by water quality and endangered species. A common practice in many ports is the biological measurement of sediment and the use of innovative technologies to clean it. Several ports work with local companies and universities to find outsolutions for contaminated dredging materials. These include the conversion of contaminated material into environmentally friendly building material. Also, in some ports, biological measurements on species have begun microinvertebrates as indicators of pollution (The International Institute for Sustainable Seaports 2010).

Source: Retrieved from the sustainability review of North Queensland Bulk Ports Corporation (NQBP)

Figure 1 Sustainability Cycle (source: review of North Queensland Bulk Ports Corporation (NQBP))

The green harbor should set the goals of green development and be the driving force behind society's environmental, environmental quality and economic prosperity.

Figure 2: Sustainability Cycle (source: DOCKSTHEFUTURE (DTF), 2018)

3.4.4 Green Port Checklist

Taking into account the above analysis which deals with the environmental impact of a modern port's operations and in conjunction with International Green Ports practices, a list is given below which will be used to assess port green practices.

Our checklist consists of (9) nine elements as listed below:

1. Prevent air pollution
2. Reduce soil and Sentiment Pollution
3. Improve water quality
4. Improve wildlife – marine life
5. Reduce Energy consumption
6. Reduce Noise pollution
7. Modern environmental perspectives for Green ports
8. Improve weather monitoring
9. Achieve sustainability

4.Port Environmental Policy

4.1 International Institutional Framework for shipping

Shipping is now a sector of commerce in which a complex network of international, regional and national regulations applies. Most of the regulations applicable to shipping have been drawn up and are in force at international level, which is essentially due to the nature of shipping, which is of a purely international nature. The most important organization with global recognition, which sets international shipping rules, is the IMO (International Maritime Organization). It was established by the UN in 1948 and its three main pillars of activity are maritime safety, the protection of the marine environment from pollution caused by ships and the human factor in shipping. About fifty (50) international treaties and agreements have been adopted during the Agency's operation, and countless protocols and amendments have been adopted. Its original name was Inter-Governmental Maritime Consultative Organization (IMCO), it started operating in 1958 and changed to IMO in 1982 (IMO Website). It is a multinational, intergovernmental organization, currently numbering 168 member states, with well-developed and extremely stringent and binding standards, at least for member states. Greece is a member of the Agency and has incorporated its regulations into its legal system. Its measures cover all areas of international shipping, including the design and construction of ships, equipment, staffing, operation etc. to ensure maritime safety, environmental maritime policy and energy efficiency. (IMO Website). Two of the most important conventions adopted by the IMO member states are the International Convention for the Safety of Life at Sea. (Safety of Life at Sea - SOLAS 74) of 1974, revised and expanded in 1995, as well as the International Convention for the Prevention of Pollution from Ships - MARPOL 73/78. Pi.). SOLAS 74 is regarded as the most important and widespread international convention in the field of maritime safety. Its main purpose is to set the minimum standards for the construction, equipment and operation of ships for their safety, adapting these specifications to their respective technical knowledge and technological developments. The Convention defines the specifications of various types of ships, as well as the issuance of certificates that certify that a ship meets the required specifications (Hellenic Marine Environment Protection Website). Just as important as SOLAS 74, but in the field of protecting the marine environment from pollution caused by ships, is MARPOL 73/78. The Convention, as extended and amended by the 1978 Protocol and its six (6) Annexes, covers pollution caused by both the day-to-

day operation of a ship and accidents by, inter alia, laying down rules on oil discharges. and other harmful substances, the technical characteristics of the different types of ships to ensure the protection of the marine environment, how to clean the vessels and the emission limit values. The measures are aimed at combating pollution of the marine environment by petroleum, various harmful bulk liquid substances and substances in packaged form, by sewage and boat waste, and to tackle air pollution from ships (IM). The work of the IMO is complemented by other important international conventions such as the International Convention on the Preparation, Cooperation and Response to the 1990 Sea Oil Pollution Prevention (OPRC) and its Protocol, adopted in 2000 to extend the scope of the Convention to incidents of pollution of dangerous and harmful substances (OPRCs) - HNS), but not yet in force (Hellenic Marine Environment Protection Website). In 2001, the Agency adopted the International Convention on the Control of Harmful Anti-Fouling Systems, the purpose of which is to prohibit the use on board ships containing environmentally hazardous substances (Ibid). In 2004 it adopted the International Convention on the Control and Management of Ballast and Sediment Ships 2004. However, the above Convention has not yet obtained the necessary number of Member States for its entry into force (Ibid). The 2007 International Convention on the Elimination of Shipwrecks (Wreck Removal), as well as the very recent International Ship Recycling Convention (Ship Recycling), adopted in 2009 (cited above), also remain in force. One of the IMO's key priorities for the foreseeable future is to promote sustainable navigation and maritime development. Through the Agency, Member States, civil society and the port industry are working together to contribute to shaping a green economy and sustainable development, including energy efficiency, the use of modern technology and innovation, maritime education, maritime security, the development of maritime infrastructure and the proper management of all types of cargo, from oil to the most dangerous (IMO Website). In addition, actions to protect marine environment from pollution caused by ships have also been developed by various regional organizations created either through the United Nations Environment Program (UNEP) or independently, with the aim of developing by the coastal states concerted action to protect the environment of their common seas (Hellenic Website Marine Environment Protection Association). In the Mediterranean region, within the framework of the UNEP Mediterranean Action Plan, the Regional Marine Pollution Emergency Center for the Mediterranean Sea (REMPEC) operates in Malta.

4.2 Port Environmental Management Standards

Due to the complexity and the high volume of information and limits contained in all national and European regulatory policies, it is difficult for companies to systematize and adopt them, as well as for them to be difficult to control for their implementation by States or by national authorities and control bodies. The result of this stiffness has been the shift to new environmental protection policies with new, more voluntary, voluntary-based tools that do not overrule regulations but complement them (Palantzas 2008). One such tool is Environmental Management Systems (EMS), which rely on either international standard such as ISO 14001 (International Organization for Standardization) or European standards such as EMAS (Eco Management Audit Scheme). The choice and proper implementation of EMS in ports

requires high quality and safety standards. It is also a challenge and a necessity, since tackling environmental issues in addition to the key objective, which is environmental improvement, can have significant economic benefits, both directly and indirectly. International and European practice endorses and encourages the implementation of appropriate EMS, as the threat of non-compliance with environmental legislation can prove particularly costly for the port authority

4.2.1 Environmental Management Systems

The Environmental Management System (EMS) is part of the overall management system of an organization or company and is primarily aimed at improving and integrating their environmental performance into their existing policies (Mandaraka & Georgakopoulos 2006). Necessary elements for an integrated EMS, according to Naniopoulos et al. (2004)

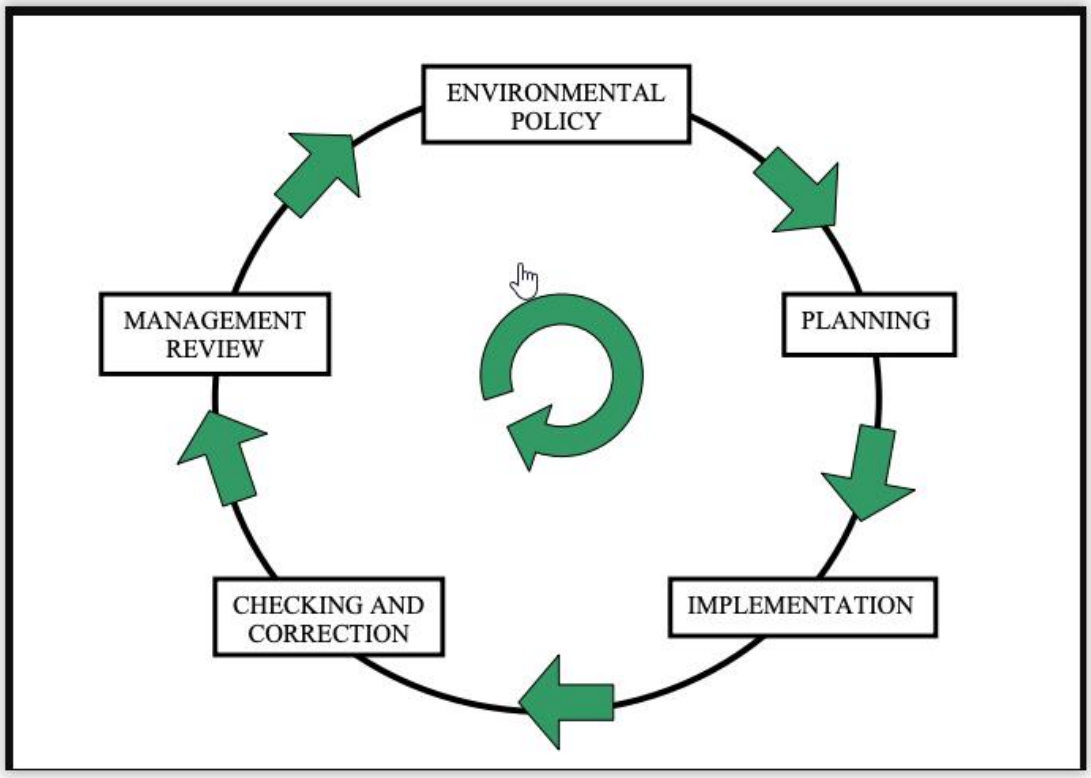


Figure 3 Map 2: EMAS (source: Niehs.nih.gov)

However, the environmental management and implementation of an EMS is a complex issue for port management. Factors that make it difficult to implement or may impede its implementation can be summarized as follows (Palantzas 2008):

- The complex framework of legislative requirements concerning the operation of ports encompasses all categories of environmental and labor legislation.
- There are many factors involved in its day-to-day operations, such as the management body, port authority, ships, land transport companies, local authorities and the ministry where the body is located.
- Solving environmental problems requires a combination of scientific, management, legal, mechanical and technical knowledge.

- The environmental interaction of the city-port, that is, the proximity of the port to urban tissue, the coastal zone and possibly to suburban industrial units, overlaps the degree of environmental burden of these factors.

According to ESPO research, the deterrent factors affecting the adoption and implementation of EMS in European ports are the recognition and complexity of responsible bodies, lack of equipment, training, competent staff and guidelines, inadequate legislative information, changes in national legislation, changes in legislation. , the low priority on the environment and the cost of development and implementation, which is a major deterrent to ports operating as public limited companies, such as the largest Greek.

4.2.2 ISO 14001

The most recognized international environmental management standard is ISO 14001. It is a model for an Environmental Management System that can be evaluated by accredited certification bodies. According to this standard, company processes that identify the environment are identified, goals and processes that reduce environmental impact are identified, controls the implementation of these processes, and if necessary corrective actions are taken, while recording competences of the personnel performing these procedures, who have been properly trained (Palantzas 2008). Developed by the International Organization for Standardization. It belongs to the ISO 14000 series, issued in 1996 and revised in 2004. It is a framework of specifications for the design of Environmental Management Systems, for the protection of the environment against pollution and, more generally, for improving environmental behavior in organizations of all kinds. Recently revised and released its new version ISO 14001: 2015, which replaced ISO 14001: 2004 ((ISO, 2019)).

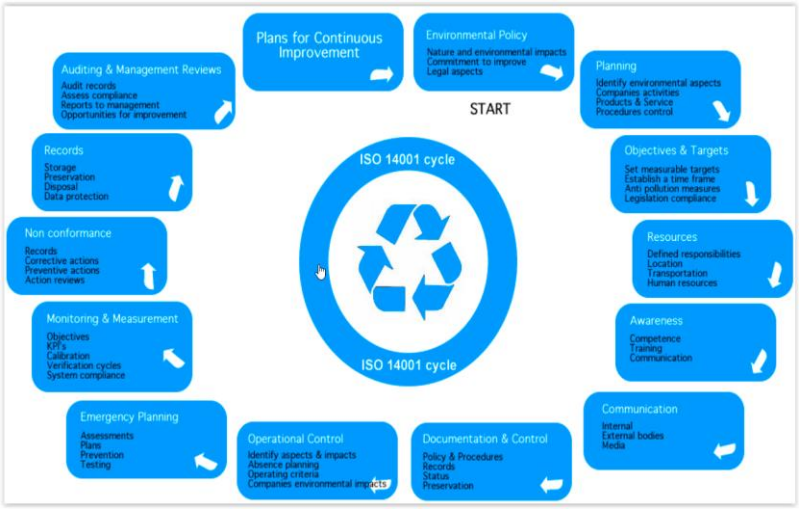


Figure 4 (Picture 1/2: (Source: ACS REFISTRARS,DSPA.NL)

4.2.3 EMAS STANDARD

The EMAS (Eco Management and Audit Scheme) is a voluntary environmental management tool designed by the European Union. It can be implemented by any public or private sector organization seeking to improve its environment. It started

operating in 1995 and was revised in 2001 and 2009. It follows the systematic “Plan-Do-Check-Act” approach. System, certification requires the incorporation of ISO 14001 environmental management specifications but is more demanding. Its additional specifications are (European Commission Website):

a) Informing the public through the EMAS environmental statement
b) Registration by public authority.
c) Performance improvement audit by environmental certification bodies.
d) Legal Compliance.
e) Employee involvement.

The EMAS Environmental Statement focuses on six (6) environmental indicators that help measure and control performance (European Commission Website):

a) Energy efficiency.
b) Material efficiency
c) Water
d) Waste
e) Biodiversity
f) CO2, CH4, N2O, HFCs, PFCs and SF6 emissions

4.2.4 PERS SYSTEM

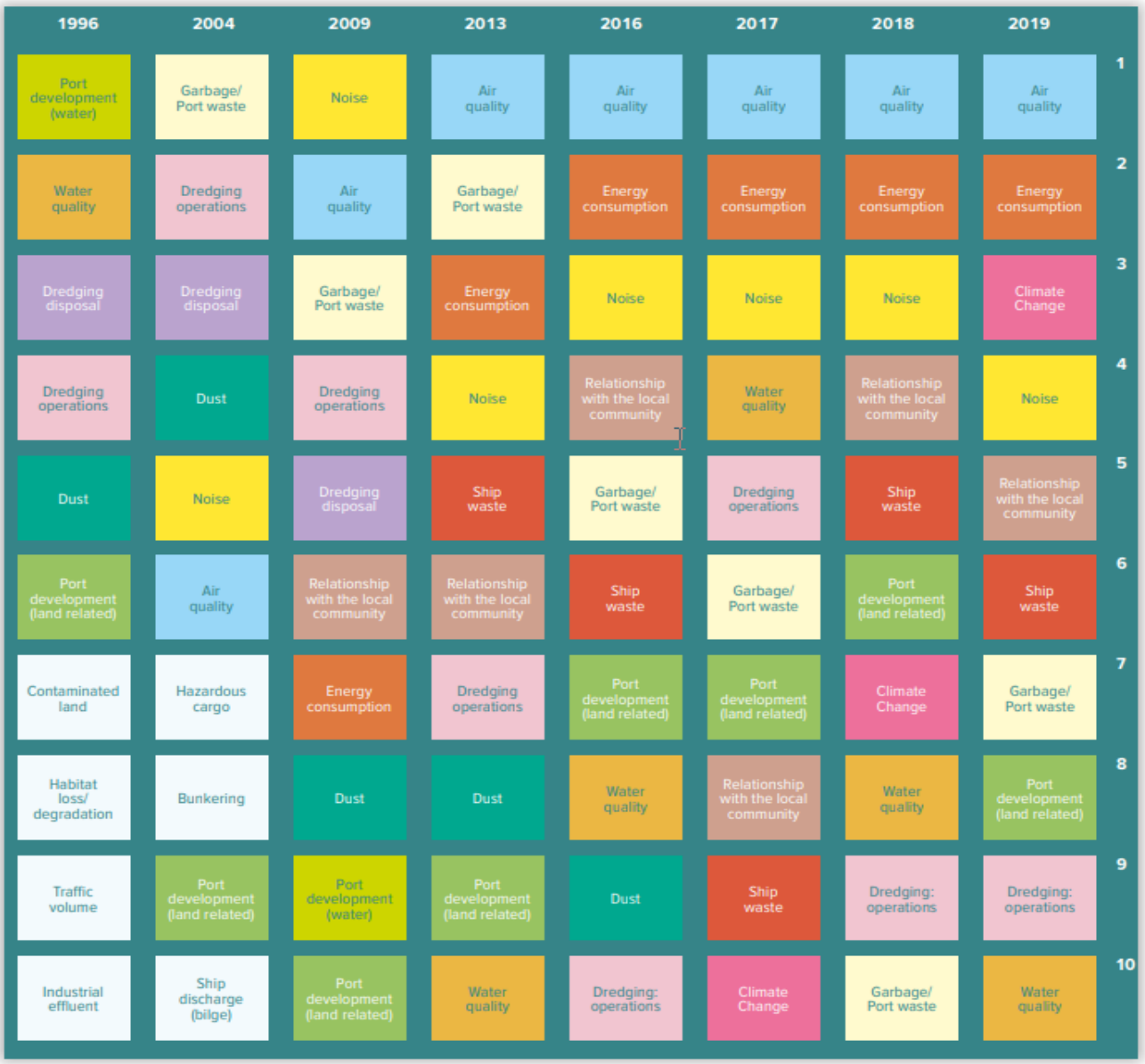
PERS is an environmental management tool developed by the European Ports Organization (ESPO) and the ECOPORTS Foundation. This system, as experts explain, is tailored to the needs and specifics of the ports and its implementation is proof of the proper environmental functioning and development of the whole port. The system addresses all environmental issues in the area of port responsibility and contributes to the definition of objectives and actions to effectively address all environmental issues.

4.2.5 European Seaports Agency and EcoPorts Network

The first body to implement environmental protection in European ports was the European Sea Ports Organization, which was established in 1993 and in 1994 adopted its first Environmental Code of Practice for the management of European ports. Its aim was to represent the European ports in the EU in order to formulate a common policy. In 1997 the "ECO - information" Program was launched, with the aim of improving environmental conditions in ports. The “ECOPORT” Program (2002-2005), initiated by the Port Authority of Valencia Port, was the first attempt to implement an EMS in ports (Darbra et al. 2009). The result of this Program has been the establishment of the EcoPorts Port Network, which currently comprises 74 ports (last updated 15/12/2015) and its main objective is to assess and improve the environmental performance of ports through the exchange of experience and practice on issues. environment, with the ultimate goal of implementing a unified approach to managing environmental issues. The network has an important role to play in

adopting ESPO's environmental policy and implementing its revised Environmental Code, issued in 2003 (Palantzas 2008).

In 2010, ECO Sustainable Logistic Chain Foundation (ECOSLC) was founded by members of the EcoPorts network, a neutral and independent non-profit foundation. ECOSLC provides port certification in and out of Europe by the independent Lloyd's Register. The project is supported by ESPO and the American Association of Port Authorities (AAPA) (ECOSLC Website). In the 2003 Environmental Code, ESPO sets the goal of sustainable development of ports and, as a first step in addressing the environmental impacts of their operations, proposes continuous environmental monitoring. Monitoring plays a key role in understanding environmental conditions, helps in managing emergencies and is a prerequisite for any EMS implementation. In-situ environmental monitoring, sensors and other equipment of the port or satellite monitoring, collect environmental data that help identify environmental problems caused by its operation (Darbra). et al. 2009). According to the literature review, the practice of environmental monitoring has been integrated into the environmental management of ports and, in many cases, is done in real time. ESPO has researched, documented and codified the ten (10) priorities that European ports have set in their environmental management areas from 1996 to date. The table below shows the evolution of environmental priorities from 2004 to 2019. The priorities shared over the years appear to be the same color (Table 1 According to the latest data (2019), air quality appears to be the first priority in port management, sustainably since 2013, water quality as last, while maintaining biodiversity is not among the 10 priorities, despite the EU environmental strategy (Framework Directive 74 on Maritime Strategy, 2008/56 / EC), sets as a key objective by 2020 the conservation of biodiversity and the ecological quality of water.



	1996	2004	2009	2013	2016	2017	2018	2019
1	Port development (water)	Garbage/ Port waste	Noise	Air quality	Air quality	Air quality	Air quality	Air quality
2	Water quality	Dredging operations	Air quality	Garbage/ Port waste	Energy consumption	Energy consumption	Energy consumption	Energy consumption
3	Dredging disposal	Dredging disposal	Garbage/ Port waste	Energy consumption	Noise	Noise	Noise	Climate Change
4	Dredging operations	Dust	Dredging operations	Noise	Relationship with the local community	Water quality	Relationship with the local community	Noise
5	Dust	Noise	Dredging disposal	Ship waste	Garbage/ Port waste	Dredging operations	Ship waste	Relationship with the local community
6	Port development (land related)	Air quality	Relationship with the local community	Relationship with the local community	Ship waste	Garbage/ Port waste	Port development (land related)	Ship waste
7	Contaminated land	Hazardous cargo	Energy consumption	Dredging operations	Port development (land related)	Port development (land related)	Climate Change	Garbage/ Port waste
8	Habitat loss/ degradation	Bunkering	Dust	Dust	Water quality	Relationship with the local community	Water quality	Port development (land related)
9	Traffic volume	Port development (land related)	Port development (water)	Port development (land related)	Dust	Ship waste	Dredging: operations	Dredging: operations
10	Industrial effluent	Ship discharge (bilge)	Port development (land related)	Water quality	Dredging: operations	Climate Change	Garbage/ Port waste	Water quality

Table 1: Evolution of environmental priorities in European ports (1996-2019)

4.2.6 EcoPorts Network Environmental Tools

To date, various tools and methodologies have been developed by the EcoPorts network to support integrated environmental management in ports. The most important are the Self-Diagnosis Method (SDM) and the Port Environmental Review System (PERS).

4.2.6.1 Port Environmental Overview System

It is based on the results of chronic surveys by ESPO and the EcoPorts network. It is their institutionalized instrument for the implementation of their principles and the solid basis for the development of an EMS for ports. Port certification with this System indicates that they are following an integrated environmental management. Its requirements are similar to those of ISO 14001, but are certified by an independent

and internationally recognized certification body, Lloyd's Register. It can be adopted from any port at any time (Darbra et al. 2009 and EcoPorts Website). According to Palantza (2008), its main features are:

- It is based on internationally recognized best practices
- It is designed to work both proactively to avoid legal consequences, but also to adapt to future legal and priority changes.
- It addresses all the environmental issues of the ports in a comprehensive way and helps to identify and define policy and performance criteria.
- Overview is a key part of it, helping ports set targets to improve their performance.
- Its implementation is voluntary.
- It provides great flexibility in setting environmental indicators and targets, and each port authority can set its own time when it adopts it.
- It is constantly updated.

5. Pioneer green harbors – Examples

This chapter will look at some of the most important green harbors in the world, in particular the Long Beach and San Diego ports of the American continent, as well as Sydney Harbor in Australia. We will proceed with the analysis of these three ports as they have, over the years, implemented green policies that have achieved significant environmental results by providing a tangible example of the results that can be achieved by implementing a sustainable development plan. Also, these three ports are crucial members of the program 'World Ports Sustainability Program', which is formed in May of 2017 based on the 'World Ports Climate Initiative' that IAPH started in 2008 (Sustainableworldports.org, 2019) There will even be remarkable green policies followed by other ports around the world.

5.1 The port of Long Beach

At the beginning of 2005, the Long Beach port in America, committed to the US authorities to make changes that would lead to an improved environment. Following this policy, it developed and announced its new environmental policy based on five main principles:

- Protecting the local community from the harmful environmental impacts of port operations.
- The port is set to become a pioneering force in environmental management.
- Its main feature is the promotion of sustainability.
- Use and implementation of new technologies aimed at reducing environmental impacts.
- Raise awareness and educate the local community and its employees on issues and actions related to the prevention and protection of the environment.

By observing the above principles one can easily see that the Port of Long Beach wants to make structural changes in its environmental policy without excluding the

local community by making it clear that the results will be faster and more drastic if it participates in all the effort and the neighboring social whole. It is therefore concluded that Long Beach Harbor avoids temporary solutions simply by adopting some green policies to reduce emissions and it prefers to set up an environmental policy aimed at long-term environmental protection.

In order to achieve this, the Port set some key parameters in which it aims to develop environmental policy. These parameters are more specific to air, water, fauna, soil, sustainability and local community. Nitrogen particles and carbon dioxide emitted by the transport of goods either by land or by sea are the main cause of air pollution. So, one of the major goals set by the Long Beach port was to protect air quality and improve it if it was possible. In 2005 the emissions of ships, trucks, trains and landing gear were on a daily basis 48 tons of nitric oxide and 2.5 tons of petroleum pollutants which resulted in the creation of smog and airborne harmful substances for the human health. As the development of the port was inevitable and the volume of work carried out would increase, the need to reduce its environmental impact was considered necessary.

Long Beach Seaport, seeking to expand its operations and maximize their efficiency, is committed to working with the Port of Los Angeles, the Environmental Protection Agency and the Regional Air Quality Management Agency in writing a comprehensive plan in parallel reduction of air pollution and consequently human health burden on port transport.

Long Beach's Port budget contains $ 2 million annually to attract green-flagged ships, while conducting continuous air quality checks by two stations it has installed at key locations.

Significant contribution to the reduction of air pollution from Long Beach port modes has been implemented by the "Clean Truck" policy, which reduced emissions by more than 80%. The main pillar of this policy was that it imposed all the port-related trucks and its operations, and on January 1, 2010 they had engines older than 1993 and were automatically excluded from working on them. Also, the same year all the lorries produced from 1993 to 2003 were checked for the pollutants they produce in order to be granted a work permit for the port. In pursuance of the above policy, Long Beach Port decides in 2011 to invest $ 10 million in order to persuade all operators involved in the operation of ships to use low sulfur low-speed engines during arrival and departure procedures.

Figure 5 : (Port of Long Beach, source: maritimeprofessional.com)

To date, Long Beach Harbor has spent $ 34 million on developing an environmental air protection policy. On August 27, 2019, Long Beach port announced that it has already received a $ 50 million grant from the "California Air Resources Board - (CARB)" for the project "Sustainable Terminals Accelerating Terminal Transformation – (START)" which is part of "California Climate Investments" which directs tens of millions Cap-and-Trade to reduce greenhouse gas emissions, boost the economy and improve public health and the environment - especially in disadvantaged communities (Maritimeprofessional.com, 2019)

Water quality protection plays an important role for Long Beach Harbor. Water as an essential asset vital to maintaining life on our planet must be kept clean as it is one of the most important factors in spreading pollution and diseases. The marine part of the port is constantly polluted by sewage sludge, garbage, oils, grease, plastics and other pollutants.

Long Beach Port, being aware of water pollution from an early age, has developed various actions and policies dating back to 1993. Arriving today, water quality monitoring stations have been installed at all estuaries, helping significantly to reduce water pollution.

An extension of the aquatic world is clearly life in it. So Long Beach Beach's plans to implement environmental protection policies could not miss the living animals in and around its waters. This is why, it has installed stations that monitor the growth of fish living in its waters, as well as monitoring the development of fauna around it. The Long Beach port has invested more than $ 50 million to date in studies to improve the living environment around it.

It is natural that soil in an area with heavy mobility for heavy vehicles for years has been burdened by these pollutants, whether they come from the burning of oil or the friction of parts of vehicles such as tires. The purpose of the Long Beach port is to restore all these contaminated soils. In the last decade alone with its soil remediation program, the Port of Long Beach has managed to remove 200,000 tonnes of pollutants. The objective of the program is now to remove pollutants that settle in the soil on an annual basis so as not to accumulate large quantities and cause greater problems.

Summarizing the Long Beach port case, we see that it implements policies and actions for the design, construction and operation of sustainable development. This policy therefore applies to all of the pieces mentioned above and is constantly evolving. However, none of this would be possible without the consent and cooperation of the local community and local government. In 2019 the port of Long Beach has been declared as a green port and continues to pioneer its sustainable development programs. Many ports are based on their own practices for developing their own sustainable development plans.

After analyzing the above and comparing it with the necessary elements of the Green Ports List as formulated in Chapter 1.6, we note that the Long Beach port is a point of reference. In particular, Long Beach harbor with its environmental policy and sustainable development plan has achieved all the objectives of the list, but has also taken further steps in environmental and environmental protection, by developing new programs such as the net tracts mentioned above but also by evolving all the existing ones.

Port environmental policy covers all of the following areas of interest:

1. Air - Reduce air emissions from Port activities
2. Water - Improve the quality of Long Beach Harbor waters
3. Wildlife - Protect, maintain or restore aquatic ecosystems and marine habitats
4. Soil / Sediment - Remove, treat, or render suitable for beneficial reuse of Port contaminated soils and sediments in the Harbor District
5. Sustainability - Implement sustainable practices in marine terminal design, development and operations as well as training, operations and practices within the Port Administration and Maintenance Centers
6. Community Engagement - Interact with and educate the community Regarding Port environmental programs (Polb.com, 2019)

	PORT OF LONG BEACH
PREVENT AIR POLLUTION	√
REDUCE SOIL AND SENTIMENT POLLUTION	√
IMPROVE WATER QUALITY	√
IMPROVE WILD LIE - MARINE LIFE	√
REDUCE ENERGY CONSUMPTION	√
REDUCE NOISE POLLUTION	√
MODERN ENVIRONMENTAL PERSPECTIVES FOR GREEN PORTS	√
IMRPOVE WEATHER MONITORING	√
ACHIEVE SUSTAINABILITY	√

Figure 6 Picture 8: (source: https://gcaptain.com/port-of-long-beach-container-volumes-fall)

5.2 The Port of San Diego (U.S.A.)

San Diego belongs to the State of California and is its 2nd largest city. The city of San Diego was created in 1769 by Spaniards who colonized the area during the 1st Spanish mission. For many years, the area around the San Diego Bay area has had a

very bad reputation as the area has been a hub for suspicious transactions and suspicious bars. The city of San Diego was slow to develop nearly a century and a half after its discovery in 1769, the city began to grow in the early 19th century, and more specifically in 1907 when the bay was discovered by the US Navy and the first base was established there.

The Port of San Diego was founded in the 19th century, and in 1962. It was rapidly developed and expanded to provide high quality services, achieving an ideal balance between land use and quality of life.

The Port Authority of San Diego approved and began implementing green policy in 2008. By doing so, Port Authority is formulating the policy to pursue long-term goals such as environmental, social and economic benefits through the conservation of natural resources, reducing waste and preventing pollution. With Green Growth in mind, the Port of San Diego sets six key areas to focus on for which there are specific formulas for measuring and evaluating progress.

Energy Resources: In order to maintain and maximize energy efficiency, the Port of San Diego has installed a Photovoltaic system in all General Administration buildings since 2009. With the usage of this renewable source of energy, Port of San Diego has achieved to generate approximately 530,000 kilowatt hours of electricity annual. It has also replaced all lamps with new advanced LED technology, reducing its energy needs by half. In 2019, the port was able to obtain a $ 5 million sponsorships from the California Energy Commission for the installation of a renewable solar-powered microgrid at the Tenth Avenue Marine Terminal, which will help to reduce greenhouse gas Emissions, save the port 60 percent per year on electrical utilities. The installation will complete on 2020 (source: portofsandiego.org).

Progress in the field of energy in the port of San Diego is rapid and always in line with the needs of the environment and the surrounding society.

Management of Wastes: The Port of San Diego aims to properly manage the waste generated by port operations through recycling, reuse and composting. In May 2019 the port was honored by the state of San Diego as the recycler of the year for all of its recycling practices, such as the collection of used coffee beans and their use as a compost for roses in the "Spanish Park", and their contribution to enhancing the quality of life in the region.

Sustainable Development: A central aim of this sector is to increase the energy efficiency of buildings with installations of energy efficiency systems such as photovoltaics. In addition, training of staff to develop environmental awareness and behavior plays an important role. Nowadays, photovoltaic installations in port administration buildings have reduced the electricity demand by 170,000 kWh.

Water: In this section, the objective was to improve the water quality of the port. A major project to replace water pipes took place in the following years of the Green Policy announcement in 2008. In this section, the objective was to improve the water quality of the port. A major project to replace water pipes took place in the following

years of the Green Policy announcement in 2008. In 2018, the "San Diego Ocean Planning Partnership" pilot program was launched, which is being implemented in partnership with Port Administration and Local Government during the which records the ocean fragments used by the port and what its uses are, with the main purpose of protecting the oceans and water in general from polluting substances.

Air: the purpose of this sector is to reduce the emission of carbon dioxide and greenhouse gases into the atmosphere. The Port of San Diego has installed many air pollutions measuring stations to date. At the same time, all port equipment, including cranes and trucks, has been replaced by new state-of-the-art machinery that emits less or zero emissions. Also, in 2019, it announced a new master plan for air pollution, which plans to reduce greenhouse gas emissions by 80% in 2050.

Sustainable business Practices: n this area, the Port of San Diego sets as a major objective the creation of a decision-making environment for environmental applications that takes into account both the environment and economic and social data. This objective is expected to be achieved through the implementation of a green procurement program aimed at the use of environmentally friendly materials, with staff training seminars on environmental issues.

San Diego Harbor today has a huge turnover having developed many activities in the maritime industry, always respecting the environment and the neighboring society, providing essential work for the sustainable development of the region.

San Diego Harbor, in addition to its actions above, is considered innovative in green development as from the first moment of its environmental plan is the only port that has introduced a clear plan for climate change in its environmental policy. This plan is called Climate Action Plan and aims to reduce greenhouse gases.

The port has also been following voluntary certification by Green Marine, North America's largest maritime volunteer program since early 2018. In June 2019 he was certified with the Green Marine Certificate consisting of 12 indicators as shown in the table below (Green-marine.org, 2019):

Table 2:Green Marine Indicators *(Green-marine.org, 2019)*

So, we understand that the level of the port of San Diego in terms of its green policy is very high and bound to that of Long Beach. This is also demonstrated in our checklist:

	PORT OF LONG BEACH	PORT OF SAN DIEGO
PREVENT AIR POLLUTION	√	√
REDUCE SOIL AND SENTIMENT POLLUTION	√	√
IMPROVE WATER QUALITY	√	√
IMPROVE WILD LIE - MARINE LIFE	√	√
REDUCE ENERGY CONSUMPTION	√	√
REDUCE NOISE POLLUTION	√	√
MODERN ENVIRONMENTAL PERSPECTIVES FOR GREEN PORTS	√	√

IMRPOVE WEATHER MONITORING	√	√
ACHIEVE SUSTAINABILITY	√	√

5.3 The Port of Sydney

Sydney Harbor was discovered by British explorer James Cook in 1770 and named after Governor Arthur Philip 1788 in honor of the British Foreign Secretary at the time Lord Sydney. Its geopolitical location and the natural depth of the region's waters quickly made it one of Australia's most important ports along with that of Melbourne. In the 19th century, with the rapid increase in container shipping, the port of Sydney is constantly changing and growing. However, since 1997 after the adoption of environmental policy Protection of the Environment Operations Act 1997, Sydney port authority obliged to implement policies to protect and improve the environment.

Bearing in mind the above environmental policy, the port of Sydney has launched a guide that encapsulates and describes strategies related to the operation and development of the port with the main objective of sustainable development. This creates a fertile ground and encourages stalwarts to develop their activities with the main objective of sustainable development, while ignoring the economic and social benefits that they derive.

The Sydney Port Strategic Guide is divided into two parts, each consisting of five sections. The first part deals with resource management and consumption, which contains the sections on material selection, waste management, water consumption, energy use and means of transport. The second part defines the quality of the environment through the sections on indoor environment, pollutant emissions, water quality, land use and environmental management. The above ten modules are objectives that require specific measures with specific criteria. As a result of the environmental policies pursued by the port of Sydney, it has been adopted each year to record and present the progress made in sustainable development.

The overall philosophy of the Sydney Port Administration is to strike a balance between the short-term obligations and the long-term benefits of decision-making in the light of sustainable development. The main objective of the Sydney port is to limit the amount of energy, water and other materials used to complete the port activities.

The natural environment is a factor influenced by both the port facilities themselves and the work carried out there. A key prerequisite for all this is that the values of sustainable development are taken seriously into account when designing plans for the development and operation of the port.

In below diagram is depicted one of the formulas on which Sydney port Administration is based in order to develop its green policy for the environment. More specific, below picture presents the “environmentally related health impact (ERHI)

assessment of coal seam gas (CSG) development in Australia, presenting subjective and objective health outcomes data" (ResearchGate, 2019)

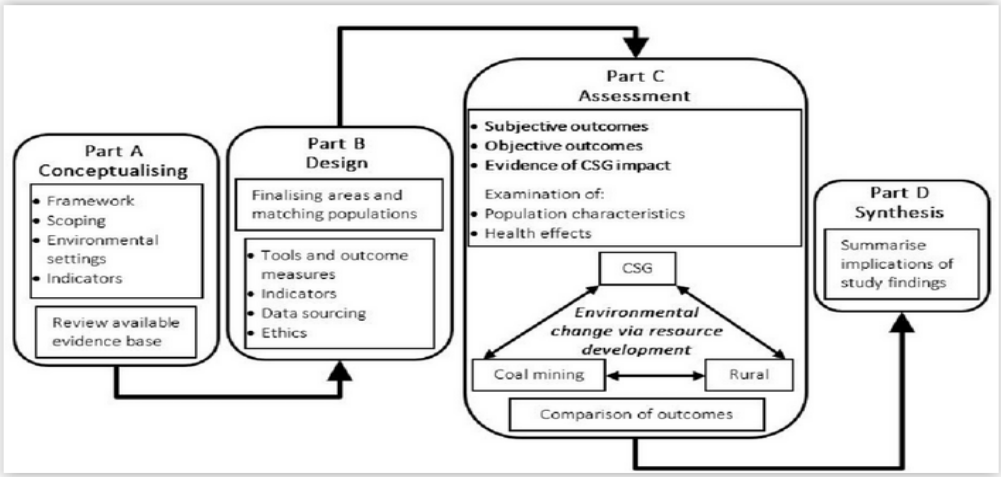


Figure 7 Picture 9: (source: www.researchgate.net/figure/The-environmentally-related-health-impact-ERHI-assessment-framework)

Since the first time Sydney Harbor has been designing and adopting a green environmental policy, it has placed a strong emphasis on the aquatic world and especially on water quality. Recognizing that water quality is a sign of a high standard of living, the Sydney port made sure to install water quality monitoring stations at various points in the port. These stations are divided into two categories.

The first category of water quality control stations is aimed at recording the water resources used for example in cooling facilities, cleaning buildings and sanitary areas. The second category of water quality monitoring stations is aimed at recording the origin of water resources, for example if they are collected from rain, whether they are from any water supply company or if they are water derived from the process of desalination of seawater.

Following this policy on the aquatic environment surrounding it, the port of Sydney has acquired the know-how to allow it to draw safe conclusions on the qualitative and quantitative characteristics of the waters they use, whilst allowing it to negotiate with water supply companies for in-port operations to achieve reduced costs per cubic meter of water.

Observing the above description of Sydney's green practices, we see a different approach to how it is implemented. The first factor for the port in the pursuit of its environmental policy is the observation and analysis of the qualitative and quantitative data derived from the natural environment in order to lead to safer and faster results.

Nowadays, Sydney Harbor, in collaboration with the Australian scientific community, is pursuing pioneering methods of water purification, such as the development of a new type of chemical element the "Graph air", a new form of carbon that promises

faster and more efficient cleaning. of water from life-threatening substances, providing an important cornerstone for sustainable development around the world.

Taking into account all the above we can see that Sydney Harbor is very environmentally conscious. The port has introduced an environmental monitoring model which is divided into two parts as previously discussed. It has also compiled a comprehensive checklist on the greening of both Sydney and other ports surrounding Australia. The port has expanded its green policy to the surrounding society, with the city of Sydney announcing a full green development plan by 2030 that primarily envisions the port's cooperation with society.

Below is an example of a checklist drawn up by Sydney Harbor:

	Item No	Purpose/criteria	Has this been addressed? (Yes, No, N/A)	How has it been addressed? Or, why has it not been addressed?	Provide details of supporting documentation/reference material
Materials selection	R1	Reduce the quantity of new materials being used by reusing materials or by utilising recycled materials.			
	R2	Encourage environmentally friendly production of materials.			
	R3	Specify materials that have minimal embodied energy and environmental impact.			
	R4	Consider the end of life of materials and the whole building, design for deconstruction.			
Waste manager	W1	Minimise the generation of wastes.			
	W2	Facilitate recycling to reduce the amount of waste going to landfill.			

Table 3 Sydney port - Green port checklist (Portauthoritynsw.com.au, 2019)

	Item No	Purpose/criteria	Has this been addressed? (Yes, No, N/A)	How has it been addressed? Or, why has it not been addressed?	Provide details of supporting documentation/reference material
Water consumption	H1	Reduce consumption of potable water internally.			
	H2	Manage and monitor water usage and any leaks.			
	H3	Reduce the quantity of potable water used for landscape irrigation.			
	H4	Treat water on-site and reuse the treated water to reduce demand on the local potable water supply and the demand on the local infrastructure.			
Energy use	E1	Reduce energy consumption and hence greenhouse gas emissions.			
	E2	Manage the use of energy to minimise consumption.			

Table 4 Sydney port - Green port checklist (Portauthoritynsw.com.au, 2019)

We thus conclude that Sydney Harbor is rightly regarded as one of the pioneers in the field of green development, which in turn fulfills the prerequisites of our checklist:

	PORT OF LONG BEACH	PORT OF SAN DIEGO	SYDNEY
PREVENT AIR POLLUTION	√	√	√
REDUCE SOIL AND SENTIMENT POLLUTION	√	√	√
IMPROVE WATER QUALITY	√	√	√
IMPROVE WILD LIE - MARINE LIFE	√	√	√
REDUCE ENERGY CONSUMPTION	√	√	√

REDUCE NOISE POLLUTION	√	√	√
MODERN ENVIRONMENTAL PERSPECTIVES FOR GREEN PORTS	√	√	√
IMRPOVE WEATHER MONITORING	√	√	√
ACHIEVE SUSTAINABILITY	√	√	√

Figure 8 Picture: 10 - 11-12 -13 -14 (The port of Sydney, source: portofsydney.org)

6. EXISTING SITUATION IN GREECE: PIRAEUS AND THESSALONIKI PORTS

In this chapter we will examine the case of the ports of Piraeus and Thessaloniki in order to see whether they have taken actions to convert them into green ports, or whether they have planned such actions.

6.1 Greek ports

Greece has the largest coastline throughout the EU. There is a well-developed port network within the country due to its peculiarity and the existence of many islands. The islands are home to about 13% of the country's total population and as a

consequence, the country's territorial cohesion depends to a large extent on maritime cabotage (Ministry of Shipping & Aegean 2012, Tsitambani 2013). Greek ports are a factor in the country's economic development both as a hub of international and national trade and as a tourist destination. In 2006, 107 million tonnes of goods were shipped, over 90 million passengers, residents and tourists, far more than other European countries (Palantzas 2008). The contribution of sea transport and ports to the Greek economy is significant. 18% of cargoes imported to Greece and 25% of inland cargoes are transported by sea, while 29,200 employees are engaged in maritime transport, including accompanying sectors such as shipbuilding and port services, fishing and more. (4th place in Europe). In addition, maritime transport and associated industries create value added of 3.2% of GDP (6th position in Europe) (Ministry of Shipping & Aegean 2012). Two key areas of tourism development are cruise and yacht tourism, two areas that require appropriate, high-quality port infrastructure and services. However, the country is lagging behind in specialized port facilities (marinas), with the result that tourist boats can be serviced in ports of general character (passenger, fishing shelters, etc.) or in natural bays / bays, without port infrastructure or corresponding organized marinas. (Ministry of Shipping & Aegean 2012). According to the Ministry of Maritime & Aegean (2012), EU enlargement has had multiple effects on maritime transport networks. Greece for the first time acquired land borders with the EU, which is expected to stimulate its long-term links with the rest of Europe, in particular in the transport of goods / goods through combined transport (maritime - road - rail). Thus, for the Greek ports, inland is not only the Greek territory, but also the neighboring countries, mainly to the north,: Serbia, FYROM, Kosovo, Bulgaria, Romania and Ukraine, as well as eastern countries, such as Turkey, for which the Greek ports are "gateways to and transit". The port of Piraeus has been established over the last decade as one of the main transit centers of the Mediterranean, having a favorable geographical location and sufficient depth to accommodate large quantities of cargo (containers and passenger cars), which are then divided to smaller quantities and are transshipped to smaller ships for transport to neighboring countries. Related activities are being developed in the port of Thessaloniki, with a positive outlook for the port, along with the port of Alexandroupolis, a transit center of transnational importance, meeting the needs of the northern neighboring countries (Ministry of Shipping & Aegean 2012). The ports of northern Greece have a particularly important role in conducting trade in the wider region of SE Europe. They are focal points on international maritime routes between the Mediterranean and the Black Sea. The main ports of northern Greece are the port of Thessaloniki, which is the most important port of the region, the port of Igoumenitsa, which is the gateway of Western Greece to the north, as well as the ports of Kavala and Alexandroupolis, which are the ports of Anatolia and they are nodes of northern Greece. In particular, the port of Thessaloniki has an advantage over others not only because of its infrastructure and links to transport networks, but also because it has a Free Zone11 (Polyzos et al. 2008). Competitive Greek ports in both the Black Sea (Varna and Burgas, Bulgaria, Constanza, Romania) and the western Adriatic ports (Croatia's Rijeka and Split, Slovenia's Koper, Montenegro's Barr and Albania's Durres), their competitive position and, year by year, increase cargo transportation (Polyzos et al. 2008). Completion of some projects, such as the Egnatia Motorway

and the Pan-European Axis (Axis IV leading to Thessaloniki, Axis X leading to Thessaloniki to Igoumenitsa and Axis IX, leading to Alexandroupolis), will increase the competitiveness of Greek ports. Greece, as the distance - time from specific destinations will be reduced. The problem with the ports of Northern Greece is that the Axes are still within the boundaries of urban areas and their connections to the urban networks (ibid.). In particular, with regard to the period 2014-2050, the EU Guidelines for the Trans-European Transport Networks are being adopted.

In addition to the completion of road connections, the integration of the rail network and its connection to international networks, corresponding to European countries, through the Pan-European Rail Network axes, which are themselves three axes, are also important. (Ministry of Shipping & Aegean Sea 2012). Given the comparatively small domestic demand for transport (Greek imports and exports and traffic to and from the islands), the great opportunities and prospects for the development of Greek ports are on their way to joining the major international shipping routes. Competition in the maritime transport sector is fierce and the continued success of Greek ports depends on their ability to invest to meet the needs, achieve the organization, prices, costs and quality of service at competitive levels, not only of the Italian, French, Spanish and Maltese ports (to which the Greek ports operate complementary to the Eastern Mediterranean), but 34 also ports in North Africa (eg Damietta, Alexandria, Israel, Turkey, Cyprus, Syria, even Lebanon etc.) (Ministry of Shipping & Aegean Sea 2012). The ports of the country are obviously facing new challenges, but also new opportunities and opportunities that will ensure their success in the evolving global environment of the shipping industry in general. The port industry's performance in terms of efficiency, productivity and sustainable development, concessions, private and public sector port financing, port integration into the Trans-European Transport Network, the effort to create a single market for port services and the simplification of administrative procedures in ports and workplaces, according to the Ministry of Shipping & Aegean (2012), are the axes around which the review of the national port will be initiated. policy initiatives and initiatives to be taken by the European Union in this area in the foreseeable future. It is noted that these elements will be linked to important initiatives and strategies underway and shaping the new landscape, such as Short Sea Shipping, Integrated Maritime Policy and the Single Maritime Transport Area. Also, ports as key points of interconnection between land and sea transport are called upon to play an important role in the development of intermodal transport and transport chains. The Hellenic Port System consists of approximately 900 ports and port facilities of different size, organization, uses and different economic importance for national and local society.

Greek ports throughout the 20th century were state-controlled and subject to the same administrative regime as all other public services (public utilities, schools, hospitals, telecommunications, electricity, transport) as public goods. Law 2688/1999 introduced a process for private sector participation, as the two international ports of the country, Piraeus and Thessaloniki, were converted into public limited companies, with the state holding 75% of the shares and has the management of ports. The next step was Law 2932 in 2001, which transformed 10 ports of national interest into public limited companies and established a special Ministry to coordinate the national

port system as a whole (Vaggelas 2007). The traditional state character was transformed into Harbor Legal Entities under state ownership. Today the main shareholder in PPA SA and THPA SA is the Public Utilization Fund (HRIPED), with 74,138% and 74,268% respectively. This means that the HRADF, as the main shareholder, now owns all the rights that the Greek State held before the transfer12. In addition, the Greek State transferred fully the ownership of 100% of the share capital of each of the 10 Société Anonyme - Port Organizations 13 (Ministry of Shipping & Aegean 2012). However, the solution of the sale of all port company shares to a private entity is no longer applicable anywhere, not only in European ports but also worldwide, as the port operates in monopolistic terms and without commitment to development, the local economy and society, and the protection of the environment. It was used in Britain, abandoned as a model, and three reform efforts were made without resolving the problems (Afentoulidis 2015). According to the new "National Ports Strategy 2013-2018" (Ministry of Maritime & Aegean Sea 2012), the merging of existing structures (Port Organizations SA) creates Port Networks in the form of Société Anonyms and subsequently evolves into Regional Networks.

In each Port Network, the administrative functions15 are separated from the port business activities16. The Port Network, through the Directorate-General for Management and Development (DGMD), oversees business and port service activities undertaken by private entities (IP). According to the new operating model, therefore, the Greek state will act as a "landowner", that is, will own the land through the intermediary (Port Authority), as well as administrative functions. The business operator will assume the commercial - business functions and activities. The Port Authority will ensure State control, despite the privatization of commercial activities. Privatization of the port of Piraeus has begun since 2009, while the privatization of the port of Thessaloniki begun in 2016.

6.2 The port of Piraeus

The port of Piraeus is one of the largest in the world in terms of passenger traffic. Every year more than twenty million passengers move through it. It is the link between mainland Greece and island Greece and Crete, and it is also a maritime gateway to the European Union. The central port extending from the mole Themistokleous up to mole Krakari.

The management and operation of the port of Piraeus is exercised by the PPA SA (Piraeus Port Authority SA) for the purpose of providing port anchoring services and the handling of cargo and passengers to and from the port and with the installation, organization and operation of any type of port reception (Information Society Operational Program, 2008).

6.2.1 Historical retrospective of the port of Piraeus

The port of Piraeus has a long history dating back to the Bronze Age in 2600-2000 BC. Then began its gradual integration with Attica, constituting its main sea gate. At the beginning of the 19th century, Piraeus was recognized as an independent municipality and with the proclamation of Athens as the new capital of Greece in

1834, the port of Piraeus was upgraded as the central seaport of Greece. At the same time, the port of Piraeus suffered a number of serious catastrophes during its lifetime.

Having as a springboard to modern history in the year 1834, the port of Piraeus has a series of important events that led to its present form, as described below:

1. In 1836, the Athens - Piraeus connection is made through the construction of the Athens - Piraeus Central Road which helps in the easier distribution of products to and from the port of Piraeus. In the same year, the first Health Center in the region was built.
2. In 1860, Piraeus acquires its first Shipyard with the establishment of Vasiliadis Shipyards.
3. In 1869, the creation of a railway line between Athens and Piraeus is a fact. At the same time, the first maritime insurance company and the first registrar company made their appearance in the same period.
4. In 1893, one of the most important projects to facilitate maritime trade in Greece, the Corinth Canal Crossing.
5. In 1934, with the continuous development of the port, there was a need to establish a company that would manage the port. Thus, according to Law 4748, the company is established Piraeus Port Authority – (PPA), with the purpose of full management of the port and its development.
6. In 1964, the expansion of the Wharf is a fact, while the Piraeus Fishery begins operating in the Keratsini region.
7. In 1973, the construction of the purely commercial part of the port begins with the construction of the 1st pier in the area of Neo Ikonio.
8. In 1976, new laws authorizing the restructuring of the port management body were passed. Also, in the same year, the great shipping exhibition "Poseidonia" is organized for the first time in Piraeus, which continues to be held every year until today.
9. In 1999, the Piraeus Port Authority was transformed into a public limited company by law of the then government.
10. In 2003, the company Piraeus Port Authority is listed on the Stock Exchange.
11. In 2009, after a long period of consultation and social reactions, the government's final agreement with the Chinese colossus CHINA OCEAN SHIPPING COMPANY (COSCO) on the concession and operation of the 40-year-old Piraeus container station was announced (naftemporiki.gr).
12. In 2019, Port of Piraeus after acquisition of COSCO has become the 7th biggest container terminal in Europe & 32nd worldwide with a moving capacity of 4,057 million TEU (naftemporiki.gr)

The following figure shows the organization chart of Piraeus Port Authority as it was formed after the acquisition by COSCO:

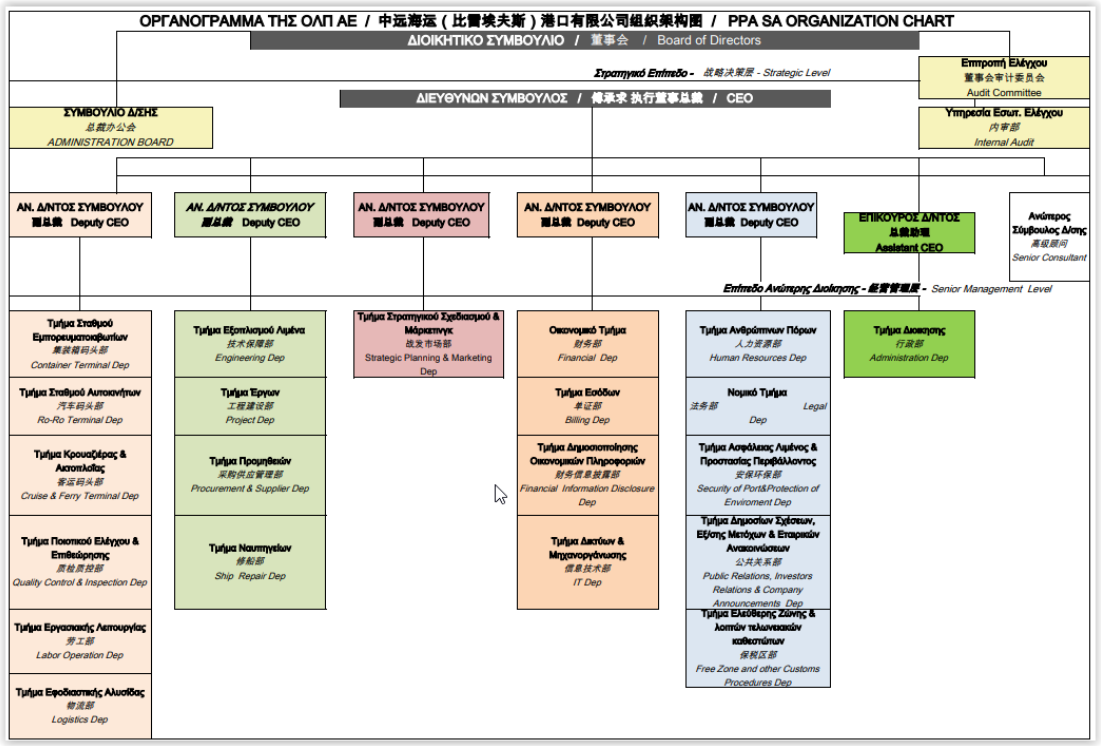


Figure 9 Picture 3: (source: olp.gr)

6.2.2 Implementation of green practices in the port of Piraeus

In preparing this thesis we have examined whether Greek ports have taken any action to designate them as green. So, for this work we have studied the cases of the port of Piraeus, the port of Thessaloniki and the cases of green ports in different parts of the globe. It is a fact that the two Greek ports have adopted and implemented green policies, as well as long-term green plans. However, there are still opportunities and opportunities for Greek ports to step up their efforts on the path to green development.

As far as Greece is concerned, the ports of Piraeus and Thessaloniki are the pioneers in the design and implementation of green policies. They have been PERS certified for many years, which may seem more resilient to solving environmental problems, but it does require that competent authorities should regularly submit detailed progress reports that they appear to be interested in identifying and subsequently to solve both their maritime and coastal problems.

Investigating through this postgraduate thesis the present status of Greek ports, we have found that Greek ports exhibit strong environmental actions while lacking green and sustainable development strategies. As it follows from the analysis above, ports following the Derming cycle model, plan, execute, monitor, and redesign their strategic development (PDCA model).

Had the Greek ports taken the Sydney port strategy as a basis, they could have set a green path of development, highly adapted to the Greek context. More specifically, Sydney's strategy proposes to divide the actions of Greek ports into those that relate to natural resources and those that relate to quality environmental characteristics,

whereby two sets of actions are created that include five areas of environmental policy implementation each.

PPA is an "EcoPort" port and belongs to the European Ports Network with " Ecoports status " (Ecoports.com, 2019). The Ecoports Ports Network consists of European ports that have assessed their environmental performance according to the European Sea Ports Organization's (ESPO) Ecoport Self Diagnosis Method (SDM). The environmental management applied by PPA is certified since 2004, according to ESPO's Port Environmental Review System PERS.

PPA SA, in its installer, caters for all types of cargo (conventional and single), also caters for cruise and cruise ships and ships for repair work. This complexity of Port activities can result in the development of environmental issues related to marine water, noise and air quality. Port Authority of Piraeus SA recognizes that the port its activities and commitment to competing and up-to-date facilities and services can have an environmental impact. In this context, it seeks long-term sustainable development by reducing any adverse effects on the natural (air, soil and water) and the social environment, in all its operations, activities and services provided. Therefore, PPA recognizes the importance of environmental issues related to air, soil, noise, quality water and consumption of natural resources. In pursuance of the foregoing, it focuses its policy on the effective management of waste generated by its installations and ships in monitoring the quality of the acoustic environment throughout its area of responsibility, both at the passenger and commercial ports, and monitoring the atmospheric environment, both in the area of passenger stations and cruising.

PPA is equally environmentally aware and active on all their existing and future development plans and projects, environmental issues affecting the coastal environment, and the need to control for potential adverse environmental impacts come from vessels owned by private companies and third parties served and operating within the general area. (Ecoports.com, 2019). The port of Piraeus, being a major center of trade in the Mediterranean, should apply the principles of sustainable development with particular emphasis on protecting the environment which is now sufficiently linked to economic viability and development. Due to its pivotal position in the port of Piraeus, it has always been subject to a development tax procedure, always in accordance with the principles of environmental protection. It is constantly evolving and implementing policies in line with European and Greek environmental policy regulations, while at the same time developing a mechanism for the environmental assessment of its activities. It has also advanced to an advanced stage of management through the following actions:

1. Marine pollution emergency response
2. Environmental quality monitoring
3. Waste Management Plan
4. Environmental management system

The port of Piraeus is now one of the 13 in Europe and one of the two in the Mediterranean, which joined the Eco Port Status Ecological Network (econews.gr/2011/03/01/eco-port-status-olp/, 2011).

In the area under the jurisdiction of the PPA has established an environmental metering station while there are ongoing photovoltaic energy parks and green space development programs. The port of Piraeus is certified as a park environmental review system PERS and is in the European database of the ports eco port status.

6.2.3 Environmental Quality Monitoring in PPA

PPA SA implements its quality monitoring programs environment in collaboration with Academic Institutions and Special Scientific Associates. The elaboration of the results of these programs leads to the identification of areas and issues that need improvement and generally helps PPA SA to assess its environmental status and take appropriate remedial measures.

More specifically, it focuses its efforts on the following areas:

6.2.4 Quality of Marine environment

In collaboration with the University of Piraeus and the University of Cardiff (UK), PPA SA implements a quality monitoring program for the marine environment on an annual basis. At a frequency of twice a year, water and sediment samples are taken from the entire PPA SA port area and examined for microbiological, physical and chemical factors. Also, as part of the implementation of the Central Port Dredging Project, a specific technical study was carried out for the rational management of dredging materials.

6.2.5 Photovoltaic

Following the approval of the photovoltaic program, it proceeds to install photovoltaic panels in 9 of the 21 buildings under its jurisdiction and will have a capacity of 1.138Mwp. The environmental benefit corresponds to an average annual CO2 reduction of 1249 tonnes CO2 / year and is the basis for the installation of an electric field for power supply. with the electricity of the ships while docking at the port. The total area to be covered is 12,869 sqm. (PPA document: Http://www.imerisia.gr/article.asp).

6.2.6 Quality of the audio environment

PPA SA implements a Headphone Monitoring Program environment for the whole port area. Following the evaluation of the results of the measurements and the studies already carried out, remedial measures have been taken, such as the installation of sound barriers along a school in the Municipality of Perama, adjacent to PPA SA facilities. At the same time, tree plantings are planned that will combine aesthetic upgrading with sound absorption, in areas of the adjacent area that may be even indirectly affected by PPA SA activities.

6.2.7 Atmospheric environment quality

Climate change and the greenhouse effect are major issues that concern modern society. The main source of CO2 emissions that contribute to the greenhouse effect are anthropogenic activities and are looking for drastic solutions that will lead to effectively address the problem. PPA SA recognizes the seriousness of the issue and, although its activities are not directly involved in the problem, takes the initiative and implements a pilot ambient quality monitoring program related to direct and indirect port activities. For the implementation of this program a Gas Pollution Monitoring Station has been installed and operates in cooperation with the National Metsovo Technical University (NTUA - School of Chemical Engineering), in the NW area of the Central Port of Piraeus, well equipped to record the concentrations of gaseous pollutants on a 24-hour basis. The purpose of the evaluation of the recordings is to provide useful conclusions on the levels of atmospheric charge, as well as on the main sources of origin of these pollutants.

6.2.8 Terrestrial landscaping

PPA has carried out a Study of Phytotechnical Configurations in collaboration with the Agricultural University of Athens for the entire port land area, with the aim of aesthetically upgrading, improving microclimate conditions by capturing gaseous pollutants and optimizing water conditions. use of pesticides, etc.). Applying the proposals of the Agricultural University of Athens, PPA reinforces the existing green by planting new trees and shrubs, compatible with existing species and local climatic conditions, including species such as owls, locust beetles, goji berries, zucchini the microclimate of the area, the aesthetics of the adjacent residential tissue and thus contributing to the improvement of the quality of life in the wider area.

6.2.9 Energy management

PPA SA takes action to inform its employees on good energy saving practices. At the same time, it is taking similar steps in this direction, such as: 1) supply of electrical appliances with the criteria of energy class and energy certification, 2) systematic maintenance of air conditioning and heating installations, 3) replacement of conventional lamps with energy saving lamps. At the same time, as part of the effort to save energy on buildings, PPA initiated the construction of a green roof in the new office building of the PPA Container Station (N. SEBO), where bush species such as lavender, rosemary have been planted. , thereby reducing the building's energy requirements, both in winter for heating and in summer for cooling. The green terrace is an additional aesthetic element of the building, which at the same time improves the aesthetics of the residents in the upstream area of Perama. The PPA also plans actions to assess the overall energy performance of PPA SA buildings, while implementing pilot projects for the use of Renewable Energy Sources.

6.2.10 Waste management

PPA operates a Waste Management System produced at its premises (offices, garages, passenger stations, warehouses, etc.) which follows a separation and recycling program. The following are considered as waste: 1) Office waste: • Paper - Glass - Packaging • Empty ink cartridges & toners • Portable batteries and accumulators • Electrical and electronic equipment (WEEE) 2) workshop waste and other waste: • Waste oil Vehicle and industrial electrical accumulators • Electrical and electronic equipment (WEEE) waste • Vehicle tires • Timber waste • Workshop waste • Tank waste (floating and permanent) • Scrap-ah solid metal objects • Excavation, construction and demolition waste. For the implementation of this program, PPA works with licensed Alternative Waste Management Systems and collection companies, always ensuring cleanliness at the collection points, where appropriate containers have been affixed, avoiding overfitting and overfilling. workers and port users.

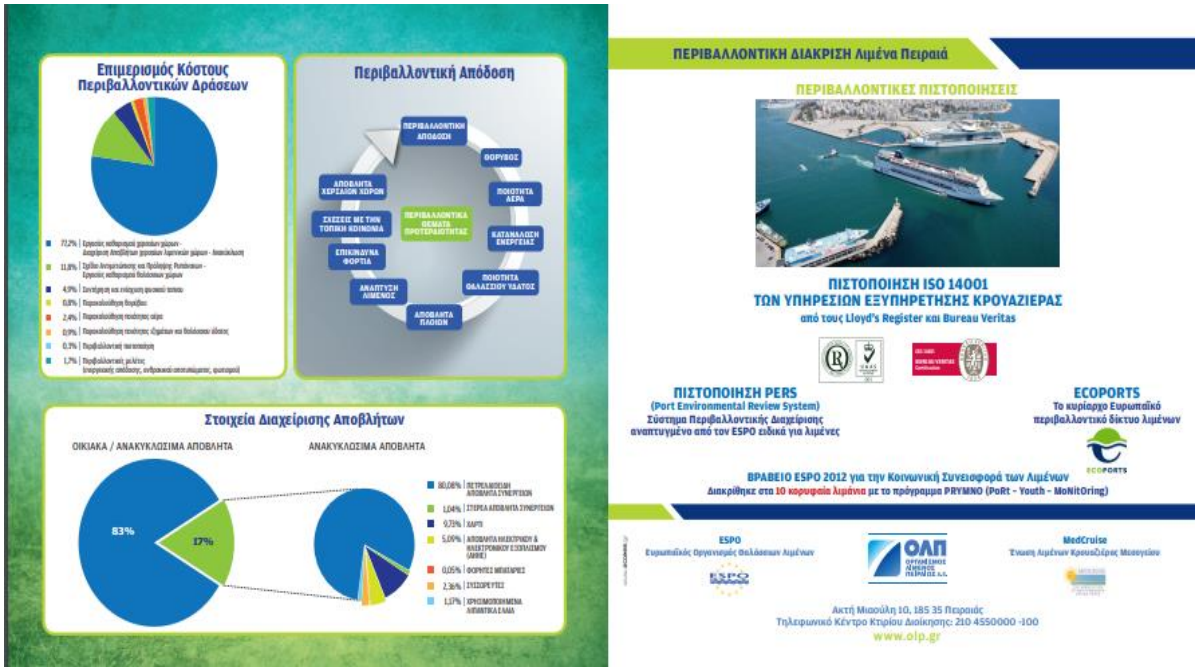


Figure 10 Picture 19-20: (source: olp.gr)

6.3 Marine Pollution Emergency Response

The Board of Directors MARPOL 73/78 has adopted the Mediterranean region as a "special area", banning any dumping of oil, chemicals or other solid and liquid waste. It is estimated that millions of tonnes of oil and processed products are shipped annually through the Mediterranean. Accidents (ship collision, landings, cargo leaks, etc.) are likely to occur during the voyages, despite the measures taken to cause water pollution, so-called accidental pollution. This type of pollution is usually caused by the leakage of extremely large quantities of petroleum or chemicals, a timely restriction that is critical to the subsequent impact on the marine ecosystem and society. The intervention of the competent authorities must be immediate and

effective. PPA, applying the provisions of the International Convention on the Prevention, Co-operation and Response to Oil Pollution of OPRC (1990), the Protocol on the Preparedness, Co-operation and Response of Marine Pollution to Hazardous and Harmful Substances (OPRC 2000)) and national legislation, has prepared and implemented, approved by the relevant Port Authority, a Marine Pollution Emergency Response Plan to deal with oil pollution and other harmful events substances within the port area of PPA. The Plan has been drawn up in accordance with the National Legislation and is in line with the local plan of the relevant Port Authority and, by extension, the National Plan (http://library.tee.gr/digital/m2045/m2045_palantzas.pdf).


Lloyd's Register

ΠΙΣΤΟΠΟΙΗΤΙΚΟ ΕΓΚΡΙΣΗΣ

Με το παρόν πιστοποιείται ότι το Σύστημα Διαχείρισης της:

ΟΡΓΑΝΙΣΜΟΣ ΛΙΜΕΝΟΣ ΠΕΙΡΑΙΩΣ Α.Ε.
'Ο.Λ.Π. Α.Ε.'

Ακτή Μιαούλη 10, 185 38 Πειραιάς, Ελλάδα

έχει εγκριθεί από το Lloyd's Register Quality Assurance σύμφωνα με τα ακόλουθα πρότυπα:

BS EN ISO 14001:2015

Gilles Bessiere - Area Technical Manager

Εκδόθηκε από: Hellenic Lloyd's S.A.

για λογαριασμό της: Lloyd's Register Quality Assurance Limited

Ημερομηνία Έκδοσης: 6 Μαρτίου 2019
Ημερομηνία Λήξης: 5 Μαρτίου 2022
Αριθμός Πιστοποιητικού: 10172037

Αρχικές Εγκρίσεις:
ISO 14001 – 6 Μαρτίου 2013

Αριθμοί έγκρισης: ISO 14001 – 0033638

Το πεδίο εφαρμογής της έγκρισης ισχύει για:
Παροχή Λιμενικών Υπηρεσιών Εξυπηρέτησης Κρουαζιέρας, Ακτοπλοΐας, Διακίνησης Αυτοκινήτων και Εμπορευματοκιβωτίων. Διαχείριση Κέντρου Εφοδιαστικής Αλυσίδας. Διαχείριση Έργων Κατασκευής και Συντήρησης Λιμενικών Εγκαταστάσεων.


Lloyd's Register

ΠΙΣΤΟΠΟΙΗΤΙΚΟ ΕΓΚΡΙΣΗΣ

Με το παρόν πιστοποιείται ότι το Σύστημα Διαχείρισης της:

ΟΡΓΑΝΙΣΜΟΣ ΛΙΜΕΝΟΣ ΠΕΙΡΑΙΩΣ Α.Ε.
'Ο.Λ.Π. Α.Ε.'

Ακτή Μιαούλη 10, 185 38 Πειραιάς, Ελλάδα

έχει εγκριθεί από το Lloyd's Register Quality Assurance σύμφωνα με τα ακόλουθα πρότυπα:

BS EN ISO 9001:2015

Gilles Bessiere - Area Technical Manager

Εκδόθηκε από: Hellenic Lloyd's S.A.

για λογαριασμό της: Lloyd's Register Quality Assurance Limited

Ημερομηνία Έκδοσης: 6 Μαρτίου 2019
Ημερομηνία Λήξης: 5 Μαρτίου 2022
Αριθμός Πιστοποιητικού: 10172039

Αρχικές Εγκρίσεις:
ISO 9001 – 6 Μαρτίου 2013

Αριθμοί έγκρισης: ISO 9001 – 0033639

Το πεδίο εφαρμογής της έγκρισης ισχύει για:
Παροχή Λιμενικών Υπηρεσιών Εξυπηρέτησης Κρουαζιέρας, Ακτοπλοΐας, Διακίνησης Αυτοκινήτων και Εμπορευματοκιβωτίων. Διαχείριση Κέντρου Εφοδιαστικής Αλυσίδας. Διαχείριση Έργων Κατασκευής και Συντήρησης Λιμενικών Εγκαταστάσεων.


CERTIFICATE OF VERIFICATION

ECOPORTS
PERS CERTIFIED

THIS IS TO CERTIFY THAT
THE DOCUMENTATION OF THE PORT ENVIRONMENTAL REVIEW SYSTEM
OF:

Piraeus Port Authority S.A.
Greece

HAS BEEN REVIEWED BY LLOYD'S REGISTER TO
THE FOLLOWING ENVIRONMENTAL MANAGEMENT
STANDARD:

Port Environmental Review System
(PERS) version 4

THE SYSTEM IS APPLICABLE
TO THE:

Activities, products and services of
the port authority

Certificate no: 078
Verification date: 10 January 2014

ON BEHALF OF ESPO

ESPO

ON BEHALF OF LLOYD'S REGISTER
ROTTERDAM

Lloyd's Register
LRQA

Figure 11 Picture 4,5,6: (source: olp.gr)

From the study of the port of Piraeus we notice that many steps have been taken towards its greening. Which are also important. However, the sector which is mainly lagging behind the port of Piraeus is that it has not yet been able to enforce a policy on greenhouse gas environmental pollution and atmospheric emissions from the trucks associated with its emissions. Also, although it has recently installed a noise pollution measuring station, it has not yet implemented more general measures to combat it. Finally, although we have seen in the presentation of the most important ports above that the green development of the port also plays an important role in the parallel green development of the surrounding society, in this case the port's association with the neighboring areas is not as close as needed. Our checklist is configured as follows:

	PORT OF LONG BEACH	PORT OF SAN DIEGO	SYDNEY	PIRAEUS
PREVENT AIR POLLUTION	√	√	√	√?
REDUCE SOIL AND SENTIMENT POLLUTION	√	√	√	√
IMPROVE WATER QUALITY	√	√	√	researches under progress
IMPROVE WILDLIFE - MARINE LIFE	√	√	√	N/A
REDUCE ENERGY CONSUMPTION	√	√	√	√
REDUCE NOISE POLLUTION	√	√	√	√?
MODERN ENVIRONMENTAL PERSPECTIVES FOR GREEN PORTS	√	√	√	√
IMRPOVE WEATHER MONITORING	√	√	√	N/A
ACHIEVE SUSTAINABILITY	√	√	√	under way

6.4 Port of Thessaloniki – Thessaloniki Port Authority

The geopolitical position of the port of Thessaloniki is of strategic importance as it is a link between Greece and the European Union and the Balkan countries. As with the Port Authority of Piraeus, the Port Authority of Thessaloniki changes its financial

recommendation to a Société Anonyme in 1999 and for the first time enters the Stock Exchange in 2001.

The port of Thessaloniki is used for commercial and passenger purposes, spanning six kilometers and a depth of 12 meters.

6.4.1 Landmarks in the History of the port of Thessaloniki

The area today known as Thessaloniki took its name in 316 BC. by the King of Macedonia who gave her the name of his wife and sister of Alexander the Great. The harbor was created at exactly the same time and began to play its natural role as a major hub between the West and the East.

Highlights of the port's History:

1. In 1904, the exploitation of the port of Thessaloniki is granted to the French-Turkish interest company: Société Ottoman d'Exploitation du Port de Thessaloniki.
2. In 1914, the Free Zone of the Port was established, which will start its operation in 1925 after the creation and establishment of the "Thessaloniki Free Zone Committee" that would play the role of the legal entity under public law at that time.
3. In 1930, the creation of the "Thessaloniki Port Fund" was considered necessary and was carried out the same year.
4. In 1953, on the basis of the better and proper operation of the Thessaloniki Port, it was decided to unify the "Thessaloniki Port Fund" and the "Thessaloniki Free Zone Committee" with the new company being renamed "Thessaloniki Free Zone and Port".
5. In 1970, management of the Port of Thessaloniki was transferred to the new company "Port Authority of Thessaloniki".
6. In 1999, the Port Authority of Thessaloniki changes its financial recommendation to a Société Anonyme in 1999 and for the first time enters the Stock Exchange in 2001.

7. In 2016, a tender was launched for the privatization of the Port of Thessaloniki with the participation of large companies in the field. The tripartite consortium of 47% of the German fund DIEP GmBH, based in Munich, holds a 33% stake in Terminal Link SAS (whose parent, CMA CGM, is the third largest shipping company in the world) and with the rest 20% of Belterra Investments LTD, owned by Ivan Savvidis, based in Nicosia, managed to win the competition. The Greek State holds a 7.22% equity stake. (https://www.huffingtonpost.gr/entry/oloklerotheke-e-exayora-toe-67-toe-olth-katavlethekan-ta-2319-ekat-eero_gr_5ab3eb57e4b008c9e5f549c6).
8. In 2019 the port under its new administration is investing in modernizing it in all areas of its activities (https://www.huffingtonpost.gr/entry/oloklerotheke-e-exayora-toe-67-toe-olth-katavlethekan-ta-2319-ekat-eero_gr_5ab3eb57e4b008c9e5f549c6).

6.4.2 Implementation of green practices in the port of Thessaloniki

According to the 2007-2010 THPA Environmental Report (Thpa.gr, 2019), the incorporation of environmental principles and regulations into the daily structure and operation of the port is a high priority issue in the strategic planning of THPA SA, with a view to its sustainable operation. For the implementation of this strategy, THPA SA incorporated the following principles in its environmental policy ((Thpa.gr, 2010 2007-2010):

1. Conduct integrated environmentally sustainable development studies.
2. Activating Environmental Management Systems to organize its activities, products and services.
3. Legal compliance with existing international and national legislation, as well as other environmental measures and guidelines (e.g. adoption of the European Sea Ports Organization Environmental Code (ESPO).
4. Monitoring and categorizing all legislative environmental requirements so that employees can be informed about the environmental issues of their competence.
5. Conservation and protection of natural resources
6. Communication with port staff, local community (authorities, academia) and government bodies.
7. Training port staff on environmental issues and developing their skills to successfully meet their obligations to environmental Protection.
8. Safety and hygiene for employees, visitors and residents.
9. Saving energy and resources by implementing energy efficient technology.
10. Water resources protection and pollution prevention (atmospheric, sound), waste reduction and recycling.
11. Integrated coastal zone management.
12. Environmental audit to monitor, evaluate and critique port environmental management and water quality by recording performance indicators.
13. Emergency response with significant environmental impact.
14. Publication of an Environmental Report presenting qualitative and quantitative data, based on the Environmental Indicators adopted, as well as the results and performance of the environmental management applied.

According to OLTH SA 2007-2010 Environmental Report, the justification for this policy of converting the port to "green" was recognized in 2007, with the Thessaloniki Prefecture receiving the Honorary Prize. In order to implement its environmental policy more effectively, OLTH SA has since 2004 established and staffed an autonomous department for the environment, the Department of Environment, Health and Worker Safety, which collaborates with external consultants in specialized scientific matters and in particular with Aristotle University of Thessaloniki. According to the Management Review Report on the Environmental Management System (OLTH SA - Vafaki 2015), the structure is considered sufficiently adequate for the management of the Environment, while the previous environmental policy is considered to be very detailed and extensive for the purposes it serves.

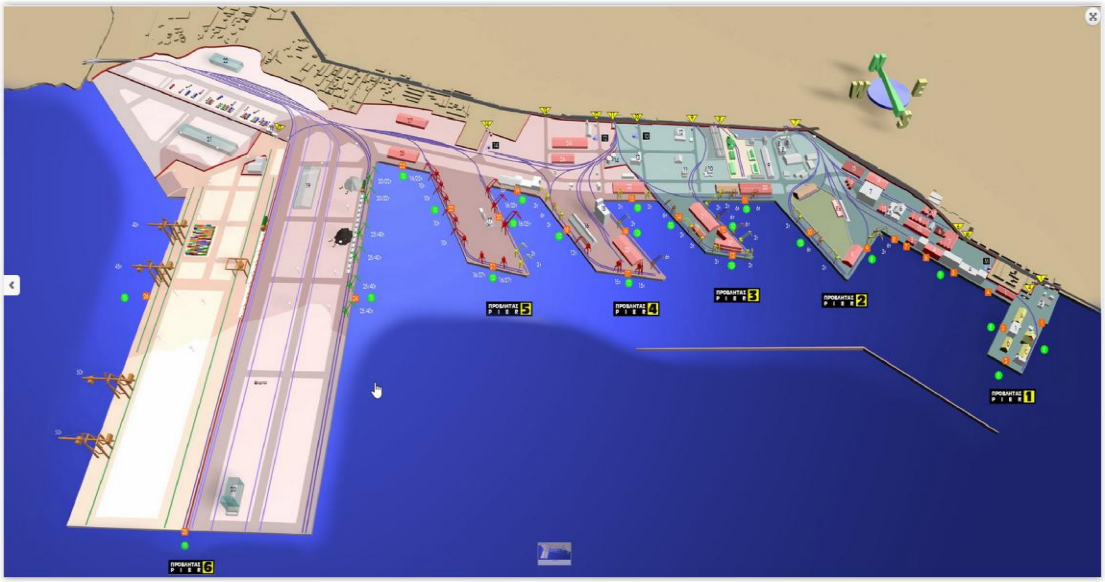


Figure 12 Map 2: Map of Thessaloniki port (source: thpa.gr)

6.4.3 The Environmental Management System of OLTH SA

The Environmental Management System (EMS) currently in place and designed in accordance with the requirements of ISO 14001 inter alia has the following objectives (OLTH SA 2015: Annual Environmental Monitoring Report for 2014):

1. Systematic monitoring of compliance with laws and regulations.
2. Observing and updating the "Environmental Mechanism Monitoring" and the evaluation of the results of its implementation (e.g. evaluation of environmental parameters measurements, etc.)
3. Establishing procedures and practices for carrying out the work at the port, controlling the environmental impacts of harmonization with international practices and related environmental legislation and authorization.
4. Prevention of dangerous environmental or pollution situations, but also readiness to deal with these situations, if they occur.
5. Lastly, the continuous improvement of the environmental performance of OLTH SA by establishing appropriate targets with measurable objectives and environmental improvement programs.

The implementation of the EMS objectives, according to the Management Review Report on the Environmental Management System (OLTH SA - Vafaki 2015), concerns the identification of environmental indicators to evaluate the elaboration of relevant programs / actions, the implementation of the Environmental Monitoring Mechanism, their results and evaluation, as well as any actions taken to comply with environmental conditions.

6.4.4 Environmental Indicators

The environmental management of the port is based on specific indicators, which are listed below, which describe the state of the environment in the port. These indicators are selected by the management to monitor and evaluate the environmental

performance of OLTH SA, reflecting qualitatively and quantitatively the port's progress in improving the environment and its legal compliance, as well as its Environmental Management System's effectiveness. According to the following indicators, relevant programs / actions were designed and implemented. The environmental indicators set from 2007 to 2014 concern the following issues:

A. Dust management by bulk dry bulk management.
B. Waste management and recycling (onshore environment and ships).
C. Improving the aesthetics of the terrestrial environment.
D. Assessment of marine environment pollution by port activities and pollution prevention.
E. Evaluation of noise levels.
F. Evaluation of the quality of the atmospheric environment and reduction of gaseous pollutants
G. Reduce electricity consumption.
H. Emergency prevention and response.
I. Assessment of dredging needs.
J. Compliance with all existing legislation.

6.4.5 Environmental Monitoring Mechanism

The Environmental Monitoring Mechanism was created following the general conditions of the "Approval of environmental conditions for the operation of the port of Thessaloniki" (EYPE SA 203978, 21-12-2012) and was approved by 124-1 / 31-1-2014 decision. It shall be updated ten months after its application in order to include any modifications made in that period. It outlines the obligations and actions required (THPA SA 2014: Updated Environmental Monitoring Mechanism):

I. Compliance with approved environmental conditions.
II. Compliance with the environmental conditions of companies operating within OLTH SA.
III. Compliance with specific permit conditions and approved studies such as the "Scheme for the Receipt and Management of Waste Ship Wreckage".
IV. Emergency preparedness for pollution.
V. The environmental monitoring program (planning, implementation and evaluation of the results of environmental measurements).
VI. Monitoring of the waste and the resulting contracts for waste management by waste management bodies.
VII. The filing of relevant environmental reports arising from the relevant legislation and permits.

The record of the Mechanism is kept in the Department of Environment, Health and Safety of Employees and the responsible person is designated as the Environmental Manager, who is responsible for drafting an "Environmental Parameter Monitoring Plan". The Plan includes: (a) Environmental Obligation Recognition (the type of Environmental Parameter to be monitored, its category if it is for Measurements, Environmental Visits, Emergencies etc. and the Obligation Origin if it comes from a law, circular, study submitted or EMS requirements). (b) Responsibilities and Responsibilities for the Management of Environmental Parameters (Supervisor,

Stakeholders, Stakeholders, e.g. waste management bodies). (c) Monitoring Data (Comments and Remarks on Environmental Parameter and its Management, Monitoring Files, Monitoring Frequency).

6.5 Environmental Management Practices

6.5.1 Atmospheric Quality Management and Monitoring

Until 2010 there was no assessment of pollutant loads for the entire port, although a meteorological station had been installed as "the measurement of atmospheric data and pollutants was in the final stages of preparation". For health and safety issues, management practices such as measuring chemical agents, rotating work, use of personal protective measures, etc. were applied. ((Thpa.gr, 2007-2010). However, a dust emission monitoring program has been in place since 2005, including: identification of dust production sites, measurements, control over legal limits, source risk assessment and assessment of the effectiveness of emergency and protection measures. The measurements were carried out with portable measuring instruments and were combined with the results of the wind direction and intensity measurements from the weather station. Thus, the location of dust source, wind direction and intensity were determined by the corresponding hazard, which then determined the measures to be taken (Palantzas 2008). In the auxiliary of dust measurements, for the integrated assessment of its hazard, a suitable mathematical model for simulating the movement, dispersion and sedimentation of dust was developed by the AUTH Laminar Sustainability Research Network. Since 2012, monitoring of air pollution has become mandatory. For this purpose, since October 2013, a metering station for monitoring air pollution has been installed. Continuous 24-hr, continuous recording of SO2, NOx and CO concentrations of particles is calculated by weighing. In PM10 filters, laboratory analyzes are performed to calculate the concentrations of Ni, Cd, Mn, PAH, benzene.

6.5.2 Dust Management

As far as dust management is concerned, port abatement practices are being implemented, as the dust that bothers the port and the city of Thessaloniki is not only due to the activities of the TLG, but also to the planning and climatic conditions of the area. Management includes mitigation measures as follows (OLTH Environmental Report 2007-2010, OLTH SA - Vafaki 2015):

A. Periodic (daily and repeated, whenever deemed necessary) scanning and wetting of port roads and piers, mainly in bulk dry scrap and scrap areas, especially during loading and unloading.
B. Storage of bulk cargoes on perimeter walls of concrete or in containers.
C. Daily clearing of all unloading materials and collection of materials.
D. Peripheral tree planting.
E. Supply aquifer (but no noticeable solution for open warehouses).
F. Compliance with the circulation for loading and unloading (1374 / 22-2-2013), by all employees in loading and unloading operations.

6.5.3 Marine Water Quality Management and Monitoring

The management and monitoring of seawater quality to reduce the burden on the Thessaloniki Bay from port operation includes (Thpa.gr, 2010 2007-2010):

a) Replacing ships' toxic antifouling with environmentally friendly ones
b) The mandatory delivery of ship waste to the port.
c) Port infrastructure preparedness for marine pollution accidents on a 24-hour basis / Emergency Plan.
d) The installation of a floating-point measurement and telemetry station for the physical characteristics of water (temperature, pH, conductivity, salinity, dissolved oxygen, turbidity).

According to the new EMS, seawater sampling and analysis of physicochemical characteristics is mandatory on a regular basis, in particular twice a year. It takes place at three fixed points within the port and one outside the port (EYPE no. 203978 / 21-12-2012). The points are: (a) between the 1st and 2nd Pier, (b) in the 3rd Pier, in front of the 13th Platform, (c) between the 5th and 6th Pier, and (d) outside the Port, at the height of the breakwater center. The first sampling of sea water took place on 22/10/2013.

6.5.4 Waste management

According to the THPA Environmental Report 2007-2010, waste management includes port waste / waste and ship waste. Port Waste Management includes waste collection and recycling of paper, used batteries, accumulators, waste electrical and electronic equipment, lubricants, metals, etc. OLTH SA systematically controls its rented private homes compliance with the agreed environmental conditions. If the individual performs a work that may cause pollution, the existing environmental legislation is strictly enforced. Since 2002 the ship's waste management has been following an integrated "Schedule of Waste and Ship Waste Management and Remedies" calling at the Thessaloniki Port, which was developed by the AUTH and designated as a private waste ship infrastructure contractor. In 2013 a new Plan was drawn up. The drafting of the new Plan took place in the context of harmonization with condition 17 of the AEPO for the operation of the port of Thessaloniki (EYPE no. 203978 / 21-12-2012). Its main purpose is to quantitatively and qualitatively record the waste generated at the ports and facilities of OLTH SA by the operation of the port, in order to manage them environmentally sound. The Scheme separates the waste into:

a) Waste and cargo residues from ships arriving at the port.
b) Waste arising at onshore facilities during the operation of OLTH SA

It also describes alternative waste management of those that can be recycled. The Plan takes into account and implements the OLTH SA Circular No. 1399 / 6-9-2013 on "Proper environmental management of waste generated at TG SA sites and facilities", as well as the "Waste and Waste Management Plan". of ship cargo residues "which was approved by the decision of the Ministry of Naval Port Policy with a decision no. 8136.1.8 / 06/2013 (OLTH SA 2015).

6.5.5 Noise Management and Monitoring

Specific measures were initially not implemented because, according to the 2007-2010 Environmental Report of FLTH SA, sporadic measurements at the perimeter of the harbor showed that noise levels were below 65db and trucks and trains entered and exited from the port. Gate 11 provided only local and limited time alerts, and therefore no measures were deemed necessary. However, since 2012 (EYPE No. 203978 / 21-12-2012), however, OLTH SA has been required to implement a noise monitoring program on the port zone boundaries. The Environmental Impact Assessment for the operation of the Port of Thessaloniki proposes a five-year meticulous investigation of the acoustic environment and a yearly follow-up with acoustic measurements where noise levels above 65dB (A) have been established (OLTH SA & EMA OE 2015).

In order to record the noise emissions and to ensure that the port's noise emissions comply with the upper limit, the contractor association ENCO - ENNUS set up a network of measurements along the inland port of the harbor, consisting of nine (9) points, 24-hour measurement and nine (9) 15 minute measurement points. The measurement data is used to create maps of the equilibrium curves. The total noise emitted by the port in the area results from the overlap of the noise contributions of road, rail and industrial noise. In addition to inland port roads, traffic noise on adjacent non-port roads is also taken into account, contributing to the measured noise levels of the area. The dominant role is played by the 26th of October and Admiral Koundouriotis avenues (OLTH SA & EMA OE 2015).

6.5.6 Energy Management - Energy Consumption

According to the management of TLG SA (Environmental Report 2007-2010), optimizing energy consumption across the whole range of port activities is its primary objective. Until 2014, no other actions had been implemented except connecting the buildings of the 1st pier to gas, although the following were planned:

- Expansion of the gas network to other areas.
- Development of photovoltaic systems at suitable locations (eg roofs of buildings or warehouses).
- Technical interventions in buildings to reduce their energy consumption (eg changing windows).
- Gradually replace old vehicles with hybrids.

The plan to reduce electricity consumption was aimed at reducing consumption by more than 2% compared to last year. According to the Management Review Report for EMS (OLTH SA - Vafakis 07/2015), the program included the replacement of two old cranes, while the purchase of capacitors is expected, which will increase the cost of the installation's cost.

6.5.7 Emergency Management

Emergency management includes prevention and response measures. An indicative list of forms and software used by THA SA to support the decision-making system in emergencies is set out in the Annex (Table 2.25). Emergency plans have been

developed and organized to reduce pollution from oil and other hazardous substances by applying simulation models of various pollution scenarios from various sources (ships, cargoes, trucks, etc.). The contractor for the services was a private company. In particular, since 2003 a "Emergency Plan for Marine Pollution Hazardous Substances" has been prepared in collaboration with the Aristotle University of Thessaloniki, in collaboration with the Aristotle University of Thessaloniki. The Plan was drafted in the context of the harmonization of OLTH SA with Law 3100 (Government Gazette 20 A / 29.01.2003) "Ratification of the Protocol on the Preparedness, Cooperation and Treatment of Marine Pollution by Hazardous and Harmful Substances, 2000" and extension with PD 11 (Government Gazette 6A / 21.01.2002) "National Emergency Plan for the Treatment of Oil Pollution and Other Harmful Substances". According to the updated "Contingency Plan for the Emergency Plan for Sea Pollution Incidents" (Port Contingency Plan), its objective is to establish and rationalize effective operational readiness processes and the involvement of all relevant stakeholders, Authority, broader public and private sector) to deal with marine pollution incidents in the jurisdiction of OLTH SA. For its implementation, GLTH SA focuses on four (4) key thematic areas: Prevention, Preparedness, Timely Response and Rehabilitation. 145 The Plan is compatible with the corresponding Local Contingency Plan of the Central Port Authority of Thessaloniki, is part of the respective National Contingency Plan and does not apply to petroleum pollution incidents. These incidents are handled in accordance with the "Emergency Plan for Oil Pollution Incidents in the area of jurisdiction of OLTH SA" (2006), which was also compiled by the scientific team of the “Port Sustainable” of Aristoteleion University of Thessaloniki thematic network.

The port of Thessaloniki has several strong elements, mainly related to the commitment of the administration:

1. (a) comply with the standards set by PERS and ISO port certification bodies, (b) comply with environmental legislation, and (c) comply with the requirements of the ESPO Environmental Code.
2. The management of OLTH SA has included in its management the collaboration with local authorities and product stakeholders, because it believes it can bring multiple benefits to both the port and the city, as their environmental interaction is intense. In this direction, the 1st pier was also reconstructed and converted into functional multi-purpose buildings, resulting in the 1st pier being a cultural activity site and connecting the city with the port (Thpa.gr 2019).There is collaboration with the University of the City either to develop Plans and Programs or to facilitate the development of "postgraduate and doctoral theses related to environmental port operation and upgrading". An example of such cooperation was the elaboration of the Emergency Plan for Marine Pollution Incidents from Hazardous and Harmful Substances, the Emergency Plan for the Treatment of Oil Pollution Incidents, in the jurisdiction of OLTH SA and the Disposal Management Plan. Ships calling at the Port of Thessaloniki and the AUTH contribution to the treatment of dust. The port's participation in the APICE Program for Co-management

with the City of Air Pollution is an implementation of its policy of cooperation with local authorities. OLTH is also a member of the Thermaikos Management and Protection Agency, where it works with local authorities and agencies.

3. Given that its strengths are properly exploited and given that its profile has been strengthened, the port may take further initiatives for a more systematic relationship and cooperation with the city's productive and educational bodies as well as with local authorities. Through such partnerships it can achieve both its immediate development goals and its long-term sustainability. Specifically, the proximity of the city and port can be a development factor for both parties, as long as they pursue the joint planning of their tourism exploitation and generally all those elements that will ensure their sustainable coexistence, taking into account both social and environmental considerations, upgrading the quality of life of the residents.

Our checklist is configured as follows:

	PORT OF LONG BEACH	PORT OF SAN DIEGO	SYDNEY	PIRAEUS	THESSALONIKI
PREVENT AIR POLLUTION	√	√	√	√?	√
REDUCE SOIL AND SENTIMENT POLLUTION	√	√	√	√	√
IMPROVE WATER QUALITY	√	√	√	researches under progress	√
IMPROVE WILDLIFE - MARINE LIFE	√	√	√	N/A	researches under progress
REDUCE ENERGY CONSUMPTION	√	√	√	√	√
REDUCE NOISE POLLUTION	√	√	√	√?	√
MODERN ENVIRONMENTAL PERSPECTIVES FOR GREEN PORTS	√	√	√	√	√
IMRPOVE WEATHER MONITORING	√	√	√	N/A	√
ACHIEVE SUSTAINABILITY	√	√	√	under way	under way

7. CONCLUSIONS

1. Modern ports are hubs of international supply chains and combined transport, whose organization requires large capital and the use of sophisticated technology. The increasing involvement of the private sector is considered a given and is managed by companies, which are usually international. Their growth apart from large investments also requires competitive advantages. One of them seems to be managing their environmental impacts in order to ensure acceptance and support of local communities and their sustainable development.

2. However, environmental problems appear to be increasing as the needs for continuous expansion and development of ports grow, requiring high cost environmental management practices, which is not feasible in smaller ports. On the other hand, there is concern as to whether large ports, with the effects caused by their operation can be viable, while modern large cities may not be viable. All the more so when environmental management has to take into account not only the particular environmental issues of the port or its local community, but also the global ones, which cannot be addressed individually and in part, as the dominant development model is responsible for them. It is therefore necessary to have a critical attitude towards competition as a driving force for the survival and development of ports, as it requires enormous investment, often overlooking social and environmental indicators.

3. The environmental issues of ports have gained the attention of their national and local management bodies. As international and Community law becomes increasingly stringent and mandatory, with penalties being imposed, the port administration is required to decipher and harmonize with a complex set of international conventions, European directives / regulations and national laws.

4. Green Harbors are considered to be the answer to modern environmental challenges with the basic philosophy of green or otherwise sustainable development, which reconciles economic activities with environmental protection. These ports also change the role of the port authority, which is not sufficient to deal with immediate environmental issues but should also ensure the long-term ecological footprint of the port, in cooperation with other ports and all stakeholders. Modern ports, therefore, in order to be viable and functional, must strengthen the relationships with their cities, with which they have a long-lasting interdependence relationship. Developing a common strategy for managing their environmental impacts is particularly important. The question, however, is why ecological issues such as seawater quality at port level do not seem to be a priority for most of today's ports, even though this is their primary natural environment.

5. The strategic aim of Greek ports, especially the larger ports, is to follow the same management model as international and European standards. This is, first of all, a competitive advantage and can help to improve their quality. The question then arises as to whether they can meet the environmental standards of standard green ports of developed countries, which accordingly are subject to international evaluation criteria.

6. This Thesis has attempted to approximate the current situation of the main Greek ports, namely those of Piraeus and Thessaloniki, through various standards or practices applied in ports worldwide. As the needs for port development continue to increase in the face of unprecedented competition, which is the dominant model of social organization in our time, they are required to deal effectively with the resulting greater environmental impacts. PPA and THPA have so far developed environmental management models, which are being further developed to help them fully achieve the main objective of sustainable development.

BIBLIOGRAPHY

Amerini G. (2010), "European Port Activity 2009 hit by the general economic crisis", Transport Statistics in Focus Eurostat, 65/2010,9-10.

Arvanitis L. (2006), "Geochemical study on surface sediments of the Piraeus Port passenger compartment", University of Patras, p.31-p.34

Darnall, N. (2001), Adopting ISO 14001: Why Some Firms Mandate Certification while Others Encourage It, North Carolina State University Raleign, NC.

EPA, Environmental Protection Agency (2009), "Sustainable Port Communities', 1st Hemispheric Convention on Port Environmental Protection, July 23, 2009.

European Commission, (2005), EMAS – Frequently Asked Questions, (cited April 2012) available from URL: http://europa.eu.int/comm/environment/emas/tools/faq_en.htm

Green Port Hull (2011), "Environmental Impact Assessment Scoping Report": Associated British Ports, (cited June 2012), available from URL:http://www.marinemanagement.org.uk/licensing/public_register/eia/documents/screening_scoping/hull.pdf

Kolios St, Anastopoulos D., Stylios C. (2011), "How will Greek Ports become green ports", to Geo-Eco-Marina, 17/2011, p.73-p.80

Kyvelou S. & Papadopoulos T. (2011), "Exploring a South –European Eco-Neighborhood Model: Planning Forms, Constraints of Implementation and Emerging Resilince Practices", International Journal of Sustainable Development, Vol. 14, Nos. 1/2, p.77-p.94.

Olp.gr. (2019). *"EcoPorts Port" Status - Environmental Management Standard PERS*. [online] Available at: http://www.olp.gr/en/nature-protection/nature-management-system [Accessed 5 Nov. 2019].

Thpa.gr. (2010). *ΟΛΘ - Environment*. [online] "Port of Thessaloniki, Open betting "Available at: https://www.thpa.gr/index.php/en/olth/social-responsibility/environment [Accessed 5 Nov. 2019]. ttp://www.maritimeprofessional.com/ [Accessed 5 Nov. 2019].

Port of Long Beach (2005), "Green Port Policy", (cited June 2012), available from URL:http://www.polb.com/environment/green_port_policy/default/.asp

Sturm, A., Upasena S. (1998), ISO 14001 – Implementing an Environmental Management System, Version 2.02, Ellipson Management Consultants, (cited May 2012) available from: URL:http://www.ellipson.com/files/ebooks/ISO14000.pdf#seach='sturm%20impleme tning%20an%20environmental%20management%20system'

Portauthoritynsw.com.au. (2019). *Annual Reports (1)*. [online] Available at: https://www.portauthoritynsw.com.au/news-and-publications/reports-publications/annual-reports-1/ [Accessed 5 Nov. 2019].Sydney Ports (2012), "Green Port Guidelines, Sustainable Port Guidelines", (cited May 2012) available from URL:http://www.sydneyports.com.au/corporation/publications/operations/green_port_guidelines

Portauthoritynsw.com.au. (2019). *Annual Reports (1)*. [online] Available at: https://www.portauthoritynsw.com.au/news-and-publications/reports-publications/annual-reports-1/ [Accessed 5 Nov. 2019]. Tselentis, V. (2010). *Marine Environment Management and Shipping*. University of Piraeus.

United Port of San Diego (2012), "Environmental Policy", (cited May 2017), available from URL:http://www.portofsandiego.org/environment/green-port.html

Vafaki Eva (2009), Head of the Department of Environment, Health and Safety OLTH SA, "Presentation slides for port operation, Environmental constraints, Integrated Environmental Management", OLTH SA

Watson, M., Emery A. (2004), Law, Economics and the Environment: a comparative study of environmental management systems, Managerial Auditing Journal, vol 19, no 6, pp 760-773

Wooldrige C F., Tselentis B S. (1999), "Environmental management of port operations – the port sector's response to the European dimension, Maritime engineering and Ports", C.A. Bebbia, WIT Press, p. 227- p. 242

ISO. (2019). *International Organization for Standardization*. [online] Available at: https://www.iso.org/home.html [Accessed 5 Nov. 2019].

Maritimeprofessional.com. (2019). *Maritime Logistics Professional*. [online] Available at: h

Thpa.gr. (2010). *ΟΛΘ - Environment*. [online] Available at: https://www.thpa.gr/index.php/en/olth/social-responsibility/environment [Accessed 5 Nov. 2019]. ttp://www.maritimeprofessional.com/ [Accessed 5 Nov. 2019].

ResearchGate. (2019). *ResearchGate | Find and share research*. [online] Available at: https://www.researchgate.net/www.researchgate.net/figure/The-environmentally-related-health-impact-ERHI-assessment-framework [Accessed 5 Nov. 2019].

econews.gr/2011/03/01/eco-port-status-olp/. (2011). [online] Available at: http://www.econews.gr/2011/03/01/eco-port-status-olp/ [Accessed 5 Nov. 2019].

Ecoports.com. (2019). *Welcome*. [online] Available at: http://www.ecoports.com/ [Accessed 5 Nov. 2019].

Sustainableworldports.org. (2019). *World Port Sustainability Program*. [online] Available at: https://sustainableworldports.org/ [Accessed 5 Nov. 2019].

AAPA. (2019). *Home - AAPA*. [online] Available at: https://www.aapa.org/ [Accessed 6 Nov. 2019].

Polb.com. (2019). [online] Available at: http://www.polb.com/civica/filebank/blobdload.asp?BlobID=2268 [Accessed 6 Nov. 2019].

Green-marine.org. (2019). Scope and Criteria - Green Marine. [online] Available at: https://green-marine.org/certification/scope-and-criteria/ [Accessed 6 Nov. 2019].

Portauthoritynsw.com.au. (2019). *Sustainability*. [online] Available at: https://www.portauthoritynsw.com.au/sustainability-and-environment/sustainability/ [Accessed 6 Nov. 2019].

Green-marine.org. (2019). *Green-Marine - Green Marine*. [online] Available at: https://green-marine.org [Accessed 6 Nov. 2019].

Unctad.org. (2019). *UNCTAD | Home*. [online] Available at: http://unctad.org/ [Accessed 9 Nov. 2019].

Antoniadou C., Sarantidis S., Chintiroglou C. (2011). Small-scale spatial variability of zoobenthic communities in a commercial Mediterranean port. Journal of the Marine Biological Association of the United Kingdom, 91 (1): 77-89

Borriello F. (2013). The Sustainability of Mediterranean Port Areas: Environmental Management for Local Regeneration in Valencia. Department of Conservation of Architectural and Environmental Heritage, University of Naples Federico II. Sustainability 2013, 5 (10): 4288-4311

Bourguignon D., EPRS (European Parliamentary Research Service) (2015). Safeguarding biological diversity, EU policy and international agreements, InDepth Analysis Daamen T., Vries I. (2013). Governing the European port–city interface: institutional impacts on spatial projects between city and port. Journal of Transport Geography, 27: 4-13

Dadic, B. Kesic, B. Hlaca (2001). Development Possibilities of the Port of Rijeka at the Beginning of the New Millennium. Pro met - Traffic-Traffico, 13 (1): 43-54

Darbra R.M. et al. (2009). Survey on environmental monitoring requirements of European Ports. Journal of Environmental Management 90 (2009): 1396-1403

ESPO/EcoPorts (2007). ESPO Code of Practice on the Birds and Habitats Directives

ESPO (2012). Green Guide: Towards excellence in port environmental management and sustainability

ESPO/EcoPorts (2012). Green Guide, Annex 2: Legislation influencing European ports

ESPO/EcoPorts (2013). Green Guide, Annex 1: Good practice example in line with 5 Es, Version 2

ESPO/EcoPorts (2013). Top environmental priorities of European Ports for 2013: Ananalysis taking port size and geography into consideration

GHD (2013). Environmental Best Practice Port Development: An Analysis of International Approaches. Report prepared for the Department of Sustainability, Environment, Water, Population and Communities. Canberra, Australia

GHD (2016). Environmental Best Practice Port Development: An Analysis of International Approaches. Report prepared for the Department of Sustainability, Environment, Water, Population and Communities. Canberra, Australia

Hiranandani V., LLM, MBA (2014). Sustainable Development in the maritime industry: a multi-case study of seaports. WMU Journal of Maritime Affairs, April,13 (1): 127-172

Hummel H. et al. (2015). A comparison of the degree of implementation of marine biodiversity indicators by European countries in relation to the Marine Strategy Framework Directive (MSFD). Journal of the Marine Biological Association of the United Kingdom, 95(8): 1519-1531

Karalis P., Antoniadou C., Chintiroglou C. (2003). Structure of the artificial hard substrate assemblages in ports in Thermaikos Gulf (North Aegean Sea). Oceanologica Acta 26. 215–224

Kura B., Dunn C., Iyer A., Bourbour A. E. (2014). Promoting Sustainability at the Ports through Knowledge Sharing. Journal of Geoscience and Environment Protection, 2 (2): 143-150

Polyzos S., Niavis S., Minetos D. (2008). The Ports of North Greece and their importance for the economic development of South - Eastern Europe. In 4th International Conference of ASECU on "Development Cooperation and Competitiveness": Bucharest Academy of Economic Studies, Bucharest, Romania, 474-488

The International Institute for Sustainable Seaports - Port of Portland (2010). Environmental Initiatives at Seaports Worldwide: A Snapshot of Best Practices

The International Institute for Sustainable Seaports - Port of Portland (2013). Environmental Initiatives at Seaports Worldwide: A Snapshot of Best Practices

United Nations Conference on Trade and Development (2008). Review of Maritime Transport 2008. New York and Geneva (unctad.org/en/docs/rmt2008_en.pdf)

Vaggelas G. (2007). Greek Ports: Structural Challenges and Forms of Adjustment. 3rd Hellenic Observatory Phd Symposium

Wakeman R. (1996). What is a sustainable port? The relationship between ports and their regions. Journal of Urban Technology, 3 (2): 65-79

WG150 - PIANC (2013). ‘Sustainable Ports’ A Guidance for Port Authorities

World Bank (2001). World Bank Port Reform Toolkit, Alternative Port Management Structures and Ownership Models, Module 3